

RDS decoding for an HC11-controlled radio

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Introduction

This application note describes, and lists the software of, the RDS aspects of the HC11 radio controller described in AN494/D. The complete application constitutes a synthesised multiband radio which includes RDS decoding (FM, band II) and uses an MC68HC(7)11 microprocessor whose program can be on-chip or contained in an external EPROM. Both LCD and VFD 16-character dot-matrix display modules can be used to display RDS and tuning information. Traffic messages on the current frequency or on another frequency, initiated by the reception of RDS EON data, are handled. The station carrying the TA is tuned for the duration of the message, followed by a return to the original frequency.

Figure 1 shows a block diagram of the application. The microprocessor used is the MC68HC(7)11. The K4 (and similar chips such as the P2 and PH8) can be used in expanded mode but the application has been included in the ROM of an E32 (ZC403311) and two PH8s (ZC428200 and ZC428202). In order to use the ROMed parts in this application, the first three bytes of EEPROM should contain an extended jump to the appropriate state address. The E32 (ZC403311) requires \$7E, \$90 and \$00 at addresses \$B600, \$B601 and \$B602, while the PH8 requires \$7E, \$40 and \$00 at addresses \$0D00, \$0D01 and \$0D02. This can be done using either PCbug11 or the Buffalo monitor (see reference 5). The E32 version uses all the I/O and can therefore only be used in single-chip mode. The circuit diagram of the HC11E controller is shown in figure 2. The 40 programs (10 on FM and MW and 20 on SW) which can be stored using the HC11E's on-chip EEPROM contain, in addition to frequency, an 8-character name (PS name on a station with RDS) and, on FM only, PI code and a traffic announcement inhibit bit.

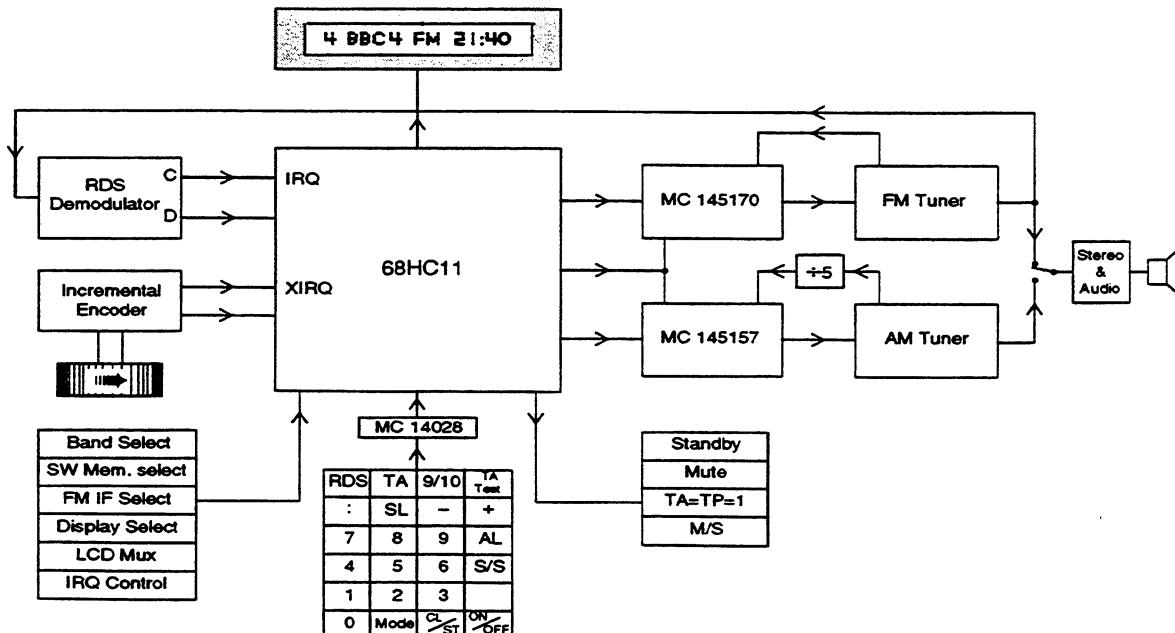


Figure 1. Main block diagram

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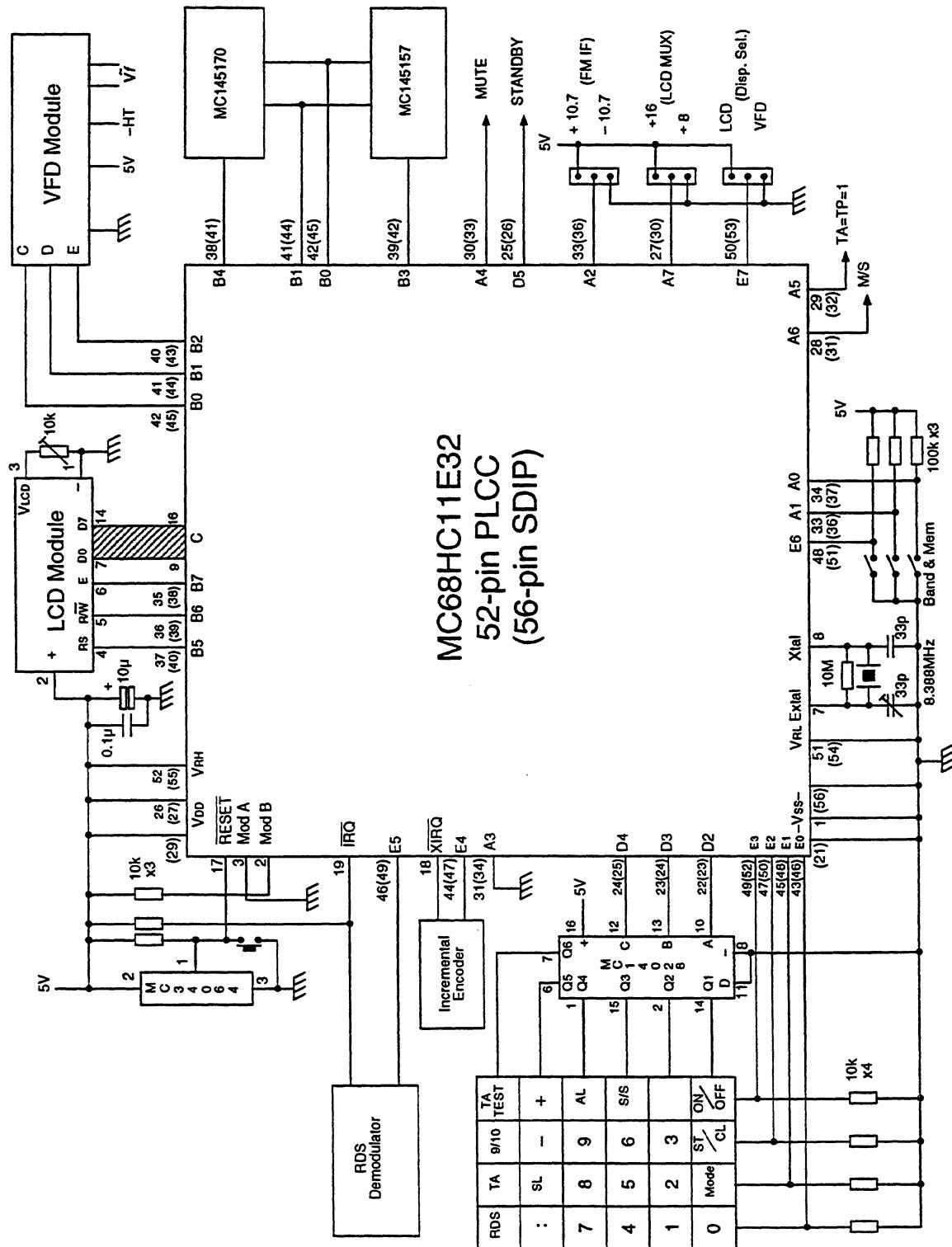


Figure 2 68HC11E32 circuit

RDS features

The Radio Data System adds a digital data capability to the FM VHF transmissions on band II (87.5 to 108 MHz). The specification is defined in CENELEC EN 50067 (formerly EBU Technical Document 3244, reference 2). An MC68HC05E0 implementation of RDS was described in AN460/D (reference 3). It monitored the RDS activity on the MPX signal of a VHF radio but was not able to tune the radio and could therefore not use AF or EON data. This application can tune the radio and uses EON data to retune the radio when a traffic announcement (TA) is taking place on another frequency. An announcement is initiated by an RDS group 14B and the radio retunes if TAs are enabled. At the end of the announcement the original station is re-tuned. TAs are not active in standby mode (standby line high).

To transmit the data, a subcarrier is added at 57 kHz. This subcarrier is amplitude modulated with the shaped bi-phase coded data signal. The subcarrier itself is suppressed to avoid data modulated cross-talk in phase-locked loop stereo decoders and to maintain compatibility with the German ARI system which uses the same subcarrier frequency. Information is sent in groups of four 26-bit blocks. Each group of 104 bits is one of several types containing different information. It is up to the broadcaster to decide which features are transmitted as long as the specified format is adhered to and PI, PTY and TP are included. Each group contains a different sub-set of the RDS features. A list of all currently defined features is shown in table 1.

Table 1. RDS features

Feature	Information
PI	Program identification
PTY	Program type
PS	Program service name
RT	Radiotext
CT	Clock time and date
AF	Alternative frequencies
TA	Traffic announcement
TP	Traffic program
MS	Music/speech switch
DI	Decoder identification
PIN	Programme item number
EON	Enhanced other networks
TDC	Transparent data channel
INH	In-house data

The retrieval of data is carried out by demodulation hardware which generates clock and data signals that can be used by the microprocessor. Suitable devices which can perform this function include SAA6579, SAA7579T (plus an external filter), TDA7330, LA2231 and RDS hybrids.

This application supports PI, PTY, PS, RT, CT, TP, TA, MS, DI, PIN and EON. These features facilitate permanent display of the 8-digit station name (PS) and time (CT) and, on request, can display program type (PTY), radiotext data (RT) and the status of the other RDS information (see table 6). EON data can be displayed and used to switch to traffic announcements, but the retuning features associated with AF are not supported as they are only appropriate for a radio intended for use in a vehicle. In a car radio, AF data would be used to tune the radio to the strongest signal carrying the selected service.

Table 2 shows all the currently defined RDS group types and the RDS features they contain. PI, PTY and TP are contained in all groups. This allows this information to be gathered quickly after the radio has been retuned. The other features are contained only in specific group types and the update frequency is thus largely up to the broadcaster. The next most important information for a car radio (AF and TA) is sent using type 0 groups which also contain the M/S and DI bits which can be used to control hardware within the radio. There are two methods of increasing the repetition rate of important information. Type B groups contain the PI code twice (in blocks 1 and 3) and type 15B groups also repeat their block 2 information (TP, PTY, M/S and DI) in block 4. Information which is required less frequently (e.g., PIN) is sent less often, while type 4 groups (CT) are sent only once per minute.

Table 2. RDS Groups

Group	Features
All	PI, PTY, TP
0	TA, DI, MS, PS, AF
1	PIN
2	RT
3	ON (replaced by EON)
4A	CT
5	TDC
6	INH
14	EON
15B	TA, DI, MS

Other network (ON) information was originally sent using type 3 groups. Limitations in the definition of this group has caused it to be superseded by type 14 groups. This enhanced other network (EON) group type effectively replaces type 3 groups which are no longer used. This application uses type 14 groups but does not handle the old type 3 groups.

Decoding

Each 26-bit block contains 16 bits of data and 10 extra bits which are used for synchronisation and error detection. There are no gaps between blocks or groups, the synchronisation being done by looking for specific checkwords in the incoming data. In order to look for a checkword a stream of 26 consecutive data bits has to be multiplied by a fixed 10x26 matrix (Figure 3).

The result of this multiplication is a 10-bit word which is compared with allowed values. There are 5 of these 10-bit "syndromes", one for each of blocks 1, 2 and 4 and two for block 3 (see table 3). The alternative syndrome for block 3 is used in the B version of a group. In this version the PI code is sent in block 3, replacing what would be sent in the A version of the same group type. This is done to increase the frequency of sending the PI code so that it can be acquired more quickly.

10 0000 0000	(\$02,\$00)
01 0000 0000	(\$01,\$00)
00 1000 0000	(\$00,\$80)
00 0100 0000	(\$00,\$40)
00 0010 0000	(\$00,\$20)
00 0001 0000	(\$00,\$10)
00 0000 1000	(\$00,\$08)
00 0000 0100	(\$00,\$04)
00 0000 0010	(\$00,\$02)
00 0000 0001	(\$00,\$01)
10 1101 1100	(\$02,\$DC)
01 0110 1110	(\$01,\$6E)
00 1011 0111	(\$00,\$B7)
10 1000 0111	(\$02,\$87)
11 1001 1111	(\$03,\$9F)
11 0001 0011	(\$03,\$13)
11 0101 0101	(\$03,\$55)
11 0111 0110	(\$03,\$76)
01 1011 0111	(\$01,\$BB)
10 0000 0001	(\$02,\$01)
11 1101 1100	(\$03,\$DC)
01 1110 1110	(\$01,\$EE)
00 1111 0111	(\$00,\$F7)
10 1010 0111	(\$02,\$A7)
11 1000 1111	(\$03,\$BF)
11 0001 1011	(\$03,\$1B)

Figure 3 10x26 decoding matrix**Table 3.** Syndromes

Block	Syndrome	Binary	Hex.
1	A	11 1101 1000	\$03,\$D8
2	B	11 1101 0100	\$03,\$D4
3	C	10 0101 1100	\$02,\$5C
	C'	11 1100 1100	\$03,\$CC
4	D	01 0101 1000	\$01,\$58

This syndrome test has to take place after each bit is received, using the last 26 bits, until a valid syndrome is found. In this application, only syndrome A is accepted during the bit-by-bit syndrome check and the data is used only after four valid syndromes have been acquired. A more complex algorithm could allow any syndrome to be accepted during initial synchronisation and require less than four valid syndromes before the data is used. This would reduce the time taken to acquire the PI code, which is also included in block 3 of type B groups, but increases the likelihood that random data, giving a valid syndrome, will be used in error. The bit rate is 1187.5 Hz so the control microprocessor is busy during this initial synchronisation (about 20% of the capability of an HC11 at a 2 MHz bus frequency). Once a valid syndrome has been found, subsequent syndrome checks need be done only after the next 26 bits have been received, as this is when the next valid syndrome would be expected. If it is not found, then bit-by-bit checking is re-started. Once consecutive A, B, C (or C') and D syndromes have been detected, a complete group has been acquired and the data can be used.

Software

The software for this application is in three modules and was assembled and linked using the Introl relocatable assembler and linker. The first module is listed in AN494/D and contains all the main control routines including the main loop and keyboard scanning and the function to be performed by each key. The second and third modules are listed in this application note. The second module (Appendix 1) contains the RDS and display functions while the third module (Appendix 2) is the 4-function 9-digit integer BCD arithmetic required for the MJD date calculations. EB419/D (reference 5) describes and lists additional debug code contained in the ROMed parts.

The second module services the RDS and timer interrupts and performs all RDS and display functions. The RDS functions were converted from the HC05 application described in AN460/D (reference 3) using the methods described in AN478/D (reference 4).

The RTI timer interrupt routine (TINTB) updates the RT scrolling pointers (DISP1 and DISP2). These pointers are incremented regularly whether or not an RT display is active so that the software can be easily converted to using a 2-line LCD module in which the top line is the normal display of PS-name, time etc., and the lower line is a permanent display of scrolling RT. The timer interrupt also decrements the sleep timer and updates the RAM locations used to store hours, minutes and seconds. All RDS data (except date and time) is cleared by this routine if no valid RDS data is detected for a period of 10 seconds. The RTI timer is enabled to cause an interrupt every 31.25 ms to run the real-time clock. Correct operation of this clock in the absence of an RDS signal requires that a 8.388 MHz crystal be used.

Hardware interrupts are vectored to jump to SDATA where serial data is received from the RDS demodulator. The clock edge causes an interrupt and a data bit is read by bit 5 on port E. The bit is shifted into a 4-byte RAM register and, if appropriate, the matrix multiplication is performed. The state of the flag at bit 0 of STAT2 determines if the multiplication is to take place after every bit or only after 26 bits have arrived. The multiplication is performed using two EOR instructions for every bit (two are required as the 10-bit syndrome requires two bytes). As the top of the matrix (see figure 3) is the unity matrix, the first 10 bits are transferred directly into the accumulators. This reduces what is a rather long and repetitive piece of code. It could be shortened by using a loop but this would incur an unacceptable penalty in execution time.

After the multiplication has been performed, the resultant 10-bit number is compared with the allowed syndromes (see table 3). The variable LEV records the current block level. It is initially zero but is incremented each time a valid syndrome is found. When it is zero, only syndrome A is accepted. If this is found then syndrome B is expected 26 bits later so when LEV is one, only syndrome B is accepted. If an invalid syndrome is found, LEV is cleared, the syndrome confidence level CONF is decremented and the interrupt is ended.

When a valid syndrome is found, CONF is increased by 4 and the 16 data bits saved in the relevant bytes of TMPGRP. If the valid syndrome is type D then a complete group has been received and all 8 bytes are transferred to the 8 RAM locations at GROUP. This double buffering means that the data in GROUP can be used while interrupts are overwriting TMPGRP with new data. Complete groups of data are handled in the subsequent routines according to their group type.

The confidence level CONF is used to decide what should be done if the data becomes unreliable due to a poor RF input to the receiver. When the first valid syndrome is found it is initialised to 42. Subsequent valid syndromes increment it by four and invalid ones decrement it by 1. If CONF falls below 41, then it is assumed that synchronisation has been lost and a bit-by-bit re-synchronisation is carried out. If it falls below 10, the signal is deemed unacceptable and the displays are re-initialised. The confidence level is not incremented by the detection of a valid syndrome if it is higher than 56.

The listed modules contain the display routines described in AN494/D. The displays are only updated when there is a change in the displayed data. At 8 Hz a check is made to see if any characters have changed, and if there has been a change, the display update routine is executed. This is done to minimise interference caused by communication with the displays. The colon between the hours and minutes of the time display changes at 1 Hz. This can be disabled (colon permanently displayed) by using the Time Colon key. The display routine (MOD) is executed in the idle loop if the flag bit 3 of STAT2 is set. It is set every 125 ms by timer B interrupts. If flag bit 4 of STAT2 is set the display is initialised indicating no valid RDS data. The dot-matrix modules are then updated, if necessary, with new data. Before each occasion that something is written to the LCD module, the subroutine WAIT is used. This checks that the controller in the module is not busy. The different display formats are selected by checking the various flags and the relevant routine executed. The normal display permanently shows PS name and time. As the locations in RAM used for hours and minutes contain binary numbers, they are converted to BCD before being written to the relevant bytes in DISP. Once all 16 bytes in DISP have been loaded, loops are used to send the data to the display modules. The standby display (alarm not enabled) shows date and time. After a power-up the display "Mon 0 inv 0:00" indicates that the date and time are invalid. The date and time will be correct once a valid RDS CT group has been received.

The VFD routine sends the same data as is shown on the LCD module to the serial VFD module. The display driver used has a different character set from the standard ASCII set used by the LCD module. The table VTAB is used to convert ASCII data into the required character in the VFD module. The small table INITF is used to send the required initialisation bytes to the VFD module. This module does not require a busy check but does require a delay between successive bytes. This is satisfied by the wait loop within the serial output loop VFDL.

Table 4. RDS Block and Group structure

Group	Block 1	Block 2	Block 3	Block 4
0,15B	PI code	15-12: Group no. 11: Group type 10: TP flag 9-5: PTY code 4: TA flag 3: M/S bit 2: DI bit 1-0: PS/DI address	AF (PI code in type 0B and 15B)	PS name 2 ASCII characters (as block 2 for 15B)
1	PI code	15-12: 0001 11: Group type 10: TP flag 9-5: PTY code 4-0: not used	not used (PI code in type 1B)	PIN data 15-11: day-of-month 10-6: hour 5-0: minute
2A	PI code	15-12: 0010 11: 0 10: TP flag 9-5: PTY code 4: Text A/B flag 3-0: Text address	RT 2 ASCII characters	RT 2 ASCII characters
4A	PI code	15-12: 0100 11: 0 10: TP flag 9-5: PTY code 4-2: not used 1-0: MJD (16-15)	CT 15-1: MJD (14-0) 0: hour (4)	CT 15-12: hour (3-0); 11-6: minute (5-0); 5: offset sense 4-0: offset (4-0)
14A	PI code	15-12: 1110 11: 0 10: TP flag 9-5: PTY code 4: TP (ON) flag 3-0: usage code	EON code: 0-3: PS 4: AF 5-9: AF (map); 10-11: not used 12-15: not imp.	PI (ON)
14B	PI code	15-12: 1110 11: 1 10: TP flag 9-5: PTY code 4: TP (ON) flag 3: TA (ON) flag 2-0: not used	PI code	PI (ON)

Table 4 shows the bit structure of the groups which are used in this application. Block 1 always contains the PI code. The five most significant bits in block 2 determine the group number and type. Block 2 also contains TP and PTY data. The uses of the other bits in blocks 2, 3 and 4 depend on the group number and type. Type B groups repeat the PI code in block 3 but type A groups contain a variety of information in blocks 3 and 4 depending on the group number.

PI, PTY, and TP

If a complete group has been received, the data can be processed. The buffering used would allow this to be done outside the interrupt but in this case there is sufficient time to do it within the interrupt. As they

are contained in all groups, PI, PTY and TP are handled first. PI is a 2-byte number which identifies the country, coverage area and service. It can be used by the control microprocessor but is not normally intended for display. This application facilitates the display of the current PI code. A change in PI code causes the initialisation of all RDS data as it indicates that the radio has been retuned. When a program is stored in NVM, its PI code is saved with the frequency and PS name. This information is used to find the correct frequency to tune to when a traffic announcement is initiated by EON. The EON information (contained in a group 14B) includes the PI code of the station transmitting the message. Further use would be made of the PI code in an application which used AF information.

PTY is a 5-bit number which indicates the current program type. At present 16 of these types are defined. Examples include "no programme type", "Current affairs" and "Pop music", although the actual syntax which is displayed is determined by the software of the controlling microprocessor. In this example PTY can be displayed on request. Table 5 shows the display used for each PTY code.

Table 5. PTY Types

PTY	Display
0	no program type
1	News
2	Current affairs
3	Information
4	Sport
5	Education
6	Drama
7	Culture
8	Science
9	Varied
10	Pop music
11	Rock music
12	Easy listening
13	Light classics
14	Serious classics
15	Other music
16-31	no program type

TP is a single bit flag and is set if the transmitter normally carries traffic information. After PI, PTY and TP have been updated, the group type (A/B) and group number (0 to 15) are identified. Group types 0A, 0B, 1A, 1B, 2A, 4A, 14A, 14B and 15B are handled. Table 2 shows the type of information contained in each group and table 4 the detailed structure of the groups actually used. The different groups are treated as detailed below.

PS, AF, TA, M/S and DI (groups 0 and 15B)

PS is the eight-character name of the station and is permanently displayed (except in standby mode). In the absence of RDS (e.g., AM bands) this application allows the name to be manually entered. If none is entered, then the frequency is used as the station name when the program is stored in EEPROM. AF would be used by a car radio to retune to the strongest signal carrying the selected service. AF data, along with TDC and INH, is not used in this application. TA, like TP, is a flag. TP is permanently set if the transmitter normally carries traffic information and TA is set when a traffic announcement is actually in progress. The combination TA=1, TP=0 is used to indicate that EON data is being used to supply information on other networks including traffic announcements. A port line (port A, bit 5) is asserted (low) when TA=TP=1. This can be used to demute or switch from another source (e.g., cassette) when a traffic announcement occurs. M/S is a single bit indicating either music or speech and is intended to be used to make a tone or volume adjustment to a radio's audio stage. The M/S bit is displayed on request. A port line (port A, bit 6) is asserted (low) when M/S=1. This can be used to control external hardware. The ROMed PH8s (ZC428200 and ZC428202) do not include the TA=TP=1 and M/S outputs. Decoder information (DI) constitutes four bits indicating the type of transmission (mono, stereo, binaural etc.). It is not currently in use in the UK but can be displayed as a number between 0 and 15.

As AF data is not handled, there is no difference in the treatment of groups 0A and 0B. PS data is extracted and placed in RAM according to the address bits in block 2 (see table 4). TA, DI and MS data are then read, DI is sent a single bit at a time and uses the same address bits as the PS name to determine which of the four bits is being updated. Groups of type 15B also contains all this switching information. They are used to increase the repetition rate of this data but contain no PS or AF information.

PIN (group 1)

Programme item number or PIN is used to identify the programme currently being broadcast. The format is a 2-byte number which includes the scheduled time and date (day-of-month) of the start of the programme.

Group types 1A and 1B are again treated identically as they contain the same data except for the repetition of the PI code in type 1B. The PIN data is recovered and saved in RAM. This is intended for future use to control external hardware, for example a tape recorder. This would facilitate the unattended recording of a pre-selected program. At present this application simply allows the display of PIN data both in its raw hexadecimal form and fully decoded to day-of-month and time (see table 6). Full use of PIN data would require continuously comparing the PIN day-of-month and time with a manually entered day-of-month and time and asserting an output pin when there was a match.

RT (group 2A)

Radiotext (RT) constitutes a string of up to 64 characters which give additional information regarding the service or programme currently being transmitted. In this application, RT is displayed on request on the 16-digit dot-matrix displays using scrolling. RT data from blocks 3 and 4 is written to RAM according to the address included in block 2. There are 4 address bits and four ASCII encoded bytes giving the possibility of 64 characters. The data often contains extra spaces to centre the text on a 2x32 character display. As these are not appropriate for a 16-character scrolling display, the software reduces all sequences of two or more spaces to a single space. If the Text A/B flag changes state, the RT area in RAM is cleared as this indicates that the message has changed. Group 2B is not handled as it is rarely if ever used (2B or not 2B.....).

Table 6. RDS display formats

RDS feature	Display format
CT date and time	Thu 12 May 21:35
PS name and CT time	4 BBC 4 FM 21:40
RT	Kaleidoscope
PTY	Culture
PI	PI code - C204
TA & TP	TP - 0 TA - 1
PIN(hex)	PIN no. - 655E
PIN(decoded)	12th at 21:30
MJD	MJ day - 49484
MS & DI	M/S M- DI 01
last TA 1	last TA PI C514
2	TA rtrn: EON PI
EON 1	BBC 3 FM 92.10
2	BBC Gael 103.70
3	BBC Nwcl 96.00
4	BBC Scot 94.30
5	BBC Scot 92.50
6	BBC Scot 94.70
7	BBC Scot 93.50
8	Classic 101.70
9	BBC Eng 107.90
10	BBC 1 FM 99.50
11	BBC 2 FM 89.90
12	BBC R5 909kHz
13	-----
14	-----
15	-----
16	-----

CT (group 4A)

CT data is transmitted every minute on the minute and facilitates a very accurate clock, traceable to national standards. The (Modified Julian) date and local time variation are also transmitted. Except in manual mode, when it is replaced with the frequency, the time is permanently displayed. In standby mode the date is displayed instead of the PS name (see table 6). The MJD number, which is the form in which the date is received, can also be displayed.

Two of the more complex tasks to be performed are required to process the CT data. These are for the local time difference and the conversion of the MJD number into a recognisable date. The broadcast time is Universal Co-ordinated Time (UTC, effectively the same as GMT). Time differences from UTC, including summer (daylight saving) time, are sent as an offset of up to +/- 12 hours in half-hour increments. The date is transmitted as the MJD (Modifier Julian Day) number and has to be converted to day-of-week, day-of-month, month and year using the formulae:

```

Y'      =  int[(MJD-15078.2)/365.25]
M'      =  int[(MJD-14956.1-int{Y'x365.25})/30.6001]
Day     =  MJD-14956-int(Y'x365.25)-int(M'x30.6001)
If M'=14 or M'=15, then K=1; else K=0
Year    =  Y'+K
Month   =  M'-1-12K

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The third software module (Appendix 2) contains the 4-function 9-digit integer BCD arithmetic required to make the MJD calculations. The main code uses these routines to display the time and date in conventional form, adjusting the time (and perhaps the date) according to the local offset.

EON (group 14)

EON (Enhanced Other Networks) replaces the older ON format. If type 14 groups are used to provide EON data, then type 3 groups (ON) will not be used; table 2 shows the currently defined group types. Type 14A groups are used to send data about other networks. A large amount of EON information can be sent using this group. It takes up to two minutes for all the data to arrive after the radio has been retuned. This application saves the PI code, PS name and principal frequency of up to 16 networks although more networks, each with many frequencies, and other data (e.g., PTY(ON), PIN(ON), TA(ON) etc.) may be sent. Table 6 shows the format of the EON displays.

Type 14B groups are used to switch to traffic announcements on a different frequency. They include the PI code of the station carrying the announcement. This PI code is searched for in NVM and the required station tuned if it is stored in NVM. This method allows the user to select which TAs are allowed (they will not occur if the station is not in NVM or if its TA inhibit bit is set) and avoids attempts to jump to an announcement which is not relevant or not receivable with sufficient signal strength to be useful. The complete procedure is described below.

Traffic announcement procedure

The radio can respond to EON initiated traffic announcements if they are enabled by the TRAFFIC (TA) key. This status is indicated by a decimal point at the 11th character on the dot-matrix displays. A switch to a TA on another frequency will only occur if the station has previously been stored in NVM (the EON data which can be displayed using the RDS key is not used for TA switching). The PI code of the last TA (or attempted TA) can be displayed by pressing the RDS key eight times. A further press displays one of the TA return/inhibit messages shown below. TAs which are the result of TA=TP=1 on the current frequency do not update the last TA PI or TA return/inhibit messages.

When a 14B group is received the following occurs:

Check traffic flag; if enabled proceed, otherwise set TA rtrn/inhb message to:

TA inhb: flag - Traffic key inhibit flag (d.p. at the 11th character position).

Search for TA PI code in NVM; if found proceed, otherwise set TA rtrn/inhb message to:

TA inhb: EON PI - The PI code given in 14B is not in the NVM.

Check station TA inhibit flag in NVM; if clear proceed, otherwise set TA rtrn/inhb message to:

TA inhb: NVM - User inhibit of station using bit stored in NVM.

Retune to frequency stored in NVM against EON PI code. The PS name display changes to show the PS name of the service carrying the traffic announcement and the time display is replaced by the new frequency. If the service has its TP flag high, then the 10s of kHz digit will flash as in the manual mode display. After one second, check TP flag at the new frequency. If high then proceed, otherwise return to original frequency and set TA rtrn/inhb message to:

TA rtrn: TP low - TP station does not have TP bit high.

Check PI code at new frequency. If correct (same as 14B EON TA PI code) then proceed, otherwise retune to original frequency and set TA rtrn/inhb message to:

TA rtrn: PI code - PI code of TP station was not as expected.

After an additional 2 seconds, start to monitor the TA flag; if high, remain on current frequency, if low return to original frequency and set TA rtrn/inhb message to:

TA rtrn: TA low - TA flag of TP station low. This is the normal return method.

If, during a TA, the radio is manually retuned, the TA rtrn/inhb message is set to:

TA rtrn: manual - User initiated manual return.

References

- 1 AN494/D, An HC11-controlled Multi-band RDS Radio.
2. CENELEC EN 50067, Specifications of the Radio Data System (RDS), formerly EBU Technical Document. 3244).
3. AN460/D, An RDS Decoder using the MC68HC05E0.
4. AN478/D, HC05 to HC11 code conversion.
5. EB419/D, ROMed HC11E32 and HC11PH8 including Buffalo monitor and PCbug11 talker.

Appendix 1


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66
67
68
69
70
71
72 00000066 >9600 RDSOK LDAA THB EIGHTHS OF SECONDS
73 00000068 8108 CMPA #8
74 0000006a 263e BNE NOTC PAST 7 ?
75 0000006c >f0000 CLR THB YES, CLEAR
76 0000006e >c0000 INC SEC UPDATE SECONDS
77 00000072 >9600 LDAA SEC
78 00000074 8101 CMPA #1
79 00000076 2603 BNE NOTS DECREMENT SLEEP TIMER MINUTES
80 00000078 >a0000 DEC SLEPT
81 0000007b 813c NOTS CMPA #60
82 0000007d 262b BNE NOTC PAST 59 ?
83 0000007f >f0000 CLR SEC YES, CLEAR
84 00000082 >c0000 INC MIN UPDATE MINUTES
85 00000085 >9600 LDAA MIN
86 00000087 813c CMPA #60
87 00000089 261f BNE NOTC PAST 59 ?
88 0000008b >f0000 CLR MIN YES, CLEAR
89 0000008e >c0000 INC CUR UPDATE HOURS
90 00000091 >9600 LDAA CUR
91 00000093 8118 CMPA #24
92 00000095 2613 BNE NOTC PAST 23 ?
93 00000097 >f0000 CLR CUR YES CLEAR
94 0000009a >c0002 INC BMUD+2
95 0000009d 2608 BNE NOTD
96 0000009f >c0001 INC BMUD+1
97 000000a2 2603 BNE NOTD
98 000000a4 >c0000 INC BMUD
99 000000a7 >140040 NOTD BSET STAT3,S40 UPDATE DATE
100 000000aa 3b NOTC RTI
101
102
103
104
105
106
107
108 000000ab >12002004 TFCC BRSET STAT6,S20,CCBH
109 000000af >140020 BSET STAT6,S20
110 000000b2 39 RTS
111 000000b3 >150020 CCBH BCLR STAT6,S20
112 000000b6 39 RTS
113
114
115
116
117
118
119
120 000000b7 18ce1000 SDATA LDY #S100C
121 000000b8 181f000807 BRCLR PORTA,Y,S08,RDSD RDS INTERRUPTS ONLY (A3) ?
122 000000b9 >13008003 BRCR STAT3,S80,RDSD NO, USE CONTROL BIT FROM BAND INPUTS
123 000000c4 >e0000 JMP SHAFT
124 000000c7 >1200081c RDSD BRSET STAT6,S08,NOTFM NO, INTERRUPT FROM SHAFT
125 000000cb 0d SEC RDS, BUT IS IT AN FM BAND ?
126 000000cc 181e0a2001 BRSET PORTE,Y,S20,DHIGH YES
127 000000d1 0c CLC
128 000000d2 >790003 DHIGH ROL DAT+3
129 000000d5 >790002 ROL DAT+2
130 000000d8 >790001 ROL DAT+1
131 000000db >790000 ROL DAT
132 000000d4 >1300010a BRCLR STAT2,S01,TRY2 BIT BY BIT CHECK ?
133 000000e2 >a00000 DEC BIT NO, WAIT FOR BIT 26
134 000000e5 2701 BEQ TRY1 THIS TIME ?
135 000000e7 3b NOTFM RTI
136
137 000000e8 861a TRY1 LDAA #26
138 000000ea >9700 STAA BIT
139 000000ec >9601 TRY2 LDAA DAT+1 LSB
140 000000ee >6600 LDAB DAT MSB (2 BITS)
141 000000f0 c403 ANDB #3
142
143 000000f2 >13030104 S03 BRCLR DAT+3,S01,S13
144 000000f6 881b EORA #S1B
145 000000f8 c803 EORB #S03
146
147 000000fa >13030204 S13 BRCLR DAT+3,S02,S23
148 000000fe 8881 EORA #S8F
149 000000f0 c803 EORB #S03
150
151 000000f2 >13030404 S23 BRCLR DAT+3,S04,S33
152 000000f6 8887 EORA #S47
153 000000f8 c802 EORB #S02
154
155 000000f0a >13030802 S33 BRCLR DAT+3,S08,S43
156 0000010e 88f7 EORA #S47
157
158 00000110 >13031004 S43 BRCLR DAT+3,S10,S53
159 00000114 88ee EORA #SEE
160 00000116 c801 EORB #S01
161
162 00000118 >13032004 S53 BRCLR DAT+3,S20,S63
163 0000011c 88dc EORA #S6C
164 0000011e c803 EORB #S03

```

```

166
167
168
169
170
171
172 00000120 >13034004
173 00000124 8801
174 00000126 c802
175
176 00000128 >13038004
177 0000012c 88bb
178 0000012e c801
179
180 00000130 >13020104
181 00000134 8876
182 00000136 c803
183
184 00000138 >13020204
185 0000013c 8855
186 0000013e c803
187
188 00000140 >13020404
189 00000144 8813
190 00000146 c803
191
192 00000148 >13020804
193 0000014c 889f
194 0000014e c803
195
196 00000150 >13021004
197 00000154 8887
198 00000156 c802
199
200 00000158 >13022002
201 0000015c 88c7
202
203 0000015e >13024004
204 00000162 886e
205 00000164 c801
206
207 00000166 >13028004
208 0000016a 883c
209 0000016c c802
210
211 0000016e >2700
212 00000170 >9701
213
214
215
216
217
218
219
220 00000172 >9600
221 00000174 8103
222 00000176 2764
223 00000178 8102
224 0000017a 2723
225 0000017c 8101
226 0000017e 2711
227 00000180 >7f0000
228
229 00000183 >9601
230 00000185 81d8
231 00000187 2632
232 00000189 >9600
233 0000018b 8103
234 0000018d 262c
235 0000018f 205d
236
237 00000191 >9601
238 00000193 81d4
239 00000195 2624
240 00000197 >9600
241 00000199 8103
242 0000019b 261e
243 0000019d 204f
244
245 0000019f >1202080c
246 000001a3 >9601
247 000001a5 815c
248 000001a7 2612
249 000001a9 >9600
250 000001ab 8102
251 000001ad 200a
252
253 000001af >9601
254 000001b1 81cc
255 000001b3 2606
256 000001b5 >9600
257 000001b7 8103
258 000001b9 2733
      ****
      *      Calculate syndrome (cont.).      *
      ****
S63  BRCLR  DAT+3,$40,S73
      EORA  #$01
      EORB  #$02
S73  BRCLR  DAT+3,$80,S02
      EORA  #$BB
      EORB  #$01
S02  BRCLR  DAT+2,$01,S12
      EORA  #$76
      EORB  #$03
S12  BRCLR  DAT+2,$02,S22
      EORA  #$$55
      EORB  #$03
S22  BRCLR  DAT+2,$04,S32
      EORA  #$13
      EORB  #$03
S32  BRCLR  DAT+2,$08,S42
      EORA  #$9E
      EORB  #$03
S42  BRCLR  DAT+2,$10,SS2
      EORA  #$87
      EORB  #$02
S52  BRCLR  DAT+2,$20,S62
      EORA  #$B7
      ****
S62  BRCLR  DAT+2,$40,S72
      EORA  #$6E
      EORB  #$01
S72  BRCLR  DAT+2,$80,FIN
      EORA  #$DC
      EORB  #$02
FIN  STAB  SYN
      STAA  SYN+1
      ****
      *      Check for syndromes A, B, C & C'.      *
      ****
LDAA  LEV
      CMPA  #3
      BEQ  TRYD
      CMPA  #2
      BEQ  TRYC
      CMPA  #1
      BEQ  TRYB
      CLR  LEV
TRYA LDAA  SYN+1          BLOCK 1
      CMPA  #$D8
      BNE  NOTV
      LDAA  SYN
      CMPA  #$03
      BNE  NOTV
      BRA  VALID
TRYB LDAA  SYN+1          BLOCK 2
      CMPA  #$D4
      BNE  NOTV
      LDAA  SYN
      CMPA  #$03
      BNE  NOTV
      BRA  VALID
TRYC BRSET  TMPGRP+2,$08,TRYCD  BLOCK 3 TYPE A
      LDAA  SYN+1
      CMPA  #$CC
      BNE  NOTV
      LDAA  SYN
      CMPA  #$02
      BRA  VC
TRYCD LDAA  SYN+1          BLOCK 3 TYPE B
      CMPA  #$CC
      BNE  NOTV
      LDAA  SYN
      CMPA  #$03
      BRA  VALID
VC   BEQ  VALID
      
```



```

260
261
262
263
264
265
266
267 000001bb >f0000  NOTV CIR LEV
268 000001bc >6000  LDAA CONF
269 000001c0 8129  CMPA #41
270 000001c2 2410  BHS DBCC
271 000001c4 >150001  BCLR STAT2,S01
272 000001c7 810a  CMPA #10
273 000001c9 230d  BLS SKPDC
274 000001cb >a0000 DEC BIT
275 000001ce 2607  BNE NNOW
276 000001d0 861a  LDAA #26
277 000001d2 >9700  SIDA BIT
278 000001d4 >a0000 DECC DEC CONF
279 000001d7 3b  NNOW RTI
280 000001d8 >140010 SKPDC BSSET STAT2,S10
281 000001d9 3b  NOT4 RTI
282
283 000001dc >9601 TRYD LDAA SYN+1
284 000001de 8158  CMPA #554
285 000001e0 26d9  BNE NOTV
286 000001e2 >9600  LDAA SYN
287 000001e4 8102  CMPA #502
288 000001e6 26d3  BNE NOTV
289 000001e8 >140002 BSSET STAT2,S02
290 000001eb >150010 BCLR STAT,S10
291
292 000001ee >12000107 VALID BRSET STAT2,S01,VLD
293 000001f2 8626  LDAA #38
294 000001f4 >9700  STAA CONF
295 000001f6 >140001 BSSET STAT2,S01
296 000001f9 >9600  VLD LDAA CONF
297 000001fb 8138  CMPA #56
298 000001fd 2204  BHI NMR
299 000001ff 8b04  ADDA #4
300 00000201 >9700  SIDA CONF
301 00000203 ce0000  NMR LDK #0
302 00000206 >x600  LDAB LEV
303 00000208 59  ROLB
304 00000209 3a  ABX
305 0000020a >7c0000 INC LEV
306 0000020d 861a  LDAA #26
307 0000020f >9700  SIDA BIT
308 00000211 >760000 ROR DAT
309 00000214 >760001 ROR DAT+1
310 00000217 >760002 ROR DAT+2
311 0000021a >760000 ROR DAT
312 0000021d >760001 ROR DAT+1
313 00000220 >760002 ROR DAT+2
314 00000223 >9602 LDAA DAT+2
315 00000225 >8701 STAA TMPGRP+1,X
316 00000227 >9601 LDAA DAT+1
317 00000229 >8700 STAA TMPGRP,X
318 0000022b >130002ac BRCLR STAT2,S02,NOT4
319 0000022f ce0008 XFER LDK #8
320 00000232 >x6ff TXLP LDAA TMPGRP-1,X
321 00000234 >87ff STAA GROUP-1,X
322 00000236 09  DEK
323 00000237 26f9  BNE TXLP
324 * RTI
325
326
327
328 * Update PI code, initialise if changed.
329 * All block 1s used, block 3s not used.
330 *
331
332
333 00000239 >9600 PROC LDAA GROUP
334 0000023b >9100 CMPA PI
335 0000023d 2606 BNE DNDX
336 0000023f >9601 LDAA GROUP+1
337 00000241 >9101 CMPA PI+1
338 00000243 270e BEQ PTYL
339 00000245 >9600 DNDX LDAA GROUP
340 00000247 >9700 STRA PI
341 00000249 >9601 LDAA GROUP+1
342 0000024b >9701 STAA PI+1
343 0000024d >b30000 JSR CLRDN
344 00000250 >140010 BSSET STAT2,S10
345
346
347
348 * Update PTY and TP.
349 * All block 2s used, not block 4 (grp 15B).
350 *
351
352
353 00000253 >9602 PTYL LDAA GROUP+2
354 00000255 >9700 STAA ITMP1
355 00000257 >13000405 BRCLR ITMP1,S04,TPL1
356 0000025b >140008 BSSET STAT3,S08
357 0000025e 2003 BRA TPL
358 00000260 >150008 TPL1 BCLR STAT3,S08
359 00000263 >9603 TPL LDAA GROUP+3
360 00000265 >760000 ROR ITMP1
361 00000268 46 RORA
362 00000269 44 LSRA
363 0000026a 44 LSRA
364 0000026b 44 LSRA
365 0000026c 44 LSRA
366 0000026d >9700 STAA PTY

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368
369
370
371
372 * Groups handled.
373 * All PI, PIY & TP
374 * 0 A & B TA, PS, DI, M/S (not AF)
375 * 1 A & B PIN
376 * 2 A RT
377 * 4 A CT
378 * 14 A & B EDN (TP only)
379 * 15 B TA
380
381
382
383
384 * Process groups 0 & 15B (PS & TA).
385
386
387
388 0000026f >9602 LDAA GROUP+2
389 00000271 84f8 ANDA #SF8
390 00000273 2708 BEQ GRP0 GROUP QA
391 00000275 8108 CMPA #S08 GROUP OB
392 00000277 2706 BEQ GRP0
393
394 00000279 81f8 TGRP15 CMPA #SF8 GROUP 15B
395 0000027b 2713 BEQ TACK
396 0000027d 2077 BRA PROC1
397
398 0000027c >d603 GRP0 LDAB GROUP+3 GROUP 0 - PS & TA
399 00000281 c403 ANDB #S03
400 00000283 58 LSLB
401 00000284 >c0e000 LDX #PSN
402 00000287 3a ABX
403 00000288 >9606 LDAA GROUP+6
404 0000028a a700 STA 0,X
405 0000028c >9607 LDAA GROUP+7
406 0000028e a701 STA 1,X
407
408 00000290 >f0000 TACK CLR RDS0 RDS OK, RESET TIME-CUT
409 00000293 >12031014 BRSET GROUP+3,S10.TAH TA HIGH ?
410 00000297 >150004 BCLR STAT3,S04 NO, TA FLAG LOW
411 00000298 >13008010 BCLR STAT2,S80.NTD SWITCHED TO TA ?
412 0000029e >12001010 BRSET STAT4,S01.NTD 3s LOCKOUT TIMEOUT FINISHED ?
413 000002a2 >150080 BCLR STAT4,S80 YES, SWITCH BACK TO NORMAL PROG
414 000002a5 8604 LDAA #4
415 000002a7 >9700 STA REARET
416 000002a9 2003 BRA NID
417 000002ab >140004 TAH BSET STAT3,S04 YES, TA FLAG HIGH
418
419
420
421
422
423
424
425 000002ae >d603 NTID LDAB GROUP+3 DI
426 000002b0 c403 ANDB #3
427 000002b2 >9603 LDAA GROUP+3
428 000002b4 8404 ANDA #S04
429 000002b6 5d TSTA
430 000002b7 2609 BNE NOT0
431 000002b9 >150008 BCLR DI, #8
432 000002bc 4d TSTA
433 000002bd 2703 BEQ NOT0
434 000002be >140008 BSET DI, #8
435 000002c2 c101 NOT0 CMPB #1
436 000002c4 2609 BNE NOT1
437 000002c6 >150004 BCLR DI, #4
438 000002c9 4d TSTA
439 000002ca 2703 BEQ NOT1
440 000002cc >140004 BSET DI, #4
441 000002cf c102 NOT1 CMPB #2
442 000002d1 2609 BNE NOT2
443 000002d3 >150002 BCLR DI, #2
444 000002d6 4d TSTA
445 000002d7 2703 BEQ NOT2
446 000002d9 >140002 BSET DI, #2
447 000002dc c103 NOT2 CMPB #3
448 000002d9 2609 BNE NOT3
449 000002e0 >150001 BCLR DI, #1
450 000002e3 4d TSTA
451 000002e4 2703 BEQ NOT3
452 000002e6 >140001 BSET DI, #1
453
454 000002e9 >150008 NOT3 BCLR STAT5,S08 M/S
455 000002ec >13030803 BCLR GROUP+3,$S08,MSZ
456 000002f0 >140008 BSET STAT5,S08
457 000002f3 >760000 JNP OUT1

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```

459
460
461      *          Process group 1 (PIN) .
462
463
464
465 000002f6 8110    PROC1  CMPA   #$10      GROUP 1A
466 000002f8 2704    BEQ    GRP1
467 000002fa 8118    CMPA   #$18      GROUP 1B
468 000002fc 260b    BNE    PROCC
469
470 000002fe >9606    GRP1  LDAA   GROUP+6
471 00000300 >9700    STAA   PIN
472 00000302 >9607    LDAA   GROUP+7
473 00000304 >9701    STAA   PIN+1
474
475 00000306 >7e0000    JMP    OUT1
476
477
478
479      *          Process group 2A (RT) .
480      *          Group 2B not handled.
481
482
483
484 00000309 8120    PROC2  CMPA   #$20      GROUP 2A
485 0000030b 2634    BNE    PROCC
486
487 0000030d >12031009    GRP2  BRSET  GROUP+3,$10,TEXTB
488 00000311 >1200020f    TEXIA  BRSET  STAT3,$02,NCH
489 00000315 >A40002    BSET   STAT3,$02
490 00000318 2007    BRA    LCDINI
491 0000031a >13000206    TEXTB  BRCRJ  STAT3,$02,NCH
492 0000031e >150002    BCLR   STAT3,$02
493 00000321 >bd0000    LCDINI JSR    INITR   CLEAR RT
494
495 00000324 >6e03    NCH    LDAB   GROUP+3
496 00000326 c401    ANDB  #$0F
497 00000328 58     LSLB
498 00000329 58     LSLB
499 0000032a >e0000    LDK    #RT
500 0000032d 3a     AEX
501 0000032e >9604    LDAA   GROUP+4
502 00000330 a705    STAA   5,X
503 00000332 >9605    LDAA   GROUP+5
504 00000334 a706    STAA   6,X
505 00000336 >9606    LDAA   GROUP+6
506 00000338 a707    STAA   7,X
507 0000033a >9607    LDAA   GROUP+7
508 0000033c a708    STAA   8,X
509 0000033e >7e0000    JMP    OUT1

```

```

511
512
513
514
515
516
517 00000341 8140
518 00000343 2703
519 00000345 >7e0000
520
521 00000348 >9603
522 0000034a 46
523 0000034b 8401
524 0000034d >9700
525 0000034f >9604
526 00000351 46
527 00000352 >9701
528
529 00000354 >9606
530 00000356 >760005
531 00000359 46
532 0000035c 44
533 0000035b 44
534 0000035c 44
535 0000035d >9700
536
537 0000035f >9605
538 00000361 >9702
539
540 00000363 >9606
541 00000365 >780007
542 00000368 49
543 00000369 >780007
544 0000036c 49
545 0000036d 843f
546 0000036e >9700
547 00000371 >7f0000
548 00000374 >7f0000
549 00000377 >140040
550
551
552
553
554
555
556
557 0000037a >3607
558 0000037c 58
559 0000037d 2764
560 0000037f 2436
561
562 00000381 54
563 00000382 54
564 00000383 54
565 00000384 54
566 00000385 240d
567 00000387 >9600
568 00000389 801e
569 0000038b 2a05
570 0000038d 8b3c
571 0000038f >7a0000
572 00000392 >9700
573
574 00000394 >d000
575 00000396 53
576 00000397 4c
577 00000398 2a19
578 0000039a cb18
579 0000039c >7f00
580
581 0000039e >7d0002
582 000003a1 260b
583 000003a3 >7d0001
584 000003a6 2603
585 000003a8 >7a0000
586 000003ab >7a0001
587 000003ae >7a0002
588 000003b1 2030
589
590 000003b3 >700
591 000003b5 202c
592
593 000003b7 54
594 000003b8 54
595 000003b9 54
596 000003ba 54
597 000003bb 240f
598 000003bd 861e
599 000003bf >9b00
600 000003c1 813b
601 000003c3 2305
602 000003c5 803c
603 000003c7 >7e0000
604 000003ca >9700
605
606 000003cc >db00
607 000003ce c117
608 000003d0 230f
609 000003d2 c018
610 000003d4 >7c0002
611 000003d7 2608
612 000003d9 >7c0001
613 000003dc 2603
614 000003de >7c0000
615 000003e1 >7f00
616 000003e3 >150002
617 000003e6 3b

***** Process group 4A (CT) *****
***** GROUP 4A - CT *****

PROC4 CMPA #$40
BEQ GRP4
JMP PROC14

GRP4 LDAA GROUP+3
RORA
ANDA #$01
STDA BMJD
LDAA GROUP+4
RORA
STDA BMJD+1
MJD MS BIT

LDAA GROUP+6
ROR GROUP+5
3210xxxx 4
LDAA GROUP+6
RORA
LSRA
LDAA GROUP+4
RORA
LSRA
LDAA OUR
MJD LSD

LDAA GROUP+6
LSL GROUP+7
ROLA
LDAA GROUP+7
LSL GROUP+7
ROLA
ANDA #$3F
STDA MIN
CLR SEC
CLR THB
BSET STAT3,S40
UPDATE MJD

***** Local time difference adjustment. *****
***** YES, POSITIVE ? *****
***** NO, NEGATIVE *****
***** HOURS IN B *****
***** 1/2 HOUR ? *****
***** YES *****
***** SUBTRACT 30 MINUTES *****
***** UNDERFLOW ? *****
***** YES, ADD 60 MINUTES *****
***** AND SUBTRACT 1 HOUR *****
***** NEGATIVE HOUR OFFSET, MINUS UTC HOURS *****
***** WRONG WAY ROUND SO COMPLEMENT *****
***** AND INCREMENT *****
***** UNDERFLOW ? *****
***** YES, ADD 24 HOURS *****
***** AND SUBTRACT A DAY *****
***** LSB WILL UNDERFLOW ? *****
***** YES *****
***** MSB WILL UNDERFLOW ? *****
***** YES DECREMENT MS BIT *****
***** DECREMENT MSB *****
***** DECREMENT LSB *****
***** POSITIVE ADJUSTMENT *****
***** HOURS IN B *****
***** HALF HOUR ? *****
***** YES, ADD 30 MINUTES *****
***** OVERFLOW ? *****
***** YES, SUBTRACT 60 MINUTES *****
***** AND ADD AN HOUR *****
***** HOUR OFFSET, ADD UTC HOURS *****
***** OVERFLOW ? *****
***** YES, SUBTRACT 24 HOURS *****
***** AND ADD A DAY *****
***** GROUP HANDLED, CLEAR FLAG *****

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619
620
621 * Process group 14 (EON).
622 *
623 ****
624
625 000003e7 81e0 PROC14 CMPA #SE0
626 000003e9 2703 BEQ GRP14A
627 000003eb >7e0000 JMP PR14B
628
629 000003ee >13031003 GRP14A BRCLR GROUP+3,S10,TPLO TP(ON) HIGH ?
630 > JMP OUT2 NO, ENABLE TO COLLECT DATA ONLY WHEN TP=1
631 000003f2 01 NOP
632 000003f3 01 NOP
633 000003f4 01 NOP
634 000003f5 >f0000 TPLO CLR ITMP1 PI MATCH (MSB) ?
635 000003f8 >d600 LPIL LDAB ITMP1
636 000003fa >ce0000 LDK #EON
637 000003fd 3a ABX
638 000003fe a600 LDAA 0,X
639 00000400 >9106 CMPA GROUP+6
640 00000402 2663 BNE NOTH
641 00000404 a601 LDAA 1,X
642 00000406 >9107 CMPA GROUP+7
643 00000408 265d BNE NOTH PI MATCH (LSB) ?
644
645 * LDAA GROUP+3 TP (ON)
646 * ANDA #S10
647 * STAA SB,X
648
649 0000040a >d603 LDAB GROUP+3
650 0000040c c40f ANDB #SOF
651 0000040e c104 CMPB #4 PS ?
652 00000410 2411 BHS NPS YES
653 00000412 58 LSLB
654 00000413 >db00 ADDB ITMP1
655 00000415 >ce0000 LDK #EON
656 00000418 3a ABX
657 00000419 >9604 LDAA GROUP+4
658 0000041b a702 STAA 2,X
659 0000041d >9605 LDAA GROUP+S
660 0000041f a703 STAA 3,X
661 00000421 20c0 BRA OUT1
662
663 00000423 c104 NPS CMPB #4 AF ?
664 00000425 262c BNE TRYPIN TRYPTY
665
666 00000427 >9604 LDAA GROUP+4 YES, METHOD A
667
668 00000429 81fa CMPA #250 MEDIUM OR LONG WAVE ?
669 0000042b 2616 BNE NMWL YES
670 0000042d a60c LDAA SC,X FIRST 2 BYTES ALREADY IN ?
671 0000042f 81ff CMPA #SFF IF NOT, DO NOTHING
672 00000431 2777 BEQ CUT2 YES
673 00000433 a60e LDAA SE,X M/L FREQUENCY ALREADY IN ?
674 00000435 81ff CMPA #SFF IF SO, DO NOTHING
675 00000437 2671 BNE CUT2 NO, STORE FIRST FREQUENCY AFTER
676 00000439 86fa LDAA #250 ARRIVAL OF INITIAL BYTES
677 0000043b a70e STAA SE,X
678 0000043d >9605 LDAA GROUP+5
679 0000043f a70f STAA SF,X
680 00000441 2067 BRA CUT2
681
682 00000443 81e0 NMWL CMPA #224
683 00000445 250a BLO TOOLS
684 00000447 81f9 CMPA #249
685 00000449 2206 BHJ TOOLS
686 0000044b a70c STAA SC,X
687 0000044d >9605 LDAA GROUP+5
688 0000044f a70d STAA SD,X
689 00000451 2057 BRA CUT2
690
691 * TRYPTY CMPB #S0D PTY
692 * BNE TRYPIN
693 * LDAA GROUP+4
694 * LSRA
695 * LSRA
696 * LSRA
697 * LDAB ITMP1
698 * LDK #EON
699 * ABX
700 * STAA SA,X END OF PI LIST ?
701 * BRA CUT2
702
703 00000453 c10e TRYPIN CMPB #S0E
704 00000455 2653 BNE OUT2
705 00000457 >9600 LDAB ITMP1 PIN
706 00000459 >ce0000 LDK #EON
707 0000045c 3a ABX
708 0000045d >9604 LDAA GROUP+4
709 0000045f a70a STAA SA,X
710 00000461 >9605 LDAA GROUP+S
711 00000463 a70b STAA SB,X
712 00000465 2043 BRA CUT2
713
714 00000467 81ff NOTH CMPA #SFF
715 00000469 260a BNE NOTH1 YES, ADD THIS PI CODE
716 0000046b >9606 LDAA GROUP+6
717 0000046d a700 STAA 0,X TO EON TABLE
718 0000046f >9607 LDAA GROUP+7
719 00000471 a701 STAA 1,X
720 00000473 2035 BRA CUT2
721
722 00000475 >9600 NOTH1 LDAA ITMP1 NOT END, TRY NEXT ENTRY
723 00000477 8810 ADDA #16
724 00000479 >9700 STAA ITMP1
725 0000047b 272d BEQ OUT2
726 0000047d >7e0000 JMP LPIL
727
728 00000480 81e8 PR14B CMPA #SE8 GROUP 14B
729 00000482 2626 BNE OUT2

```



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834
835
836
837
838
839
840 0000053a >13001006
841 0000053e >b40000
842 00000541 >150030
843 00000544 181f08200d
844 00000549 >1200046e
845 0000054d >12000087c
846 00000551 >b40000
847 00000554 207a
848 00000556 >13000258
849 0000055a >9600
850 0000055c 8101
851 0000055e 2605
852 00000560 >b40000
853 00000563 206b
854 00000565 8102
855 00000567 2605
856 00000569 >b40000
857 0000056c 2062
858 0000056e 8103
859 00000570 2605
860 00000572 >b40000
861 00000575 2059
862 00000577 8104
863 00000579 2605
864 0000057b >b40000
865 0000057e 2050
866 00000580 8105
867 00000582 2605
868 00000584 >b40000
869 00000587 2047
870 00000589 8106
871 0000058b 2605
872 0000058d >b40000
873 00000590 203e
874 00000592 8107
875 00000594 2605
876 00000596 >b40000
877 00000599 2035
878 0000059b 8108
879 0000059d 2605
880 0000059f >b40000
881 000005a2 202c
882 000005a4 8109
883 000005a6 2605
884 000005a8 >b40000
885 000005ab 2023
886 000005ad >b40000
887 000005b0 201e
888
889
890
891
892
893
894
895 000005b2 >13000405
896 000005b4 >b40000
897 000005b6 2015
898 000005b8 >13000405
899 000005bf >b40000
900 000005c2 200c
901 000005e4 >12000805
902 000005e8 >b40000
903 000005cb 2003
904 000005cd >b40000
905
906 000005d0 >e0000
907 000005d3 a600
908 000005d5 a110
909 000005d7 2607
910 000005d9 08
911 000005da >e00010
912 000005d4 2654
913 000005df 39
914
915 000005e0 18ce1000
916 000005e4 181f0a8049
917 000005e9 >b40000
918 000005ec 860c
919 000005ed >b40000
920 000005f1 >b40000
921 000005f4 8630
922 000005f6 181f008002
923 000005fb 8638
924 000005fd >b40000
925 00000600 >b40000
926 00000603 8640
927 00000605 >b40000
928
929 00000608 >e0000
930 0000060b 18ce1000
931 0000060f >b40000
932 00000612 181c0420
933 00000616 a600
934 00000618 a710
935 0000061a 81ff
936 0000061c 2602
937 0000061e 862d
938 00000620 >b40000
939 00000623 08
940 00000624 >e00010
941 00000627 2646
942 00000629 181f008003
943 0000062e >b40000
944 00000631 39

*****  

* * Display type selection. * *  

*****  

MOD BRCLR STAT2,$10,NOCL  

JSR INITD  

BCLR STAT2,$10 CLEAR PIN, DI, M/S, PTY & RT  

PARMS EVEN PS  

NOCL BRCLR PORTD,Y,$20,TRYRT STANDBY ?  

BRSST STATUS,$04,SLPD YES, SLEEP DISPLAY ?  

BRSST STATUS,$08,ALRMJ NO, ALARM DISPLAY ?  

JSR STBYD NO, NORMAL STANDBY DISPLAY  

BRA ROW1  

TRYRT BRCLR STATUS,$02,RITTS RDS DISPLAY ?  

LDAA RTDIS  

CMPA #1  

BNE NPTY  

JSR PTMD PTY DISPLAY  

BRA ROW1  

NPTY CMPA #2  

BNE NPI  

JSR DIP1 PI  

BRA ROW1  

NPI CMPA #3  

BNE NTAP  

JSR DTAP TA & PT  

BRA ROW1  

NTAP CMPA #4  

BNE NPIN1  

JSR DPIN1 PIN - HEX  

BRA ROW1  

NPIN1 CMPA #5  

BNE NPIN2  

JSR DPIN2 PIN - DAY AND TIME  

BRA ROW1  

NPIN2 CMPA #6  

BNE NMJD  

JSR DMJD MJD  

BRA ROW1  

NMJD CMPA #7  

BNE NMSD  

JSR DMSC M/S & DI  

BRA ROW1  

NMSD CMPA #8  

BNE NCNPI  

JSR DCNPI LAST TA PI  

BRA ROW1  

NCNPI CMPA #9  

BNE NRET  

JSR DRET TA RETURN  

BRA ROW1  

NRET JSR DECN  

BRA ROW1  

*****  

* * Display type selection (cont.). * *  

*****  

RTTTS BRCLR STAT2,$04,SLPD RT DISPLAY ?  

JSR RTDSP  

BRA ROW1  

SLPD BRCLR STATUS,$04,NRMD SLEEP TIMER DISPLAY ?  

JSR SLEEPD  

BRA ROW1  

NRMD BRSST STATUS,$08,ALRMJ ALARM DISPLAY ?  

JSR NRMD  

BRA ROW1  

ALRMJ JSR ALRD  

ROW1 LDX #DISP HAS CHARACTER CHANGED ?  

CLOP2 LDAA 0,X  

CMPA 16,X  

BNE DIFF  

INX  

CPX #DISP+16  

BNE CLOP2  

RIS YES, NO NEED TO UPDATE DISPLAYS  

DIFF LDY #S1000 LCD OR VFD ?  

BRCLR PORTB,Y,S80,VFD  

JSR WAIT LCD  

LDAA #S0C SWITCH DISPLAY ON  

JSR CLOCK LATCH IT  

ROW1 LDAA #S30 /8 DISPLAY  

BRCLR PORTA,Y,S80,M8A  

LDAA #S38 /16 DISPLAY  

JSR CLOCK LATCH IT  

M8A JSR ADDRESS DISPLAY RAM  

LDAA #S80  

JSR CLOCK LATCH IT  

ROW1 LDX #DISP  

LDY #S1000  

JSR WAIT  

LCD BSST PORTB,Y,S20 WRITE DATA  

LDAA 0,X GET A BYTE  

STA 16,X SAVE IT IN "CURRENT" BUFFER  

CMPA #FFF  

BNE COK  

LDAA #S2D  

JSR CLOCK SEND IT TO MODULE  

INX  

CPX #DISP+16 DONE ?  

BNE LCD  

BRCLR PORTA,Y,S80,MUX8  

JSR LCD401  

MUX8 RIS  

*****  


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946
947
948
949
950
951
952 00000632 18ce1000
953 00000636 181d0402
954 00000636 181c0401
955 0000063e 181d0404
956
957 00000642 >e0000
958 00000645 a600
959 00000647 >f100
960 00000649 8d2c
961 0000064b >c0007
962 0000064e 26e5
963
964 00000650 >e0000
965 00000653 >d100
966 00000655 e600
967 00000657 e710
968 00000659 c1ff
969 0000065a 2602
970 0000065d c62d
971 0000065f c47f
972 00000661 >e0000
973 00000661 3a
974 00000665 a600
975 00000667 8d0e
976 00000669 >c0010
977 0000066c 26e5
978
979 0000066a 181c0404
980 00000672 181d0401
981 00000676 39
982
983 00000677 c608
984 00000679 44
985 0000067a 2404
986 0000067c 181c0402
987 00000680 181d0401
988 00000684 181c0401
989 00000688 181d0402
990 0000068c 5a
991 0000068d 26ea
992 0000068f c654
993 00000691 5a
994 00000692 26fd
995 00000694 >e000
996 00000696 08
997 00000697 39
998
999 00000698 a00fb000800090
1000
1001
1002
1003
1004
1005
1006
1007
1008 0000069f 8620
1009 000006a1 >570001
1010 000006a4 >570004
1011 000006a7 862e
1012 000006a9 >13000203
1013
1014 000006ad >570001
1015 000006b0 >12000403
1016 000006b4 >57000a
1017
1018 000006b7 >13004047
1019 000006b8 >150040
1020 000006b9 86ff
1021 000006c0 >18ce0000
1022 000006c4 18e700
1023 000006c7 1808
1024 000006c9 >18ce0007
1025 000006ca 23f5
1026 000006cb >1300012f
1027 000006d3 >4601
1028 000006d5 2602
1029 000006d7 86f0
1030 000006d9 cb30
1031 000006db >770003
1032 000006d9 >9602
1033 000006e0 2606
1034 000006e2 c120
1035 000006e4 2602
1036 000006e6 86f0
1037 000006e8 bb30
1038 000006ed >570004
1039 000006ed >9603
1040 000006ef bb30
1041 000006f1 >570005
1042 000006f4 >9604
1043 000006f6 bb30
1044 000006f8 >570006
1045 000006f9 >9605
1046 000006f9 bb30
1047 000006ff >570007
1048
1049 00000702 >18ce0000
1050 00000706 >ee0000
1051 00000709 18e600
1052 0000070c a702
1053 0000070e 08
1054 0000070f 1808
1055 00000711 >18ce0007
1056 00000715 23f2
1057 00000717 >9600
1058 00000719 bb30
1059 0000071b >b70000
1060 0000071e >13004009

*****  

*          *          *          *          *  

*          VFD.          *          *          *  

*          *          *          *          *  

*****  

VFD LDY #S1000  
BCLR PORTB,Y,S02  
BSET PORTB,Y,S01  
BCLR PORTB,Y,S04  
  

DISS LDX #INITF  
LDAA 0,X  
STX W7  
BSR VFDL  
CPX #INITF+7  
BNE DISS  
  

VFD3 LDX #DISP  
STX W7  
LDBA 0,X  
STAB 16,X  
CMPB #FF  
BNE NOTFF  
LDBA #52D  
ANDB #57F  
LDX #VTAB  
AEX  
LDAA 0,X  
BSR VFDL  
CPX #DISP+16  
BNE VFDL3  
  

NOTFF LDY #VTAB  
LDBA #57F  
BSET PORTB,Y,S04  
BCLR PORTB,Y,S01  
RTS  
  

DIS3 LDBA #8  
LSRA  
BCC DIS4  
BSET PORTB,Y,S02  
BCLR PORTB,Y,S01  
BSET PORTB,Y,S01  
BCLR PORTB,Y,S02  
DEC8  
BNE DIS3  
LDBA #84  
  

DIS4 DECB  
BNE DEL  
LDBA #84  
DECB  
BNE DEL  
LDBA #84  
LDX W7  
RESTORE INDEX  
  

DIS5 LDY #PSNAME  
BSET STAT4,S02,NOTIP  
BCLR TH8,S04,NOTIP  
STAA DISP+1  
BSET STAT4,S04,TYP1  
STAA DISP+10  
  

TYP1 BRCLR STAT2,S40,TYP2  
BCLR STAT2,S40  
LDBA #5FF  
LDY #PSN  
STAA 0,Y  
INY  
CPY #PSN+7  
BLS CPS  
BRCLR STAT,S01,TYP2  
LDBA R0+1  
LDY #PSN  
STAA NZ1B  
LDBA #5F0  
ADD A0DB #53C  
STAB PSN+3  
LDAA R0+3  
AIDA #530  
LDAA R0+4  
AIDA #531  
LDAA R0+5  
AIDA #532  
LDAA R0+6  
AIDA #533  
LDAA R0+7  
STAA NZ2B  
ADD A0DB #530  
STAA PSN+4  
LDAA R0+3  
AIDA #530  
LDAA R0+4  
AIDA #531  
LDAA R0+5  
AIDA #532  
LDAA R0+6  
AIDA #533  
LDAA R0+7  
  

NZ1B ADD A0DB #530  
STAA PSN+4  
LDAA R0+3  
AIDA #530  
LDAA R0+4  
AIDA #531  
LDAA R0+5  
AIDA #532  
LDAA R0+6  
AIDA #533  
LDAA R0+7  
  

NZ2B ADD A0DB #530  
STAA PSN+4  
LDAA R0+3  
AIDA #530  
LDAA R0+4  
AIDA #531  
LDAA R0+5  
AIDA #532  
LDAA R0+6  
AIDA #533  
LDAA R0+7  
  

TYP2 LDY #PSN  
LDX #DISP  
MPS LDAA 0,Y  
STAA 2,X  
SONG INY  
INY  
CPY #PSN+7  
BLS MPS  
LDAA LED  
ADD A0DB #530  
STAA DISP  
BRCLR STAT5,S40,NTSCN2  
STORE MODE ?  


```

1061 00000722 >13000405			
1062 00000726 8620	BRCLR	THB,S04,NTSCN2	YES, FLASH ?
1063 00000728 >b70000	LDAA	#\$20	YES
1064	STAA	DISP	
1065 0000072b >d500			
1066 0000072d 2718	NTSCN2	LDAB PNP	
1067 0000072f >13000702	BEQ	CJ	EDITING ?
1068 00000733 2012	BRCLR	THB,S07,NCJ	YES, FLASH
1069 00000735 >c0001	BRA	CJ	
1070 00000738 3a	LDA	#DISP+1	
1071 00000739 a600	ABK		
1072 0000073b 8120	LDAA	0,X	GET CHARACTER TO FLASH
1073 0000073d 2704	CMPA	#\$20	SPACE ?
1074 0000073f 8620	BEQ	SPCE	
1075 00000741 2002	LDAA	#\$20	NO, REPLACE WITH SPACE
1076 00000743 862d	BRA	CJP	
1077 00000745 a700	SPCE	LDAA	YES, REPLACE WITH -
1078	CJP	STAA	0,X
1079 00000747 >12000807	CJ	BRSET STAT2,S08,TYPE3	TA SWITCH ?
1080 0000074b >13000103	BRCLR	STAT,S01,TYPE3	NO, FREQUENCY MODE ?
1081 0000074f >e0000	JMP	PRGM	NO, DISPLAY TIME
1082 00000752 18ce1000	TYPE3	LDY #\$1000	
1083 00000756 181e00251	BRSET	PORTA,Y,S02,AMD	YES DISPLAY FREQUENCY, AM BAND ?
1084 0000075b >d601	FMD	LDAA R0+1	NO, FM
1085 0000075d 2602	LDAA	NZ1	
1086 0000075f c6f0	LDAA	#\$F0	
1087 00000761 cb30	NZ1	ADD	#\$30
1088 00000763 >f7000a	STAB	DISP+10	
1089 00000766 >9602	LDAA	R0+2	
1090 00000768 2606	ENE	NZ2	
1091 0000076a c120	CMPB	#\$20	
1092 0000076c 2602	ENE	NZ2	
1093 0000076e 86f0	LDAA	#\$F0	
1094 00000770 8230	ADD	#\$30	
1095 00000772 >b7000b	STAA	DISP+11	
1096 00000775 >9603	LDAA	R0+3	
1097 00000777 8230	ADD	#\$30	
1098 00000779 >b7000c	STAA	DISP+12	
1099 0000077e >862e	LDAA	#\$2E	
1100 00000782 >13000206	BRSET	STATS,S02,SKCL	RDS (EON) DISPLAY ?
1101 00000782 >13000202	BRCLR	STATS,S20,SKCL	
1102 00000786 862d	LDAA	#\$2D	
1103 00000788 >b7000d	STAA	DISP+13	
1104 0000078b >9604	LDAA	R0+4	
1105 0000078d 8230	ADD	#\$30	
1106 0000078f >b7000e	STAA	DISP+14	
1107 00000792 >9605	LDAA	R0+5	
1108 00000794 8230	ADD	#\$30	
1109 00000796 >1200020e	BRSET	STATS,S02,SKCL2	RDS (EON) DISPLAY ?
1110 0000079a >1200020a	BRSET	STATS,S20,SKCL2	NO, INHIBITED ?
1111 0000079e >13000086	BRCLR	STAT3,S08,SKCL2	NO, TP FLAG SET ?
1112 000007a2 >13000042	BRCLR	THB,S04,SKCL2	YES, FLASH ?
1113 000007a6 862e	LDAA	#\$2E	
1114 000007a8 >b7000f	SKCL2	STAA	DISP+15
1115 000007ab 39	RTS		
1116			
1117			*
1118			*
1119		*	Normal display (cont.)..
1120			*
1121			*
1122			
1123 000007ac c620	AMD	LDAA #\$20	YES, AM
1124 000007ae >f7000a	STAB	DISP+10	
1125 000007b1 >d501	LDAA	R0+1	
1126 000007b3 2602	ENE	NZ1A	
1127 000007b5 c6f0	LDAB	#\$F0	
1128 000007b7 cb30	NZ1A	ADD	#\$30
1129 000007b9 >f7000b	STAB	DISP+11	
1130 000007bc >9602	LDAA	R0+2	
1131 000007be 2606	ENE	NZ2A	
1132 000007c0 c120	CMPB	#\$20	
1133 000007c2 2602	ENE	NZ2A	
1134 000007c4 86f0	LDAA	#\$F0	
1135 000007c6 8230	ADD	#\$30	
1136 000007c8 >b7000c	STAA	DISP+12	
1137 000007cb >9603	LDAA	R0+3	
1138 000007cd 8230	ADD	#\$30	
1139 000007cf >b7000d	STAA	DISP+13	
1140 000007d2 >9604	LDAA	R0+4	
1141 000007d4 8230	ADD	#\$30	
1142 000007d6 >b7000e	STAA	DISP+14	
1143 000007d9 >9605	LDAA	R0+5	
1144 000007db 8230	ADD	#\$30	
1145 000007dd >b7000f	STAA	DISP+15	
1146 000007e0 39	RTS		
1147			
1148 000007e1 >9600	PRGM	LDAA OUR	GET TIME
1149 000007e3 >b20000	JSR	CBCD	
1150 000007e6 8130	CMPA	#\$30	LEADING ZERO ?
1151 000007e8 2602	ENE	TNZ	
1152 000007ea 8620	LDAA	#\$20	YES, MAKE IT A SPACE
1153 000007ec >fd000b	TNZ	STD	DISP+11
1154 000007ef >9600	CMIN	LDAA MIN	
1155 000007f1 >b2000c	JSR	CBCD	
1156 000007f4 >fd000e	STD	DISP+14	
1157 000007f7 863a	CSEC	LDAA #\$3A	
1158 000007f9 >12000206	BRSET	STAT6,S20,DOC	FLASHING ENABLED ?
1159 000007fd >13000402	BRCLR	THB,S04,DOC	YES, TIME TO FLASH ?
1160 00000801 8620	LDAA	#\$20	YES, 0.5 Hz FLASHING COLON
1161 00000803 >b7000d	DOC	STAA	DISP+13
1162 00000806 39	RTS		

```

1164 * ****
1165 * RT display mode. *
1166 * ****
1167 * Last TA PI display. *
1168 * ****
1169 * ****
1170 ****

1171
1172 000000807 >9600 RDSP LDAA DISP2
1173 000000809 261b ENE SKP1
1174 00000080b >e0000 JMP PYWD
1175 00000080e >d600 NDT LDBA DISP2
1176 000000810 >ceffff LDX #RT-1
1177 000000813 3a ABX
1178 000000814 a600 LDAA 0,X RT
1179 000000816 8120 CMPA #$20
1180 000000818 2617 BNE NOTSP
1181 00000081a >1300200e BRCLR STAT2,$20,FSP SPACE ?
1182 00000081c >7c000 INC DISP1 YES, FIRST ONE ?
1183 000000821 >c0000 INC DISP2 NO, SKIP THIS ONE
1184 000000824 >9600 LDAA DISP2
1185 000000826 8145 SKP1 CMPA #69
1186 000000828 221e BHI LCD4 END OF RT BUFFER
1187 00000082a 20e2 BRA NNT NO, GET NEXT CHARACTER
1188 00000082c >140020 FSP BSET STAT2,$20 FIRST SPACE, SET FLAG
1189 00000082f 2003 BRA CNT
1190 000000831 >150020 NOTSP ECLR STAT2,$20
1191 000000834 >9700 CNT STA4 W7 NOT A SPACE, CLEAR FLAG
1192 000000836 >ce0000 LDIX #DISP
1193 000000839 a601 ILP1 LDAA 1,X MOVE
1194 00000083b a700 STAA 0,X REST
1195 00000083d 08 INK LEFT
1196 00000083e >8c000f CPX #DISP+15 ONE
1197 000000841 28f6 ENE ILP1 PLACE
1198 000000843 >9600 LDAA W7
1199 000000845 >b7000f STA4 DISP+15 ADD NEW CHAR.
1200 000000848 39 LCD4 RTS

1201
1202 000000849 >ce0000 DONPI LDIX #CNPIST*
1203 00000084c >18ce0000 LDIV #DISP
1204 000000850 a600 DLOPO LDAA 0,X
1205 000000852 18a700 STAA 0,Y
1206 000000855 08 INK
1207 000000856 1808 INY
1208 000000858 >8c000f CRX #CNPIST+15
1209 00000085b 23f3 BLS DLOPO
1210 00000085d >9600 LDAA PICN
1211 00000085f 270e BEQ PINO
1212 000000861 >bd0000 JSR SPLIT
1213 000000864 >fd000b SID DISP+11
1214 000000867 >9601 LDAA PICN+1
1215 000000869 >bd0000 JSR SPLIT
1216 00000086c >fd000d STD DISP+13
1217 00000086f 39 PINV0 RTS

1218
1219
1220
1221 Standby display. *
1222
1223
1224
1225 000000870 >12001058 STBYD BRSET STAT4,$10,ALRMA ALARM ARMED ?
1226 000000874 >d600 NOTODAY LDAB DOW NO, GET DAY OF WEEK
1227 000000876 58 LSLB
1228 000000877 >db00 ADDB DOW
1229 000000879 >ce0000 LDIX #NAME
1230 00000087c 3a ABX
1231 00000087d a600 LDAA 0,X
1232 00000087f >bd70000 STAA DISP
1233 000000882 a601 LDAA 1,X
1234 000000884 >bd70001 STAA DISP+1
1235 000000887 a602 LDAA 2,X
1236 000000889 >bd70002 STAA DISP+2
1237 00000088c 8620 LDAA #S20
1238 00000088e >bd70003 STAA DISP+3
1239 000000891 >bd70006 STAA DISP+6
1240 000000894 >bd7000a STAA DISP+10
1241 000000897 >9601 LDAA DOM+1 DATE
1242 000000899 8630 ADDA #S30
1243 00000089b >bd70005 STAA DISP+5
1244 00000089e >9600 LDAA DOM
1245 0000008a0 2702 BEQ ADD20 IF ZERO USE A SPACE
1246 0000008a2 8b10 ADDA #S10 IF NOT MAKE ASCII
1247 0000008a4 8b20 ADDA #S20
1248 0000008a6 >bd70004 ADD20
1249 0000008a9 >bd1601 LDAB MNTH+1 MONTH, LSD
1250 0000008ab >9600 LDAA MNTH MONTH, MSD
1251 0000008ad 2702 BEQ MTZH
1252 0000008af cbfa ADDB #1C
1253 0000008b1 >bd7000 LDAB W7
1254 0000008b3 58 LSLB
1255 0000008b4 >db00 ADDB W7
1256 0000008b6 >ceffff LDIX #NAME-3
1257 0000008b9 3a ABX
1258 0000008ba a600 LDAA 0,X
1259 0000008bc >bd70007 STAA DISP+7
1260 0000008be a601 LDAA 1,X
1261 0000008bf 2b70008 STAA DISP+8
1262 0000008c4 a602 LDAA 2,X
1263 0000008c6 >bd70009 STAA DISP+9
1264 0000008c9 >e00000 JMP PRGM

```

```

1266
1267
1268
1269
1270
1271
1272 000008cc >13008006 ALRMA BRCLR STAT5,S80,D7 ARMED, BUT IS IT 5-DAY ?
1273 000008d0 >9600 LDAA IDW YES
1274 000008d2 8104 CMPA #4 SAT OR SUN ?
1275 000008d4 229e BHI NOTDAY IF SO, THEN NORMAL STANDBY DISPLAY
1276 000008d6 >9600 D7 LDAA ACR GET ALARM HOURS
1277 000008d8 >bd0000 JSR CECB
1278 000008db >fd0000 STD DISP
1279 000008de >9600 LDAA AMIN
1280 000008e0 >bd0000 JSR CECB
1281 000008e3 >fd0002 STD DISP+2
1282 000008e5 >ce0000 LDX #ALARMF
1283 000008e9 >18ce0000 LDY #DISP
1284 000008ed a601 ALOP2 LDAA 1.X
1285 000008ef 18a704 STAA 4.Y
1286 000008f2 08 INX
1287 000008f3 1808 INY
1288 000008f5 >8c0006 CPX #ALARMF+6
1289 000008f8 23f3 BLS ALOP2
1290 000008fa >7e0000 JMP PRGND
1291
1292
1293
1294
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1297
1298 000008fd >ce0000 DIPI LDX #PIST
1299 00000900 >18ce0000 DLOP LDY #DISP
1300 00000904 a600 LDAA 0.X
1301 00000906 18a700 STAA 0.Y
1302 00000909 08 INK
1303 0000090a 1808 INY
1304 0000090c >8c000f CPX #PIST+15
1305 0000090f 23f3 BLS DLOP
1306 00000911 >9600 LDAA PI
1307 00000913 270e BEQ PINV
1308 00000915 >bd0000 JSR SPLIT
1309 00000918 >fd000b SID DISP+11
1310 0000091b >9601 LDAA PI+1
1311 0000091d >bd0000 JSR SPLIT
1312 00000920 >fd000d SID DISP+13
1313 00000923 39 PINV RTS
1314
1315
1316
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1320
1321 00000924 >ce0000 ALRMD LDX #ALARMF
1322 00000927 >13001003 BRCLR STAT4,S10,ALOFD ARMED ?
1323 0000092b >ce0000 LDY #ALARMF YES
1324 0000092e >18ce0000 ALOFD LDY #DISP NO
1325 00000932 a600 ALOP LDAA 0.X
1326 00000934 18a700 STAA 0.Y
1327 00000937 08 INK
1328 00000938 1808 INY
1329 0000093a >18ce000f CPY #DISP+15
1330 0000093e 23f2 BLS ALOP
1331 00000940 >13001037 BRCLR STAT4,S10,ALOF ALARM ARMED ?
1332 00000944 >13006005 BRCLR STAT5,S80,NSD YES, WEEKDAY ONLY ?
1333 00000948 8635 LDAA #S35 TES, REPLACE 7 WITH 5
1334 0000094a >bd0000 STAA DISP
1335 0000094d >9600 NSD LDAA ACUR GET ALARM HOURS
1336 0000094f >bd0000 JSR CECB
1337 00000952 >fd000c STD DISP+12
1338 00000955 >9600 LDAA AMIN
1339 00000957 >bd0000 JSR CECB
1340 0000095a >cd000e STD DISP+14
1341 0000095d >1300201a BRCLR STAT4,S20,ALOF SET-UP ?
1342 00000961 >13007072 BRCLR TMR,S07,NALOF
1343 00000965 2014 BRA ALOF
1344 00000967 8620 NALOF LDAA #S20
1345 00000969 >12004008 BRSET STAT4,S40,FH HOURS ?
1346 0000096d >bd0000 STAA DISP+14 NO, FLASH MINUTES
1347 00000970 >bd000f STAA DISP+15
1348 00000973 2006 BRA ALOF
1349 00000975 >bd000c FH STAA DISP+12 YES, FLASH HOURS
1350 00000978 >bd000d STAA DISP+13
1351 0000097b 39 ALOF RTS
1352
1353
1354
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1358
1359 0000097c >ce0000 DTDPB LDX #TAPST
1360 0000097f >18ce0000 LDY #DISP
1361 00000983 a600 BLOP LDAA 0.X
1362 00000985 18a700 STAA 0.Y
1363 00000988 08 INK
1364 00000989 1808 INY
1365 0000098b >8c000f CPX #TRPST+15
1366 0000099e 23f3 BLS BLOP
1367 00000990 8631 LDAA #S31
1368 00000992 >13008003 BRCLR STAT5,S08,TPLCOW
1369 00000996 >bd0006 STAA DISP+6
1370 00000999 >130040403 TPLCOW BRCLR STAT3,S04,TALCOW
1371 0000099d >bd000e STAA DISP+14
1372 000009a0 39 TALCOW RTS

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1374
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1376
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1379
1380 000009e1 >ce0000
1381 000009e4 >18ce0000
1382 000009e8 a600
1383 000009ea 18a700
1384 000009ad 08
1385 000009ae 1808
1386 000009b0 >188c000f
1387 000009b4 23f2
1388 000009b6 >9600
1389 000009b8 270e
1390 000009b9 >bd0000
1391 000009bd >fd000b
1392 000009c0 >9601
1393 000009c2 >ad0000
1394 000009c5 >fd000d
1395 000009c8 39
1396
1397 000009c9 >ce0000
1398 000009cc >18ce0000
1399 000009d0 a600
1400 000009d2 18a700
1401 000009d5 08
1402 000009d6 1808
1403 000009d8 >188c000f
1404 000009dc 23f2
1405 000009de >9600
1406 000009e0 27e6
1407 000009e2 44
1408 000009e3 44
1409 000009e4 44
1410 000009e5 >bd0000
1411 000009e8 8130
1412 000009ec 2602
1413 000009ec 8620
1414 000009ee >fd0002
1415 000009f1 8131
1416 000009f3 272a
1417 000009f5 c131
1418 000009f7 260a
1419 000009f9 8673
1420 000009fb >b70004
1421 000009fe 8674
1422 00000a00 >b70005
1423 00000a03 c132
1424 00000a05 260a
1425 00000a07 866e
1426 00000a09 >b70004
1427 00000a0c 8664
1428 00000a0e >b70005
1429 00000a11 c133
1430 00000a13 260a
1431 00000a15 8672
1432 00000a17 >b70004
1433 00000a1a 8664
1434 00000a1c >b70005
1435 00000a1f >9600
1436 00000a21 8407
1437 00000a23 >ad01
1438 00000a25 58
1439 00000a26 49
1440 00000a27 58
1441 00000a28 49
1442 00000a29 >bd0000
1443 00000a2c >fd000a
1444 00000a2f >9601
1445 00000a31 843f
1446 00000a33 >bd0000
1447 00000a36 >fd000d
1448 00000a39 39
1449
1450
1451
1452
1453
1454
1455
1456 00000a3a 8d26
1457 00000a3c >9600
1458 00000a3e 2721
1459 00000a40 8830
1460 00000a42 >b7000a
1461 00000a45 >9601
1462 00000a47 8830
1463 00000a49 >b7000b
1464 00000a4c >9602
1465 00000a4e 8830
1466 00000a50 >b7000c
1467 00000a53 >9603
1468 00000a55 8830
1469 00000a57 >b7000d
1470 00000a5a >9604
1471 00000a5c 8830
1472 00000a5e >b7000e
1473 00000a61 39
1474
1475 00000a62 >ce0000
1476 00000a65 >18ce0000
1477 00000a69 a600
1478 00000a6b 18a700
1479 00000a6e 08
1480 00000a6f 1808
1481 00000a71 >188c000f
1482 00000a75 23f2
1483 00000a77 39

***** PIN displays. *****

DPIN1 LDX #PINST1
LDY #DISP
PLOP LDAA 0,X
STAA 0,Y
INX
INY
CPY #DISP+15
BLS PLOP
LDAA PIN
BED PINNV
JSR SPLIT
STD DISP+11
LDAA PIN+1
JSR SPLIT
STD DISP+13
PINNV RTS

DPIN2 LDX #PINIZ
LDY #DISP
PLOP2 LDAA 0,X
STAA 0,Y
INX
INY
CPY #DISP+15
BLS PLOP2
LDAA PIN
BED PINNV
JSR CBOD
CMPA #S3C
BNE DINO
LDAA #S20
STD DISP+2
CMPA #S31
BNE NOTRD
LDAA #T
STDAA DISP+5
NOTST CMPB #S32
BNE NOTIND
LDAA #D
STDAA DISP+4
LDAA #D
STDAA DISP+5
NOTIND CMPB #S33
BNE NOTRD
LDAA #R
STDAA DISP+4
LDAA #D
STDAA DISP+5
NOTRD LDAA PIN
ANDA #7
LDAB PIN+1
LDAA MJD
STD DISP+10
LDAA PIN+1
ANDA #S3F
JSR CBOD
STD DISP+13
RTS

***** MJD display. *****

DMJD BSR SMJD
LDAA MJD
MJDINV
ADD A #S30
STDAA DISP+10
LDAA MJD+1
ADD A #S30
STDAA DISP+11
LDAA MJD+2
ADD A #S30
STDAA DISP+12
LDAA MJD+3
ADD A #S30
STDAA DISP+13
LDAA MJD+4
ADD A #S30
STDAA DISP+14
MJDINV RTS

SMJD LDX #MJDST
LDY #DISP
MLOP LDAA 0,X
STAA 0,Y
INX
INY
CPY #DISP+15
BLS MLOP
RTS

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1485
1486
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1490
1491 00000a78 >9600
1492 00000a7a c610
1493 00000a7c 3d
1494 00000a7d >e0000
1495 00000a80 3a
1496 00000a81 >8ce0000
1497 00000a85 a600
1498 00000a87 18a700
1499 00000a88 08
1500 00000a8b 1808
1501 00000a8d >188c000f
1502 00000a91 23f2
1503 00000a93 39
1504
1505
1506
1507
1508
1509
1510
1511 00000a94 >ce0000
1512 00000a97 >18ce0000
1513 00000a9b a600
1514 00000a9d 18a700
1515 00000aa0 08
1516 00000aa1 1808
1517 00000aa3 >188c000f
1518 00000aa7 23f2
1519 00000aa9 >9600
1520 00000aab >fd0000
1521 00000aae >fd0008
1522 00000ab1 39
1523
1524 00000ab2 >ce0000
1525 00000ab5 >18ce0000
1526 00000ab9 a600
1527 00000abb 18a700
1528 00000abb 08
1529 00000ab1 1808
1530 00000ac1 >188c000f
1531 00000ac5 23f2
1532 00000ac7 >13000805
1533 00000acb 864d
1534 00000acd >b70006
1535 00000ad0 >9600
1536 00000ad2 >bd0000
1537 00000ad5 >fd000d
1538 00000ad8 39
1539
1540
1541
1542
1543
1544
1545
1546 00000ad9 >bd0000
1547
1548 00000adc >9600
1549 00000ade 800a
1550 00000ae0 c610
1551 00000ae2 3d
1552 00000ae3 >ce0000
1553 00000ae6 3a
1554
1555 00000ae7 8620
1556 00000ae9 >b70008
1557 00000aec >b70009
1558 00000aef a602
1559 00000af1 >b70000
1560 00000af4 a603
1561 00000af6 >b70001
1562 00000af9 a604
1563 00000afb >b70002
1564 00000afe a605
1565 00000b00 >b70003
1566 00000b03 a605
1567 00000b05 >b70004
1568 00000b08 a607
1569 00000b0a >b70005
1570 00000b0d a608
1571 00000b0f >b70006
1572 00000b12 a609
1573 00000b14 >b70007
1574
1575 00000b17 a60d
1576
1577 00000b19 81cd
1578 00000b1b 2603
1579 00000b1d 08
1580 00000b1e a60d
1581 00000b20 81fa
1582 00000b22 2718
1583
1584 00000b24 81cc
1585 00000b26 22b0
1586 00000b28 c60a
1587 00000b2a 3d
1588 00000b2b cb2e
1589 00000b2d >d700
1590 00000b2f 8922
1591 00000b31 >9700
1592 00000b33 >b30000
1593 00000b36 >bd0000
1594 00000b39 >7e0000

***** TA return display. *****
      DRET LDAA REARET
      LDAB #16
      MUL
      LDX #DRET
      ABX
      LDY #DISP
      RLOP LDAA 0,X
      STA 0,Y
      INX
      INY
      CPY #DISP+15
      BLS RLOP
      RTS

***** Sleep and M/S & DI displays. *****
      SLEEPD LDX #SLPST
      LDY #DISP
      SLOP LDAA 0,X
      STA 0,Y
      INX
      INY
      CPY #DISP+15
      BLS SLOP
      LDAA SLEPT
      JSR CRCD
      STD DISP+8
      RTS

***** MSDST *****
      DMSD LDX #MSDST
      LDY #DISP
      ILOP LDAA 0,X
      STA 0,Y
      INX
      INY
      CPY #DISP+15
      BLS ILOP
      BCLR . STATUS,$08,MSM
      LDAA # 'M'
      STA DISP+6
      MSM LDAA DI
      JSR CBCD
      STD DISP+13
      FNOK RTS

***** EON display. *****
      DEON JSR SWJD      CLEAR FREQUENCY CHARACTERS
      LDAA RTDIS
      SUBA #10
      LDAB #16
      MUL
      LDX #EON
      ABX
      LDAA #S20
      STA DISP+8
      LDAA #S21
      STA DISP+9
      LDAA 2,X
      STA DISP
      LDAA 3,X
      STA DISP+1
      LDAA 4,X
      STA DISP+2
      LDAA 5,X
      STA DISP+3
      LDAA 6,X
      STA DISP+4
      LDAA 7,X
      STA DISP+5
      LDAA 8,X
      STA DISP+6
      LDAA 9,X
      STA DISP+7
      LDAA 13,X
      CMPA #205      FILLER ?
      BNE NFIL
      INX
      LDAA 13,X      YES, TRY AGAIN
      CMPA #250      MEDIUM/LONG ?
      NFIL BEQ MLWF
      LDAB #10
      CMPA #204      FREQUENCY OK ?
      BHI FNOK
      LDAB #10
      ADDB #S25
      STAB W1
      ADCA #S22
      STA W2
      LDONC
      JSR TYPEN
      JMP NEW
      RESTORE Q

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1701
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1707 00000be2 16
1708 00000be3 840f
1709 00000be5 c4f0
1710 00000be7 8b00
1711 00000be9 19
1712 00000bea c010
1713 00000bec 2505
1714 00000bee 8b16
1715 00000bf0 19
1716 00000bf1 20c7
1717 00000bf3 >7e0000
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1725 00000bf6 6e6f2070726f6772
1726 00000c00 2020202020204e65
1727 00000c16 43757272656e7420
1728 00000c26 20204956e666f726d
1729 00000c36 202020202053706f
1730 00000c46 2020204564756361
1731 00000c56 202020202047261
1732 00000c66 2020202043756c74
1733 00000c76 2020202053636965
1734 00000c86 20202020566172
1735 00000c96 202020506f7020ed
1736 00000ca6 202020526f636b20
1737 00000cb6 2045617379206c59
1738 00000cc6 204c6956768742063
1739 00000cd6 536572696f757320
1740 00000ce6 20204f7468657220
1741
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1747
1748 00000cf6 >ee0000
1749 00000cf9 86ff
1750 00000cd9 a700
1751 00000cc9d 08
1752 00000cfce >8c0100
1753 00000dd1 2618
1754 00000dd3 39
1755
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1761
1762 00000dd4 >7f0000
1763 00000dd7 >7f0001
1764 00000dd9 >7f000C
1765 00000dd9 >150008
1766 00000dd10 >7f0000
1767 00000dd13 >150008
1768 00000dd16 >130000103
1769 00000dd1a >cd0000
1770
1771 00000dd1d 86a0
1772 00000dd1f >700000
1773 00000dd22 >700001
1774 00000dd25 >700003
1775 00000dd28 >700004
1776 00000dd2b 862d
1777 00000dd2d >700002
1778 00000dd30 8620
1779 00000dd32 >ee0000
1780 00000dd35 2705
1781 00000dd37 08
1782 00000dd38 >8c0040
1783 00000dd3b 26f8
1784 00000dd3d >7f0000
1785 00000dd40 >7f0000
1786 00000dd43 >150004
1787 00000dd46 39
1788
1789 00000dd47 2020416c61726d20
1790 00000dd57 372044617920416c
1791 00000dd57 20504920636f6465
1792 00000dd77 6661737420544120
1793 00000dd87 205450202d203020
1794 00000dd97 2050494e206e6f2e
1795 00000dd97 2020202074682061
1796 00000dd97 2044442064617920
1797 00000dd97 20536c656702020
1798 00000dd97 204d2f5320205320
1799 00000dd97 20313020536eef6f
1800
1801 00000df7 5441207274726e3a
1802 00000e07 544120696e68623a
1803 00000e17 5441207274726e3a
1804 00000e27 5441207274726e3a
1805 00000e37 5441207274726e3a
1806 00000e47 5441207274726e3a
1807 00000e57 544120696e68623a
1808 00000e67 544120696e68623a
1809 00000e77 544120696e68623a
1810 00000e87 5441207274726e3a
-----+
*      Hex->BCD conversion (& decimal adjust). *
-----+
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-----+
*      DECREMENT MSB
*      TOO FAR ?
*      NO, ADD 16 TO A,
*      ADJUST,
*      AND TRY AGAIN
-----+
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1800
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-----+
*      Programme Type (PTY) Codes.
-----+
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-----+
*      Clear EON data.
-----+
1701
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-----+
*      EON RAM CLEAR
-----+
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*      LCD initialisation.
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-----+
*      CLEAR RT
*      INITIALSIE SPACES BEFORE RT
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-----+
*      AND -
*      INITIALISE RADIOTEXT TO SPACES
*      AFTER CONFIDENCE LOSS OR TEXT A/B CHANGE
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-----+
*      INITIALISE SCROLLING POINTERS
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-----+
*      CANCEL RT DISPLAY
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*      NOT USED
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*      TA rtrn: flag : 1
*      TA rtrn: signal : 2 NOT USED
*      TA rtrn: PI code : 3
*      TA rtrn: TA low : 4
*      TA rtrn: TP low : 5
*      TA rtrn: ill freq : 6 NOT USED
*      TA rtrn: EON PI : 7
*      TA rtrn: NVM : 8
*      TA rtrn: manual : 9
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1826 00000e97 7e7e7e7e      VTAB   PCB    $7E,$7E,$7E,$7E      all
1827 00000eb5 7e7e7e7e      PCB    $7E,$7E,$7E,$7E      all
1828 00000ef5 7e7e7e7e      PCB    $7E,$7E,$7E,$7E      all
1829 00000ea3 7e7e7e7e      PCB    $7E,$7E,$7E,$7E      all
1830
1831 00000ea7 7e7e7e7e      PCB    $7E,$7E,$7E,$7E      all
1832 00000eab 7e7e7e7e      PCB    $7E,$7E,$7E,$7E      all
1833 00000ea9f 7e7e7e7e     PCB    $7E,$7E,$7E,$7E      all
1834 00000eb3 7e7e7e7e     PCB    $7E,$7E,$7E,$7E      all
1835
1836 00000eb7 7e7b7a7e      PCB    $7E,$7B,$7A,$7E      ! * # *
1837 00000ebb 7e7e7a7a      PCB    $7E,$7E,$7E,$7A      S * E : Stk
1838 00000ebf 7e7e7e7e      PCB    $7E,$7E,$7E,$7E      ( ) * + all
1839 00000ec3 3f7d3e7d      PCB    $3F,$7D,$3E,$7D      - . /
1840
1841 00000ec7 00010203      PCB    $00,$01,$02,$03      0 1 2 3
1842 00000ecb 04050607      PCB    $04,$05,$06,$07      4 5 6 7
1843 00000ecf 08097d7e      PCB    $08,$09,$7D,$7E      8 9 : :
1844 00000ed3 7e7e7c7c      PCB    $7E,$7E,$7E,$7C      < = > ? <>
1845
1846 00000ed7 7e0a0b0c      PCB    $7E,$0A,$0B,$0C      @ A B C @
1847 00000edb 0d0e0f10      PCB    $0D,$0E,$0F,$10      D E F G
1848 00000edf 11121314      PCB    $11,$12,$13,$14      H I J K
1849 00000ee3 15161718      PCB    $15,$16,$17,$18      L M N O
1850
1851 00000ee7 191a1b1c      PCB    $19,$1A,$1B,$1C      P Q R S
1852 00000eef 1d1e1f20      PCB    $1D,$1E,$1F,$20      T U V W
1853 00000eff 2122237e      PCB    $21,$22,$23,$7E      X Y Z { [
1854 00000ef3 7e7e7e7d      PCB    $7E,$7E,$7E,$7D      \ ] ^ - ` ] ~
1855
1856 00000ef7 7a242526      PCB    $7A,$24,$25,$26      . a b c
1857 00000efb 2728292a      PCB    $27,$28,$29,$2A      d e f g
1858 00000eff 2b2c2d2e      PCB    $2B,$2C,$2D,$2E      h i j k
1859 00000f03 2f303132      PCB    $2F,$30,$31,$32      l m n o
1860
1861 00000f07 33343536      PCB    $33,$34,$35,$36      p q r s
1862 00000f0b 3738393a      PCB    $37,$38,$39,$3A      t u v w
1863 00000f0f 3b3c3d7e      PCB    $3B,$3C,$3D,$7E      x y z ( {
1864 00000f13 7e7e7e7e      PCB    $7E,$7E,$7E,$7E      all
1865
1866      END

```

Section synopsis

- 1 00000ae (174) .RAM1
- 2 00000100 (256) .RAM2
- 3 0000006d (109) .RAM3
- 4 00000f17 (3863) .ROM3

Symbol table

.RAM1	1 00000000	DIS3	4 00000679	LT60	4 00000392	NPIN1	4 00000580	RDSTO	1 00000049
.RAM2	2 00000000	DIS4	4 00000680	M8A	4 000005fd	NPIN2	4 00000589	REARET	1 000000a2
.RAM3	3 00000000	DIS5	4 00000645	MIN	1 00000070	NPS	4 00000423	RLOP	4 00000a85
.ROM3	4 00000000	DISP	3 00000000	MJD	1 00000030	NPTY	4 00000565	ROW1	4 000005d0
ADD	I 0 00000000	DISPI	1 00000074	MJDAT	E 4 000004cf	NRET	4 000005ad	RP	1 0000007c
ADD20	4 000008a4	DISP2	1 00000075	MJDC	I 0 00000000	NRMD	4 000005c4	RQ	1 00000076
ADDON	4 000003e1	DISPP	3 00000010	MJDNV	4 00000a61	NTAP	4 00000577	RR	1 00000082
ALARMF	4 00000d47	DIST	1 00000047	MJDST	4 00000db7	NTD	4 000002ac	RT	3 00000028
ALARMN	4 00000d57	DITAP	4 0000097c	MLOP	4 00000a69	NTSCN2	4 0000072b	RTDIS	1 000000a3
ALOF	4 0000097b	DLOP	4 00000904	MLWF	4 00000b3c	NUM1	1 0000009b	RTDSP	4 00000807
ALOFD	4 0000092e	DLOPO	4 00000850	MNAME	I 0 00000000	NUM2	1 0000009d	RTITS	4 000005b2
ALOP	4 00000932	DMJD	4 00000a3a	MNTH	1 00000042	NWR	4 0000025	S02	4 00000130
ALOP2	4 000008ed	DMSD	4 00000ab2	MOD	E 4 0000053a	NWR2	4 000002c	S03	4 000000f2
ALRMA	4 000008cc	DNAME	I 0 00000000	MOREB	4 00000bea	NXT	4 0000080c	S12	4 00000138
ALRMD	4 00000924	DNDX	4 00000245	MPS	4 00000709	NXTJ	4 00000503	S13	4 000000fa
ALRMJ	4 000005cd	DOM	1 00000044	MSDST	4 00000dd7	NZ1	4 00000761	S22	4 00000140
AMD	4 000007ac	DONPI	4 00000849	MSM	4 00000ad0	NZ1A	4 000007b7	S23	4 00000102
AMIN	1 00000072	DOW	1 00000046	MSZ	4 000002f3	NZ1B	4 000006d9	S32	4 00000148
AOK	4 00000ba8	DPIN1	4 000009a1	MTHZ	4 000008b1	NZ2	4 00000770	S33	4 0000010a
AOUR	1 00000073	DPIN2	4 000009c9	MUX8	4 00000631	NZ2A	4 000007c6	S42	4 00000150
BCTO	1 000000ac	DRET	4 00000a78	N14B	4 00000053	NZ2B	4 000006e8	S43	4 00000110
BDONE	4 00000bf3	DTNO	4 000009ee	N5D	4 0000094d	NZ3	4 00000b57	S52	4 00000158
BIT	1 00000068	ELOP	4 00000cfb	NALOF	4 00000967	ONPIST	4 00000d77	S53	4 00000118
BLOP	4 00000983	EON	2 00000000	NCH	4 00000324	OUT	1 00000071	S62	4 0000015e
BMJD	1 00000000	FH	4 00000975	NCJ	4 00000735	OUT1	4 000003e3	S63	4 00000120
BOK	4 000004b5	FIN	4 0000016e	NEG	4 00000381	OUT2	4 000004aa	S72	4 00000166
CARRY	1 00000099	FMD	4 0000075b	NEW	I 0 00000000	OUT3	4 000004a7	S73	4 00000128
CBCD	E 4 00000be2	FNOK	4 00000ad8	NFIL	4 00000b20	P	1 00000015	SCCHAN	1 000000a5
CCBH	4 000000b3	FOK2	4 00000b28	NMJD	4 00000592	PI	1 00000061	SCNG	4 0000070e
CJ	4 00000747	FOUR	4 00000012	NMLW	4 00000443	PIN	1 00000065	SCNT	1 000000ad
CJP	4 00000745	FSP	4 0000082c	NMR	4 00000203	PINNV	4 000009c8	SDATA	E 4 000000b7
CLKC	4 00000037	GROUP	1 00000057	NMSD	4 0000059b	PINST1	4 00000d97	SEC	1 0000006f
CLOCK	E 4 00000ba9	GRP0	4 0000027f	NNOW	4 000001d7	PINST2	4 00000da7	SHRAFT	I 0 00000000
CLOC	4 00000d35	GRP1	4 000002fe	NOCL	4 00000544	PINV	4 00000923	SKCL	4 00000788
CLOP2	4 000005d3	GRP14A	4 000003ee	NONPI	4 000005a4	PINVO	4 0000086f	SKCL2	4 000007a8
CLRAS	I 0 00000000	GRP14B	4 00000484	NORMD	4 0000069f	PION	1 00000063	SKP1	4 00000826
CLREON	E 4 00000cf6	GRP2	4 0000030d	NOT0	4 000002c2	PIST	4 00000d67	SKPDC	4 000001d8
CLRPS	4 00000b83	GRP4	4 00000348	NOT1	4 000002cf	PLOP	4 000009a8	SLEEPD	4 00000a94
CLTR	I 0 00000000	HDON	4 000003ca	NOT2	4 000002dc	PLOP2	4 000009d0	SLEPT	1 00000048
CMIN	4 000007ef	ILOP	4 00000ab9	NOT3	4 000002e9	PLOP3	4 00000b88	SLOP	4 00000a9b
COKE	4 00000620	ILP1	4 00000839	NOT4	4 000001db	POS	4 000003b7	SLPD	4 000005bb
COKE2	4 00000530	INITD	E 4 00000404	NOT5	4 0000007b	PR14B	4 00000480	SLPST	4 00000dc7
CONF	1 0000006c	INITF	4 00000698	NOTC	4 000000aa	PRGMD	4 000007e1	SMEM	1 000000a0
CONT	4 00000834	INITR	4 00000d1d	NOTD	4 000000a7	PROC	E 4 00000239	SMJD	4 00000a62
COUNT	1 00000094	ITMP1	1 00000069	NOTEST	4 000000bd	PROC1	4 000002f6	SNCZ	4 00000de7
CPS	4 000006c4	KEY	1 00000096	NOTFF	4 0000065f	PROC14	4 000003e7	SPCE	4 00000743
CSEC	4 000007f7	KOUNT	1 00000097	NOTFM	4 000000e7	PROC2	4 00000309	SPLIT	4 00000b91
D7	4 000008d6	LCD	4 0000060f	NOTH	4 00000467	PROC4	4 00000341	STAT	1 000000a6
DAT	1 0000004b	LCD3	4 000004c0	NOTH1	4 00000475	PSN	3 00000020	STAT2	1 000000a7
DCON2	I 0 00000000	LCD4	4 00000848	NOTHN	4 00000394	PSNP	1 0000004a	STAT3	1 000000a8
DDC	4 00000803	LCD401	4 00000516	NOTHP	4 0000003c	PTY	1 0000005f	STAT4	1 000000a9
DECC	4 000001d1	LCD41	4 00000521	NOTND	4 00000a11	PTYCMP	1 00000060	STAT5	1 000000aa
DEL	4 00000691	LCDINI	4 00000321	NOTODAY	4 00000874	PTYD	4 0000044e	STAT6	1 000000ab
DEON	4 00000ad9	LED	1 0000009f	NOTP	4 000006b0	PTYL	4 00000253	STBYD	4 00000870
DHIGH	4 000000d2	LEV	1 00000067	NOTRD	4 00000a1f	PTYT	4 00000bf6	SYN	1 0000006a
DI	1 000000a4	LOCAL	4 0000037a	NOTSP	4 00000831	Q	1 00000003	TACK	4 00000290
DIFF	4 000005e0	LONG	4 00000b45	NOTST	4 00000a03	R	1 00000027	TAH	4 000002ab
DIG2	1 00000098	LOOPJ	4 000004f0	NOTV	4 000001b1	RDSD	4 000000c7	TALOW	4 000000a0
DIP1	4 000008fd	LPII	4 000003f8	NPI	4 0000056e	RDSOK	4 00000066	TAOH	4 00000499
TAPST	4 00000d87	TMQ	1 0000000c	TRYC	4 0000019f	TYPE3	4 00000752	WS	1 0000008c
TARET	4 00000df7	TNZ	4 000007ec	TRYCD	4 000001af	VALID	4 000001ee	W4	1 0000008e
TEXTA	4 00000311	TOOLS	4 00000451	TRYD	4 000001dc	VC	4 000001b9	W5	1 00000090
TEXTB	4 0000031a	TPL	4 00000263	TRYPIN	4 00000453	VFD	4 00000632	W6	1 00000092
TFCC	E 4 000000ab	TPL1	4 00000260	TRYRT	4 00000556	VFD3	4 00000653	W7	1 00000094
TGRP15	4 00000279	TPLO	4 000003f5	TT1	4 000003ab	VFDL	4 00000677	WAIT	E 4 00000bb9
TH32	1 0000006d	TPLOW	4 00000999	TT2	4 000003ae	VLD	4 000001f9	WLOOP	4 00000bc8
TH8	1 0000006e	TRY1	4 000000e8	TXLP	4 00000232	VTAB	4 00000e97	XFER	4 0000022f
TINTB	E 4 00000000	TRY2	4 000000ec	TYPI	4 000006b7	WI	1 00000088	XOK	4 00000b9e
TMP	1 0000001e	TRYA	4 00000183	TYP2	4 00000702	W2	1 0000008a	YR	1 00000039
TMPGRP	1 0000004f	TRYB	4 00000191	TYPE3	4 00000752				

Appendix 2


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84 00000042 >df00
85 00000044 8d08
86 00000046 >7e0000
87 00000049 >7c0000
88 0000004c 8d0c
89
90 0000004e >de00
91 00000050 8d03
92 00000052 >de00
93 00000054 39
94
95 00000055 c609
96 00000057 8609
97 00000059 a008
98 0000005b a708
99 0000005d 09
100 0000005e 5a
101 0000005f 26f6
102 00000061 39
103
104 00000062 82f1
105 00000064 c609
106 00000066 6c11
107 00000068 a611
108 0000006a 810a
109 0000006c 2508
110 0000006e 800a
111 00000070 a711
112 00000072 09
113 00000073 58
114 00000074 26f0
115 00000076 39
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123 00000077 >ce0000
124 00000078 >bd0000
125 0000007d >ce0000
126 00000080 >bd0000
127 00000083 ce012
128 00000086 >df00
129 00000088 ce0009
130 0000008b >6f1
131 0000008d >df00
132 0000008f >9700
133
134 00000091 ce0009
135 00000094 >6f1
136 00000096 >9700
137 00000098 2733
138 0000009a >9600
139 0000009c >9700
140 0000009e 4f
141 0000009f >740000
142 000000a2 2402
143 000000a4 >9500
144 000000a6 >7d0000
145 000000a9 2705
146 000000ab >780000
147 000000ac 20ef
148 000000b0 09
149 000000b1 >df00
150 000000b3 >de00
151 000000b5 >bf6
152 000000b7 >bd0000
153 000000b8 >756
154 000000bc >9600
155 000000b9 >bf5
156 000000c0 >755
157 000000c2 >9600
158 000000c4 >9700
159 000000c5 09
160 000000c7 >df00
161 000000c9 >de00
162 000000cb 2004
163 000000cd >a0001
164 000000d1 09
165 000000d3 26c1
166 000000d4 >601
167 000000d5 8b08
168 000000d7 >9701
169
170 000000d9 >de00
171 000000db 09
172 000000dc 26ad
173 000000de >ce0000
174 000000e1 39

*****  

* Subtraction, complementing and incre-  

* menting (X=REG-ND) of BCD numbers.  

*  

* (X) <- (NUM1) - (NUM2), X preserved.  

* (X and NUM2 should not be equal)  

*****  

SUB STX W6 ANSWER POINTER  

BSR COM2 9S COMP. SECOND NUMBER  

CLR CARRY SET CARRY TO ONE  

INC CARRY BEFORE ADDING  

BSR AD ADD FIRST NUMBER  

*****  

COM2 LDK NUM2 9S COMPLIMENT  

BSR COMP SECOND NUMBER  

LDK W6 RESTORE ANSWER POINTER  

RTS  

*****  

COMP LDAB #ND 9S COMPLIMENT  

LOOP3 LDAA #S09  

SUBA ND-1,X  

STAA ND-1,X  

CMPA #SOA  

BLO RETURN  

SUBA #10  

STRA 2*ND-1,X  

DEX  

DBCB  

BNE ADD2  

RETURNS RTS  

*****  

* Mult., R <- P * Q, over. in TMP, X = MR. *
*****  

MULT LDK #R CLEAR RESULT  

JSR CLRAS  

LDK #TMP  

JSR CLRAS  

LDK #2*ND  

LDAA P-1,X INIT. R POINTER  

LDK #ND  

LDK W6  

STX W6  

STAA CARRY  

SAVE P POINTER  

STAA CARRY  

SAVE P  

BHQ DCP  

LDK #ND  

INIT. Q POINTER  

XTT LDAA Q-1,X  

STAA W4  

SAVE Q  

BHQ TZ0 IF ZERO GOTO NEXT Q  

LDAA CARRY RECALL P  

STDA W3  

SAVE P  

CLRA  

LSR CARRY RIGHT SHIFT INTO C  

BCC SHF C = ZERO ?  

ADD A NO, A=A-Q  

SHF TST CARRY ZERO ?  

BHQ C4 YES, FINISHED WITH THIS Q  

ASL W4 NO, LEFT SHIFT Q  

BRA PLY  

C4 DEX Q = Q + 1  

STX W2 SAVE Q POINTER  

LDK W6 R POINTER  

ADD A R-ND-1,X ADD R TO A WAS -(ND+1)  

JSR ADJ ADJUST  

LDAA R-ND-1,X R = R + A WAS -(ND+1)  

LDAA CARRY  

ADD A R-ND-2,X ADD R-(ND+2) TO CARRY WAS -(ND+2)  

STDA R-ND-2,X R-(ND+2) = R-(ND+2) + CARRY WAS -(ND+2)  

LDAA W3 RECALL P  

STAA CARRY SAVE IN CARRY  

DEX  

STX W6  

LDK W2  

BRA C3  

TZO DEC W6+1 DEC. R POINTER  

DEC. Q POINTER  

C3 BNE XTT  

LDAA W6+1 R POINTER  

ADD A #ND-1  

STAA W6+1 R = R + ND-1  

DEC W6+1  

LDK W1  

DEX P = P + 1  

BNE STR IF NOT ZERO GOTO NEXT P  

RTS

```

```

176
177
178
179
180
181
182
183
184
185 000000e8 >ce0000
186 000000e5 >bd0000
187
188 000000eb >df00
189 000000ed >ce0000
190 000000f0 >bd0000
191 000000f3 >ce0000
192 000000f8 >ce0000
193 000000f6 >df00
194 000000f8 >ce0000
195 000000fb >bd0000
196
197 000000fe c609
198 00000100 >ce0000
199 00000103 a600
200 00000105 2607
201 00000107 >bd0000
202 0000010a 26f4
203 0000010c 2035
204 0000010e >7f0000
205 00000111 >d701
206
207 00000113 >ce0000
208 00000116 >df00
209 00000118 >bd0000
210 0000011b >9600
211 0000011d 2706
212 0000011f >de00
213 00000123 >cfcf
214 00000123 20ee
215 00000125 >ce0000
216 00000128 >bd0000
217 0000012b >ce0000
218 0000012c c608
219 00000130 a607
220 00000132 a708
221 00000134 09
222 00000135 5a
223 00000136 26f8
224 00000138 6f08
225 0000013a >7c0001
226 0000013d >9601
227 0000013f 810a
228 00000141 26d0
229 00000143 >ce0000
230 00000146 39
231
232
233
234
235
236
237
238
239
240
241 00000147 >ce0000
242 00000148 >bd0000
243 0000014d >ce0000
244 00000150 >bd0000
245
246 00000153 >efff7
247 00000156 >bd0000
248 00000159 >efff7
249 0000015c >bd0000
250 0000015f >ce0000
251 00000162 >bd0000
252 00000165 8607
253 00000167 >7f08
254 00000169 >bd0000
255 0000016c >9608
256 0000016e >7f00
257
258 00000170 >ce0000
259 00000173 >bd0000
260 00000176 >ce0000
261 00000179 >df00
262 0000017b >ce0000
263 0000017e >bd0000
264 00000181 >ce0000
265 00000184 >bd0000
266 00000187 >bd0000
267 0000018a >df00
268 0000018c >ce0000
269 0000018f >bd0000

***** Division of BCD numbers. *****
* R <- P / Q, remainder in TMP.
* on exit X = #R, TMQ used.
*****
```

DIV	LDK	#R	CLEAR	
	JSR	CLRAS	RESULT	
*	CLR	W2	SIGN	
	LDK	#P	TRANSFER	
	STX	NUM1	P TO	
	LDK	#TMP	WORKING	
	JSR	TRA	P (TMP)	
	LDK	#Q	TRANSFER	
	STX	NUM1	Q TO	
	LDK	#TMQ	WORKING	
	JSR	TRA	Q (TMQ)	
	POSS	LDB8	ND	NUMBER DIGITS
LOOP6	LDK	#TMQ	FIND LEAST SIGNIFICANT	
	LDBA	0,X	NON-ZERO DIGIT	
	BNE	NOSH	ZERO ?	
	JSR	SHIFT	YES, SHIFT Q	
	BNE	LOOP6	UP ONE PLACE	
ZQ	BRA	RTRN	Q WAS ZERO	
	CLR	W1	SAVE	
	STAB	W1+1	NO. DIGITS - NO. SHIFTS	
	SUBB	LDK	#TMP	SUBTRACT Q
	STX	NUM1	FROM	
	JSR	SUB	P	
	LDAA	CARRY	TOO FAR ?	
	BED	NEXTD	IF YES, GO TO NEXT DIGIT	
	INC	W1	INCREMENT RELEVANT	
	INC	R-1,X	DIGIT IN RESULT	
	BRA	SUBB	ONCE AGAIN	
NEXTD	LDK	#TMP	TOO FAR, ADD	
	JSR	ADD	Q BACK ON	
	ROR	LDK	#TMQ	SET UP TO
	LDAB	ND-1	SHIFT BACK WORKING Q	
RRJ	LDAA	ND-2,X	MOVE ALL	
	STAA	ND-1,X	DIGITS	
	DEX		DOWN	
	DEC8		ONE PLACE	
	BNE	RRJ	LONE ?	
	CLR	ND-1,X	CLEAR MS DIGIT	
	INC	W1+1	INCREMENT POINTER	
	LDAA	W1+1		
	CMPA	#ND-1	FINISHED ?	
	BNE	SUBS	NO. NEXT DIGIT	
	RTRN	LDK	#R	
		RTS		

	*	MJD - day of week and year.	*	
	*	*	*	
	*	DOW = (MJD+2)MOD7 (= WD-1) (DOW)	*	
	*	Y' = INT((MJD-15078.2)/3652500) (YR)	*	
	*	*	*	

MJDC	LDK	#MJD	P <- MJD	
	JSR	XFERP		
	LDK	#MJD		
	JSR	T10K	MJD <- MJD TIMES 10,000	
DOFFW	LDK	#P-ND	P <- MJD + 1	
	JSR	ADD1		
	LDK	#P-ND	P <- MJD + 2	
	JSR	ADD1		
	LDK	#Q		
	JSR	CLRAS		
	LDBA	#7		
	STAA	Q+ND-1	Q <- 7	
	JSR	DIV	R <- (MJD+2)/7	
	LDAA	TMP-ND-1	REMAINDER (WD-1) IN TMP	
	STAA	DOW		
YEAR	LDK	#CY		
	JSR	XFERQ	Q <- CY (150782000)	
	LDK	#MJD	NUM2 <- (Q)	
	STX	NUM1		
	LDK	#P		
	JSR	SUB	P <- 10K(MJD-15078.2)	
	LDK	#DY		
	JSR	XFERQ	Q <- 3652500	
	JSR	DIV	R <- Y' ((MJD-15078.2)/365.25);	
	LDK	NUM1		
	JSR	#YR		
		YR <- Y'		

```

271
272
273
274
275
276
277
278
279
280 00000192 >bd0000
281 00000195 >ce0000
282 00000198 >bd0000
283 0000019b >ce0000
284 0000019e >df000
285 000001a0 >ce0000
286 000001a3 >bd0000
287 000001a6 >df000
288 000001a8 >ce0000
289 000001ab >df000
290 000001ad >ce0000
291 000001bc >bd0000
292 000001b3 >ce0000
293 000001b6 >bd0000
294 000001b9 >bd0000
295 000001bc >bd0000
296 000001bc >9607
297 000001c1 >9700
298 000001c3 >9608
299 000001c5 >9701
300
301 000001c7 >bd0000
302 000001ca >df000
303 000001cc >ce0000
304 000001cf >bd0000
305 000001d2 >bd0000
306 000001d5 >df000
307 000001d7 >ce0000
308 000001da >df000
309 000001dc >bd0000
310 000001df >ce0000
311 000001e2 >bd0000
312 000001e5 >7f0005
313 000001e8 >ce0000
314 000001eb >df000
315 000001ed >ce0000
316 000001f0 >bd0000
317 000001f3 >df000
318 000001f5 >ce0000
319 000001f8 >df000
320 000001fa >ce0000
321 000001fd >bd0000
322 00000200 a604
323 00000202 >9701
324 00000204 a603
325 00000206 >9700
326
327
328
329
330
331
332
333
334
335
336
337 00000208 >9600
338 0000020a 2720
339 0000020c >9601
340 0000020e 2715
341 00000210 8104
342 00000212 2518
343 00000214 >ceffff
344 00000217 >bd0000
345 00000219 >f00000
346 0000021d >7a0001
347 00000220 >7a0001
348 00000223 2007
349 00000225 8d58
350 00000227 >9701
351 00000229 >f00000
352 0000022c >7a0001
353 0000022f 39
354
355 00000230 >ce0000
356 00000233 8d58
357 00000235 >ce0000
358 00000238 8d5b
359 0000023a >bd0000
360 0000023d >f00005
361 00000240 >f00006
362 00000243 >f00007
363 00000246 >f00008
364 00000249 39
365
366 0000024a c605
367 0000024c a604
368 0000024e a700
369 00000250 08
370 00000251 5a
371 00000252 26f8
372 00000254 6200
373 00000256 6f01
374 00000258 6f02
375 0000025a 6f03
376 0000025c 39

***** MJD - month and day. *****
***** M' = INT((MJD-14956.1-INT(Y'*365.25))/306001) (P)
***** D = MJD-14956-INT(Y'*365.25)-INT(M'*30.6001) (Q(x10K)) *****
***** MONTH JSR INT R <- 10K(INT(Y'*365.25))
***** LDX #DD1
***** JSR XFERP P <- 149561000
***** LDX #MJD NUM2 <- (P)
***** STX NUM1
***** LDX #Q
***** JSR SUB Q <- 10K(MJD-14956.1)
***** STX NUM1
***** LDX #R
***** STX NUM2
***** LDX #P
***** JSR SUB P <- 10K(MJD-14956.1-INT(Y'*365.25))
***** LDX #M
***** JSR XFERQ Q <- 306001
***** JSR DIV R <- M' ( MJD-14956.1-INT(Y'*365.25) )
***** JSR XFERP P <- M' INT ( ----- )
***** LDAA P+ND-2 SAVE M' ( 306001 )
***** STAA MNTH
***** LDAA P+ND-1
***** STAA MNTH-1
***** DAY JSR MULTI R <- 10K(INT(M'*30.6001))
***** STX NUM1
***** LDX #TMQ
***** JSR TRA TMQ <- 10K(INT(M'*30.6001))
***** JSR INT R <- 10K(INT(Y'*365.25))
***** STX NUM2
***** LDX #TMQ
***** JSR ADD TMQ <- 10K(INT(Y'*365.25)+INT(M'*30.6001))
***** STX NUM1
***** LDX #DD1
***** JSR XFERP P <- 149561000
***** CLR P+ND-4 P <- 149560000
***** LDX #TMQ NUM2 <- (P)
***** STX NUM1
***** LDX #R
***** JSR ADD R <- 10K(14956+INT(Y'*365.25)+INT(M'*30.6001))
***** STX NUM2
***** LDX #MJD
***** STX NUM1
***** LDX #Q
***** JSR SUB Q <- MJD-R (10K*DOM)
***** LDAA ND-5,X
***** LDAA DCM-1 MJD-14956-INT(Y'*365.25)-INT(M'*30.6001)
***** LDAA ND-6,X
***** STAA DCM
***** STAA DCM
***** ***** MJD - final correction of year & month and subs. *****
***** If M' = 14 or 15, then K = 1, else K = 0
***** Y = Y' + K
***** M = M' - 1 - K*12
***** ADJU LDAA MNTH, MSD
***** BCD KE02 0 ?
***** LDAA MNTH-1 NO, M' = 10 THRU 15
***** BCD KE01 0 ?
***** CNA #4 NO, M' = 11 THRU 15
***** BCD KE02 LESS THAN 14
***** CLR MNTH NO, M' = 14 OR 15, K=1
***** MNTH, MSD (-10)
***** DEC MNTH-1 DEC, MNTH
***** DEC MNTH-1 AND AGAIN (-2)
***** BRA KE02 -12
***** KE01 LDAA #10 M' = 10
***** STAA MNTH-1 PUT 10 IN LSD
***** CLR MNTH CLEAR MSD
***** KE02 DEC MNTH-1 9<-10, 1,2<-14,15, 3-8<-4-9, 10-12<-11-13
***** RTS
***** INT LDX #YR P <- Y'
***** BSR XFERP
***** LDX #DY
***** BSR XFERQ Q <- 10K*365.25
***** MULT JSR MULT R <- 10K*Y'*365.25
***** CLR R+ND-4
***** CLR R+ND-3
***** CLR R+ND-2
***** CLR R+ND-1 R <- 10K(INT(Y'*365.25))
***** RTS
***** T10K LDAB #ND-4 TIMES 10,000
***** SLP LDAA 4,X
***** SDA 0,X
***** IMR DECB
***** ENB SLP
***** CLR 0,X
***** CLR 1,X
***** CLR 2,X
***** CLR 3,X
***** RTS
***** KTS

```

```

378
379
380
381
382
383
384 0000025d >e0000
385 00000260 >df00
386 00000262 c609
387 00000264 6f00
388 00000266 08
389 00000267 5a
390 00000268 26fa
391 0000026a >de00
392 0000026c 39
393
394 0000026d >f700
395 0000026f 8d11
396 00000271 >e000
397 00000273 a601
398 00000275 a700
399 00000277 08
400 00000278 >c000
401 0000027a 26f7
402 0000027c >f600
403 0000027e a700
404 00000280 5a
405 00000281 39
406
407 0000028d >df00
408 00000284 8608
409 00000286 08
410 00000287 4a
411 00000288 26fc
412 0000028a >df00
413 0000028c 39
414
415 0000028d >df00
416 0000028f >e0000
417 00000292 >e0000
418
419 00000295 >df00
420 00000297 >e0000
421 0000029a >e0000
422
423 0000029d 4d6f6e5475655765
424 000002b2 696e76
425 000002b5 4a616e4665624d61
426
427 000002a9 0105000708020000
428 000002e2 000030605020500
429 000002eb 0104090506010000
430 000002f4 000000300060000
431
432
END

```

Section synopsis

1 000000ae (174) .RAM1
2 00000100 (256) .RAM2
3 0000006d (109) .RAM3
4 000002fd (765) .ROM2

Symbol table

.RAM1	1 00000000	COUNT	1 0000009a	KEY	1 00000096	PSNP	1 0000004a	SSTAT4	1 000000a9
.RAM2	2 00000000	CR	4 00000264	KOUNT	1 00000097	FTY	1 0000005f	SSTAT5	1 000000a8
.RAM3	3 00000000	CY	4 000002d9	LED	1 0000009f	FTYCMP	1 00000060	SSTAT6	1 000000ab
.ROM2	4 00000000	DAT	1 0000004b	LEV	1 00000067	Q	1 00000003	STR	4 000000b
AD	4 0000000a	DAT	4 000001c7	LOOP	4 00000016	R	1 00000027	SUB	E 4 00000042
ADD	E 4 00000005	DI	1 00000084	LOOP3	4 00000057	FDSTO	1 00000049	SUBB	4 00000113
ADD1	E 4 00000064	DIG2	1 00000098	LOOP6	4 00000100	REARET	1 00000048	SYN	1 0000006a
ADD2	4 00000066	DISP	3 00000000	MIN	1 00000070	RETURN	4 00000076	T10K	4 000024a
ADJ	4 0000003d	DISP1	1 00000074	MJD	1 00000030	ROR	4 0000012b	TH32	1 0000063
ADJU	4 00000208	DISP2	1 00000075	MJD	E 4 00000147	RP	1 0000007c	TH8	1 000006e
ACS	4 00000273	DISPP	3 00000010	MNAME	E 4 000002b5	RQ	1 00000076	TMPL	1 0000001e
AJ	4 00000038	DIST	1 00000047	MNTH	1 00000042	RR	1 00000082	TMPPGP	1 0000004f
AMIN	1 00000072	DIV	E 4 00000062	MONTM	4 00000192	RRJ	4 00000130	TRR	1 000000c
ACUR	1 00000073	DM	4 00000214	MULT	E 4 00000077	RT	3 00000028	TRA	E 4 0000000c
AXL	4 00000286	DNAME	E 4 0000029d	MULTI	4 0000023a	RIDIS	1 00000043	TZG	4 00000cd
ECTO	1 000000ac	ED1	4 000002e8	NEXTD	4 00000125	RTRN	4 00000143	W1	1 0000086
BIT	1 00000068	EDFW	4 00000153	NOSH	4 0000010e	SCHAN	1 00000045	W2	1 000008a
BMUD	1 00000000	EDM	1 00000044	NUM1	1 0000009b	SCNT	1 0000004d	W3	1 000000c
C2	4 000000ba	EDW	1 00000046	NUM2	1 0000009d	SEC	1 0000006f	W4	1 000000fe
C3	4 0000001d	DR1	4 00000282	CUR	1 00000071	SHE	4 00000046	W5	1 00000090
C4	4 000000b0	DY	4 000002e2	P	1 00000015	SHIFT	4 0000026d	W6	1 00000092
CARRY	1 00000099	EM	2 00000000	PI	1 00000061	SLEPT	1 00000048	W7	1 00000094
CLO	E 4 0000025d	GROUP	1 00000057	PIN	1 00000065	SLP	4 0000024c	XFERP	4 00002hd
CLRAS	E 4 00000260	INT	4 00000230	PIGN	1 00000063	SMEH	1 000000a0	XFERQ	4 00000295
CM10	4 00000062	JMP1	1 00000069	PLY	4 0000009f	STAT	1 00000046	XIT	4 00000094
CM2	4 0000004e	KE01	4 00000225	POSS	4 000000fe	STAT2	1 00000047	YEAR	4 00000170
COMP	4 00000055	KE02	4 0000022c	PSN	3 00000020	STAT3	1 00000048	YR	1 00000039
CONF	1 0000006e	KE1	4 00000214	PSNF	1 0000004a				

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