

HILIPS

Electronic components and materials

# Technical note 064

## Digital cassette interface for a 2650 microprocessor system

The digital cassette recorder offers many attractive facilities to the microcomputer user: its large storage capacity (0,5 Mbyte) and high data I/O rate are far superior to either punched cards or paper tape. Moreover, its sturdy construction and small size make it an excellent medium for data storage and transport. In use, the digital cassette recorder is quiet, reliable and simple to operate.

This publication describes an interface between the Philips Digital Cassette Drive (DCR) and a 2650-based microcomputer system. Data transfer is performed under interrupt program control in order to prevent undue wastage of processing time. The data format on the cassettes complies with the ECMA\* standards 34 and 41 for BASIC labelled cassettes.

Table 1 gives brief specifications of the DCR and Table 2 a summary of the functions provided by the interface.

TABLE 1 Brief specification of the DCR

head type	single track, read after write (one head with double gap).
recording technique	phase encoded, bit serial, character serial.
recording density	800 bpi.
tape speed	19 cm/s (7,5 in/s).
data rate	750 eight-bit characters/s.
start time	20 ms max.
stop time	20 ms max.
max. rewind time	45 s.
cassette type	twin hub coplanar.
tape size	86 m long, 3,81 mm wide, 19 $\mu$ m thick.
data capacity	1,9 x 10 <sup>6</sup> bits.
number of tracks	one on each cassette side (A or B).
tape side indentifier	asymmetrically positioned cut out in the rear edge of cassette frame.
tape markers	two 0,6 mm holes centrally positioned in the tape at $450 \pm 30$ mm from the transparent leaders.
file protect	two replaceable write enable plugs in the rear edge of cassette frame.

TABLE 2 Summary of interface functions

block size	2 to 256 data bytes + 2 CRC bytes + 1 byte preamble and 1 byte postamble.
error detection	CRC using the polynomial $X^{16} + X^{15} + X^2 + 1$
cassette functions	write tape mark(s); search tape mark(s); write one or more data blocks; read one or more data blocks.

\* ECMA: European Computer Manufacturers Association.



## Cassette data format

Data is recorded on the cassette in a single track, serial mode in blocks of 8-bit bytes. The least significant bit of a byte is written and read first. By turning the cassette onto its other side, a second track is available, recorded in the reverse direction. The DCR can distinguish between side A and side B by sensing an asymmetrical slot in the cassette.

For recognition and synchronization purposes, the data in a block is preceded by a preamble character and followed by two CRC\* bytes and a postamble character. The preamble and postamble characters are each a single byte with the hexadecimal value 'AA' (binary pattern 10101010).

Tape marks are used to define the beginning-of-file, end-of-records and end-of-file. A tape mark consists of a preamble character, two bytes of all zeros and a postamble character.

Tape marks and data blocks are all separated by a gap corresponding to at least 100 ms at the nominal transport speed.

A data block may contain from 2 to 256 data bytes; this interface has been designed to write a variable length block in this range as specified by the user's write command. When requested to write more than 256 data bytes, the interface directs the DCR to write a variable length block followed by a number of blocks each of 256 data bytes. The interface allows from 1 to 256 data blocks to be read or written from one command.

## Recording technique

The DCR uses the well-known phase-encoding technique in which a data bit is recorded as a change in the magnetic flux of the tape. A *zero* is recorded as a flux transition from a north pole to a south pole, and a *one* as a flux transition from a south pole to a north pole. This method of encoding allows a high bit-density on the tape.

When two or more consecutive ones or zeros are to be written, additional flux changes are required between the bit flux changes. These phase flux changes occur at the nominal mid-point between the bit flux changes. Figure 1 shows the relationship between the data to be recorded and the bit and phase flux changes.

## Interface description

The interface is designed to perform data I/O under interrupt program control: the microcomputer requests action from the DCR and then continues with its main program until informed by an interrupt that the DCR is ready for data transfer. Upon receipt of the interrupt, the

\* CRC: Cyclic Redundancy Check for detection of bit errors in the recorded data.

microcomputer stops execution of the current program, saves the status and program address and jumps to execute the DCR interrupt program. When the data transfer is complete, the microcomputer restores its previous status and program address and continues execution of the interrupted program. In this manner, the microcomputer does not have to wait while the DCR searches for information or rewinds the cassette etc.

From the foregoing description it will be realized that both interface hardware, between the DCR and the microcomputer data I/O system, and interface software, comprising the interrupt program and the connection routine in the program requiring the cassette action, are required. Figure 2 shows the interface hardware and DCR as part of the microcomputer system.

A program using this interface specifies the cassette action required by defining a control table for the connection routine. Using the information in this table, the interface can perform eight read/write functions on the tape:

write data; write data from beginning of tape; read data; read data from beginning of tape; write tape mark(s); write tape mark(s) from beginning of tape; search for tape mark(s); search for tape mark(s) from beginning of tape.

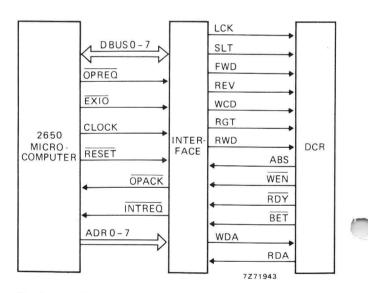


Fig. 2 Block diagram of the microcomputer system with cassette drive.

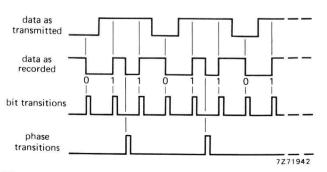


Fig. 1 Phase-encoded data showing the bit and phase flux transitions.

#### Interface hardware

This is comprised of 27 TTL integrated circuits. Figure 3 shows the schematic diagram of the cassette interface hardware. Table 3 lists the signals to and from the micro-computer while Table 4 lists those to and from the DCR.

 TABLE 3 Signals between microcomputer and interface

signal	function					
OPREQ	operation request from microcomputer, active LOW.					
<b>OPACK</b>	operation acknowledge from interface, active LOW.					
INTREQ	interrupt request from interface, active LOW.					
EXIO	extended I/O signal from the microcomputer instructing the interface to compare its address with the data on the address bus. It is an active LOW signal, formed by the combination: $\overline{M/\overline{10} \cdot E/NE}$					
DBUS0-7	8-bit bidirectional data bus.					
ADR0-7	8-bit command/peripheral number bus.					
CLOCK	nominal 1 MHz clock from microcomputer.					
RESET	general system reset signal, active LOW.					

TABLE 4 Signals between DCR and interface

signal	function					
control	lines					
LCK	locks the cassette retrieval bar in position and lights the LOCK lamp.					
SLT	selects the DCR - enables cassette action.					
FWD	forward, causes the tape to move forwards at capstan speed.					
REV	reverse, causes tape to move in the reverse direction at capstan speed.					
WCD	write command, enables the write logic.					
RGT	read gate, enables the read logic.					
RWD	rewind the tape at hub speed.					
status li	nes					
ABS	A or B side of cassette, LOW when A side in use (on top)					
WEN	write enabled, active LOW, indicates that the write enabl plug is present for the side in use.					
PDV	ready active IOW indicates that the term has been					

 RDY
 ready, active LOW, indicates that the tape has been positioned and the LCK and SLT lines are active.

BET Beginning-or-End-of-Tape, active LOW, indicates that the BOT or EOT marker (hole in tape) or transparent leader has been detected by the photocell.

#### data lines

WDA	write data, serial, phase-encoded data to be recorded.
DDA	

RDA read data, serial, phase-encoded data read from the tape.

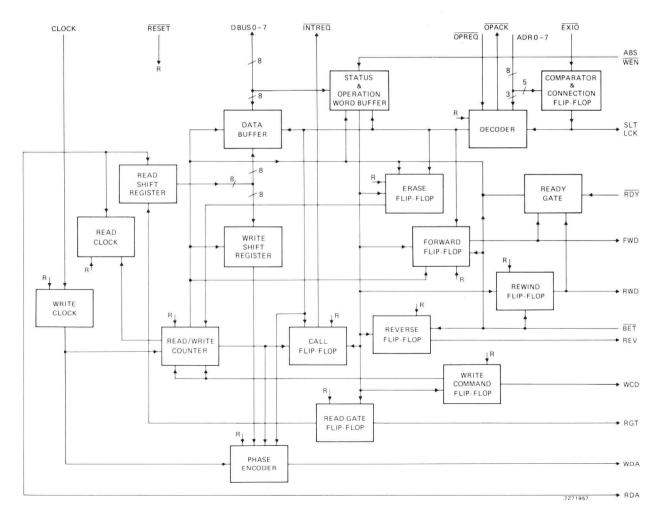


Fig. 3 Block diagram of the interface hardware.

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#### Address bus

The least significant eight bits of the microcomputer address bus are used for peripheral selection when the signal  $M/\overline{IO}$  indicates I/O action. ADR0 to ADR4 are used as a peripheral address, the peripheral responding when the data on these lines coincides with its own hardwired address. ADR5 to ADR7 are used to command the interface, the commands are listed in Table 5. Figure 4 shows the peripheral address and command decoding logic.

TABLE 5 Commands to the interface

mnemonic	command	ADR7	ADR6	ADR5
STAT	status request	1	0	1
CX	connection	0	1	0
OEC	output exchange	1	0	0
IEC	input exchange	0	0	1
DX	disconnection	1	1	1

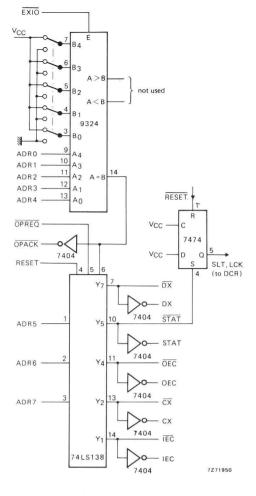


Fig. 4 Address and command decoding logic.

#### Data bus

Data from the microcomputer, on the data bus, is clocked into the peripheral register during the Output Exchange Command (OEC) and transferred to the write circuit. During an Input Exchange Command (IEC), the data that has been read from the tape is transferred to the data bus.

#### Status and control logic

Before commencing data transfer, the microcomputer must establish that the DCR is ready for such an action. The status request command to the peripheral asks for the status word, the value of which describes the condition of the peripheral. The information conveyed by the status word is given in Table 6.

#### TABLE 6 Status words

bit	function
0	ABS signal: 0, side A; 1, side B.
1	$\overline{\text{WEN}}$ , write enable signal, 0: write enabled.
2	not used.
3	not used.
4	RDY, ready signal.
5	not used.
6	GAPS signal, indicates no data on tape, gap between tape marks and/or data blocks.
7	BET signal, 0: marker indicating Beginning-or-End-of-Tape sensed.

Once the microcomputer has ascertained the status of the DCR, it issues a Connection Command (CX) and outputs an operation word to the data bus. When the interface recognizes the connection command, the operation word on the data bus is clocked into the operation word buffer. Each bit of the operation word, apart from bit 3 which is not used, corresponds to a particular signal within the interface:

- bit 0 A signal, which sets the Read Gate (RGT) flip-flop to enable reading after the start-reading delay (20 ms) is finished. The RGT flip-flop is reset either by the reset signal or by a disconnection command.
- bit 1 B signal, which sets the CALL flip-flop. The not-true output of the CALL flip-flop is the signal INTREQ. The flip-flop is reset either by the reset signal or by a disconnection or exchange command.
- bit 2 C signal, which sets the Write Command (WCD) flip-flop to enable writing after the start-writing delay (60 ms) is finished. The flip-flop is reset either by the reset signal or by a disconnection command.

- bit 3 Not used.
- bit 4 E signal, which sets the ERASE and WCD flip-flops. The not-true output of the ERASE flip-flop is used to set the WDA flip-flop so that the data line does not convey data during the erase function.
- bit 5 F signal, which sets the Forward (FWD) flip-flop. It is reset by the reset signal or a disconnection command.
- bit 6 G signal, which sets the Reverse (REV) flip-flop. It is reset by the reset signal or a disconnection command.
- bit 7 H signal sets the Rewind (RWD) flip-flop. The rewind flip-flop is reset either by the reset signal or by the signal BET (not Beginning-or-End-of-Tape).

The bidirectional operation/status word register and the associated control flip-flops are shown in Fig. 5.

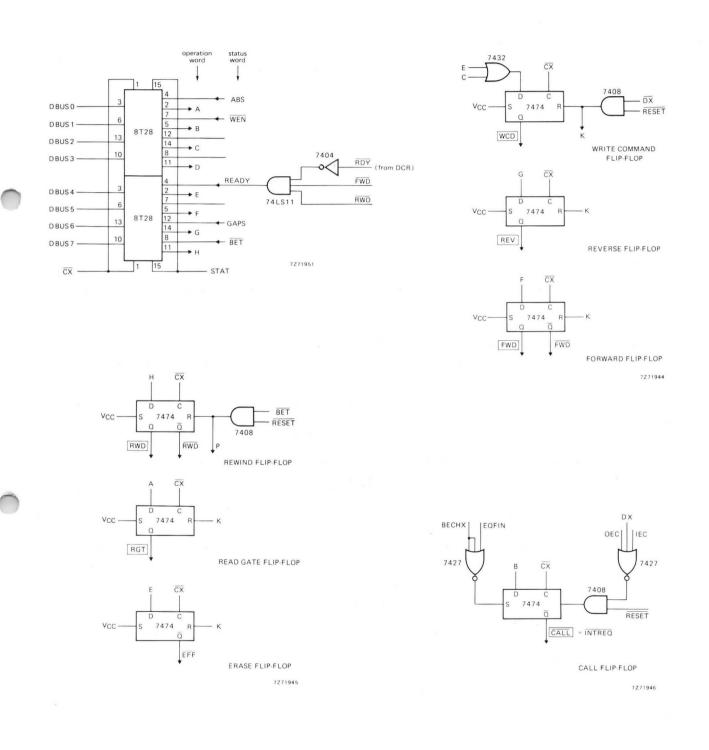


Fig. 5 Operation/status word register and logic.

#### Write logic

The write logic consists of the write clock, write/read counter, write shift register, phase encoder and WCD flip-flop. The write logic is activated when the microcomputer has issued the appropriate connection command followed by an output exchange command with the data to be written. During the output exchange command, the data is transferred via the data buffer to the write shift register. The data path can be seen in Fig. 3 and the timing sequence is shown in Fig. 6.

The circuit of the write clock is shown in Fig. 7; it comprises two decade counters to derive the 12 kHz square-wave from the 1 MHz clock from the micro-computer.

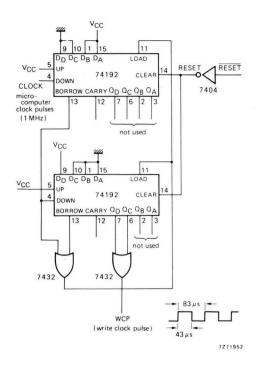
The write/read counter, Fig. 8, is used to count cycles of the write clock waveform corresponding to the eight bits of a character. The output QA is used to shift each of the data bits serially out of the shift register, the BECHX signal being generated by the carry output at the end of a character.

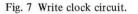
The write data circuit is shown in Fig. 9. The data is converted from parallel to serial format by the register and then phase encoded by the exclusive-OR gate. The QA signal to the exclusive-OR gate provides the phase flux transitions when these are required. The output of the phase encoder is stored in the WDA (write data) flip-flop for a period determined by the WCP (write clock pulse) signal. The EFF signal from the ERASE flip-flop is connected to the set input of the WDA flip-flop so that the data line remains HIGH during erasing.

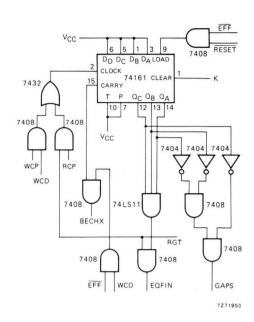
At the end of each character, the BECHX signal allows the write register to be loaded with the next character from the data buffer. The BECHX signal also causes the CALL flip-flop to be set, in order to receive the next character (command) from the microcomputer.

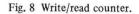


Fig. 6 Timing sequence for writing.









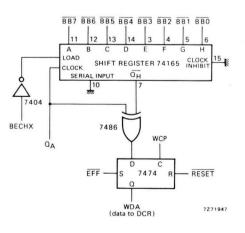


Fig. 9 Write data circuit.

#### Read logic

The read logic comprises the read clock, read shift register, write/read counter and read gate flip-flop.

The read clock acts as a discriminator between the bit flux transitions and the phase flux transitions in the data signal from the DCR. Both preamble and postamble characters possess only bit flux transitions, so that the read clock, which is a monostable, can be synchronized to these and then mask out the phase flux transitions in the data signal. The phase flux transitions occur midway between bit flux transitions and the monostable remains set for 130  $\mu$ s in a period of 166  $\mu$ s. The circuit of the read clock is shown in Fig. 10.

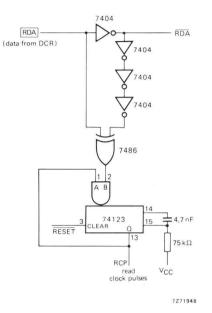
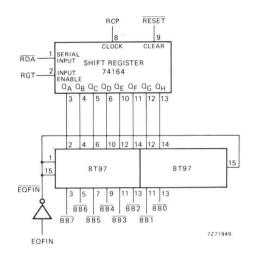
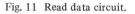


Fig. 10 Read clock circuit.

In the read mode, the write/read counter counts the bit flux transition pulses and sets the EQFIN signal at the end of a byte (eight pulses). The EQFIN signal enables the three-state outputs of the read register and sets the CALL flip-flop to inform the microcomputer that the data is ready for transfer.

The read data circuit is shown in Fig. 11. The phaseencoded output from the DCR is shifted through the register, clocked by the read clock to ensure that only data is accepted. When the byte is complete, the EQFIN signal enables the three-state data buffer to accept the data from the parallel outputs of the shift register. The timing sequence for reading is shown in Fig. 12.





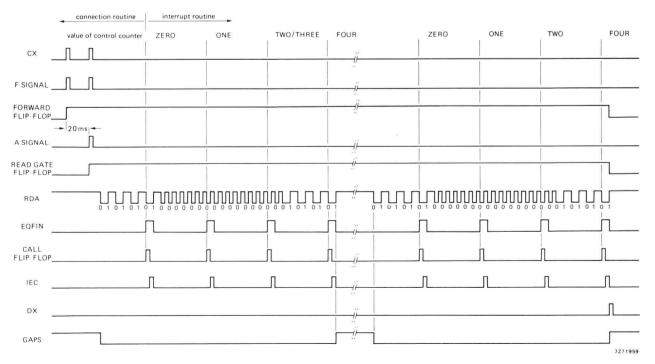


Fig. 12 Timing sequence for reading.

#### Data buffer

The data buffer is a bidirectional three-state buffer: there are two buses which operate independently, one in each direction. In Fig. 13 bus A is the microcomputer data bus and bus B is the internal bus to the read and write registers. In the writing mode, the buffer accepts data from the microcomputer data bus when the output exchange command is active. The data is then held until the BECHX signal allows transfer to the write shift register. In the reading mode, the buffer accepts data from the read register when the EQFIN signal is active. The data is held until an input exchange command is received, when it is transferred to the microcomputer data bus.

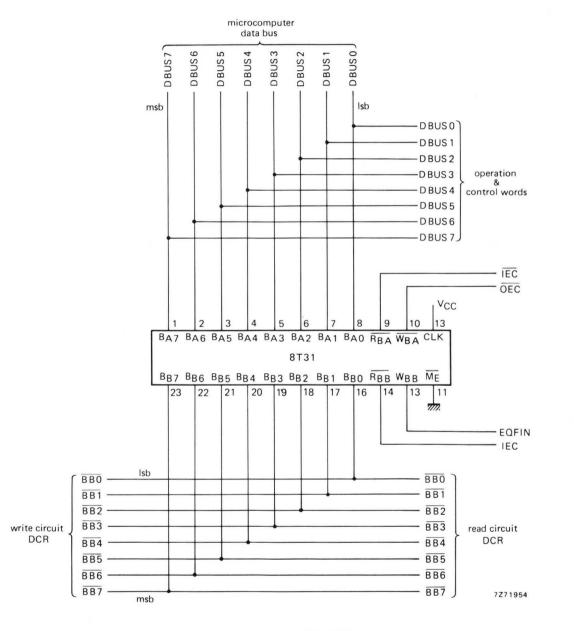


Fig. 13 Bidirectional data buffer.

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#### Interface software

The software can communicate with the peripheral using the two 2-byte I/O instructions READ EXTENDED (REDE) and WRITE EXTENDED (WRTE). The second byte of these instructions is presented on the address bus as the peripheral address and the command. Table 5 shows the five peripheral commands available. The software is comprised of two parts: the connection routine and the interrupt program.

START

LOAD ADDRESS OF CONTROL TABLE

INTO R0, R1

STORE REGISTER IN RET, RET + 1 CCXR

The connection routine is part of the main program in order to conserve space in the return address stack. Its function is to transfer the control table, specifying the cassette action that is required, to the cassette memory locations CML to CML+5, check the DCR status and issue a connection command if the status is correct; Fig. 14.

The interrupt program is entered each time the microcomputer receives an interrupt request from the CALL flip-flop. This program uses the control table to define its action, in conjunction with the control counter, which is incremented after each phase of the required operation. It is this program that controls the input/output of data, as specified by the control block. Each entry into the interrupt program will result in a transfer of one byte to or from the microcomputer.

The flow chart of the interrupt program is shown in Fig. 15.

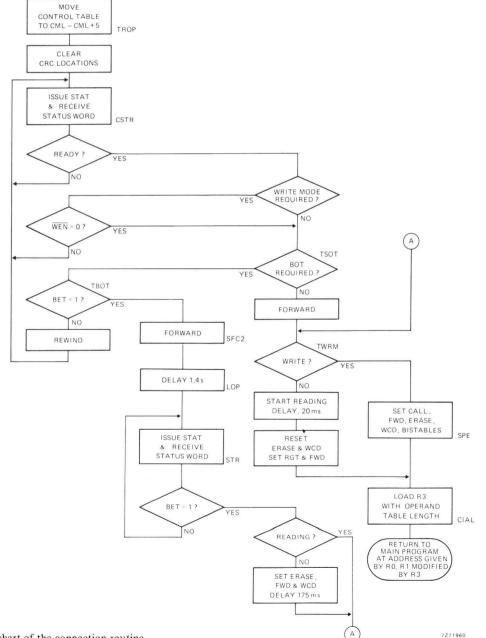


Fig. 14 Flow chart of the connection routine.

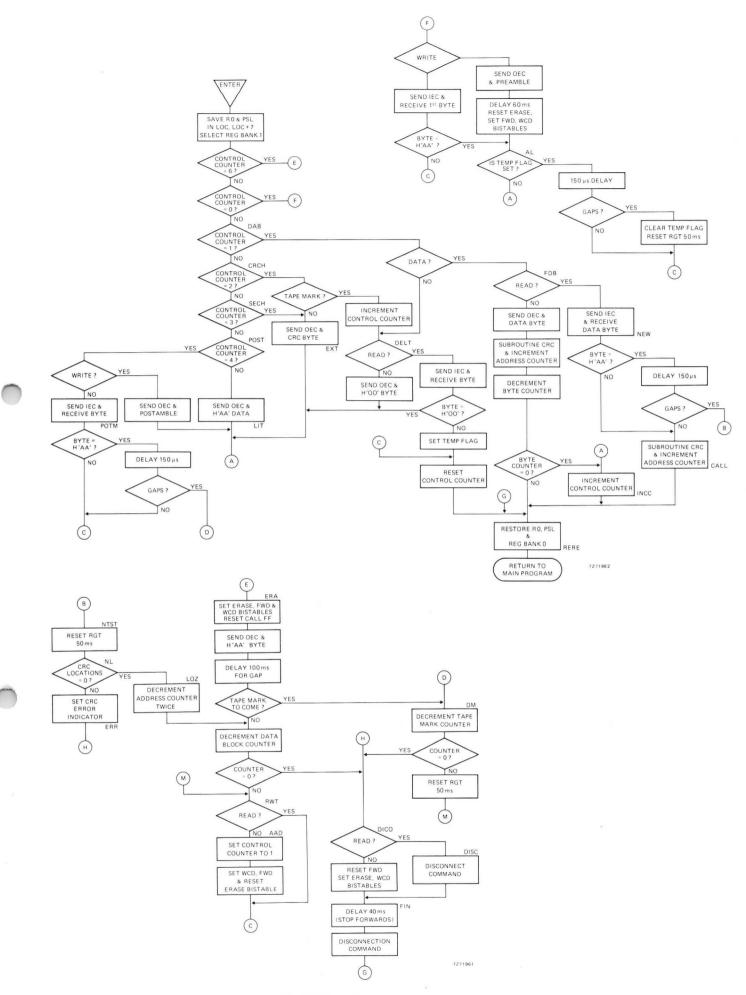


Fig. 15 Flow chart of the interrupt program.

#### Cassette operation sequence

Data exchange with the DCR is initiated by entry into the connection routine: this stores the continuation address of the main program and transfers the control table into the locations CML to CML+5 for use by the interrupt routine. Figure 14 shows the flow chart of the connection routine.

The information in the control table is shown in Table 7, with the operands that must be defined for a particular function in Table 8.

#### TABLE 7 Contents of the control table

operand	byte	function	
1	1	$ \begin{array}{c} \text{control word: bit 0} \\ \text{bit 1} \\ \text{bit 2} \end{array} \begin{cases} \text{three-bit control counter} \\ \text{used by interrupt routine.} \\ \text{Must initially be zeros.} \end{cases} $	
		bit 3 not used.	
		bit 4 1 indicates read/write from BOT.	
		bit 5 CRC error flag. 1 if error detected.	
		bit 6 data/tape mark indicator, 1 indicates tape mark.	
		bit 7 read/write select, 1 indica write.	tes
2	2	number of bytes in the first block to be written.	
3	3	number of tape marks to be read/written.	
4	4	number of data blocks to be read/written.	
5	$\binom{5}{6}$	address of the first byte to be read/written.	

TABLE 8 Specification of control word and operands

control word	function	operands to be specified
Н'80'	write data	2,4,5
H <b>'9</b> 0'	write data from beginning of tape	2,4,5
H'00'	read data	4,5
H'10'	read data from beginning of tape	4,5
H'CO'	write tape marks	3
H'DO'	write tape marks from beginning of tape	3
H'40'	read tape marks	3
H'50'	read tape marks from beginning of tape	3

After requesting the DCR status and, if necessary, waiting until this is correct, the connection routine issues a connection command accompanied by an operation word to start the required cassette action, e.g. rewind to beginning of tape. When the tape has been positioned as required, the connection routine takes into account any delays, e.g. start-reading delay, and issues another connection command. The operation word will be set to enable reading or writing and in the case of writing, the CALL flip-flop will be set, enabling the interface to ask for the first byte of write data. In the reading mode, the CALL flip-flop will be set by the end-of-character signal EQFIN, informing the microcomputer that the requested data is available. Setting the CALL flip-flop results in the signal INTREO, causing entry to the interrupt program to perform the data transfer.

After performing the above actions, the connection routine forms a branch indexed absolute instruction to the address following the control table, to continue execution of the main program.

The microcomputer will enter the interrupt program after receiving an interrupt request from the interface hardware. In this, the first action is to save the contents of R0 and the PSL in locations LOC and LOC+1.

Further actions of the interrupt program depend on the value of the control counter, held in the least significant three bits of the control word. The control counter is initially zero.

#### Counter = 0

Writing mode: the microcomputer sends an OEC and a preamble character. It then goes to the start-writing delay subroutine (60 ms) before resetting the ERASE flip-flop and setting the WCD and FWD flip-flops. The control counter is then incremented and the saved registers restored before control reverts to the main program.

Reading mode: the microcomputer sends an IEC to receive a byte. If this is a preamble, the control counter is incremented, otherwise it remains unchanged.

#### *Counter* = 1

Writing tape marks: the microcomputer sends an OEC accompanied by an '00' byte and increments the control counter.

Reading tape marks: an IEC is sent to receive a byte. If the byte is '00', the control counter is incremented, otherwise the initial conditions are restored and the interface again looks for a tape mark.

Writing data: an OEC and data byte are sent. The address counter is incremented and the byte counter decremented. If the byte counter is zero, the control counter is incremented.

Reading data: an IEC is sent and a data byte received. If the byte is 'AA' followed by the GAPS signal, the end of block is detected. Otherwise the address counter is incremented and the CRC locations updated.

#### Counter = 2

Writing data: an OEC and the first CRC character are sent and the control counter is incremented.

Writing tape mark: an OEC and an '00' byte are sent and the control counter is incremented.

Reading tape mark: an IEC is sent and a byte received. If the byte was '00', the control counter is incremented, otherwise the initial conditions are restored and the GAPS signal is awaited.

#### Counter = 3

Writing tape mark: an OEC and the second CRC character are sent and the control counter is incremented.

#### Counter = 4

Writing data or tape mark: an OEC and an 'AA' byte are sent and the control counter is incremented.

Reading data or tape mark: an IEC is sent and a byte received. If this is 'AA', followed by the GAPS signal, the tape mark counter is decremented. If the tape mark counter is zero, a disconnection command is given, otherwise the initial conditions are reset to search for another tape mark.

#### Counter = 5

An OEC and an '00' byte are sent to clear the write shift register and reset the CALL flip-flop. The control counter is incremented.

#### Counter = 6

The ERASE, FWD and WCD flip-flops are set. An OEC and preamble ('AA') are sent. After an inter-block gap is generated, the data block counter or the tape mark counter is decremented. When the relevant counter is zero, the DCR is disconnected, otherwise the initial conditions are restored to write the next tape mark or data block.

(a)

ENTER

SAVE VALUES

OF CONTROL WORD CONTROL COUNTER IN SUCH, SUCH +1

SET WC BIT (WITH CARRY) IN PROGRAM STATUS

FETCH CRC BYTES

EXCLUSIVE OR NEW DATA BYTE TO CRC BYTES

#### Cyclic redundancy check subroutine

The cyclic redundancy check is performed by software using the polynominal:

$$X^{16} + X^{15} + X^2 + 1.$$

A 16-bit remainder is generated during writing, and written at the end of each data block. The same CRC process during reading the data will produce the same 16-bit remainder, which then becomes zero when the CRC bytes are processed. If an error occurs during reading or writing, the final remainder is not zero and an error flag is set. The flow chart and simulated hardware are shown in

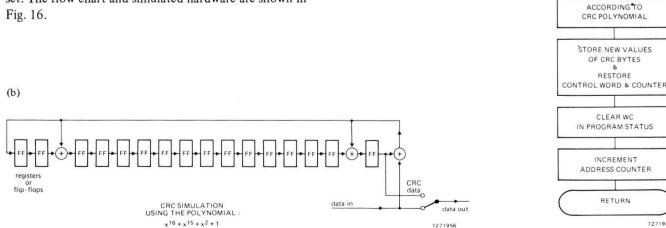


Fig. 16 Flow chart of the CRC subroutine (a) and simulated hardware (b).

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PRGE 0001

<del>89</del> 81	*JOSE LUIS CORTINAS 770202-9.30					
6662	*					
8983	<b>#CONNECTION ROUTINE FOR DIGITAL CRSSETTE RECORDER</b>					
0004	*					
0005	*IT IS A PART OF THE MAIN PROGRAM					
6666	*FIVE OPERANDS ARE TRANSFERRED FROM A TABLE TO THE					
0087	*MEMORY LOCATIONS (CMLCML+5), THE STATUS OF THE					
0008	*DIGITAL CASSETTE RECORDER IS TESTED AND					
0009	*THE RIGHT SIGNALS ARE GENERATED TO THE DOR TO					
0010	*PERFORM THE REQUIRED FUNCTION.					
0011	*					
0012	*THE FIVE OPERANDS ARE:					
8813	* OPER1: 1 BYTE: CONTROLMORD					
0014	* OPER2: 1 BYTE: NUMBER OF BYTES OF FIRST BLOCK TO					
0015	* BE WRITTEN ON TAPE					
0016	* OPER3: 1 BYTE: NUMBER OF TAPEMARKS TO BE WRITTEN					
0017	* ON TAPE OR SEARCHED FOR					
0018	* OPER4: 1 BYTE: NUMBER OF DATABLOCKS TO BE WRITTEN					
6619	* ON TAPE OR READ FROM TAPE					
0028	* OPER5: 2 BYTES: ADDRESS OF FIRST BYTE IN MEMORY TO BE WRITTEN					
0821	* ON TAPE OR READ FROM TAPE					
<del>00</del> 22	*					
0623	* CONTROLHORD FUNCTION TO BE DEFINED OPERANDS					
8824	* *************************************					
0025	*					
0826	* H'90' WRITE DATA FROM BEGIN OF TAPE OPER2, 4, 5					
0027	* H'88' WRITE DATA SOMEWHERE ON TAPE OPER2, 4, 5					
9928	* H'10' READ DATA FROM BEGIN OF TAPE OPER4, 5					
0829	* H'88' READ DATA SOMEWHERE ON TAPE OPER4, 5					
0030	* H'DO' WRITE TAPEMARK(S) FROM BEGIN OF TAPE OPER3					
0031	# H'CO' WRITE TAPEMARK(S) SOMEWHERE ON TAPE OPER3					
6032	* H'50' SEARCH TAPEMARK(S) FROM BEG. OF TAPE OPER3					
0033	* H'48' SEARCH TAPEMARK(S) SOMENH. ON TAPE OPER3					
0034	*					
0035	*					
0036	*******************					

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<b>6</b> 938	* DEFINITIONS OF SYMBOLS:			
<b>6</b> 039	*			
0848 0008	RØ	EQU	0	PROCESSOR REGISTERS
8841 8861	R1	EQU	1	
0042 0002	R2	EQU	2	
0043 0003	R3	EQU	3	
8844 8888	S	EQU	H'88'	PSU: SENSE
0045 0040	F	EQU	H'40'	FLAG
0046 0020	II	EQU	H'20'	INTERRUPT INHIBIT
0847 0897	SP	EQU	H'07'	STRCKPOINTER
8848 8808	23	EQU	H'CØ'	PSL: CONDITION CODE
8849 8828	IDC	EQU	H'20'	INTER DIGIT CARRY
8858 8818	RS	EQU	H'10'	REGISTER BRACK SELECT
0051 0008	MC	EQU	H'08'	1=WITH 0=NO CARRY
0052 0004	OVF	EQU	H'84'	OVERFLON
0053 0002	COM	EQU	H'021	1=LOG., Ø=ARITH. COMP.
0054 0091	С	EQU	H'01'	CRRRY/NO BORRON
0055 0000	Z	EQU	0	BRANCH COND: ZERO
0056 0001	Ρ	EQU	1	POSITIVE
0057 0002	N	EQU	2	NEGATIVE
0058 0000	EQ	EQU	0	EQUAL
0859 0001	GT	EQU	1	GREATER THAN
0060 0082	LT	EQU	2	LESS THAN
0061 0003	UN	EQU	3	UNCONDITIONAL
8862 8888	<b>R1</b>	EQU	0	ALL BITS ARE 1
0063 0002	NI	EQU	2	NOT ALL BITS ARE 1
0064	*			
8865 8898	DCR		0	DIGITAL CASSETTE RECORDER
0066 0000	STAT		H'A0'	status command
0067 0040	CX	EQU	H'40'	CONNECTION COMMAND
9968 9989	OEC		H'89'	output exchange command
8869 8829	IEC		H'201	INPUT EXCHANGE COMMAND
0070 00E0	DX	EQU	H'E0'	DISCONNECTION COMMAND
0071	*			
<b>6</b> 672	*			
8873 8888		ORG	H'7F0'	
0074 07F0	CHL	RES	6	CRSSETTE MEMORY LOCATIONS
0075 07F6	RET	RES	2	KEEPS ADDRESS FIRST OPERAND
0076 07F8	LOC	RES	2	SAVE LOCATIONS OF RO AND PSL
8877 87FR	CRC	RES	2	ADDRESSES OF CRC CHARACTERS
0078 07FC	SUCH		2	SAVES R2, R1 DURING CRC SUBROUTINE
<b>6</b> 879	****	*******	*******	**********

PRGE 0003

0004	075			000	11/2007	
		7540		ORG		CELECT DECISTEDDONE #0
						SELECT REGISTERBANK #0
						LOGICAL COMPARE
						FETCH ADDRESS HIGH FIRST OPERAND
						FETCH ADDRESS LOW FIRST OPERAND
- 9935 - 99887		1F0620				CALL DOR CONNECTION ROUTINE AN EXAMPLE FOR WRITING A BLOCK
						AN EXAMPLE FOR ARTITAG IN BLOCK
						HED FROM MEMORY ADDRESS H110001.
	0/00	80	+INC		H'89'	
		28				
						BYTECTR (32)
						NUMBER OF TAPEMARKS
						NUMBER OF DATABLOCKS
		1000		UHIH	H110, 001	ADDRESS OF FIRST BYTE
0095	0611		*	000	11/2007	
0897			*	org	H- 520	
		000756			DET	SAVE ADDRESS FIRST OPERAND
				STRA R1		SHIFE HUUKESS FIRST UPERHIN
6109		UD0/FY	*	STRUE KL	KEITI	
		0706		1001 07	6	LORD R3 WITH # OF OPERANDS
						TRANSFER OF OPERANDS INTO
						CRSSETTE MEMORY LOCATIONS CHL CHL+5
				BRNR, R3		GESCHE REIGHT EGGITTORS GREETT GREFS
0105		3010	*		INU	
		28		EORZ	R9	
					CRC	CLEAR CRC LOCATIONS
		CC07FB		STRA, RØ		
			CSTR		STRT+DCR	READ DCR STATUS
		F710				
		987A			CSTR	BRANCH IF NOT READY
					CML	
					TSOT	
		F702				
		1871			CSTR	BRANCH IF WEN SIGNAL NOT ACTIVE
		F610		THI, R2	H'10'	
		1886		BCTR, R1		BRANCH IF STARTING THE TAPE
		8428		LODI, RO	H'28'	
						send forward command
		1821		BCTR, UN		
0121		aurea	*			
		F780	TBOT	THI, R3	H'88'	
		9886				BRANCH IF LEADER
		0480				
						SEND REWIND COMMAND
		1850		BCTR, UN		
		6428	SFC2	L001, R0	H'28'	
0128	0650	D448		HRTE, RO	CX+DCR	send forward command

#### PRGE 0004

			-	
0130 065E 0508				DELAY FOR PRISSING LEADER
0131 0668 3825	LOP			(1.4 SEC)
0132 0662 F97C		BORR, R1	LOP	
0133	*		CTOT. 800	
0134 0664 57R0	STR			SEND STATUS REQUEST
0135 0666 1A7C		BCTR, N		BRANCH IF NO TAPE HOLE
0136 0668 02		LOOZ		
0137 0669 9906		BCFR, N		BRANCH IF READING
0138 0668 0430		LODI, R8		
8139 8660 D448				SET ERRSE, FORW AND WCD FF
0140 066F 3816		BSTR, UN	CBTR	CALL BEGIN OF TAPE SUBROUTINE 175 MS
0141	*			
0142 0671 02	THRM	LOOZ		
0143 0672 1A0A		BCTR, N		BRANCH IF WRITING
0144 0674 0708		L001, R3		
0145 0676 3811			LOP8	CALL START READING DELAY SUBROUTINE 20 MS
0146 0678 0421		LODI, RØ	H'21'	
0147 067R D448		HRTE, RO	CX+DCR	set Rgt ff and forward
0148 067C 1B04		BCTR, UN	CIAL	
0149 067E 0432	SPE	LODI, RØ	H'32'	
0150 0680 D440		HRTE, RO	CX+DCR	set erase, form, woo and call FF
0151	*			
0152 0682 0706	CIAL	LODI, R3	6	LOAD R3 WITH NUMBER OF OPERANDS
0153 0684 9F87F6		BXR	*RET	RETURN TO ADDRESS (RET) +(R3)
0154	*			
0155	*			
0156	*			
0157	*	DELRY	SUBROUTINES	5
0158	*			
0159 0687 074D	CBTR	LODI, R3	77	DELRY TIME 175 MS 1 MHZ CLOCK
0160 0689 20	LOPE	EORZ	R9	
0161 0688 F87E	LOP7	BORR, RO	LOP7	
0162 068C FB7C		BORR, R3	LOP7	
0163 068E 17		RETC, UN		
0164	*			
0165	*			
0166	* 9	AVE AND	RESTORE SUB	ROUTINES
0167	*			
0168 068F CC07F8	SRVE	STRA, RO	LOC	SRVE (R0) IN LOC
0169 0692 7710				SELECT REG. BANK #1
0170 0694 13				(PSL) INTO RO
				SAVE (PSL) IN LOC+1
0172 0698 17		RETC, UN		RETURN
	*			
8174 8699 8C87F9	REST	LODA, RO	L0C+1	FETCH (PSL) IN RO
0175 069C C1				(R0) TO R1
0176 0690 93		LPSL		
			LOC	FETCH OLD VALUE RO
				RECONSTRUCT CC IN PSL
				SELECT REG. BRYK #9
0180 06R5 17				

PRGE 0005

<b>91</b> 82	* CYCLIC REDUNDANCY C	
0182 0183	* LYULIC KEDUNDHINCY U	HEUK SUBRUUTINE
<b>6184</b>	* *INITIALISATION PROCED	IDF
0185	*	OKE
0186 0686 CE07FC		SAVE CONTROLCTR IN SUCH
0187 06R9 CD07FD		SAVE CONTROLINORD IN SUCH+1
0188 06AC_7708	PPSL MC	ROTATE WITH CARRY
0189 06RE 0007FB		OLD LSB REMAINDER
0190 0681 0E07FR		OLD MSB REMRINDER
6191	*	
6192	*EXECUTION OF CRC	
6193	*	
01.94 0684 0708	LODI, R3 8	
01.95 0686 22	LBL1 EORZ R2	excl., or R2 and R9 to R9
01.96 0687 D0	RRL RO	MSB TO CARRY
0197 0688 D1	RRL R1	ROTATE CARRY IN R1
0198 0689 D2	RRL R2	
0199 0688 22	EORZ R2	REPRIR RO
0200 0688 F501	THI, R1 H'01'	TEST IF EXOR'S HERE ACTIVE
6201 6680 9884	BCFR, A1 LBL2	BRANCH IF NOT ACTIVE
8282 86BF 2584	EORI, R1 H'04'	APPLY FEEDBACK
8283 8601 2688	EORI, R2 H'88'	
0204 06C3 FB71	LBL2 BORR R3 LBL1	
0205	*	
8286	#DISCHARGE OF SYNDROME	
8287	*	
8288 86C5 CE87FA	STRR, R2 CRC	NEH MSB REMAINDER
8289 86C8 CD87FB	STRA R1 CRC+1	NEH LSB REHRINDER
8210 86CB 8E87FC	LODA, R2 SUCH	Restore R2 AND R1
0211 06CE 0007FD	LODA RI SUCH+1	
8212 8601 7588	CPSL MC	
6213	*	
8214	*INCREMENT OF ADDRESS	COUNTER
6215 6603 6762	IAC LODI, R3 2	
0216 0605 0F47F4	LOP5 LODA, RO CML+4, R3,	- Fetch L/U HALF Addressctr.
0217 0608 D805	BIRR, RO NEXT	
0218 06DA CF67F4	STRR, RO CHL+4, R3	Restore L/U HALF Addressctr.
8219 8600 5876	BRINR, R3 LOP5	
		Restore L/U HALF Addressctr.
0221 06E2 17	RETC, UN	
6222	*	

PAGE 0006

8224	*SUBROUTINE FOR INHIBIT	reading during gap
6225	*	
0226 06E3 0420	IGR LODI, RO H'20'	
0227 06E5 D440	HRTE, RØ CX+DCR	RESET RGT FLIPFLOP
0228 06E7 0719	LODI, R3 25	
0229 06E9 3F0689	BSTR, UN LOP8	DELAY FOR 50 MSEC
0230 06EC 0421	LODI, R0 H'21'	
0231 06EE D440	HRTE, RØ CX+DCR	SET RGT FLIPFLOP
0232 06F0 17	RETC, UN	
6233	*	
8234	*	
0235	*SUBROUTINE FOR GAPCHE	CK
8236	*	
0237 06F1 0710	GAPC LODI, R3 H'10'	Delay of 150 usec for gapcheck
0238 06F3 FB7E	BORR R3 \$	
0239 06F5 57A0	REDEL R3 STAT+DCR	Read DCR status
0240 06F7 F740	THI, R3 H'40'	test for GAPS signal
0241 06F9 17	RETC, UN	
8242	*	

PRGE 0007

8244         *INTERRUPT ROUTINE FOR DIGITAL CRSSETTE RECORDER           8245         *           8246         ØFR           8247         9477           8247         9477           8247         9477           8247         9477           8248         9470           8249         9470           8249         9470           8250         9477-92           8250         9477-92           8251         9480           8252         9477           8253         9481           8253         9483           8253         9483           8254         9485           8255         9487           8256         9487           8257         8483           8258         9482           8258         9487           8258         9482           8257         #8           8258         9483           8257         #8           8258         9480           8259         9480           8251         9491           8251         8491           8251         8493 </th <th>8245         *           8246         06FR         0RG         H'477'           8247         8477         3F068F         BSTR. UN         SAVE         CALL         SAVE SUBROUTI           8248         8478         7702         PPSL         COM         L0GICAL         COMPARE           8249         9477         6687F8         L006. R2         CM         L0GICAL         COMPARE           6259         9477-762         L002         R2         TRANSFER R2         TO RI           9251         9483         4687         ANDI. R1         H'78'         CLEAR         LOMER 3         BITS           9253         9483         4687         ANDI. R1         H'78'         CLEAR         LOMER 3         BITS           9254         9485         E686         COMI. R2         H'67'         CLEAR         LOMER 3         BITS           9255         9480         108588         BCTA. EQ         ERR         BRANCH IF         CONTROLC           9256         9480         90447         BCCR         R2         BRANCH IF         CONTROLC           9261         9490         1         L002         R1         BCCR         R2         BRANCH IF</th> <th>DECODE/ED</th>	8245         *           8246         06FR         0RG         H'477'           8247         8477         3F068F         BSTR. UN         SAVE         CALL         SAVE SUBROUTI           8248         8478         7702         PPSL         COM         L0GICAL         COMPARE           8249         9477         6687F8         L006. R2         CM         L0GICAL         COMPARE           6259         9477-762         L002         R2         TRANSFER R2         TO RI           9251         9483         4687         ANDI. R1         H'78'         CLEAR         LOMER 3         BITS           9253         9483         4687         ANDI. R1         H'78'         CLEAR         LOMER 3         BITS           9254         9485         E686         COMI. R2         H'67'         CLEAR         LOMER 3         BITS           9255         9480         108588         BCTA. EQ         ERR         BRANCH IF         CONTROLC           9256         9480         90447         BCCR         R2         BRANCH IF         CONTROLC           9261         9490         1         L002         R1         BCCR         R2         BRANCH IF	DECODE/ED
8246         66FR         0RG         H'477'           8247         6477         3F658F         BSTR. UN SAVE         CRLL SAVE SUBROUTINE           8248         6478         7762         PPSL         COM         LOGICAL COMPARE           8249         6477         6268778         LOGA. R2         CHL         SST         OKROLLORR           8258         6477-62         LOOZ         R2         TRANSFER R2         TO R1           8251         6489         C1         STRZ         R1           8253         6483         4687         ANDI. R2         H'76'         CLEAR LOWER 3         BITS           8253         6483         4687         ANDI. R2         H'76'         CLEAR UPPER 5         BITS           8254         6485         E606         COMI. R2         H'06'         BRANCH 1F         CONTROLLOR         E001. CR           8255         6487         7588         BCTR. N         REP         BRANCH 1F         CONTROLLOR         E002           8256         6480         62         LOOZ         R2         8263         6493         6493         BCTR. N         REPP           8251         6493         6493         BCTR. N         REPP	2246         06G         H'477'           6247         9477         3F068F         BSTR. UN         SAVE         CALL         SAVE         SUBROUT)           6248         9470         7702         PPSL         COH         L0GIORL         COMPARE           6249         947C         86076         L000, R2         CHL         SET         CONTROLMORD           6259         947F-62         L002         R2         TRANSFER R2         TO         R1           6251         9480         C1         STRZ         R1         6252         9481         4558         RND1, R1         H'F8'         CLEAR         LOMER 3         BIT9           6253         9483         4667         RND1, R2         H'67'         CLEAR         UMER 3         BIT9           6254         9483         4667         RND1, R2         H'67'         CLEAR         UMER 5         BIT9           6255         9487         10658         BCTR. EQ         ERA         BRANCH IF         CONTROL           6256         4480         9064F0         BCFR. Z         DAB         BRANCH IF         CONTROL           6261         6493         9404         L002         R1	, RELUKUER
8247         6477         3F068F         BSTR, UN_SAVE         CALL_SAVE SUBROUTINE           8248         6476         7702         PPSL         COM         LOGICAL_COMPRE           8249         6477         622         PPSL         COM         LOGICAL_COMPRE           8258         6477-02         LOOZ         R2         RL         SET_CONTROLMORD           8253         6483         4667         MOL.R1 H'767'         CLEAR LOMER 3 BITS           8253         6483         4667         MOL.R2 H'767'         CLEAR UPPER 5 BITS           8254         6485         6566         COMI.R2 H'767'         CLEAR UPPER 5 BITS           8255         6487         7588         BCTR. EQ ERA         BRANCH IF CONTROLCTR EQUAL 6           8256         6480         622         LOOZ         R2           8259         6480         624         LOOZ         R2           8250         6480         624         LOOZ         R2           8253         6480         624         LOOZ         R2           8253         6480         BCFR.N         REPP         BRANCH IF CONTROLCTR IS NOT ZERO           8263         6493         9448         BCFR.N         REPP </td <td>6247         6477         3F668F         BSTR. UN         SRVE         CALL         SRVE         CALL         SRVE         CALL         SRVE         COLL         SRUE         CONTROLMORD           6248         6477         762         PPSL         CON         LOGICAL         CONTROLMORD           6259         6477-62         LODZ         R2         TRANSFER         R2 TO R1           6251         6483         611         STRZ         R1           6252         6483         4667         PND1, R2 H'07'         CLEAR         LOMER 3 BITS           6253         6483         4667         PND1, R2 H'07'         CLEAR         UPPER 5 BITS           6254         6485         E666         COMI, R2 H'06'         ECS5         6487         7688           6257         *         6258         6480         9264F0         BCFR, Z         PAB         BRANCH IF         CONTROL           6261         6491         9628         6480         9264B         BCFR, N         REPP         BRANCH IF         CONTROL           6262         *         6266         6497         671C         LODI, R9         H'AA'           6264         6493         644A         &lt;</td> <td></td>	6247         6477         3F668F         BSTR. UN         SRVE         CALL         SRVE         CALL         SRVE         CALL         SRVE         COLL         SRUE         CONTROLMORD           6248         6477         762         PPSL         CON         LOGICAL         CONTROLMORD           6259         6477-62         LODZ         R2         TRANSFER         R2 TO R1           6251         6483         611         STRZ         R1           6252         6483         4667         PND1, R2 H'07'         CLEAR         LOMER 3 BITS           6253         6483         4667         PND1, R2 H'07'         CLEAR         UPPER 5 BITS           6254         6485         E666         COMI, R2 H'06'         ECS5         6487         7688           6257         *         6258         6480         9264F0         BCFR, Z         PAB         BRANCH IF         CONTROL           6261         6491         9628         6480         9264B         BCFR, N         REPP         BRANCH IF         CONTROL           6262         *         6266         6497         671C         LODI, R9         H'AA'           6264         6493         644A         <	
8248         9478         7782         PPSL         COM         LOGICRL COMPRE           8249         947C         663770         LOGA.R2         CML         SET CONTROLMORD           8250         9483         6437         R         STR R1           8252         9481         4558         RNDI, R1         H'F8'         CLEAR         LOBER 3         BITS           8253         9483         4687         RNDI, R1         H'87'         CLEAR         LOPER 5         BITS           8253         9483         109588         BCTA.E9         ERA         BRANCH IF CONTROLCTR EQUAL 6         6           8256         9487         7688         BCTA.E9         ERA         BRANCH IF CONTROLCTR EQUAL 6         6           8257         *         *         8         BCTA.E9         ERA         BODA NITHOUT CARKY           8257         *         *         8         BCTA.E9         ERA         BODA NITHOUT CARKY           8257         *         8         BCTA.E9         ERA         BRANCH IF CONTROLCTR IS NOT ZERO           8258         9480         9041         LOOZ         R2         *         8           8264         9493         9494         L	8248         8478         7782         PPSL         COM         LOGICRL         COMPRE           6249         6470         6687F8         LOGA, R2         CNL         SET         CONTROLMORD           6258         6477-62         LODZ         R2         TRANSFER, R2         TO         R1           6252         6481         4558         ANDI, R1         H'F8'         CLEAR         LOMER 3         BIT3           6253         6483         4687         ANDI, R2         H'67'         CLEAR         LOMER 3         BIT3           6254         6485         E666         COMI, R2         H'66'         6255         6487         TC0588         BCTA, E9         ERA         BRANCH IF         CONTROLG           6255         6487         7568         CPSL         MC         ADD WITHOUT CARRY         6256           6259         6480         9624F6         BCFR, Z         DRB         BRANCH IF         CONTROL         6268           6259         6480         9624F6         BCFR, N         REPP         BRANCH IF         CONTROL           6264         6493         64A9         LODI, R3         28         6267         6493         6449         RTE, R9	
8249         847C         6E97F9         LOOR, R2         CHL         SET_CONTROLMORD           8250         647F-62         LOOZ         R2         TRANSFER R2 TO R1           8251         6489         C1         STRZ         R1           8252         6481         45F8         ANDI, R1 H'F87         CLEAR LOMER 3 BITS           8253         6483         4607         ANDI, R2 H'67'         CLEAR UPPER 5 BITS           8254         6485         E666         COMI, R2 H'67'         CLEAR UPPER 5 BITS           8255         6487         7588         BCTA, EQ ERA         BRANCH IF CONTROLCTR EQUAL 6           8256         6488         7588         CPSL         NC         HOD NITHOUT CARKY           8257         *         *         6228         6480         9204F8         BCFA, Z         DRB         BRANCH IF CONTROLCTR IS NOT ZERO           8258         6480         9204F8         BCFA, Z         DRB         BRANCH IF CONTROLCTR IS NOT ZERO           8256         6493         9404         LOOZ         R1         6262         *           8251         6493         9464         LOOI, R3         28         F         627         6493         54668         NE	8249         647C         6E97F0         LODA, R2         CML         SET         CONTROLHORD           8250         647F-62         LODZ         R2         TRANSFER         R2	
8258         0477-02         LODZ         R2         TRNNSFER R2 TO R1           8251         0480         C1         STRZ         R1           8252         0483         4578         NNDI, R1 H/F8'         CLEAR LOWER 3 BITS           8253         0483         4607         NNDI, R2 H'67'         CLEAR UPPER 5 BITS           8253         0483         4607         NNDI, R2 H'67'         CLEAR UPPER 5 BITS           8253         0483         4607         ANDI, R2 H'66'         BRANCH IF CONTROLCTR EQUAL 6           8254         0485         E666         COMI, R2 H'66'         BRANCH IF CONTROLCTR EQUAL 6           8256         0480         9C84F6         BCFR, Z         DR8         BRANCH IF CONTROLCTR IS NOT ZERO           8259         0480         9C84F6         BCFR, Z         DR8         BRANCH IF CONTROLCTR IS NOT ZERO           8261         0491         LO02         R1         CO2         R2           8261         0491         LO02         R1         CO2         R2           8262         #         BCFR, N         REPP         BRANCH IF CONTROLCTR IS NOT ZERO           8262         #         LO01, R3         28         S2           8263         0493 <td>0258       047F-02       LODZ       R2       TRANSFER R2 TO R1         0251       0489       C1       STRZ       R1         0252       0481       45F8       RNDI, R1       H'F8'       CLEAR       LOMER 3 BITS         0253       0483       4687       RNDI, R1       H'F8'       CLEAR       LOMER 3 BITS         0253       0483       4687       RNDI, R2       H'67'       CLEAR       LOMER 3 BITS         0255       0487       10258       BCTA, E9       ERA       BRANCH IF CONTROLO         0256       0487       7588       CPSL       WC       ADD WITHOUT CARKY         0257       *       80259       0480       904479       BCFA, Z       DAB       BRANCH IF CONTROLO         0256       0480       90204F8       BCFA, Z       DAB       BRANCH IF CONTROLO         0256       0491       9627       8480       BCFR, N       REPP       BRANCH IF CONTROLO         0256       0493       044A       LODI, R8       LODI, R8       RE       RE         0256       0495       D488       NRTE, R8       DEC+DCR       MRITE PREAMBLE       0265         0256       0497       071C       LODI, R8</td> <td></td>	0258       047F-02       LODZ       R2       TRANSFER R2 TO R1         0251       0489       C1       STRZ       R1         0252       0481       45F8       RNDI, R1       H'F8'       CLEAR       LOMER 3 BITS         0253       0483       4687       RNDI, R1       H'F8'       CLEAR       LOMER 3 BITS         0253       0483       4687       RNDI, R2       H'67'       CLEAR       LOMER 3 BITS         0255       0487       10258       BCTA, E9       ERA       BRANCH IF CONTROLO         0256       0487       7588       CPSL       WC       ADD WITHOUT CARKY         0257       *       80259       0480       904479       BCFA, Z       DAB       BRANCH IF CONTROLO         0256       0480       90204F8       BCFA, Z       DAB       BRANCH IF CONTROLO         0256       0491       9627       8480       BCFR, N       REPP       BRANCH IF CONTROLO         0256       0493       044A       LODI, R8       LODI, R8       RE       RE         0256       0495       D488       NRTE, R8       DEC+DCR       MRITE PREAMBLE       0265         0256       0497       071C       LODI, R8	
8251         6488         C1         STRZ         R1           8252         6481         45F8         AND1, R1 H'F8'         CLEAR LOMER 3 BITS           8253         6483         4687         AND1, R2 H'67'         CLEAR UPPER 5 BITS           8254         6485         E686         COMI, R2 H'66'         EERA         BRANCH IF CONTROLCTR EQUEL 6           8256         6487         7588         CPSL         WC         ADD WITHOUT CARKY           8257         *         *         88948C         62         LOOZ         R2           8258         6480         62         LOOZ         R2         88948C         62         LOOZ         R2           8259         6480         62         LOOZ         R1         88948C         1F CONTROLCTR IS NOT ZERO           8261         6499         61         LOOZ         R1         88948C         1F CONTROLCTR IS NOT ZERO           8261         6499         6464         LOOI, R0 H'AA'         88948C         1F CONTROLCTR IS NOT ZERO           8262         6499         6414         LOOI, R0 H'AA'         88948C         158         1680           8265         6497         671C         LOOI, R0 H'24'         88740CH	6251       6489       C1       STRZ       R1         6252       6481       45F8       RNDI, R1       H'F8'       CLEAR       LOMER 3       BITS         6253       6483       4687       RNDI, R1       H'F8'       CLEAR       LOMER 3       BITS         6254       6485       E686       COMI, R2       H'66'       BRANCH       IF       CONTROLO         6255       6487       7568       CPSL       NC       ADD       WITHOUT       CRRY         6256       6480       9084F0       BCFR, Z       DRB       BRANCH       IF       CONTROLO         6260       6499       61       LOOZ       R2       B263       6480       9044F0       BCFR, Z       DRB       BRANCH       IF       CONTROLO         6262       #       B021       LOOZ       R1       B264       6491       9420       BCFR, N       REPP       BRANCH IF       CONTROLO         6262       #       B021, R8       H'AA'       B265       B266       B497       G71C       LODI, R8       H'AA'       B265       B465       B276       B499       B6689       BSTR, UN       LOP8       CFLL       STRT WRITTING         6	
8252         8481         45F8         RND1, R1 H'F8'         CLEAR LOWER 3 BITS           8253         6483         4687         RND1, R2 H'07'         CLEAR UPPER 5 BITS           8254         6485         E666         COM1, R2 H'07'         CLEAR UPPER 5 BITS           8255         6487         7568         CPSL         HC         ADD NITHOUT CARKY           8255         6487         7568         CPSL         HC         ADD NITHOUT CARKY           8257         *         8258         6480         928         LODZ         R2           8259         6480         928         BCFR, Z         DRB         BRANCH IF CONTROLCTR IS NOT ZERO           8260         6499         F628         BCFR, N         REPP         BRANCH IF CONTROLCTR IS NOT ZERO           8261         6493         6488         BCFR, N         REPP         BRANCH IF READING MODE           8262         #         LODI, R8         CFL R4         ERPP         BRANCH IF READING MODE           8262         #         LODI, R8         CFL R4         LODI, R8         CFL R4           8264         6493         6493         BTA UN LOP8         CALL START MRITING DELRY SUBR. (60 MSEC)           8265         64937	6252         6481         45F8         RNDI, R1         H*F8*         CLEAR LOWER 3 BIT5           6253         6483         4607         RNDI, R2         H*07*         CLEAR UPPER 5 BIT5           6254         6485         E606         COMI, R2         H*06*         BRANCH IF CONTROLO           6255         6487         7508         CPSL         NC         ADD WITHOUT CARKY           6257         *         8         8         CPSL         NC         ADD WITHOUT CARKY           6258         6487         7508         CPSL         NC         ADD WITHOUT CARKY           6257         *         8         8         CPSL         NC         ADD WITHOUT CARKY           6257         *         8         8         CPSL         NC         ADD WITHOUT CARKY           6257         *         8         8         CPSL         NC         ADD WITHOUT CARKY           6257         *         8         6         6         9         9         CAL         CONTROLO           6261         6493         9448         BCRA         L001, R3         R         R         R           6265         *         6         6         SET FORMARD AND M<	KI .
8253         6483         4607         ANDI, R2         H'07'         CLEAR UPPER 5         BITS           8254         6485         E606         COMI, R2         H'06'         BRANCH IF CONTROLCTR EQUAL 6           8255         6487         7568         CPSL         NC         ADD WITHOUT CARRY           8257         *         6258         6480         92         LOZ         R2           8259         6480         92         LOZ         R2         6259         6480         92         R           8256         6449         01         LODZ         R2         6259         6480         92         R           8256         6449         01         LODZ         R2         8         8         8           6251         4480         9624         BCFR, R         REPP         BRANCH IF CONTROLCTR IS NOT ZERO           6252         *         8         COLI, R0         H'AA'         8         8           6253         6493         9464         LODI, R3         28         8         8           6256         442         LODI, R3         28         8         8         8           6259         9450         9440 </td <td>0253       0483       4607       ANDI, R2       H'07'       CLERR UPPER 5 BITS         0254       0485       E606       COMI, R2       H'06'         0255       0487       10858       BCTA, E9       ERA       BRANCH IF CONTROLO         0256       0487       7588       CPSL       WC       ADD WITHOUT CARRY         0257       *       0258       0480       9004F0       BCFA, Z       DRB       BRANCH IF CONTROLO         0258       0480       9004F0       BCFA, Z       DRB       BRANCH IF CONTROLO         0268       0491       91       LODZ       R1       0266         0263       0493       0404       BCFR, N       REPP       BRANCH IF CONTROLO         0266       0493       0404A       MRTE, R0       0EC+DCR       WRITE PREAMBLE         0265       *       0266       0493       BRANCH IF READING       0404         0268       *       0266       0493       BRAS       WRITE R0       WRITE PREAMBLE         0266       0497       071C       LODI, R3       28       CALL START WRITING         0268       *       0267       0449       WRIE, R0       CALL START WRITING         <td< td=""><td></td></td<></td>	0253       0483       4607       ANDI, R2       H'07'       CLERR UPPER 5 BITS         0254       0485       E606       COMI, R2       H'06'         0255       0487       10858       BCTA, E9       ERA       BRANCH IF CONTROLO         0256       0487       7588       CPSL       WC       ADD WITHOUT CARRY         0257       *       0258       0480       9004F0       BCFA, Z       DRB       BRANCH IF CONTROLO         0258       0480       9004F0       BCFA, Z       DRB       BRANCH IF CONTROLO         0268       0491       91       LODZ       R1       0266         0263       0493       0404       BCFR, N       REPP       BRANCH IF CONTROLO         0266       0493       0404A       MRTE, R0       0EC+DCR       WRITE PREAMBLE         0265       *       0266       0493       BRANCH IF READING       0404         0268       *       0266       0493       BRAS       WRITE R0       WRITE PREAMBLE         0266       0497       071C       LODI, R3       28       CALL START WRITING         0268       *       0267       0449       WRIE, R0       CALL START WRITING <td< td=""><td></td></td<>	
8254         64435         E606         COMI, R2 H'06'           8255         64487         102588         BCTR, EQ ERR         BRANCH IF CONTROLCTR EQUAL 6           8256         6458         7588         CPSL         NC         ADD WITHOUT CARKY           8257         *         *         8258         6480         62         LODZ         R2           8258         6480         62         LODZ         R2         8058         CONTROLCTR IS NOT ZERO           8258         64430         9024476         BCFR, Z         DAB         BRANCH IF CONTROLCTR IS NOT ZERO           8256         6439         641         LODZ         R1         8264         8430         902446           8261         6431         9629         BCFR, N         REPP         BRANCH IF CONTROLCTR IS NOT ZERO           8262         *         8261         6437         6448         HTTE, R8         06C+DCR         HRITE PREAMBLE         8265           8265         6437         671C         LODI, R3         28         6447         620         MSEC         82           8265         6449         RTE, R8         CC+DCR         HRITE PREAMBLE         827         64498         5424         LODI, R8	8254         6485         E686         COMI, R2         H'06'           8255         0487         102588         BCTA, EQ         ERA         BRANCH IF CONTROLO           8256         0487         7508         CPSL         WC         ADD WITHOUT CARRY           8257         *	
8255         6447         1C8588         BCTR. EQ ERA         BRANCH IF CONTROLCTR EQUAL 6           8256         64487         7508         CPSL         NC         ADD WITHOUT CARRY           8257         *         8         6257         *         8           8258         6480         92         LODZ         R2         8           8259         6480         924F9         BCFR.Z         DAB         BRANCH IF CONTROLCTR IS NOT ZERO           8258         6493         924F9         BCFR.Z         DAB         BRANCH IF CONTROLCTR IS NOT ZERO           8256         6493         9423         9449         LODZ         R1         8           8251         6491         9428         BCFR.N         REPP         BRANCH IF READING MODE           8252         #         8         8         HTE.R8         0EC+DCR         WRITE PREAMBLE           8256         #         1001, R3         28         6447         6268         #           8256         6497         671C         LODI, R3         28         CALL START WRITING DELRY SUBR. (60 MSEC)           8258         #         1001, R3         28         CALL START WRITING DELRY SUBR. (60 MSEC)           8258	8255         6487         1C8588         BCTR. EQ         ERA         BRANCH IF         CONTROLO           8256         6488         7588         CPSL         NC         HOD WITHOUT CARRY           8257         *         *         8258         6482         0.002         R2           8259         6480         90.04F8         BCFR. Z         DAB         BRANCH IF         CONTROLO           8258         6480         90.04F8         BCFR. Z         DAB         BRANCH IF         CONTROLO           8259         6480         90.04F8         BCFR. N         REPP         BRANCH IF         CONTROLO           8261         6491         9628         BCFR. N         REPP         BRANCH IF         CONTROLO           8262         6493         8488         MRTE. R8         0EC+DCR         WRITE PREAMBLE         8265           8265         *         80001.R3         28         8267         8493         9448           8268         *         8001.R8         H/247         8479         8479         8479           8268         *         8001.R8         H/247         8479         9479         9448         9448         9479         9470         9479	115
8256         6488         7583         CPSL         NC         ADD         NITHOUT         CARRY           8257         *         *         *         *         *         *         *           8258         6480         90.964F0         BCFR.Z         DR8         BRANCH         IF         CONTROLCTR         IS         NOT         ZER0           8259         6439         961         LO0Z         R1         *         *         *           8261         6491         9620         BCFR.N         REPP         BRANCH         IF         CONTROLCTR         IS         NOT         ZER0           8261         6493         94AP         LODI, R8         H/AP/         * </td <td>8256         0488         7588         CPSL         NC         ADD         NITHOUT         CARRY           8257         *         8258         0480         9204F8         BCFA, Z         DAB         BRANCH IF CONTROLO           8259         0480         9204F8         BCFA, Z         DAB         BRANCH IF CONTROLO           8259         0480         9204F8         BCFR, Z         DAB         BRANCH IF CONTROLO           8261         0491         9628         BCFR, N         REPP         BRANCH IF CONTROLO           8262         *         0263         0493         04AA         LODI, R8         H'AA'           8262         *         0264         0495         D488         MRTE, R8         0EC+DCR         MRITE         PREAMBLE           8265         *         0267         0493         3F6689         BSTR. UN         LOP8         CALL         START MRITING           8268         *         0267         0493         3F6689         BSTR. UN         LOP8         CALL         START MRITING           8268         *         0267         0499         5468         RL         TMI, R1         H'08'           8270         0492         0448</td> <td></td>	8256         0488         7588         CPSL         NC         ADD         NITHOUT         CARRY           8257         *         8258         0480         9204F8         BCFA, Z         DAB         BRANCH IF CONTROLO           8259         0480         9204F8         BCFA, Z         DAB         BRANCH IF CONTROLO           8259         0480         9204F8         BCFR, Z         DAB         BRANCH IF CONTROLO           8261         0491         9628         BCFR, N         REPP         BRANCH IF CONTROLO           8262         *         0263         0493         04AA         LODI, R8         H'AA'           8262         *         0264         0495         D488         MRTE, R8         0EC+DCR         MRITE         PREAMBLE           8265         *         0267         0493         3F6689         BSTR. UN         LOP8         CALL         START MRITING           8268         *         0267         0493         3F6689         BSTR. UN         LOP8         CALL         START MRITING           8268         *         0267         0499         5468         RL         TMI, R1         H'08'           8270         0492         0448	
8257       *         8258       6480       62       LO0Z       R2         8259       6480       9064F0       BCFR.Z       DRB       BRANCH IF CONTROLCTR IS NOT ZERO         8260       6499       01       LO0Z       R1         8261       6491       91       LO0Z       R1         8261       6493       9449       BCFR.N       REPP       BRANCH IF CONTROLCTR IS NOT ZERO         8262       *       8001.00       R0FR.N       REPP       BRANCH IF READING MODE         8262       *       8001.00       R0 EC+DCR       MRITE PREAMBLE         8263       6493       944A       LODI.R8       H'AA'         8264       6495       0485       MRTE.R8       CC+DCR       MRITE PREAMBLE         8265       *       8267       9499       3F6689       BSTR.UN LOP8       CALL START WRITING DELRY SUBR. (60 MSEC)         8268       9427       9449       WRTE.R8       CX+DCR       SET FORMARD AND MCD, RES ERRSE FF         8279       9448       908564       BCFR.A1       NGPC       CALL GAPCHECK SUBROUTINE         8274       9448       908567       BCFR.A1       RIC       BRANCH IF TEMP FLAG NOT SET	8257       *         8258       048C       02       LODZ       R2         8259       0480       9C84F0       BCFA, Z       DAB       BRANCH IF CONTROLO         8263       0499       01       LODZ       R1         8261       0491       9626       BCFR, N       REPP       BRANCH IF CONTROLO         8262       *       0261       0495       D488       BCFR, N       REPP       BRANCH IF READING         8262       *       0263       0493       04AR       LODI, R0       H'AA'         8264       0495       D488       HRTE, R8       0EC+DCR       HRITE PREAMBLE         8265       *       0267       0499       3F0689       BSTR, UN       LOP3       CFLL       START HRITING         8268       *       0267       0499       3F0689       BSTR, UN       LOP8       CFLL       START HRITING         8268       *       0261       0492       0424       LODI, R3       28       CFLL       START HRITING         8268       #       0271       0468       F588       RL       TMI, R1       H'08'       CFLL       START HRITING         8271       0487       3F06F1	
6258       648C       62       L00Z       R2         6259       6480       9064F8       BCFA, Z       DAB       BRANCH IF CONTROLCTR IS NOT ZERO         6268       6499       61       L00Z       R1       BCFA, Z       DAB       BRANCH IF CONTROLCTR IS NOT ZERO         6268       6499       61       L00Z       R1       BCFA, N       REPP       BRANCH IF READING MODE         6262       *       6263       6493       64AA       L00I, R0       H'AA'         6264       6495       0488       MRTE, R0       0EC+DCR       MRITE PREAMBLE       6265         6265       *       6266       6497       671C       L00I, R3       28         6267       6499       3F6659       BSTA, UN LOP8       CFLL START MRITING DELRY SUBR. (60 MSEC)         6268       *       100I, R8       H'24'       6269       649C       6424       L00I, R8       FSTA, UN LOP8       CFLL START MRITING DELRY SUBR. (60 MSEC)         6268       *       1001, R8       H'24'       6269       649C       6424       L001, R8       FSTA       FSTA, UN LOP8       CFLL START MRITING DELRY SUBR. (60 MSEC)       6268       6279       6448       SETA, UN LOP8       CFL GAPCHECK SUBROUTINE <t< td=""><td>0258         048C         02         LO0Z         R2           0259         0480         9C04F0         BCFR.Z         DAB         BRANCH IF CONTROLO           0260         0490         01         LO0Z         R1           0261         0491         9A20         BCFR.N         REPP         BRANCH IF CONTROLO           0262         *         0263         0493         04AR         LODI, R0         H'AA'           0264         0495         D488         WRTE, R8         0EC+DCR         WRITE PREAMBLE           0265         *         0266         0497         071C         LODI, R3         28           0266         0497         071C         LODI, R3         28         0424         0263           0263         #         0264         0495         D448         WRTE, R8         CFLL         START WRITING           0268         #         0261, R8         H'24'         0270         0492         D448         WRTE, R8         CALL         START WRITING           0271         04R9         F88         RL         TMI, R1         H'08'         SET FORMARD AND MC           0271         04R9         F888         RL         TMI, R1</td><td>.KΥ</td></t<>	0258         048C         02         LO0Z         R2           0259         0480         9C04F0         BCFR.Z         DAB         BRANCH IF CONTROLO           0260         0490         01         LO0Z         R1           0261         0491         9A20         BCFR.N         REPP         BRANCH IF CONTROLO           0262         *         0263         0493         04AR         LODI, R0         H'AA'           0264         0495         D488         WRTE, R8         0EC+DCR         WRITE PREAMBLE           0265         *         0266         0497         071C         LODI, R3         28           0266         0497         071C         LODI, R3         28         0424         0263           0263         #         0264         0495         D448         WRTE, R8         CFLL         START WRITING           0268         #         0261, R8         H'24'         0270         0492         D448         WRTE, R8         CALL         START WRITING           0271         04R9         F88         RL         TMI, R1         H'08'         SET FORMARD AND MC           0271         04R9         F888         RL         TMI, R1	.KΥ
6259         6480         9064F8         BCFR.Z         DRB         BRANCH IF CONTROLCTR IS NOT ZERO           6268         6499         01         LOOZ         R1           6261         6491         9620         BCFR.N         REPP         BRANCH IF CONTROLCTR IS NOT ZERO           6262         *         6262         *         6263         6493         64AP         LODI.R8         H'AP'           6264         6495         0488         WRTE.R8         0EC+DCR         WRITE PREAMBLE         6265           6265         *         6266         6497         671C         LODI.R3         28           6267         6499         3F6689         BSTR.UN         LOP8         CFLL         START WRITING DELRY SUBR. (60 MSEC)           6268         *         6269         6424         LODI.R8         H'24'         627           6270         6492         6424         LODI.R9         H'24'         627         6498         F688         RL         TMI.R1         H'08'           6271         6449         F688         RL         TMI.R1         H'08'         627         6484         S0056F         BCFR.R1         INC         BRANCH IF TEMP FLAG NOT SET         627         6	6259       6480       9C64F0       BCFR. Z       DAB       BRANCH IF CONTROLO         6260       6490       01       LODZ       R1         6261       6491       9A20       BCFR. N       REPP       BRANCH IF CONTROLO         6262       *         6263       6493       64AA       LODI, R0       H'AA'         6263       6493       64AA       LODI, R0       H'AA'         6264       6495       D488       MRTE, R8       0CC+DCR       WRITE PREAMBLE         6265       *       6265       *       6265       *         6266       6497       671C       LODI, R3       28       6267         6499       3F6689       BSTR, UN LOP8       CALL START WRITING       6268       *         6267       6497       671C       LODI, R3       28       57         6267       6499       3F6689       BSTR, UN LOP8       CALL START WRITING         6268       *       6274       A440       WRTE, R9       CALL START WRITING         6276       6492       D440       WRTE, R9       CALL START WRITING       6271         6272       6481       558       RL       TMI, R1       H	
8260         0490         01         LO0Z         R1           8261         0491         9620         BCFR.N         REPP         BRANCH IF READING MODE           8262         *         *         *         *           8263         0433         04AA         LODI, R0         H'AA'           8264         0495         D488         MRTE, R0         DEC+DCR         MRITE PREAMBLE           8265         *         *         *         *           8266         0497         071C         LODI, R3         28           8267         0499         3F0669         BSTR, UN LOP8         CFLL START HRITING DELRY SUBR. (60 MSEC)           8268         *         *         *         *           8269         0492         0424         LODI, R0 H'24'         *           8269         0492         0448         MRTE, R0 CX+DCR         SET FORMARD AND HCD, RES ERRSE FF           8271         0440         FS8         RL         TMI, R1 H'08'         SET FORMARD AND HCD, RES ERRSE FF           8272         0482         902568         BCFA, R1 INC         BRANCH IF TEMP FLAG NOT SET           8272         0448         902569         BCFA, R1 RIC         BRANCH IF NO GAP	8260         0490         01         LOOZ         R1           6261         6491         9620         BCFR.N         REPP         BRANCH IF READING           6262         *         6263         6493         04AA         LODI, R0         H'AA'           6263         6493         04AA         LODI, R0         H'AA'         6264         6495         D488.         WRTE, R0         0EC+DCR         WRITE PREAMBLE         6265         *         6266         6497         671C         LODI, R3         28         6267         6499         3F6689         BSTR, UN         LOP8         CALL         START WRITINK         6268         *         6269         6492         6424         LODI, R0         H'24'         6279         6496         5440         WRTE, R0         CALL         START WRITINK         6278         *         6271         6480         F588         RL         TMI, R1         H'08'         SET         FORMARD AND MC         6272         64A2         SET FORMARD AND MC         6273         64A5         54661         BSTR, UN         GPC         CALL         GPCHECK         SUB           6273         64A5         5F06F1         BSTA, UN         GPC         CALL         GPCHECK <t< td=""><td></td></t<>	
8261         8491         9628         BCFR. N         REPP         BRANCH IF READING MODE           8262         *           8263         8493         84RA         LODI, R0         H/AA'           8264         8495         D488         MRTE, R0         0EC+DCR         MRITE PREAMBLE           8265         *	6261         6491         9628         BCFR. N         REPP         BRANCH IF         READING           6262         *         6263         6493         64AA         LODI, R0         H'AA'         6264         6495         0488         HRTE, R0         DEC+DCR         HRITE         PREAMBLE         6265         *         6265         *         6265         *         6267         6493         3F6689         BSTR. UN         LOP8         CFLL         START HRITING         6268         *         6267         6497         671C         LODI, R3         28         6267         6493         3F6689         BSTR. UN         LOP8         CFLL         START HRITING         6268         *         6269         6497         671C         LODI, R3         28         6267         6493         3F6689         BSTR. UN         LOP8         CFLL         START HRITING         6268         *         6269         6497         6440         HRTE, R8         CX+DCR         SET         FORMARD AND MC         6271         6478         54661         BSTR. UN         CRLL         SRANCH IF         TENP FLF         6273         6475         3F66F1         BSTR. UN         GAPC         CRLL         GAPCHECK SUBF         6276         64700	OLCIR IS NOT ZERU
8262         *           8263         8493         84R1         LODI, R8 H'AA'           8264         8495         D488         HRTE, R8 0EC+DCR         HRITE PREAMBLE           8265         *         *         *         *           8266         8497         071C         LODI, R3 28         CRLL START HRITING DELRY SUBR. (60 MSEC)           8265         *         *         *         *           8267         0499         3F0639         BSTR, UN LOP8         CRLL START HRITING DELRY SUBR. (60 MSEC)           8268         *         *         *         *           8269         049C 0424         LODI, R9 H'24'         *           8269         049C 0424         LODI, R9 H'24'         *           8270         0478         F588         RL         TMI, R1 H'08'           8271         0478         F588         RL         TMI, R1 H'08'           8272         0478         52661         BSTR, UN GRPC         CALL GAPCHECK SUBROUTINE           8273         0475         3F06F1         BSTR, UN GRPC         CALL GAPCHECK SUBROUTINE           8274         0478         9C05AF         BCR, A1 RIC         BRANCH IF NO GRP           8275	6262         *           6263         6493         64AA         LODI, R0         H'AA'           6264         6495         D488         MRTE, R8         DEC+DCR         MRITE PREAMBLE           6265         *         6266         6497         071C         LODI, R3         28           6267         6499         3F6689         BSTA, UN         LOP8         CALL         START MRITING           6268         *         6269         649C         6424         LODI, R8         H'24'           6268         *         6267         6499         3F6689         BSTA, UN         LOP8         CALL         START MRITING           6268         *         6269         649C         6424         LODI, R8         H'24'           6270         649E         D448         MRTE, R8         CX+DCR         SET         FORMARD AND MC           6271         64A9         F588         AL         TMI, R1         H'08'         SET         FORMARD AND MC           6272         64A9         9C0568         BCFA, A1         INC         BRANCH IF         TEMP FLAG           6273         64A8         9C05AF         BCFA, A1         RIC         BRANCH IF NO GAP	IN MODE
8263       64933       64943       66944       64943       66944       64944       66944       64944       66944       64944       66944       64944       66944       64944       66944       64944       66944       64944       66944       64944       66944       64944       66944       64944	0263       0493       04RR       LODI, R0       H'AR'         0264       0495       D488       MRTE, R8       DEC+DCR       WRITE PREAMBLE         0265       *       0266       0497       071C       LODI, R3       28         0267       0499       3F0689       BSTR, UN       LOP8       CALL       START MRITING         0268       *       0269       049C       0424       LODI, R9       H'24'         0279       0495       D448       MRTE, R9       CX+DCR       SET       FORMARD AND MC         0271       04R9       F588       RL       TMI, R1       H'08'       BRANCH IF TEMP FLF         0272       04R2       9C0568       BCFR, R1       INCC       BRANCH IF TEMP FLF         0273       04R5       3F06F1       BSTR, UN       GPC       CALL       GALL       GAPCHECK SUBA         0274       04R8       9C05AF       BCFR, R1       INCC       BRANCH IF TEMP FLF         0275       04R8       9C05AF       BCFR, IN       GR       INHIBIT REPOING DC         0275       04R8       1F05AF       BCTR, UN       IGR       INHIBIT REPOING DC         0276       04R0       JF05AF       BCTR,	NU NUC
0264       0495       0488       NRTE, R0       0EC+DCR       NRITE PREAMBLE         0265       *         0266       0497       071C       LODI, R3       28         0267       0499       3F0669       BSTR, UN       LOP8       CRLL       START HRITING DELRY SUBR. (60 MSEC)         0268       *         0269       0490       0424       LODI, R0       H'247         0270       0492       D440       NRTE, R0       CX+DCR       SET FORMARD AND MCD, RES ERRSE FF         0271       0469       F588       RL       TMI, R1       H'087         0272       0442       902560       BCFA, R1       NCC       BRANCH IF TEMP FLAG NOT SET         0273       0445       3F06F1       BSTA, UN GAPC       CALL GAPCHECK SUBROUTINE         0274       0448       9025AF       BCFA, R1 RIC       BRANCH IF NO GAP         0275       0448       905AF       BCFA, R1 RIC       BRANCH IF NO GAP         0276       0440       3F66E3       BSTA, UN IGR       INHIBIT READING DURING GAP         0276       0440       3F66E3       BSTA, UN RIC       2027         0279       0483       5420       REPP       REDE, R0 IEC+DCR       R	0264         0495         D488         HRTE, R8         DEC+DCR         HRITE PREAMBLE           0265         *         0266         0497         071C         LODI, R3         28           0267         0499         3F0689         BSTA, UN         LOP8         CALL         START HRITING           0268         *         0267         0499         3F0689         BSTA, UN         LOP8         CALL         START HRITING           0268         *         0267         0492         0424         LODI, R8         H'24'           0268         *         0279         0492         D440         HRTE, R9         CX+DCR         SET         FORMARD AND HX           0271         0469         F588         AL         TMI, R1         H'08'         BTA, UN         GPC+CR         SET         FORMARD AND HX           0272         0462         902568         BCFA, A1         INCC         BRANCH IF         TEMP FLG           0273         0465         3F06F1         BCFA, A1         RIC         BRANCH IF         NO GAP           0275         0468         902568         EORI, R1         H'08'         CLEAR TEMP FLAG           0276         04690         IF056F	
0265       *         0266       0497       071C       LODI, R3       28         0267       0499       3F0669       BSTR. UN LOP8       CALL START WRITING DELRY SUBR. (60 MSEC)         0268       *         0269       049C       0424       LODI, R9       H'24'         0270       049E       D440       WRTE, R9       CX+DCR       SET FORWARD AND WCD, RES ERRSE FF         0271       0468       F588       AL       TNI, R1       H'08'         0272       0469       5669       BCFR, A1       INCC       BRANCH IF TEMP FLAG NOT SET         0273       0463       3F06F1       BSTR, UN GAPC       CALL GAPCHECK SUBROUTINE         0274       0488       9C05AF       BCFR, A1       RIC       BRANCH IF TEMP FLAG NOT SET         0275       0448       9C05AF       BCFR, A1       RIC       BRANCH IF NO GAP         0275       0448       9C05AF       BCFR, A1       RIC       BRANCH IF NO GAP         0276       04403       3F06E3       BSTR, UN IGR       INHIBIT READING DURING GAP         0279       0483       5420       REPP       REDE, R0       IEC+DCR       READ FIRST BYTE         0280       0485       E4AR	0265       *         0266       0497       071C       LODI, R3       28         0267       0499       3F0689       BSTR. UN       LOP8       CRLL       STRT WRITING         0268       *         0269       049C       0424       LODI, R9       H'24'         0270       049E       D440       WRTE, R9       CX+DCR       SET       FORWRRD AND WC         0271       04R9       F588       RL       TMI, R1       H'08'       BTR. UN       GRANCH       IF       TEMP       FLF         0272       04R2       9C8568       BCFR, A1       INCC       BRANCH       IF       TEMP       FLF         0273       04R5       3F06F1       BSTR. UN       GRPC       CRLL       GRPCHECK       SUBF         0275       04R8       9C85AF       BCFR, A1       RIC       BRANCH       IF       NO       GRP         0275       04R8       9C85AF       BCFR, A1       RIC       BRANCH       IF       NO       GRP         0274       04R9       3F06E3       BSTR. UN       IGR       INHIBIT       READ       FLAG         0276       04R0       3F06E3       BSTR. UN	
0266       0497       071C       L001, R3 28         0267       0499       3F0689       BSTR, UN LOP8       CFLL START WRITING DELRY SUBR. (60 MSEC)         0268       *         0269       049C       0424       L001, R9 H'24'         0270       049E       D440       WRTE, R0 CX+DCR       SET FORMARD AND MCD, RES ERASE FF         0271       04A0       F588       RL       TMI, R1 H'08'         0272       04R2       9C0560       BCFA, R1 INCC       BRANCH IF TEMP FLAG NOT SET         0273       04R5       3F06F1       BSTR, UN GAPC       CALL GAPCHECK SUBROUTINE         0274       04R8       9C05AF       BCFA, R1 RIC       BRANCH IF TEMP FLAG       NOT SET         0275       04R8       9C05AF       BCFA, R1 RIC       BRANCH IF NO GAP         0275       04R8       9C05AF       BCFA, R1 RIC       BRANCH IF NO GAP         0276       04R0       3F06E3       BSTA, UN IGR       INHIBIT READING DURING GAP         0277       04B0       1F05AF       BCTA, UN RIC       279         04B3       5420       REPP REDE, R0 IEC+DCR       READ FIRST BYTE         0280       04B5       E4AR       COMI, R0 H'AR'         0281       04B7 </td <td>0266         0497         071C         LODI, R3         28           0267         0499         3F0689         BSTR, UN         LOP8         CALL         START WRITING           0268         *         0269         049C         0424         LODI, R9         H'24'           0270         049E         D440         WRTE, R9         CX+DCR         SET         FORMARD AND WC           0271         0489         F588         RL         TMI, R1         H'08'         BRANCH         IF         TEMP         FL6           0273         0485         3F06F1         BSTR, UN         GRPC         CALL         GRPCHECK SUBS           0273         0485         3F06F1         BSTR, UN         GRPC         CALL         GRPCHECK SUBS           0273         0485         3F06F1         BSTR, UN         GRPC         CALL         GRPCHECK SUBS           0274         0488         9C05AF         BCFR, A1         RIC         BRANCH         IF         NO         GRP           0275         0488         9C05AF         BCFR, A1         RIC         BRANCH IF         NO         GRP           0276         0480         3F06E3         BSTR, UN         IGR         I</td> <td></td>	0266         0497         071C         LODI, R3         28           0267         0499         3F0689         BSTR, UN         LOP8         CALL         START WRITING           0268         *         0269         049C         0424         LODI, R9         H'24'           0270         049E         D440         WRTE, R9         CX+DCR         SET         FORMARD AND WC           0271         0489         F588         RL         TMI, R1         H'08'         BRANCH         IF         TEMP         FL6           0273         0485         3F06F1         BSTR, UN         GRPC         CALL         GRPCHECK SUBS           0273         0485         3F06F1         BSTR, UN         GRPC         CALL         GRPCHECK SUBS           0273         0485         3F06F1         BSTR, UN         GRPC         CALL         GRPCHECK SUBS           0274         0488         9C05AF         BCFR, A1         RIC         BRANCH         IF         NO         GRP           0275         0488         9C05AF         BCFR, A1         RIC         BRANCH IF         NO         GRP           0276         0480         3F06E3         BSTR, UN         IGR         I	
0267         0499         3F0689         BSTR, UN LOP8         CALL START HRITING DELRY SUBR. (60 MSEC)           0268         *           0269         049C         0424         LODI, R0 H'24'           0270         049E         D440         MRTE, R0 CX+DCR         SET FORMARD AND MCD, RES ERASE FF           0271         04A9         F588         AL         TNI, R1 H'08'         BRANCH IF TEMP FLAG NOT SET           0272         04A2         9C0560         BCFA, A1 INCC         BRANCH IF TEMP FLAG NOT SET           0273         04A5         3F06F1         BSTR, UN GAPC         CALL GAPCHECK SUBROUTINE           0275         04A8         9C05AF         BCFA, A1 RIC         BRANCH IF NO GAP           0275         04A8         9C05AF         BCFA, A1 RIC         BRANCH IF NO GAP           0275         04A8         9C05AF         BCFA, A1 RIC         BRANCH IF NO GAP           0275         04A8         9C05AF         BCFA, A1 RIC         BRANCH IF NO GAP           0276         04A0         3F66E3         BSTR, UN IGR         INHIBIT READING DURING GAP           0277         04B3         1F05AF         BCTA, UN RIC         2001, R0 H'AA'           0279         04B3         5420         REPP REDE, R0 IEC	0267       0499       3F0689       BSTR. UN LOP8       CALL START WRITING         0268       *         0269       0490       0424       LODI, R0 H'24'         0270       0496       D440       WRTE, R0 CX+DCR       SET FORMARD AND WC         0271       0480       F588       AL       TMI, R1       H'08'         0272       0482       906560       BCFR, A1       INCC       BRANCH IF TEMP FLF         0273       0485       3F06F1       BSTR, UN GAPC       CALL GAPCHECK SUBF         0274       0488       9065AF       BCFR, A1       RIC       BRANCH IF TEMP FLF         0275       0485       3F06F1       BSTR, UN GAPC       CALL GAPCHECK SUBF         0275       0488       9065AF       BCFR, A1       RIC       BRANCH IF NO GAP         0275       0488       9065AF       BCFR, A1       RIC       BRANCH IF NO GAP         0275       0488       506E3       BSTR, UN IGR       INHIBIT READING OL         0277       0480       1F05AF       BCTR, UN RIC       0278       #         0279       0483       5420       REPP       REDE, R0 IEC+DCR       READ FIRST BYTE         0280       0485       E4AR	
8268       *         8269       049C       0424       LODI, R0 H'24'         8270       049E       D440       MRTE, R0 CX+DCR       SET FORMARD AND MCD, RES ERASE FF         8271       04A8       F588       AL       TNI, R1 H'08'       BRANCH IF TEMP FLAG NOT SET         8273       04A5       3F06F1       BSTR, UN GAPC       CALL GAPCHECK SUBROUTINE         8275       04A8       9C05AF       BCFR, R1 RIC       BRANCH IF NO GAP         8275       04A8       9C05AF       BCFR, R1 RIC       BRANCH IF NO GAP         8275       04A8       9C05AF       BCFR, R1 RIC       BRANCH IF NO GAP         8275       04A8       9C05AF       BCFR, R1 RIC       BRANCH IF NO GAP         8275       04A8       9C05AF       BCFR, R1 RIC       BRANCH IF NO GAP         8275       04A8       9C05AF       BCFR, R1 RIC       BRANCH IF NO GAP         8275       04A8       9C05AF       BCFR, R1 RIC       BRANCH IF NO GAP         8277       04B8       1F05AF       BCTR, UN IGR       INHIBIT READING DURING GAP         8277       04B3       5420       REPP REDE, R0 IEC+DCR       READ FIRST BYTE         8280       04B5       E4AR       COMI, R0 H'AR'       <	0268       *         0269       049C       0424       LODI, R0       H'24'         0270       049E       D440       MRTE, R0       CX+DCR       SET       FORMARD AND MO         0271       04A0       F588       RL       TMI, R1       H'08'       BRANCH IF       TEMP       FLF         0272       04A2       9C0560       BCFA, A1       INCC       BRANCH IF       TEMP       FLF         0273       04A5       3F06F1       BSTA, UN       GAPC       CALL       GAPCHECK       SUBF         0274       04A8       9C05AF       BCFA, A1       INCC       BRANCH IF       TEMP       FLF         0273       04A5       3F06F1       BSTA, UN       GAPC       CALL       GAPCHECK       SUBF         0274       04A8       9C05AF       BCFA, A1       RIC       BRANCH IF       NO GAP         0275       04A8       9C05AF       BCFA, A1       RIC       BRANCH IF       NO GAP         0276       04A0       3F06E3       BSTA, UN       IGR       INHIBIT       READ ING DA         0277       04B0       1F05AF       BCTA, UN       RE       READ FIRST BYTE         0280       04B5	
0269       049C       0424       LODI, R0       H'24'         0270       049E       D440       WRTE, R0       CX+DCR       SET FORMARD AND WCD, RES ERASE FF         0271       04A0       F588       RL       TNI, R1       H'08'         0272       04A2       9C0560       BCFA, A1       INCC       BRANCH IF TEMP FLAG NOT SET         0273       04A5       3F06F1       BSTA, UN GAPC       CALL GAPCHECK SUBROUTINE         0274       04A8       9C05AF       BCFA, A1       RIC       BRANCH IF NO GAP         0275       04A8       9C05AF       BCFA, A1       RIC       BRANCH IF NO GAP         0275       04A8       9C05AF       BCFA, A1       RIC       BRANCH IF NO GAP         0275       04A8       9C05AF       BCFA, A1       RIC       BRANCH IF NO GAP         0275       04A8       9C05AF       BCFA, D1       RIC       BRANCH IF NO GAP         0276       04A0       3F06E3       BSTA, UN IGR       INHIBIT READING DURING GAP         0278       *        0279       0483       5420       REPP REDE, R0       IEC+DCR       READ FIRST BYTE         0280       0485       E4AA       COMI, R0       H'AA'       BRANCH	0269       049C       0424       LODI, R8       H'24'         0279       049E       D440       MRTE, R9       CX+DCR       SET       FORMARD AND MO         0271       04A8       F588       RL       TMI, R1       H'08'       BRANCH IF       TEMP FLF         0272       04A2       9C6560       BCFA, A1       INCC       BRANCH IF       TEMP FLF         0273       04A5       3F06F1       BSTA, UN       GAPC       CALL       GAPCHECK       SUBF         0274       04A8       9C65AF       BCFA, A1       RIC       BRANCH IF       TEMP FLF         0275       04A8       9C65AF       BCFA, A1       RIC       BRANCH IF       NO GAP         0275       04A8       9C65AF       BCFA, A1       RIC       BRANCH IF       NO GAP         0275       04A8       9C65AF       BCFA, A1       RIC       BRANCH IF       NO GAP         0277       04A8       1F05AF       BCFA, UN IGR       INHIBIT       READ ING DA         0278       *       0279       04B3       5420       REPP       REDE, R0       IEC+DCR       READ FIRST BYTE         0280       04B5       E4AA       COMI, R0       H'AA'	ING DELINY SUBR. (60 MSEC)
0270       049E       D440       HRTE, R0       CX+DCR       SET FORMARD AND MCD, RES ERRSE FF         0271       04R0       F508       AL       TNI, R1       H'08'         0272       04R2       9C0560       BCFR, A1       INCC       BRANCH IF TEMP FLAG NOT SET         0273       04R5       3F06F1       BSTR, UN GAPC       CALL GAPCHECK SUBROUTINE         0274       04R8       9C05AF       BCFR, A1       RIC       BRANCH IF NO GAP         0275       04R8       9C05AF       BCFR, A1       RIC       BRANCH IF NO GAP         0276       04R0       3F06E3       BSTR, UN IGR       INHIBIT READING DURING GAP         0276       04R0       JF05AF       BCTR, UN RIC       ECR. UN RIC         0278       *       *        READ FIRST BYTE         0281       0485       E4RA       COMI, R0 H'AR'       BRANCH IF PREAMBLE         0282       0485       E4RA       COMI, R0 H'AR'       BRANCH IF PREAMBLE         0282       0489       1F05AF       BCTR, UN RIC       BRANCH IF PREAMBLE         0282       0489       1F05AF       BCTR, UN RIC       BRANCH IF PREAMBLE	0270       049E       D440       HRTE, R0       CX+DCR       SET       FORMARD AND HO         0271       04A0       F508       AL       TMI, R1       H'08'         0272       04A2       9C0560       BCFA, A1       INCC       BRANCH IF       TEMP FLF         0273       04A5       3F06F1       BSTR, UN       GAPC       CALL       GAPCHECK       SUBA         0274       04A8       9C05AF       BCFA, A1       RIC       BRANCH IF       TEMP FLF         0275       04A8       9C05AF       BCFA, A1       RIC       BRANCH IF       NO GAP         0275       04A8       9C05AF       BCFA, A1       RIC       BRANCH IF       NO GAP         0276       04A0       3F66E3       BSTR, UN       IGR       INHIBIT       READ ING DA         0278       *       BCTR, UN       IGR       INHIBIT       READ ING DA         0278       *       COMI, R0       HCA'       BRANCH IF       PREAD         0278       *       COMI, R0       IEC+DCR       READ FIRST BYTE         0280       04B5       E4AR       COMI, R0       IEC+DCR       READ FIRST BYTE         0281       04B7       1667       BC	
0271       04R0       F508       RL       TNI, R1       H'08'         0272       04R2       9C0560       BCFR, R1       INCC       BRRNCH IF TEMP FLAG NOT SET         0273       04R5       3F06F1       BSTR, UN GAPC       CALL GAPCHECK SUBROUTINE         0274       04R8       9C05AF       BCFR, R1       RIC       BRRNCH IF NO GAP         0275       04R8       9C05AF       BCFR, R1       RIC       BRRNCH IF NO GAP         0275       04R8       2508       EORI, R1       H'08'       CLEAR TEMP FLAG         0276       04R0       3F06E3       BSTR, UN IGR       INHIBIT READING DURING GAP         0277       0480       1F05AF       BCTR, UN RIC       ECRI, UN RIC         0278       *       *       ECRI, R0       H'AR'         0280       0485       E4RA       COMI, R0       H'AR'         0281       0487       1867       BCTR, EQ RL       BRANCH IF PREAMBLE         0282       0489       1F05AF       BCTR, UN RIC       ECR. UN RIC         0282       0489       1F05AF       BCTR, UN RIC       ECR. UN RIC         0283       *       *       ECRI, UN RIC       ECRI, UN RIC	0271       04R0       F588       RL       TMI, R1       H'08'         0272       04R2       9C0560       BCFR, R1       INCC       BRRNCH IF TEMP FLF         0273       04R5       3F06F1       BSTR, UN       GRPC       CRLL       GRPCHECK SUBS         0274       04R5       3F06F1       BSTR, UN       GRPC       CRLL       GRPCHECK SUBS         0275       04R5       9C05AF       BCFR, A1       RIC       BRRNCH IF NO       GRP         0275       04R5       2508       EORI, R1       H'08'       CLEAR TEMP FLAG         0276       04R0       3F06E3       BSTR, UN       IGR       INHIBIT READING DA         0276       04R3       1F05AF       BCTR, UN       IGR       INHIBIT READING DA         0278       *              0280       04B3       5420       REPP       REDE, R0       IEC+DCR       READ FIRST BYTE         0280       04B5       E4RR       COMI, R0       H'AR'            0281       04B7       1867       BCTR, UN       RE       BRANCH IF PREAMBLE           0283       *	
027204R29C0560BCFR, R1INCCBRRNCH IF TEMP FLAG NOT SET027304R53F06F1BSTR, UN GRPCCALL GAPCHECK SUBROUTINE027404R89C05AFBCFR, R1RICBRRNCH IF NO GRP027504R89C05AFBCFR, R1RICBRRNCH IF NO GRP027504R82598EORI, R1H'08'CLEAR TEMP FLAG027604R03F06E3BSTR, UN IGRINHIBIT READING DURING GAP027704891F05AFBCTR, UN RIC0278**02800485E4RRCOMI, R0H'AR'028104871867BCTR, EQRLBRNCH IF PREAMBLE028204891F05AFBCTR, UN RIC0283***	0272         04R2         9C0560         BCFR. AL         INCC         BRANCH         IF         TEMP         FLF           0273         04R5         3F06F1         BSTR. UN         GRPC         CALL         GRPCHECK         SUBF           0274         04R5         3F06F1         BSTR. UN         GRPC         CALL         GRPCHECK         SUBF           0274         04R5         9C05AF         BCFR. AL         RIC         BRANCH         IF         NO         GRP           0275         04R8         9C05AF         BCFR. AL         RIC         BRANCH         IF         NO         GRP           0275         04R8         2508         EORI, RL         H'08'         CLEAR         TEMP         FLRG           0276         04R0         3F06E3         BSTR. UN         IGR         INHIBIT         READ ING OL           0277         04B0         1F05AF         BCTR. UN         RIC         0278         *           0279         04B3         5420         REPP         REDE, R0         IEC+DOR         READ         FIRST         BYTE           0280         04B5         E4RR         COMI, R0         H'AR'         BRANCH         IF         PREAM	MUU, KES EKTSE FF
027304R53F06F1BSTR, UN GRPCCALL GAPCHECK SUBROUTINE027404R89C05AFBCFR, R1 RICBRANCH IF NO GRP027504R82508EORI, R1 H'08'CLEAR TEMP FLAG027604R03F06E3BSTR, UN IGRINHIBIT READING DURING GAP027704801F05AFBCTR, UN RIC0278*027904835420REPP REDE, R0 IEC+DCRREAD FIRST BYTE02800485E4RACOMI, R0 H'AR'028104871867BCTR, EQ RLBRANCH IF PREAMBLE028204891F05AFBCTR, UN RIC0283**	0273       04R5       3F06F1       BSTR. UN GAPC       CALL GAPCHECK SUBF         0274       04R8       9035AF       BCFA. A1. RIC       BRANCH IF NO GAP         0275       04AB       2508       EORI, R1. H1081       CLEAR TEMP FLAG         0276       04AD       3F06E3       BSTR. UN IGR       INHIBIT READING DA         0277       04B0       1F05AF       BCTA. UN RIC       0279         0278       *       0279       04B3       5420       REPP REDE, R0       IEC+DCR       READ FIRST BYTE         0280       04B5       E4AR       COMI, R0       H1AA1       0281       04B7       1867         0281       04B7       1867       BCTR, UN RIC       BRANCH IF PREAMBLE         0283       *       0283       *       0283       *         0284       04B5       3F06E3       NTST BSTR, UN IGR       RESET RGT DURING OF         0284       04B5       3F06E3       NTST BSTR, UN IGR       RESET RGT DURING OF         0285       04BF       0702       LODI, R3       2       0286       0401.0F47FA	
027404R89C05AFBCFA, R1, R1CBRANCH IF NO GAP027504R82508EORI, R1, H'08'CLEAR TEMP FLAG027604R03F06E3BSTA, UN, IGRINHIBIT READING DURING GAP027704801F05AFBCTA, UN, RIC0278*027904835420REPP REDE, R0, IEC+DCRREAD FIRST BYTE02800485E4RACOMI, R0, H'AR'028104871867BCTR, EQ, RLBRANCH IF PREAMBLE028204891F05AFBCTR, UN, RIC0283**	0274         0488         9085AF         BCFA. AL         RIC         BRANCH         IF         NO         GAP           0275         04AB         2508         EORI, R1         H'08'         CLEAR         TEMP         FLAG           0276         04AB         2508         BSTA. UN         IGR         INHIBIT         READING DX           0276         04AB         1F05AF         BCTA. UN         IGR         INHIBIT         READING DX           0277         04B8         1F05AF         BCTA. UN         RIC         INHIBIT         READING DX           0278         *         0279         04B3         5420         REPP         REDE, R0         IEC+DCR         READ         FIRST         BYTE           0280         04B5         E4AR         COMI, R0         H'AA'         BRANCH IF         PREAMBLE           0281         04B7         1867         BCTR, EQ         RL         BRANCH IF         PREAMBLE           0283         *         0284         04BC         3F66E3         NTST         BSTR, UN         RESET         RGT DURING O           0285         04BF         0702         LODI, R3         2         0286         04C1         0F47FA <td< td=""><td></td></td<>	
0275       04AB       2508       EORI, R1 H'08'       CLEAR TEMP FLAG         0276       04AD       3F06E3       BSTA, UN IGR       INHIBIT READING DURING GAP         0277       04B0       1F05AF       BCTA, UN RIC	0275       04AB       2508       EQRI, R1       H'08'       CLEAR       TEMP FLAG         0276       04AD       3F06E3       BSTA, UN       IGR       INHIBIT       READING DA         0277       04B0       1F05AF       BCTA, UN       IGR       INHIBIT       READING DA         0278       *       0279       04B3       5420       REPP       REDE, R0       IEC+DCR       READ       FIRST       BYTE         0280       04B5       E4AR       COMI, R0       H'AA'       DECAL       BRANCH       IF       PREAMBLE         0281       04B7       1867       BCTR, EQ       AL       BRANCH       IF       PREAMBLE         0283       *       0283       *       0283       *       0284       04BC       3F06E3       NTST       BSTA, UN       IGR       RESET       REST       DURING (DECAL)         0284       04BC       3F06E3       NTST       BSTA, UN       IGR       RESET       REST       DURING (DECAL)         0285       04BF       0702       LODI, R3       2       0286       04C1       0F47FA       NL       LODA, R0       CRC, R3, -	
0276       04A0       3F06E3       BSTR, UN_IGR       INHIBIT_READING_DURING_GAP         0277       04B0       1F05AF       BCTR, UN_RIC	0276         04400         3F66E3         BSTR. UN         IGR         INHIBIT         READING DO           0277         0480         1F65AF         BCTR. UN         RIC         0278         0279         0483         5420         REPP         REDE, R0         IEC+DCR         READ         FIRST         BYTE         0280         0485         E4AR         COMI, R0         H'AR'         0281         0487         1867         BCTR. EQ         AL         BRANCH IF         PREAMBLE           0281         0487         1867         BCTR. EQ         AL         BRANCH IF         PREAMBLE           0282         0489         1F05AF         BCTR. UN         RIC         0283         *           0283         *         0283         *         0284         04BC         3F06E3         NTST         BSTR. UN         IGR         RESET         RGT         DURING (0           0285         04BF         0702         LODI, R3         2         0286         0401         06477R         NL         LODA, R0         CRC, R3, -	
6277         04B0         1F05AF         BCTA, UN         RIC           6278         *         *         *           6279         04B3         5420         REPP         REDE, R0         IEC+DCR         READ         FIRST         BYTE           6280         04B5         E4AR         COMI, R0         H'AR'         BRANCH         IF         PREAMBLE           6281         04B7         1867         BCTR, EQ         AL         BRANCH         IF         PREAMBLE           6282         04B9         1F05AF         BCTR, UN         RIC         #         #	0277         04B0         1F05AF         BCTA. UN         RIC           0278         *         0279         04B3         5420         REPP         REDE, R0         IEC+DCR         READ         FIRST         BYTE           0280         04B5         E4AR         COMI, R0         H'AA'         0281         04B7         1867         BCTR, EQ         AL         BRANCH IF         PREAMBLE           0281         04B7         1867         BCTR, EQ         AL         BRANCH IF         PREAMBLE           0282         04B9         1F05AF         BCTR, UN         RIC         0283         *           0283         *         0283         *         0284         04BC         3F06E3         NTST         BSTR, UN         IGR         RESET         RGT DURING (0285         04BF         0702         LODI, R3         2           0286         04C1         0F47FA         NL         LODA, R0         CRC, R3, -	
#         #           0279         04B3         5420         REPP         REDE, R0         IEC+DCR         READ         FIRST         BYTE           0280         04B5         E4AR         COMI, R0         H'AR'         BRANCH         IF         PREAMBLE           0281         04B7         1867         BCTR, EQ         AL         BRANCH         IF         PREAMBLE           0282         04B9         1F05AF         BCTR, UN         RIC         #	0278         *           0279         04B3         5420         REPP         REDE, R0         IEC+DCR         READ         FIRST BYTE           0280         04B5         E4RA         COMI, R0         H'AA'         0281         04B7         1867         BCTR, EQ         AL         BRANCH IF         PREAMBLE           0282         04B9         1F05AF         BCTR, UN         RIC         0283         *           0284         04BC         3F06E3         NTST         BSTR, UN         IGR         RESET         RGT DURING (0           0285         04BF         0702         LODI, R3         2         0286         04C1         0F47FA         NL         LODA, R0         CRC, R3, -	DURING GHP
0279         04B3         5420         REPP         REDE, R0         IEC+DCR         READ         FIRST         BYTE           0280         04B5         E4RA         COMI, R0         H'RA'         BRANCH         IF         PREAMBLE           0281         04B7         1867         BCTR, EQ         AL         BRANCH         IF         PREAMBLE           0282         04B9         1F05AF         BCTR, UN         RIC         #	0279         04B3         5420         REPP         REDE, R0         IEC+DCR         READ         FIRST         BYTE           0280         04B5         E4RA         COMI, R0         H'AA'         0281         0487         1867         BCTR, EQ         RL         BRANCH IF         PREAMBLE           0282         04B5         1F05AF         BCTR, UN         RIC         0283         *           0283         *         0284         04BC         3F06E3         NTST         BSTR, UN         IGR         RESET         RGT DURING (0           0285         04BF         0702         LODI, R3         2         0286         04C1         0F47FA         NL         LODA, R0         CRC, R3, -	
0280         04B5         E4AR         COMI, R0         H'AR'           0281         04B7         1867         BCTR, EQ         AL         BRANCH IF PREAMBLE           0282         04B9         1F05AF         BCTR, UN         RIC           0283         *	0280         0485         E4AR         COMI, R0         H'AA'           0281         0487         1867         BCTR, EQ         AL         BRANCH IF         PREAMBLE           0282         0489         1F05AF         BCTR, UN         RIC         BC78, UN         RIC           0283         *         0284         0485         3F66E3         NTST         BSTR, UN         IGR         RESET         RGT DURING (0285         0485         0486         0702         LODI, R3         2         0286         0411         0547FA         NL         LODG, R0         CRC, R3, -	-
0281         0487         1867         BCTR, EQ_RL         BRANCH IF PREAMBLE           0282         0489         1F05AF         BCTR, UN_RIC           0283         *	0281         0487         1867         BCTR, EQ_RL         BRANCH IF_PREAMBLE           0282         0489         1F05AF         BCTR, UN_RIC         0283         *           0283         *         0284         04BC         3F06E3         NTST_BSTR, UN_IGR         RESET_RGT_DURING (0285         04BF 0702         LODI, R3_2         0286         04C1_0F47FR         NL_LODA, R0_CRC, R3, -	
0282 04B9 1F05AF BCTR, UN RIC 0283 *	0282         0489         1F05AF         BCTA. UN         RIC           0283         *         *         0284         04BC         3F06E3         NTST         BSTA. UN         IGR         RESET         RGT DURING (           0285         04BF         0702         LODI, R3         2	
0283 *	0283         *           0284         04BC         3F06E3         NTST         BSTR, UN         IGR         RESET         RGT         DURING         0           0285         04BF         0702         LODI, R3         2         0286         04C1         0F47FA         NL         LODR, R0         CRC, R3, -	BLE.
	0284         04BC         3F66E3         NTST         BSTR, UN         IGR         RESET         RGT         DURING         0           0285         04BF         0702         LODI, R3         2         <	
MCR4 M4R1 (FMAFK NIST RSTR. DN TGR RESET RGT DURING GRP	0285         04BF         0782         LOD I, R3         2           0286         04C1         0F47FA         NL         LODA, R8         CRC, R3, -	10.000
	0286 04C1 0F47FA NL LODA, RO CRC, R3, -	li unr
	10287 0404 9825 BUFR, Z ERR BRHNUCH IF CRC BYTE	HTEC ODE NOT TEDA
		YTES HRE NUT ZERU
6288 64C6 5879 BRNR, R3 NL	10288 10406 5879 BRNK, R3 NL	

#### PRGE 0008

						FETCH ADDRESSCTR LON
						BRANCH IF ZERO
						DECR. ADDRESSCTR LON
						BRANCH IF ZERO
						DECREMENT ADDRESSCTR LON
8295	0403	CC07F5		STRR, RØ	CHL+5	RESTORE ADDRESSCTR LOW
8296	04D6	1F059C		BCTR, UN	DDBC	
8297	6409	F809	LOZ	BORR, RO	\$+2	DECREMENT ADDRESSCTR LOW
8298	04D8	F888	LOZA	BORR, RØ	\$+2	DECREMENT ADDRESSCTR LOW
						RESTORE ADDRESS CTR LOW
8388	R4FR	9C97F4		1008.89	()4 +4	FETCH ADDRESSCTR HIGH
						DECREMENT ADDRESSCTR HIGH
						RESTORE ADDRESSCTR HIGH
		1F059C				RESTORE NORESSON III OII
0304		D 60 X	*	DC IN UN	woo	
		0500		COD1 04	U/20/	SET CRC ERROR BIT
						SET UKU EKKUK BIT
		1F0580		BCTA, UN	VICU	
0307			*			
		E601	DAB			·
0309	64F2	908530		BCFA, EQ	CRCH	BRANCH IF CONTROLCTR UNEQUAL TO ONE
0310			*			
		F548				
0312	04F7	9813		BCFR, A1	FDB	Branch if byte is data
8313			*			
0314	04F9	81	DELT	LOOZ	R1	
0315	<b>0</b> 4FR	9886		BCFR, N	RZB	BRANCH IF READING MODE
0316			*			
		28		EORZ	89	
						output a zero byte
		1F0560				BRANCH TO INCREMENT CONTROLCTR
0320		1,0200	*	DUTTO UN	11400	DRINGH TO INCREMENT CONTROLCTR
		5400		DENE DO	TECHNOD	INPUT A BYTE
		100560				
						BRANCH TO INCREMENT CONTROLCTR
						set temporary flag
		1F05AF		BCTH, UN	RIC	
0325			*			
			FDB	LODZ	R1	
0327	6560	9A19		BCFR, N	NEW	BRANCH IF READING MODE
0328	1		*			
0329	050F	0C87F4				FETCH BYTE TO BE WRITTEN
0330	6512	D480		HRTE RO	DEC+DCR	OUTPUT A BYTE
0331	0514	3F86A6		ESTA, UN	CRCS	CRC SUBROUTINE AND INCREMENT ADDR. CTR
0332		nna merina tarte processi dallere	*			
		0F07F1		LODA, R3	CHL+1	Fetch Bytectr.
		FB86		BORR, R3		
		CF07F1				TE ZERN RESTORE AND
		1F0560			TNCC	IF ZERO RESTORE AND
9550	OUL	1.0700		DUINUN	INCC	INCREMENT CONTROLCTR

PRGE 0009

LINE ROOR OBJECT E SOURCE

0338 0522 CF07F1		RESTORE BYTECTR.
0339 0525 1F0589	BCTR, UN RERE	
0340	*	
0341 0528 5420		
0342 052R CC87F4	STRR, RØ +CML+4	STORE THE READ BYTE
0343 0520 E4AA	COMI, RO H'AR'	
0344 052F 9806	BCFR, EQ CALL	BRANCH IF NOT AR
0345 0531_3F06F1		CALL GAPCHECK SUBROUTINE
0346 0534 1C048C	BCTR, R1 NTST	BRANCH TO CRC CHECK IF GAP
0347 0537 3F06A6	CALL BSTR, UN CRCS	CRC SUBROUTINE AND INCREMENT ADDR. CTR
0348 053A 1F05B9	BCTR, UN RERE	BRANCH TO RESTORE REGISTERS
0349 0530 E602	CRCH COMI, R2 H'82'	
0350 053F 9807	BCFR, EQ SECH	BRANCH IF CONTROLCTR UNEQUAL TO 2
0351	*	
0352 0541 F540	THI. R1 H'40'	
0353 0543 9807		BRANCH IF BYTE IS DATA
0354	*	
0355 0545 DE04F9	BIRB, R2 DFI T	INCREMENT CONTROLCTR
0356	*	
0357 0548 E603	SECH COMI, R2 H'03'	
0358 054A 9888		BRANCH IF CONTROLCTR UNEQUAL TO 3
0359	*	
0360 054C 0E67F8		>
0361 054F D480		OUTPUT CRC CHARACTERS
0362 0551 1F0560	BCTR, UN INCC	DOTTOT CKC CHARTELES
0363	*	
0364 0554 E604		
0365 0556 982E		BRANCH IF CONTROLCTR UNEQUAL TO 4
0366	*	Did North Controlotik Chedone 10 4
0367 0558 01	LOOZ R1	
0368 0559 9E056A		BRANCH IF READING MODE
0369	*	
0370 055C 04AA	+ LODI, RØ H'AA'	
8371 855E D488		output postamble
		INCREMENT CONTROLCTR
0373 0562 01		TRANSFER R1 TO R0
0374 0563 82		Include controlctr Srve complete controlword
		SHAE CONTRETE CONTROLATORD
	BCTA, UN RERE	
<b>8</b> 377	*	
	POTH REDE, RO IEC+DCR	KENU BYIE
0379 056C E4RA	COMI, RO H'AR'	
	BCFA, EQ RIC	BRANCH IF NOT AR
0381 0571 3F06F1	BSTR, UN GAPC	CALL GAPCHECK SUBROUTINE
0382 0574 9005AF	BCFA, A1 RIC	
		Fetch Tape Mark Counter
0384 0578 F882	BORR, RO ONCE	
	BCTR, UN DICO	
		RESTORE TAPE MARK COUNTER
0387 0581 3F06E3		RESET RGT DURING GAP
0388 0584 1B20	BCTR, UN RHT	

#### PRGE 0010

#### LINE ADDR OBJECT E SOURCE

LIT EORZ RØ HRTE, RØ DEC+DCR BCTR. UN INCC ERA LODI, RO H'30' MRTE RO CX+DCR LODI, RO H'AA' HRTE, RØ DEC+DCR LODI, R3 47 BSTR. UN LOP8 THI, R1 H'48' BCTR, A1 DH DDBC LODA RO CHL+3 BORR, RØ MOR BCTR, UN DICO MOR STRA, RO CHL+3 RWT LODZ R1 BCFR.N RIC AND ADDLR11 LODI, R9 H'24' WRTE, R9 CX+DCR RIC STRA R1 CML EORZ RØ STRA RØ CRC STRR, RØ CRC+1 RERE BSTR. UN REST RETE, UN \* DICO LODZ R1 BCFR, N DISC LODI, R9 H'19' HETE RO CX+DCR FIN LODI, R3 19 BSTA, UN LOP8 WRTE, RO DX+DCR BCTR, UN RIC DISC WRTE, RO DX+DCR BCTR, UN FIN \* END H'477'

OUTPUT A ZERO BYTE BRANCH TO INCREMENT CONTROLCTR. SET ERRSE, FORN AND HCD FF OUTPUT PRE/POSTAMBLE CALL GAP DELAY SUBROUTINE (100 MSEC) BRANCH IF TAPEMARK FETCH DATABLOCK-COUNTER RESTORE DATA BLOCK COUNTER BRANCH IF READING MODE SET ONE TO CONTROLCTR SET NCD AND FORWARD, RES ERRSE FLIPFLOP RESTORE CONTROLHORD CLEAR RO CLEAR CRC LOCATIONS RESTORE REGISTERS, STATUS RETURN TO MRIN PROGRAM. ENABLE INTERRUPT BRANCH IF READING RESET FORMARD, SET MCD AND ERASE CALL STOP FORWARD DELRY SUBROUTINE (40MS) DISCONNECTION COMMAND DISCONNECTION COMMAND

TOTAL ASSEMBLY ERRORS = 0000

#### **Related 2650 publications**

no.	title	summary
AS50	Serial Input/Output	Using the Sense/Flag capability of the 2650 for serial I/O interfaces.
<b>AS</b> 51	Bit & Byte Testing Procedures	Several methods of testing the contents of the internal registers in the 2650.
<b>AS</b> 52	General Delay Routines	Several time delay routines for the 2650, including formulas for calculating the delay time.
AS53	Binary Arithmetic Routines	Examples for processing binary arithmetic addition, subtraction, multiplication, and division with the 2650.
AS54	Conversion Routines	<ul> <li>Eight-bit unsigned binary to BCD</li> <li>Sixteen-bit signed binary to BCD</li> <li>Signed BCD to binary</li> <li>Signed BCD to ASCII</li> <li>ASCII to BCD</li> <li>Hexadecimal to ASCII</li> <li>ASCII to Hexadecimal</li> </ul>
AS55	Fixed Point Decimal Arithmetic Routines	Methods of performing addition, subtraction, multiplication and division of BCD numbers with the 2650.
SP50	2650 Evaluation Printed Circuit Board (PC1001)	Detailed description of the PC1001, an evaluation and design tool for the 2650.
SP51	2650 Demo System	Detailed description of the Demo System, a hardware base for use with the 2650 CPU prototyping board (PC1001 or PC1500).
SP52	Support Software for use with the NCSS Timesharing System	Step-by-step procedures for generating, editing, assembling, punching, and simulating Signetics 2650 programs using the NCSS timesharing service.
SP53	Simulator, Version 1.2	Features and characteristics of version 1.2 of the 2650 simulator.
SP54	Support Software for use with the General Electric Mark III Timesharing System	Step-by-step procedures for generating, editing, assembling, simulating, and punching Signetics 2650 programs using General Electric's Mark II timesharing system.
SP55	The ABC 1500 Adaptable Board Computer	Describes the components and applications of the ABC 1500 system development card.
SS50	PIPBUG	Detailed description of PIPBUG, a monitor program designed for use with the 2650.
S51	Absolute Object Format	Describes the absolute object code format for the 2650.
MP51	Initialization	Procedures for initializing the 2650 microprocessor, memory, and $I/O$ devices to their required initial states.
MP52	Low-Cost Clock Generator Circuits	Several clock generator circuits, based on 7400 series TTL, that may be used with the 2650. They include RC, LC and crystal oscillator types.
MP53	Address and Data Bus Interfacing Techniques	Examples of interfacing the 2650 address and data busses with ROMs and RAMs, such as the 2608, 2606 and 2602.
MP54	2650 Input/Output Structures and Interfaces	Examines the use of the 2650's versatile set of I/O instructions and the interface between the 2650 and I/O ports. A number of application examples for both serial and parallel I/O are given.

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