UNION SWITCH & SIGNAL
A member of the ANSALDO Group
5800 Corporate Drive, Pittsburgh, PA 15237

SERVICE MANUAL 7051

Software Manual

DIGITAIR®
END-OF-TRAIN MONITOR SYSTEM

Models 6656, 6656A
Communications Display Unit

January, 1994
A-1/94-3023

ANSALDO
Trasporti

TABLE OF CONTENTS

1.0 INTRODUCTION

The purpose of this manual is to provide a software overview. The reader should be familiar with the hardware descriptions provided in Service Manuals 7050 and 7050A.

The CDU is comprised of three microprocessor based assemblies as follows:

1) The CLU Logic Board

2) The CLU Modem-I/O Board

3) The CDU Front Panel Assembly.

Items 1 and 2 above, operate in conjunction with each other and should, for all practical purposes, be considered one board (ie., the CLU Logic Board Set).

This manual provides a top level software description for the CLU Logic Board Set and the CDU Front Panel Assembly.

1.1 CLU LOGIC BOARD SET SOFTWARE DESCRIPTION

1.1.1 Software Structure

The CLU Logic Board Set (or simply CLU for subsequent discussions) software is required to perform four primary tasks when it is in normal Operating mode:

a) Listen to the Rear Unit, process received messages and display the information.

b) Transmit emergency and communication test messages to the Rear Unit.

c) Service the odometer.

d) Service the datalogger.

In addition, the software has a Test mode which allows for CLU testing and calibration as well as the collection of comprehensive system communications statistics.

The software comprises a foreground program (the Main Program), and a background program (the Timer Interrupt Service Program). The former runs in a continuous loop while the latter is executed every 2.0 ms. Flow charts of these programs are shown in Figures 1.1 and 1.2.

Software module header listings are provided in Section 1.3, CLU Logic Board Set Module Header Listings.

1.1.2 Operating Mode

a) Listen, Process and Display:

The CLU receiver and demodulator are continuously enabled except during a transmission. When the CLU receives a byte from the SBU the BCH routine processes it. After the CLU receives the eighth byte of a message, it performs error detection/correction. It corrects one-bit and two-adjacent-bit errors. The CLU receiver can detect more errors than this, but will not correct them.

If the message is correct or correctable, it is processed and a report of the latest information is sent to the CDU Front Panel Assembly for display.

b) Transmit:

Every 10 minutes, or when the EMERGENCY or COMM TEST button is pressed, the CLU sends a transmission automatically. If the CLU does not receive a confirming reply from the SBU within a specified period of time, an automatic retransmission may occur.

c) Odometer:

The odometer counts incoming axle alternator pulses and converts them to feet for display. The ODOM button controls the odometer.

d) Datalogger:

The CLU transmits information shown on the front panel displays to the datalogger serial port. The baud rate, number of data bits, and state of the parity bit are user-selectable on switch bank S1.

1.1.3 Test Mode

Pressing the internal TEST button (S3) mounted on the Logic Board activates Test Mode. Selection of a specific test can be done by setting the Test Mode number on internal switch bank S2 and again pressing the TEST button or by using a Model 6677 Auxiliary Test Unit plugged into the CDU's Datalogger/ATU connector located at the rear of the unit.

1.1.4 CLU/Modem Interface

The Modem's function is completely under CLU control. The Modem is normally left to run in "demodulation mode" where it hunts for bit sync, demodulates data bytes, then returns automatically to hunt for bit sync. When the CLU wants to transmit, it lowers the DEMOD/MOD line, then sends a reset pulse to the modem. This sets the Modem in "modulation mode" where it runs until the CLU resets it back to "demodulation mode". The TX DATA AVAILABLE and TX DATA ACK lines control data flow during transmission (modulation mode), and the RX DATA AVAILABLE and RX INT lines control data flow during reception (demodulation mode).

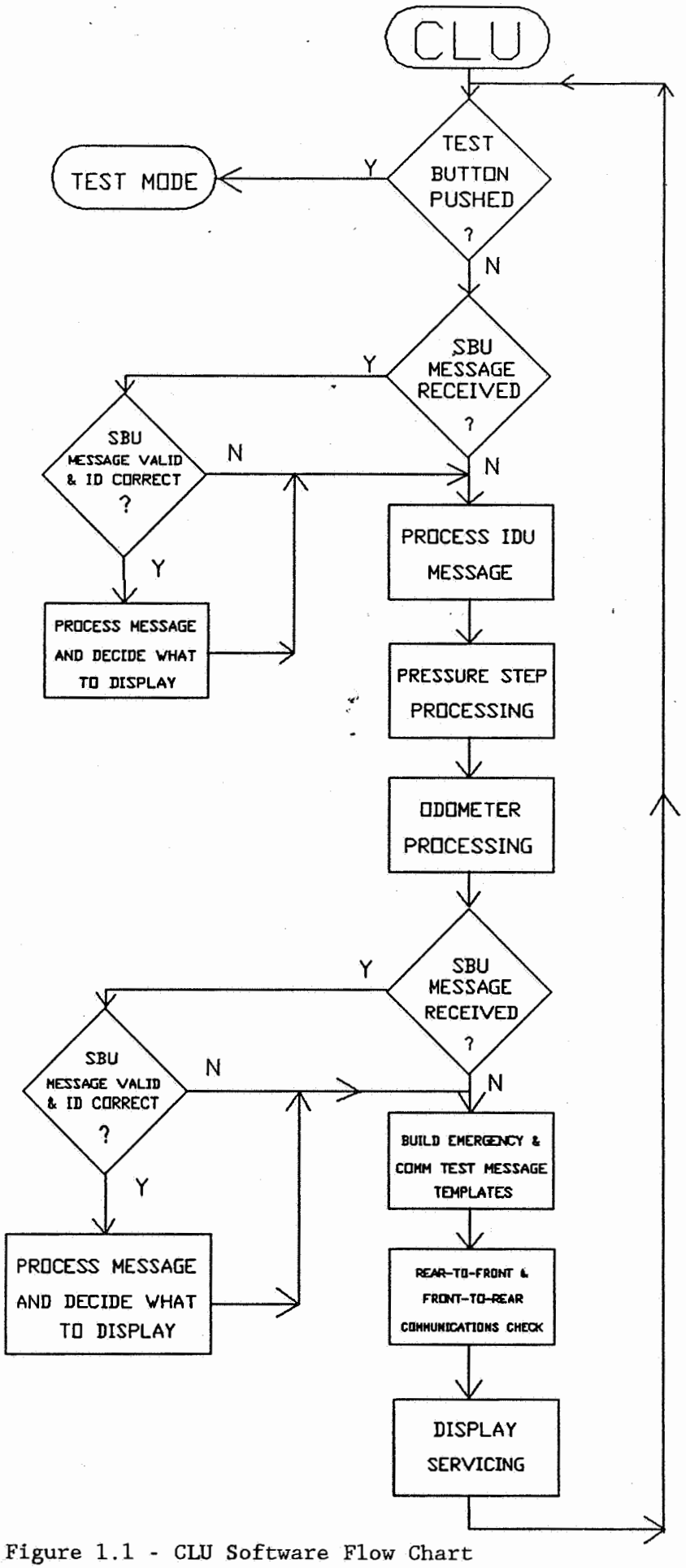

Figure 1.1 - CLU Software Flow Chart

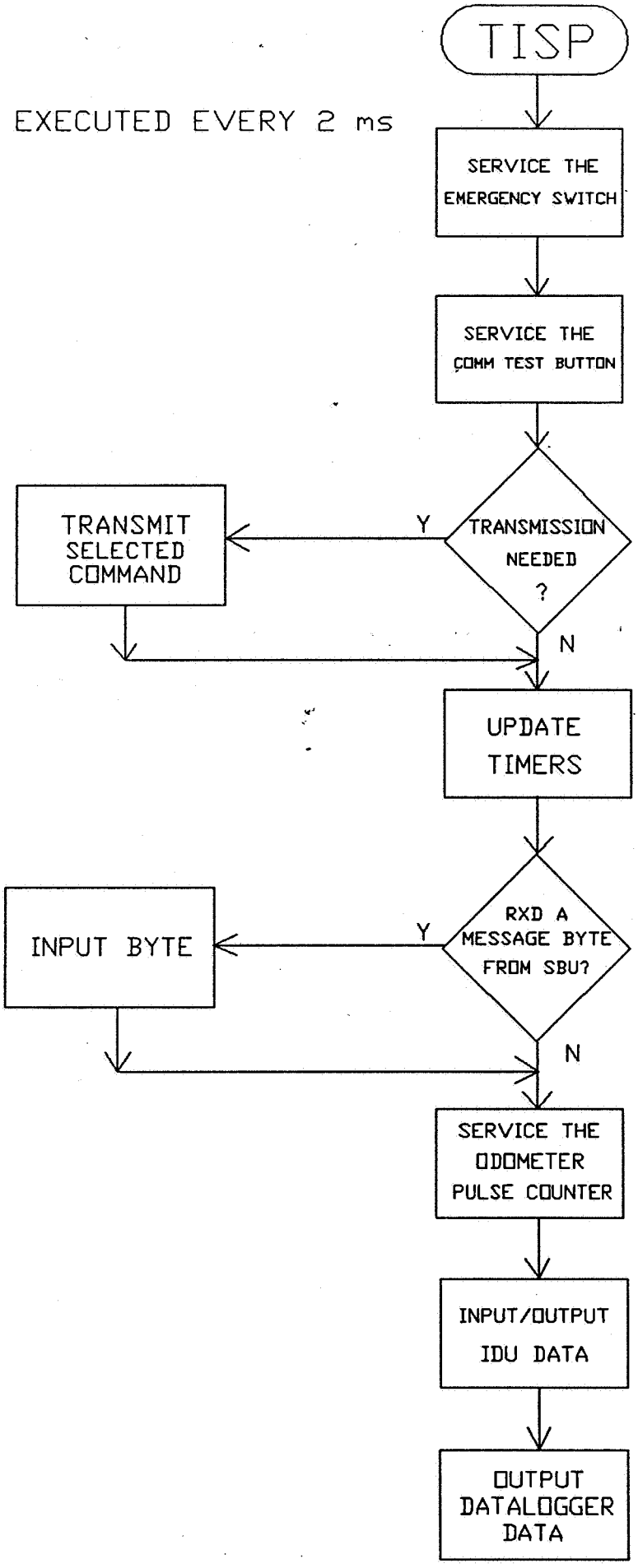

Figure 1.2 - CLU Timer Interrupt Service Program

1.2 CDU FRONT PANEL ASSEMBLY SOFTWARE DESCRIPTION

1.2.1 Software Structure

The software is responsible for providing the following major functions:

1) Perform the "Human Interface" logic required to execute functions selected by the user

2) Interface to the front panel switches

3) Interface to the LED displays

4) Drive the audible alarm

5) Communicate with the CLU Board Set in a serial fashion.

Internal tests of this assembly are built into the CLU's Test Mode software.

The main software modules are listed below and a description for each as well as the sub-modules is provided in the Section 1.5, CDU Front Panel Assembly Module Header listings.

1) CDU_MAIN
2) CDU_INIT
3) CDU_DB
4) COMMON
5) POWER_UP
6) PROCCOMM
7) PROCDIM
8) PROCODOM
9) PROCSET
10) PROCVIEW
11) PROCVOL
12) PROC_RX

1.3 CLU BOARD SET MODULE HEADER LISTINGS

This section provides the top level module headers for the CLU Logic Board Set software.

```
;*****************************************************************************
;
;DIGITAIR COMMUNICATIONS LOGIC UNIT (CLU) SOFTWARE - VERSION 6650 J14
;
;MODULE :   MAIN.ASM
;
;FUNCTION :  THIS MODULE PROCESSES THE MESSAGES RECEIVED IN TISP AND RESPONDS
;            ACCORDINGLY :
;         1. BCH PROCESS MESSAGE FROM SBU, IF MESSAGE VALID, DECIDE ON
;            HOW TO RESPOND
;         2. PROCESS MESSAGE FROM IDU AND ACT ACCORDINGLY
;         3. SERVICE THE ODOMETER AS REQUESTED
;         4. CONSTANTLY UPDATE THE EMERGENCY AND UPDATE REQUEST MASKS
;         5. LOAD DISPLAY MESSAGES IN BUFFER TO SEND TO IDU
;         4. MONITOR REAR TO FRONT COMMUNICATIONS AND REQUEST AN UPDATE
;            REGULARLY
;
;AUTHORS:   MONICA J. BURGESS & MING C. WOO
;
;REVISED BY: MARTIN J. REMPEL
;
;LAST REVISED : 01 JUNE 1989
;
;*****************************************************************************
;
;The complete CLU program is comprised of the following files:
;
;     MAIN
;     TISP
;     MSGPRO
;     COMMNS
;     DISPLAY
;     ODOMETER
;     RADIO_CO
;     COMMON
;     TEST
;
;
;Important hardware facts:
;
;XTAL FREQUENCY:  11.0592 MHZ (CYCLE TIME = 1.09 usec)
;INTERRUPT FREQUENCY:   500 HZ
;
;
;*****************************************************************************
;
;$Header:   D:/clu/clumain.asv   2.0   04 Apr 1990 16:00:30   GKPRINGLE  $
;
;
;$Log:   D:/clu/clumain.asv  $
;
;     Rev 2.0   04 Apr 1990 16:00:30   GKPRINGLE
;               All COMM TEST windows widened.
;
;     Rev 1.5   10 Oct 1989 13:46:14   MJREMPEL
```

```
;
;     Rev 1.4   10 Oct 1989 13:31:08   MJREMPEL
;
;     Rev 1.3   10 Oct 1989 13:16:42   MJREMPEL
;
;     Rev 1.2   10 Oct 1989 13:00:10   MJREMPEL
;
;     Rev 1.1   10 Oct 1989 12:03:52   MJREMPEL
;
;     Rev 1.0   10 Oct 1989 11:33:58   MJREMPEL
;  Initial revision.
;
;**************************************************************************
```

```
;*******************************************************************************
;
;DIGITAIR COMMUNICATIONS LOGIC UNIT (CLU) SOFTWARE - VERSION 6650 J12
;
;MODULE :  TISP.ASM (TIMER 0 INTERRUPT SERVICE PROCEDURE)
;
;FUNCTION: SERVICE EMERGENCY AND UPDATE REQUESTS
;          INPUT AND OUTPUT DATA TO MODEM
;          UPDATE SYSTEM TIMERS AND DEBOUNCE PUSH BUTTONS
;          UPDATE AXLE COUNTER
;          READ FROM AND WRITE TO UART
;
;AUTHORS:  MONICA J. BURGESS & MING C. WOO
;
;LAST REVISED : 13 JULY 1988
;
;*******************************************************************************
;*******************************************************************************
;
;$Header:   D:/clu/tisp.asv   2.0   04 Apr 1990 16:04:12   GKPRINGLE  $
;
;
;$Log:   D:/clu/tisp.asv  $
;
;     Rev 2.0   04 Apr 1990 16:04:12   GKPRINGLE
;  All COMM TEST windows widened.
;
;     Rev 1.4   11 Oct 1989 09:21:54   MJREMPEL
;
;     Rev 1.3   10 Oct 1989 13:14:42   MJREMPEL
;
;     Rev 1.2   10 Oct 1989 12:59:40   MJREMPEL
;
;     Rev 1.1   10 Oct 1989 12:03:24   MJREMPEL
;
;     Rev 1.0   10 Oct 1989 11:48:44   MJREMPEL
;  Initial revision.
;
;*******************************************************************************
```

```
;*****************************************************************************
;
;DIGITAIR COMMUNICATIONS LOGIC UNIT (CLU) SOFTWARE - VERSION 6650 J12
;
;MODULE :   MSGPRO.ASM (MESSAGE PROCESS)
;
;FUNCTION : PROCESS RECEIVED MESSAGE FROM SBU
;
;AUTHORS: MONICA J. BURGESS & MING C. WOO
;
;LAST REVISED : 13 JULY 1988
;
;*****************************************************************************
;*****************************************************************************
;
;$Header:   D:/clu/msgpro.asv   2.0   04 Apr 1990 16:03:22   GKPRINGLE  $
;
;
;$Log:   D:/clu/msgpro.asv  $
;
;     Rev 2.0   04 Apr 1990 16:03:22   GKPRINGLE
;  All COMM TEST windows widened.
;
;     Rev 1.4   10 Oct 1989 13:29:06   MJREMPEL
;
;     Rev 1.3   10 Oct 1989 13:17:08   MJREMPEL
;
;     Rev 1.2   10 Oct 1989 12:58:42   MJREMPEL
;
;     Rev 1.1   10 Oct 1989 12:02:24   MJREMPEL
;
;     Rev 1.0   10 Oct 1989 11:41:46   MJREMPEL
;  Initial revision.
;
;*****************************************************************************
```

```
;*****************************************************************************
;
;DIGITAIR COMMUNICATIONS LOGIC UNIT (CLU) SOFTWARE - VERSION 6650 J7
;
;MODULE :    COMMNS.ASM (COMMUNICATIONS)
;
;FUNCTION : MONITOR THE REAR TO FRONT COMMUNICATIONS AND REQUEST UPDATES
;           FROM THE REAR UNIT REGULARLY. AN UPDATE REQUEST WILL BE MADE
;           EVERY 10 MINUTES, OR IF NO VALID MESSAGE IS RECEIVED FROM THE
;           THE REAR UNIT FOR 196 SECONDS.
;           READ IN AND PROCESS THE MESSAGE FROM THE IDU. IF ERROR IS DETECTED
;           IN THE MESSAGE, A REQUEST FOR A RETRY WILL BE SENT.
;           UPDATE PRESSURE BLOCKS IF STEP PRESSURE TIMERS EXPIRE.
;
;AUTHORS:    MONICA J. BURGESS & MING C. WOO
;
;LAST REVISED : 29 OCTOBER 1987
;
;*****************************************************************************
;*****************************************************************************
;
;$Header:    D:/clu/commns.asv   2.1   27 Apr 1990 17:18:08   GKPRINGLE  $
;
;
;$Log:   D:/clu/commns.asv  $
;
;     Rev 2.1   27 Apr 1990 17:18:08   GKPRINGLE
;  FIXED EMERG TX AFTER CHANGING ID
;
;     Rev 2.0   04 Apr 1990 16:02:04   GKPRINGLE
;  All COMM TEST windows widened.
;
;     Rev 1.3   10 Oct 1989 13:15:52   MJREMPEL
;
;     Rev 1.2   10 Oct 1989 12:57:52   MJREMPEL
;
;     Rev 1.1   10 Oct 1989 12:01:24   MJREMPEL
;
;     Rev 1.0   10 Oct 1989 11:39:04   MJREMPEL
;  Initial revision.
;
;*****************************************************************************
```

```
;*******************************************************************************
;
;DIGITAIR COMMUNICATIONS LOGIC UNIT (CLU) SOFTWARE - VERSION 6650 J14
;
;MODULE :   DISPLAY.ASM
;
;FUNCTION : PUTS THE DISPLAY MESSAGE IN WRBUF TO OUTPUT TO IDU
;
;AUTHORS:   MONICA J. BURGESS & MING C. WOO
;
;REVISED BY: MARTIN J. REMPEL
;
;LAST REVISED : 01 JUNE 1989
;
;*******************************************************************************
;*******************************************************************************
;
;$Header:   D:/clu/cludisp.asv   2.2   27 Apr 1990 17:17:32   GKPRINGLE  $
;
;
;$Log:   D:/clu/cludisp.asv  $
;
;     Rev 2.2   27 Apr 1990 17:17:32   GKPRINGLE
;  FIXED EMERG TX AFTER CHANGING ID
;
;     Rev 2.1   20 Apr 1990 16:17:12   GKPRINGLE
;  Fixed test mode bug (bad common file).
;
;     Rev 2.0   04 Apr 1990 15:59:48   GKPRINGLE
;  All COMM TEST windows widened.
;
;     Rev 1.5   10 Oct 1989 13:46:42   MJREMPEL
;
;     Rev 1.4   10 Oct 1989 13:31:32   MJREMPEL
;
;     Rev 1.3   10 Oct 1989 13:17:38   MJREMPEL
;
;     Rev 1.2   10 Oct 1989 13:00:40   MJREMPEL
;
;     Rev 1.1   10 Oct 1989 12:04:20   MJREMPEL
;
;     Rev 1.0   10 Oct 1989 11:32:06   MJREMPEL
;  Initial revision.
;
;*******************************************************************************
```

```
;*****************************************************************************
;
;DIGITAIR COMMUNICATIONS LOGIC UNIT (CLU) SOFTWARE - VERSION 6650 J5
;
;MODULE :    ODOMETER.ASM
;
;FUNCTION : TURNS ODOMETER ON AND OFF ACCORDING TO BUTTON INFORMATION,
;           AND UPDATES AND CALIBRATES THE ODOMETER AS REQUIRED.
;
;AUTHORS:    MONICA J. BURGESS & MING C. WOO
;
;LAST REVISED : 16 APRIL 1987
;
;*****************************************************************************
;*****************************************************************************
;
;$Header:    D:/clu/odometer.asv   1.1   10 Oct 1989 12:02:48   MJREMPEL  $
;
;
;$Log:    D:/clu/odometer.asv  $
;
;     Rev 1.1   10 Oct 1989 12:02:48   MJREMPEL
;
;     Rev 1.0   10 Oct 1989 11:43:36   MJREMPEL
;  Initial revision.
;
;*****************************************************************************
```

```
;*****************************************************************************
;
;DIGITAIR COMMUNICATIONS LOGIC UNIT (CLU) SOFTWARE - VERSION 6650 J7
;
;MODULE :   RADIO_CO.ASM
;
;FUNCTION : MEASURE THE TEMPERATURE AND CORRECT THE RECEIVER CRYSTAL FREQUENCY
;           ACCORDINGLY
;
;AUTHOR:   MONICA J. BURGESS
;
;LAST REVISED : OCTOBER 28, 1987
;
;*****************************************************************************
;*****************************************************************************
;
;$Header:   D:/clu/radio_co.asv   2.0   04 Apr 1990 16:04:52   GKPRINGLE  $
;
;
;$Log:   D:/clu/radio_co.asv  $
;
;     Rev 2.0   04 Apr 1990 16:04:52   GKPRINGLE
;  All COMM TEST windows widened.
;
;     Rev 1.1   10 Oct 1989 12:03:02   MJREMPEL
;
;     Rev 1.0   10 Oct 1989 11:45:20   MJREMPEL
;  Initial revision.
;
;*****************************************************************************
```

```
;*******************************************************************************
;
;DIGITAIR COMMUNICATIONS LOGIC UNIT (CLU) SOFTWARE - VERSION 6650 J10
;
;MODULE :    COMMON.ASM
;
;FUNCTION : MODULE CONTAINS MEMORY MAPPED I/O LOCATIONS, PORT DEFINITIONS,
;           CONSTANTS AND MACROS.
;
;AUTHORS: MONICA J. BURGESS & MING C. WOO
;
;LAST REVISED : 20 APRIL 1988
;
;*******************************************************************************
;*******************************************************************************
;
;$Header:   D:/clu/common.asv   2.0   04 Apr 1990 16:02:40   GKPRINGLE  $
;
;
;$Log:   D:/clu/common.asv  $
;
;     Rev 2.0   04 Apr 1990 16:02:40   GKPRINGLE
;  All COMM TEST windows widened.
;
;     Rev 1.3   10 Oct 1989 13:16:16   MJREMPEL
;
;     Rev 1.2   10 Oct 1989 12:58:14   MJREMPEL
;
;     Rev 1.1   10 Oct 1989 12:01:50   MJREMPEL
;
;     Rev 1.0   10 Oct 1989 11:40:26   MJREMPEL
;  Initial revision.
;
;*******************************************************************************
```

```
;*****************************************************************************
;
;DIGITAIR COMMUNICATIONS LOGIC UNIT (CLU) SOFTWARE - VERSION 6650 J27
;
;MODULE: TEST.ASM
;
;FUNCTION: ALLOWS TECHNICIAN TO TEST AND CALIBRATE THE CLU. ALSO PERMITS
;          DISPLAY OF SBU COMMUNICATIONS STATISTICS. ONCE IN THIS MODE, THE
;          UNIT MUST BE EITHER BE POWERED OFF THEN ON TO RETURN TO THE
;          OPERATING MODE, OR THE TEST BUTTON MUST BE HELD DOWN FOR THREE
;          SECONDS WITH TEST 0 SELECTED.
;
;AUTHOR: MONICA J. BURGESS
;
;REVISED BY: MARTIN J. REMPEL
;
;LAST REVISED: 01 DEC 1992
;
;*****************************************************************************
;*****************************************************************************
;
;$Header:   D:/clu/clutest.asv   2.2   27 Apr 1990 17:16:18   GKPRINGLE  $
;
;
;$Log:   D:/clu/clutest.asv  $
;
;     Rev 2.2   27 Apr 1990 17:16:18   GKPRINGLE
;  FIXED EMERG TX AFTER CHANGING ID
;
;     Rev 2.1   20 Apr 1990 16:18:04   GKPRINGLE
;  Fixed test mode bug (bad common file).
;
;     Rev 2.0   04 Apr 1990 16:01:06   GKPRINGLE
;  All COMM TEST windows widened.
;
;     Rev 1.5   10 Oct 1989 13:44:58   MJREMPEL
;
;     Rev 1.4   10 Oct 1989 13:29:34   MJREMPEL
;
;     Rev 1.3   10 Oct 1989 13:15:12   MJREMPEL
;
;     Rev 1.2   10 Oct 1989 12:57:14   MJREMPEL
;
;     Rev 1.1   10 Oct 1989 12:00:42   MJREMPEL
;
;     Rev 1.0   10 Oct 1989 11:36:04   MJREMPEL
;  Initial revision.
;
;*****************************************************************************
```

1.4 CDU FRONT PANEL ASSEMBLY MODULE HEADER LISTINGS

This section provides the Module headers for the CDU Front Panel Assembly software.

```
*****************************************************************************
*                                                                           *
*    MODULE NAME          :  CDU_MAIN.ASM                                   *
*    TITLE                :  CDU MAIN MODULE                                *
*    AUTHOR               :  M. Mandl                                       *
*    REFERENCES           :  CDU FIRMWARE                                   *
*    RELEASE DATE         :  June 17/91, Rev. 1.0                           *
*    DESCRIPTION          :  CDU_MAIN is the CDU firmware main loop. It     *
*                            performs the following:                        *
*                                                                           *
*                             - Initialize software variables.              *
*                                                                           *
*                             - Read inputs (ie., pushbuttons, messages     *
*                               from CLU).                                  *
*                                                                           *
*                             - Process data.                               *
*                                                                           *
*                             - Write outputs (ie., displays, messages      *
*                               to CLU).                                    *
*                                                                           *
*                                                                           *
*    REVISION #           :  Rev. 2.0                                       *
*    REVISION DATE        :  June 22, 1992.                                 *
*    REVISION AUTHOR      :  Daniel Talbot                                  *
*    REFERENCES           :  Implemented new functions (menus) to the CDU.  *
*    REVISION DESCRIPTION :  Modified to implement the new CDU's fucntions. *
*                                                                           *
*                            The UPDATE_5 function call was moved right     *
*                            after the PROC_RX function call in order for   *
*                            the displays to display the appropriate status *
*                            of the current CLU/CDU state.  This was done in*
*                            order to prevent fast users to store values of *
*                            the previous state display as for the current  *
*                            state (e.i. storing odometer value as the ID), *
*                            since the display was updated on the next      *
*                            iteration after the keys where all decoded.    *
*                                                                           *
*                            Moved the FLASHDIG function call right after   *
*                            the UPDATE_5 function call in order to enable  *
*                            the numeric display to flash when the CLU is   *
*                            in Test Mode #1.                               *
*                                                                           *
*****************************************************************************
```

```
*****************************************************************************
* MODULE NAME:  CDU_INIT.ASM                                                *
*                                                                           *
* REVISION :    1.0                                                         *
*                                                                           *
* DATE:         June 14/91                                                  *
*                                                                           *
* PROGRAMMER:   M. Mandl                                                    *
*                                                                           *
* INPUTS:       Hardware RESET                                              *
*                                                                           *
* OUTPUTS:      Front Panel Hardware Elements.                              *
*                                                                           *
* DESCRIPTION:  CDU_INIT initializes all of the hardware comprising the CDU *
*               Front Panel Assembly as follows:                            *
*                                                                           *
*               - Setup Interrupt Vector Jump Table.                        *
*                                                                           *
*               - Initialize the stack pointer.                             *
*                                                                           *
*               - Ensure Sonalert is OFF.                                   *
*                                                                           *
*               - Blank all front panel displays.                           *
*                                                                           *
*               - Initialize Timer 0 for interrupts every 10mS.             *
*                                                                           *
*               - Initialize Timer 1 for serial port @ 1200 baud.           *
*                                                                           *
*               - Initialize Timer 0 to Mode 1, Timer 1 to Mode 2.          *
*                                                                           *
*               - Initialize Serial Port for Async communications,          *
*                 1 start bit, 1 stop bit. Enable reception.                *
*                                                                           *
*               - Jump to Power-Up Tests.                                   *
*                                                                           *
* REVISIONS:    None.                                                       *
*****************************************************************************
```

```
*****************************************************************************
*                                                                           *
*    MODULE NAME          :  CDU_DB.ASM                                     *
*    TITLE                :  CDU DATA BASE (VARIABLE DEFINITIONS)           *
*    AUTHOR               :  M. Mandl                                       *
*    REFERENCES           :  CDU FIRMWARE                                   *
*    RELEASE DATE         :  June 14/91, Rev. 1.0                           *
*    DESCRIPTION          :  CDU_DB comprises the data base for the CDU     *
*                            front panel software. All system variables,    *
*                            constants, and flags are defined here.         *
*                                                                           *
*                            Memory is assigned as follows:                 *
*                                                                           *
*                                                                           *
*                            INTERNAL RAM:                                  *
*                                                                           *
*                             - 00H through 0FH: Register Banks 0 and 1.    *
*                                                                           *
*                             - 10H through 1FH: Unused.                    *
*                                                                           *
*                             - 20H through 2FH: Flags.                     *
*                                                                           *
*                             - 30H through 5FH: Internal RAM Variables.    *
*                                                                           *
*                             - 60H through 7FH: Stack.                     *
*                                                                           *
*                                                                           *
*                            EXTERNAL RAM:                                  *
*                                                                           *
*                             - 0000H through 07FFH: 2K External RAM.       *
*                                                                           *
*                             - 0000H through 7FFFH: 32K EPROM.             *
*                                                                           *
*                                                                           *
*                                                                           *
*    REVISION #           :  Rev. 2.0                                       *
*    REVISION DATE        :  July 21, 1992.                                 *
*    REVISION AUTHOR      :  Daniel Talbot                                  *
*    REFERENCES           :  Implemented new functions (menus) to the CDU.  *
*    REVISION DESCRIPTION :  Added the followings variables:                *
*                                                                           *
*                              o  STU_ENABLED,                              *
*                              o  STU_SBU_FLG,                              *
*                              o  STU_SBU_MODE,                             *
*                              o  STU_SBU_INIT,                             *
*                              o  STU_REQUEST,                              *
*                              o  AN_LOCKOUT,                               *
*                              o  KEY_LOCKOUT,                              *
*                              o  VIEW_LOCKOUT,                             *
*                              o  INVALID_STATE,                            *
*                              o  INVALID_INIT,                             *
*                              o  NOVRAM_ERR,                               *
*                              o  MUL2BIT,                                  *
*                              o  EXCEED,                                   *
*                              o  MSRD_MIL_FLG,                             *
```

```
*                            o  WHEELSZ_ACK,                                    *
*                            o  TIMEOUTTIM,                                     *
*                            o  WHEEL_ACK_2X,                                   *
*                            o  WHEELSZ_LEV,                                    *
*                            o  WHEEL_SZ_ERR,                                   *
*                            o  WHEEL_ACK_ERR,                                  *
*                            o  THW_WHEEL_SZ,                                   *
*                            o  MODEMSG,                                        *
*                            o  STUMODEMSG,                                     *
*                            o  SBUMODEMSG,                                     *
*                            o  SERVICE1MSG,                                    *
*                            o  SERVICE2MSG,                                    *
*                            o  BEEP_5.                                         *
*                                                                               *
*                                                                               *
*********************************************************************************
```

```
*******************************************************************************
*                                                                             *
*    MODULE NAME           :  COMMON.ASM                                      *
*    TITLE                 :  CDU'S COMMON DEFINITIONS.                       *
*    AUTHOR                :  M. Mandl                                        *
*    REFERENCES            :  CDU FIRMWARE                                    *
*    RELEASE DATE          :  June 14/91, Rev. 1.0                            *
*    DESCRIPTION           :  This module is an INCLUDE file containing       *
*                             system wide EQUATE definitions.                 *
*                                                                             *
*                                                                             *
*    REVISION #            :  Rev. 2.0                                        *
*    REVISION DATE         :  June 22, 1992.                                  *
*    REVISION AUTHOR       :  Daniel Talbot                                   *
*    REFERENCES            :  Implemented new functions (menus) to the CDU.   *
*    REVISION DESCRIPTION  :  Added the following definitions:                *
*                                                                             *
*                               o LN_MODE,                                    *
*                               o WS_MODE.                                    *
*                                                                             *
*******************************************************************************
```

```
*****************************************************************************
* MODULE NAME:  POWER_UP.ASM                                                *
*                                                                           *
* REVISION :    1.0                                                         *
*                                                                           *
* DATE:         June 17/91                                                  *
*                                                                           *
* PROGRAMMER:   M. Mandl                                                    *
*                                                                           *
* INPUTS:       None. Jumped to from CDU_INIT.                              *
*                                                                           *
* OUTPUTS:      Front Panel Display.                                        *
*                                                                           *
* DESCRIPTION:  POWER_UP performs a brief diagnostic of the Front Panel     *
*               Assembly hardware. The follow elements are tested:          *
*                                                                           *
*               - The internal RAM register banks are tested.               *
*                                                                           *
*               - The internal RAM is tested and left zeroed.               *
*                                                                           *
*               - A checksum is performed on the EPROM.                     *
*                                                                           *
*               - The external RAM is tested and left zeroed.               *
*                                                                           *
*               - A display test is performed.                              *
*                                                                           *
*               - Jumps to CDU_MAIN upon completion where a display test    *
*                 is first performed before the application code runs.      *
*                                                                           *
*                                                                           *
*               If an error is found, an error message is displayed on the  *
*               alphanumeric display indefinately.                          *
*                                                                           *
*                                                                           *
* REVISIONS:    None.                                                       *
*****************************************************************************
```

```
*****************************************************************************
* MODULE NAME:  PROCCOMM.ASM                                                *
*                                                                           *
* REVISION :    1.0                                                         *
*                                                                           *
* DATE:         July 10/91                                                  *
*                                                                           *
* PROGRAMMER:   M. Mandl                                                    *
*                                                                           *
* INPUTS:                                                                   *
*                                                                           *
* OUTPUTS:                                                                  *
*                                                                           *
* DESCRIPTION:  PROCCOMM processes the functions associated with the COMM   *
*               TEST button.                                                *
*                                                                           *
*                                                                           *
*                                                                           *
* REVISIONS:    None.                                                       *
*****************************************************************************
*****************************************************************************
* MODULE NAME:  PROCDIM.ASM                                                 *
*                                                                           *
* REVISION :    1.0                                                         *
*                                                                           *
* DATE:         June 26/91                                                  *
*                                                                           *
* PROGRAMMER:   M. Mandl                                                    *
*                                                                           *
* INPUTS:                                                                   *
*                                                                           *
* OUTPUTS:                                                                  *
*                                                                           *
* DESCRIPTION:  PROCDIM processes the functions associated with the DIM     *
*               button.                                                     *
*                                                                           *
*                                                                           *
*                                                                           *
* REVISIONS:    None.                                                       *
*****************************************************************************
```

```
*****************************************************************************
* MODULE NAME:  PROCODOM.ASM                                                *
*                                                                           *
* REVISION :    1.0                                                         *
*                                                                           *
* DATE:         June 26/91                                                  *
*                                                                           *
* PROGRAMMER:   M. Mandl                                                    *
*                                                                           *
* INPUTS:                                                                   *
*                                                                           *
* OUTPUTS:                                                                  *
*                                                                           *
* DESCRIPTION:  PROCODOM processes the functions associated with the ODOM   *
*               button.                                                     *
*                                                                           *
*                                                                           *
*                                                                           *
* REVISIONS:    None.                                                       *

*****************************************************************************
*****************************************************************************
*                                                                           *
*    MODULE NAME          :  PROCSET.ASM                                    *
*    TITLE                :  PROCESS SET PUSH BUTTON REQUESTS.              *
*    AUTHOR               :  M. Mandl                                       *
*    REFERENCES           :  CDU FIRMWARE                                   *
*    RELEASE DATE         :  June 25/91, Rev. 1.0                           *
*    DESCRIPTION          :  PROCSET processes the functions associated with *
*                            the SET button when it's pressed at various    *
*                            levels.                                        *
*                                                                           *
*                                                                           *
*    REVISION #           :  Rev. 2.0                                       *
*    REVISION DATE        :  June 22, 1992.                                 *
*    REVISION AUTHOR      :  Daniel Talbot                                  *
*    REFERENCES           :  Implemented functionality of the new the CDU   *
*                            functions.                                     *
*    REVISION DESCRIPTION :  Implemented functionality for the followings:  *
*                                                                           *
*                                 o  Train Length function,                 *
*                                 o  Wheel Size fucntion.                   *
*                                                                           *
*                            The function was also modified in order to be  *
*                            disabled when the SBU/STU selection mode is    *
*                            enabled.                                       *
*                                                                           *
*****************************************************************************
```

```
*****************************************************************************
*                                                                           *
*    MODULE NAME          :  PROCVIEW.ASM                                   *
*    TITLE                :  PROCESS VIEW PUSH BUTTON REQUESTS.             *
*    AUTHOR               :  M. Mandl                                       *
*    REFERENCES           :  CDU FIRMWARE                                   *
*    RELEASE DATE         :  June 21/91, Rev. 1.0                           *
*    DESCRIPTION          :  PROCVIEW processes the functions associated    *
*                            with the VIEW button at different operating    *
*                            levels and modes.                              *
*                                                                           *
*                                                                           *
*    REVISION #           :  Rev. 2.0                                       *
*    REVISION DATE        :  June 22, 1992.                                 *
*    REVISION AUTHOR      :  Daniel Talbot                                  *
*    REFERENCES           :  Implemented new functions (menus) to the CDU.  *
*    REVISION DESCRIPTION :  Implemented the followings:                    *
*                                                                           *
*                                 o  Train Length function,                 *
*                                 o  Wheel Size fucntion.                   *
*                                                                           *
*                            The Measured Mile function (menu) as been      *
*                            modified in the sense that it will be disabled *
*                            upon a thumbwheel assembly with a valid value  *
*                            is mounted on the CDU unit otherwise the       *
*                            function is enabled and available to the user. *
*                                                                           *
*                            The module was also modified in order to be    *
*                            disabled when the SBU/STU mode selection is    *
*                            enabled.                                       *
*                                                                           *
*****************************************************************************
*****************************************************************************
* MODULE NAME:  PROCVOL.ASM                                                 *
*                                                                           *
* REVISION :    1.0                                                         *
*                                                                           *
* DATE:         June 25/91                                                  *
*                                                                           *
* PROGRAMMER:   M. Mandl                                                    *
*                                                                           *
* INPUTS:                                                                   *
*                                                                           *
* OUTPUTS:                                                                  *
*                                                                           *
* DESCRIPTION:  PROCVOL processes the VOLUME function.                      *
*                                                                           *
* REVISIONS:    None.                                                       *
*****************************************************************************
```

```
*****************************************************************************
*                                                                           *
*    MODULE NAME           :  PROC_RX.ASM                                   *
*    TITLE                 :  PROCESS MESSAGES RECEIVED FROM THE CLU BOARD  *
*    AUTHOR                :  M. Mandl                                      *
*    REFERENCES            :  CDU FIRMWARE                                  *
*    RELEASE DATE          :  July 03/91, Rev. 1.0                          *
*    DESCRIPTION           :  PROC_RX checks to see if a message is available *
*                             from the CLU. If so, it decodes the message and *
*                             updates the data base and CDU displays.       *
*                                                                           *
*                                                                           *
*    REVISION #            :  Rev. 2.0                                      *
*    REVISION DATE         :  July 21, 1992.                                *
*    REVISION AUTHOR       :  Daniel Talbot                                 *
*    REFERENCES            :  Implemented decoding for the CDU new functions. *
*    REVISION DESCRIPTION  :  Implemented decoding for the followings:      *
*                                                                           *
*                              o  'i' Display Train Length Acknowledge,'    *
*                              o  't' Store Train Length Acknowledge,       *
*                              o  'x' Display Wheel Diameter Acknowledge,   *
*                              o  'y' Record Wheel Diameter Acknowledge,    *
*                              o  'p' Train length Odometer ON Control,     *
*                              o  'q' Train Length Exceeded Odom. ON Control, *
*                              o  Annunciator #2 STU Acknowledge and the    *
*                                 setup of the STU decimal point in the     *
*                                 pressure display unit field.              *
*                              o  Added code to cause the sonalert to beep  *
*                                 5 times after the CLU test #1.  This was  *
*                                 via the BEEP_5 bit variable.              *
*                              o  Set the wheel size level to 99 when the CLU *
*                                 goes into test mode.  This is to prevent  *
*                                 the WHEELSZ function to hang-up if the    *
*                                 user is holding down the CLU test button  *
*                                 during power-up.                          *
*                                                                           *
*                                                                           *
*    REVISION #            :  Rev. 3.0                                      *
*    REVISION DATE         :  October 05, 1992.                             *
*    REVISION AUTHOR       :  Daniel Talbot                                 *
*    REFERENCES            :  Alphanumeric Display Bugs.                    *
*    REVISION DESCRIPTION  :  Made changes to this module to allow CLU      *
*                             messages to overwrite CDU messages.           *
*                                                                           *
*                                                                           *
*    REVISION #            :  Rev. 4.0                                      *
*    REVISION DATE         :  November 04, 1992.                            *
*    REVISION AUTHOR       :  Daniel Talbot                                 *
*    REFERENCES            :  Alphanumeric Display Bugs.                    *
*    REVISION DESCRIPTION  :  Prevent NOT ARMED message to be displaed during *
*                             the STU/SBU mode selection.  Also reset the   *
*                             SETID_ACTIVE flag within the after the        *
*                             CLU_MSG_DONE label.                           *
*                                                                           *
*****************************************************************************
```

```
*****************************************************************************
*                                                                           *
*    MODULE NAME           :  SETID.ASM                                     *
*    TITLE                 :  PROCESS SET ID FUNCTION + WHEEL DIAM + TRN LEN. *
*    AUTHOR                :  M. Mandl                                      *
*    REFERENCES            :  CDU FIRMWARE                                  *
*    RELEASE DATE          :  June 27/91, Rev. 1.0                          *
*    DESCRIPTION           :  SETID stores the newly entered ID, wheel      *
*                             diameter, or train length and initiates a store *
*                             to NOVRAM request to the CLU.                 *
*                                                                           *
*                                                                           *
*    REVISION #            :  Rev. 2.0                                      *
*    REVISION DATE         :  June 22, 1992.                                *
*    REVISION AUTHOR       :  Daniel Talbot                                 *
*    REFERENCES            :  Implemented new functions (menus) to the CDU. *
*    REVISION DESCRIPTION  :  Implemented the following functions:          *
*                                                                           *
*                               o Initialize SBU/STU mode selection function, *
*                               o Store Train Length.                       *
*                                                                           *
*****************************************************************************
*****************************************************************************
*                                                                           *
*    MODULE NAME           :  SETMODE.ASM                                   *
*    TITLE                 :  PROCESS THE STU/SBU MODE FUNCTION.            *
*    AUTHOR                :  Daniel Talbot                                 *
*    REFERENCES            :  CDU FIRMWARE                                  *
*    RELEASE DATE          :  May 08, 1992, Rev 1.0                         *
*    DESCRIPTION           :  Process the STU/SBU mode function.            *
*                                                                           *
*                                                                           *
*                                                                           *
*    REVISION #            :  Rev. 3.0                                      *
*    REVISION DATE         :  October 05, 1992.                             *
*    REVISION AUTHOR       :  Daniel Talbot                                 *
*    REFERENCES            :  Alphanumeric Display Bugs.                    *
*    REVISION DESCRIPTION  :  Made changes to this module to allow CLU      *
*                             messages to overwrite CDU messages.           *
*                                                                           *
*                                                                           *
*                                                                           *
*    REVISION #            :  Rev. 4.0                                      *
*    REVISION DATE         :  December 04, 1992.                            *
*    REVISION AUTHOR       :  Daniel Talbot                                 *
*    REFERENCES            :  Alphanumeric Display Bugs.                    *
*    REVISION DESCRIPTION  :  Clear CLU_MSG_FALG and ROM_RAM_FLAG when the  *
*                             CLU is in "Store ID Mode Acknowledge".  This  *
*                             makes sure the STU/SBU message gets displayed *
*                             even when a CLU message is displayed.         *
*                                                                           *
*****************************************************************************
```

```
*****************************************************************************
* MODULE NAME:   SETREAR.ASM                                                *
*                                                                           *
* REVISION :     1.0                                                        *
*                                                                           *
* DATE:          Aug 14/91                                                  *
*                                                                           *
* PROGRAMMER:    M. Mandl                                                   *
*                                                                           *
* INPUTS:                                                                   *
*                                                                           *
* OUTPUTS:                                                                  *
*                                                                           *
* DESCRIPTION:   SETREAR displays the message "SET REAR" and beeps if the   *
*                "SET" button is pressed when the rear thumbwheels are in   *
*                range.                                                     *
*                                                                           *
* REVISIONS:     None.                                                      *
*****************************************************************************
*****************************************************************************
*                                                                           *
*    MODULE NAME           :  TIMERS.ASM                                    *
*    TITLE                 :  PROCESS CDU'S TIMERS                          *
*    AUTHOR                :  M. Mandl                                      *
*    REFERENCES            :  CDU FIRMWARE                                  *
*    RELEASE DATE          :  June 17/91, Rev. 1.0                          *
*    DESCRIPTION           :  TIMERS is the Timer 0 interrupt service routine.*
*                             It updates each timer once every 10mS.        *
*                                                                           *
*                                                                           *
*    REVISION #            :  Rev. 2.0                                      *
*    REVISION DATE         :  June 22, 1992.                                *
*    REVISION AUTHOR       :  Daniel Talbot                                 *
*    REFERENCES            :  Implemented STU/SBU selection timeout timer.  *
*    REVISION DESCRIPTION  :  Implemented the followings:                   *
*                                                                           *
*                              o TIMEOUTTIM, which is the STU/SBU mode      *
*                                            selection timeout timer.       *
*                              o MUL2BIT, which allows to double the value  *
*                                         of the TIMEOUTTIM variable.       *
*                                                                           *
*****************************************************************************
```

```
*****************************************************************************
* MODULE NAME:  TX_MSG.ASM                                                  *
*                                                                           *
* REVISION :    1.0                                                         *
*                                                                           *
* DATE:         July 2/91                                                   *
*                                                                           *
* PROGRAMMER:   M. Mandl                                                    *
*                                                                           *
* INPUTS:                                                                   *
*                                                                           *
* OUTPUTS:                                                                  *
*                                                                           *
* DESCRIPTION:  TX_MSG checks a flag to see if a message is ready to be sent *
*               to the CLU. If the flag is set, it computes the checksum and *
*               sets up the message for transmission, otherwise it exits.   *
*               Note that all characters up to the checksum bytes are       *
*               included, excluding the leading carriage return.            *
*                                                                           *
* REVISIONS:    None.                                                       *
*****************************************************************************
*****************************************************************************
*                                                                           *
*    MODULE NAME          :  UPDATE_5.ASM                                   *
*    TITLE                :  UPDATES THE CDU'S NUMERIC DISPLAYS             *
*    AUTHOR               :  M. Mandl                                       *
*    REFERENCES           :  CDU FIRMWARE                                   *
*    RELEASE DATE         :  November 12/91, Rev. 1.0                       *
*    DESCRIPTION          :  UPDATE_5 writes the appropriate stored ID,     *
*                            wheel diameter, odometer value, or train length *
*                            to the 5 digit numeric display depending on the *
*                            current operating mode.                        *
*                                                                           *
*                                                                           *
*    REVISION #           :  Rev. 2.0                                       *
*    REVISION DATE        :  June 22, 1992.                                 *
*    REVISION AUTHOR      :  Daniel Talbot                                  *
*    REFERENCES           :  Implemented new functions (menus) to the CDU.  *
*    REVISION DESCRIPTION :  Implemented the followings:                    *
*                                                                           *
*                                 o  Train Length function,                 *
*                                 o  Wheel Size fucntion,                   *
*                                 o  STU mode function display update.      *
*                                                                           *
*                                                                           *
*****************************************************************************
```

```
*******************************************************************************
*                                                                             *
*    MODULE NAME          :  VIEWLEV3.ASM                                     *
*    TITLE                :  PROCESS VIEW PUSH BUTTON REQUESTS AT LEVEL 3.    *
*    AUTHOR               :  M. Mandl                                         *
*    REFERENCES           :  CDU FIRMWARE                                     *
*    RELEASE DATE         :  June 27/91, Rev. 1.0                             *
*    DESCRIPTION          :  VIEWLEV3 processes the functions associated      *
*                            with the VIEW button when it is pressed in       *
*                            LEVEL 3.                                         *
*                                                                             *
*                                                                             *
*    REVISION #           :  Rev. 2.0                                         *
*    REVISION DATE        :  June 22, 1992.                                   *
*    REVISION AUTHOR      :  Daniel Talbot                                    *
*    REFERENCES           :  Implemented new functions (menus) to the CDU.    *
*    REVISION DESCRIPTION :  Implemented the following:                       *
*                                                                             *
*                              o  Train length,                               *
*                              o  Wheel Size.                                 *
*                                                                             *
*******************************************************************************
```

```
*****************************************************************************
*                                                                           *
*    MODULE NAME           :  WHEELSZ.ASM                                   *
*    TITLE                 :  WHEEL DIAMETER (SIZE)                         *
*    AUTHOR                :  M. Mandl                                      *
*    REFERENCES            :  CDU FIRMWARE                                  *
*    RELEASE DATE          :  Aug 8/91, Rev. 1.0                            *
*                                                                           *
*                                                                           *
*    REVISION #            :  Rev. 2.0                                      *
*    REVISION DATE         :  July 21, 1992.                                *
*    REVISION AUTHOR       :  Daniel Talbot                                 *
*    REFERENCES            :  New functionality of the wheel diameter.      *
*    REVISION DESCRIPTION  :  Modified the module to allow the new          *
*                             functionality of the wheel diameter.          *
*    DESCRIPTION           :  WHEELSZ reads the current thumbwheel switch   *
*                             setting and if it finds it in the range of    *
*                             36.0" to 43.0" (ie., 60 to 30) it displays    *
*                             "WHEEL SZ" on the A/N display and the wheel   *
*                             diameter in inches on the 5 digit display.    *
*                             If the setting is outside the range of 36.0"  *
*                             to 43.0", WHEELSZ reverts to entry of wheel   *
*                             diameter from the front panel. In this case it*
*                             displays "SET DIAM" on the A/N display and    *
*                             prompts for input in the same fashion as entry*
*                             of EOT ID code.                               *
*                                                                           *
*                             When the wheel size level is set to 99 the CLU*
*                             is in test mode.  The PROC_RX function sets   *
*                             the wheel size level to 99 in order to prevent*
*                             the WHEELSZ function to hang-up if the user is*
*                             holding down the CLU test button during       *
*                             power-up.                                     *
*                                                                           *
*                                                                           *
*    REVISION #            :  Rev. 3.0                                      *
*    REVISION DATE         :  December 04, 1992.                            *
*    REVISION AUTHOR       :  Daniel Talbot                                 *
*    REFERENCES            :  TESTS MODE.                                   *
*    REVISION DESCRIPTION  :  Made sure that the keys are not lockout and   *
*                             that the error flag are clear when going into *
*                             Tests Mode.                                   *
*                                                                           *
*****************************************************************************
```

```
*****************************************************************************
* MODULE NAME:  FLASHDIG.ASM                                                *
*                                                                           *
* REVISION :    1.0                                                         *
*                                                                           *
* DATE:         June 26/91                                                  *
*                                                                           *
* PROGRAMMER:   M. Mandl                                                    *
*                                                                           *
* INPUTS:                                                                   *
*                                                                           *
* OUTPUTS:                                                                  *
*                                                                           *
* DESCRIPTION:  FLASHDIG flashes the current thumbwheel digit if thumbwheel *
*               mode is active.                                             *
*                                                                           *
*                                                                           *
* REVISIONS:    None.                                                       *
*****************************************************************************
*****************************************************************************
* MODULE NAME:  EMERGENC.ASM                                                *
*                                                                           *
* REVISION :    1.0                                                         *
*                                                                           *
* DATE:         July 10/91                                                  *
*                                                                           *
* PROGRAMMER:   M. Mandl                                                    *
*                                                                           *
* INPUTS:                                                                   *
*                                                                           *
* OUTPUTS:                                                                  *
*                                                                           *
* DESCRIPTION:  EMERGENC processes the functions associated with the        *
*               EMERGENCY switch.                                           *
*                                                                           *
*                                                                           *
*                                                                           *
* REVISIONS:    None.                                                       *
*****************************************************************************
```

```
*****************************************************************************
*                                                                           *
*    MODULE NAME           :  ERRORS.ASM                                    *
*    TITLE                 :  PROCESS CDU ERRORS                            *
*    AUTHOR                :  Daniel Talbot                                 *
*    REFERENCES            :  CDU FIRMWARE                                  *
*    RELEASE DATE          :  July 21, 1992, Rev. 1.0                        *
*    DESCRIPTION           :  This function prompts the error and warning   *
*                             messages to the user.                         *
*                                                                           *
*    REVISION #            :  Rev. 2.0                                      *
*    REVISION DATE         :  October 05, 1992.                             *
*    REVISION AUTHOR       :  Daniel Talbot                                 *
*    REFERENCES            :  Changed Wheel Acknowledge Error Message.      *
*    REVISION DESCRIPTION  :  Changed Wheel Acknowledge Error Message from  *
*                             "I/O ERR" to "NO DATA".                       *
*                                                                           *
*****************************************************************************
*****************************************************************************
* MODULE NAME:  CDUMOVX.ASM                                                 *
*                                                                           *
* REVISION :    1.0                                                         *
*                                                                           *
* DATE:         June 26/91                                                  *
*                                                                           *
* PROGRAMMER:   M. Mandl                                                    *
*                                                                           *
* INPUTS:       R7.                                                         *
*                                                                           *
* OUTPUTS:      ACC.                                                        *
*                                                                           *
* DESCRIPTION:  CDUMOVX is a utility which does the equivalent of           *
*               MOVX A,@A+DPTR. R7 is an input which contains the index (@A).*
*                                                                           *
*                                                                           *
* REVISIONS:    None.                                                       *
*****************************************************************************
```

```
*****************************************************************************
* MODULE NAME:  AN_DRVR.ASM                                                 *
*                                                                           *
* REVISION :    1.0                                                         *
*                                                                           *
* DATE:         January 29/91                                               *
*                                                                           *
* PROGRAMMER:   M. Mandl                                                    *
*                                                                           *
* INPUTS:       1. AN_BUFF:  8 character buffer located in external RAM     *
*                            that contains the message to be displayed.     *
*                                                                           *
*               2. WAG_FLAG: ON/OFF flag used to display Wagon Wheel        *
*                            characters in all 8 display positions. This is *
*                            typically set at power-up and during LAMPTEST. *
*                                                                           *
*               3. AN_STAT:  ON/OFF flag used to display spaces (ie. blanks)*
*                            in all 8 character positions.                  *
*                            message pointed to by AN_PTR.                  *
*                                                                           *
* OUTPUTS:      DL2416 alphanumeric displays (8 characters total).          *
*                                                                           *
* DESCRIPTION:  This driver displays an 8 character message contained in    *
*               AN_BUFF.                                                    *
*               It also displays 'Wagon Wheel' characters or 'Space'        *
*               characters in all 8 character positions if flag WAG_FLAG is *
*               set and AN_STAT is reset, respectively.                     *
*                                                                           *
* REVISIONS:    None.                                                       *
*****************************************************************************
```

```
*****************************************************************************
*                                                                           *
*    MODULE NAME          :  AN_SETUP.ASM                                   *
*    TITLE                :  PROCESS THE ALPHA NUMERIC MESSAGES.            *
*    AUTHOR               :  M. Mandl                                       *
*    REFERENCES           :  CDU FIRMWARE                                   *
*    RELEASE DATE         :  June 17/91, Rev. 1.0                           *
*    DESCRIPTION          :  AN_SETUP copies the 8 characters pointed to by *
*                            DPTR to AN_BUFF whose contents are displayed by *
*                            AN_DRVR. The flag RQM_RAM_FLAG is used to      *
*                            determine whether DPTR was pointing to ROM or  *
*                            RAM at entry. The default is always forced to  *
*                            be ROM.                                        *
*                                                                           *
*                                                                           *
*    REVISION #           :  Rev. 2.0                                       *
*    REVISION DATE        :  June 22, 1992.                                 *
*    REVISION AUTHOR      :  Daniel Talbot                                  *
*    REFERENCES           :  Implemented a Alpha Numeric Display Disable.   *
*    REVISION DESCRIPTION :  An Alpha Numeric Display Disable flag,         *
*                            AN_LOCKOUT, was added in other to lockout the  *
*                            alpha numeric display.                         *
*                                                                           *
*                                                                           *
*****************************************************************************
*****************************************************************************
* MODULE NAME:  ASCIIHEX.ASM                                                *
*                                                                           *
* REVISION :    1.0                                                         *
*                                                                           *
* DATE:         July 4/91                                                   *
*                                                                           *
* PROGRAMMER:   M. Mandl                                                    *
*                                                                           *
* INPUTS:       ACC.                                                        *
*                                                                           *
* OUTPUTS:      ACC.                                                        *
*                                                                           *
* DESCRIPTION:  ASCIIHEX is a utility which converts a 7-bit ASCII value   *
*               in ACC to HEX. The HEX value is returned in ACC.            *
*                                                                           *
*                                                                           *
* REVISIONS:    None.                                                       *
*****************************************************************************
```

```
*************************************************************************
* MODULE NAME:   B_STREAM.ASM                                           *
*                                                                       *
* REVISION :     1.0                                                    *
*                                                                       *
* DATE:          March 11/91                                            *
*                                                                       *
* PROGRAMMER:    M. Mandl                                               *
*                                                                       *
* INPUTS:        LEDBUFF.                                                *
*                                                                       *
* OUTPUTS:       A serial bit stream of 84 bits which are sent to the   *
*                5-Digit Function Display, the 3-Digit Pressure Display,*
*                the 15 Annunciators, and the 5 Pushbuttons residing on the*
*                LED Driver PCB. The bits are assigned as follows:      *
*                                                                       *
*                BIT            FUNCTION                               *
*                -----          --------                               *
*                1               "COMM TEST" PUSHBUTTON                *
*                2               "VALVE FAIL" LED                      *
*                3               "F>R NO COMM" LED                     *
*                4               "SET" PUSHBUTTON                      *
*                5               "VIEW" PUSHBUTTON                     *
*                6               "REPLY PENDING" LED                   *
*                7               "REPLACE BATTERY" TELEMETRY LED       *
*                8               "BATTERY WEAK" TELEMETRY LED          *
*                9               "REPLACE BATTERY" HVM LED             *
*                10              "LIGHT ON" LED                        *
*                11              "STOPPED" LED                         *
*                12              "REVERSE" LED                         *
*                13              "MOVING" LED                          *
*                14              "FORWARD" LED                         *
*                15              "ODOM" PUSHBUTTON                     *
*                16              "DIM" PUSHBUTTON                      *
*                17              "R>F NO COMM" LED                     *
*                18              "NO AIR" LED                          *
*                19              "LOW PRESS" LED                       *
*                20              "NOT ARMED" LED                       *
*                                                                       *
*     56        59        63        67        26          30        44        41    *
*    ----      ----      ----      ----      ----        ----      ----      ----   *
* 54|     | 58|     | 61|     | 66|     | 24|     |   52|     | 31|     | 45|     |39*
*   | 53 |55 | 57 |60 | 62 |64 | 65 |68 | 22 |28   | 37 |29 | 48 |47 | 42 |   *
*    ----      ----      ----      ----      ----        ----      ----      ----   *
* 84|     | 80|     | 76|     | 72|     | 21|     |   38|     | 32|     | 36|     |  *
*   | 83 |82 | 79 |77 | 75 |74 | 71 |70 | 23 |25   | 51 |50 | 33 |35 | 46 |43*
*    ---- 0    ---- 0    ---- 0    ---- 0    ---- 0      ---- 0    ---- 0    ---- 0 *
*         81        78        73        69        27          49        34        40*
*                                                                       *
*                                                                       *
```

```
*                                                                              *
*              Bits are organized in memory as follows:                        *
*                                                                              *
*                                                                              *
*              7                                    0       Bits shifted       *
*             ---------------------------------------      this way.          *
*  @LEDBUFF: | 8    7    6    5    4    3    2    1 | --->                     *
*            | 16   15   14   13   12   11   10   9 | --->                     *
*            | 24   23   22   21   20   19   18  17 | --->                     *
*            | 32   31   30   29   28   27   26  25 | --->                     *
*            | 40   39   38   37   36   35   34  33 | --->                     *
*            | 48   47   46   45   44   43   42  41 | --->                     *
*            | 56   55   54   53   52   51   50  49 | --->                     *
*            | 64   63   62   61   60   59   58  57 | --->                     *
*            | 72   71   70   69   68   67   66  65 | --->                     *
*            | 80   79   78   77   76   75   74  73 | --->                     *
*            | XX   XX   XX   XX   84   83   82  81 | --->                     *
*             ---------------------------------------                          *
*                                                                              *
*                                                                              *
*                                                                              *
*                                                                              *
*                                                                              *
* DESCRIPTION:  This is a common routine called by display drivers NUM_DRVR,   *
*               and LED_DRVR. These drivers update the appropriate             *
*               bit groups as defined above, and call this routine which       *
*               sends the entire 84-bit stream to the LED Driver PCB to        *
*               update the display.                                            *
*                                                                              *
* REVISIONS:    None.                                                          *
********************************************************************************
```

```
*****************************************************************************
* MODULE NAME:  DIM_DRVR.ASM                                                *
*                                                                           *
* REVISION :    1.0                                                         *
*                                                                           *
* DATE:         March 18/91                                                 *
*                                                                           *
* PROGRAMMER:   M. Mandl                                                    *
*                                                                           *
* INPUTS:       The input to this driver is a control byte located in       *
*               external memory at variable DIM_CNTL which takes on         *
*               binary values 0 to 7, where 0 is the value for minimum      *
*               display intensity and 7 is the value for maximum display    *
*               intensity.                                                  *
*                                                                           *
* OUTPUTS:      Output is to the CDU's dimmer hardware.                     *

*                                                                           *
* DESCRIPTION:  This driver reads the value contained in variable DIM_CNTL  *
*               and uses it to provide eight levels of display intensity.   *
*               A value of 0 in DIM_CNTL provides the least brightness, a   *
*               value of 7 provides maximum brightness.                     *
*                                                                           *
* REVISIONS:    None.                                                       *
*****************************************************************************
```

```
*****************************************************************************
*                                                                           *
*    MODULE NAME          :  KEY_DRVR.ASM                                   *
*    TITLE                :  PROCESS CDU'S KEYS.                            *
*    AUTHOR               :  M. Mandl                                       *
*    REFERENCES           :  CDU FIRMWARE                                   *
*    RELEASE DATE         :  June 18/91, Rev. 1.0                           *
*    DESCRIPTION          :  This driver reads the keys, debounces them, and *
*                            sets a flag for each key to indicate the key is *
*                            valid.                                         *
*                                                                           *
*                                                                           *
*    INPUTS:       VIEW_PB:       VIEW Pushbutton.                         *
*                  SET_PB:        SET Pushbutton.                          *
*                  ODOM_PB:       ODOM Pushbutton.                         *
*                  DIM_PB:        DIM Pushbutton.                          *
*                  COMM_TEST_PB:  COMM TEST Pushbutton.                    *
*                  EMERG_SW:      EMERGENCY Switch.                        *
*                                                                           *
*                  VIEWPBSTA:   Contains previous VIEW pushbutton state.    *
*                  SETPBSTA:    Contains previous SET pushbutton state.     *
*                  ODOMPBSTA:   Contains previous ODOM pushbutton state.    *
*                  DIMPBSTA:    Contains previous DIM pushbutton state.     *
*                  COMTSTPBSTA: Contains previous COMM TEST pushbutton state.*
*                  EMERGSWSTA:  Contains previous EMERGENCY SWITCH state.   *
*                                                                           *
*                  VIEWPBTIM:                                               *
*                  SETPBTIM:                                                *
*                  ODOMPBTIM:   Value of 00H indicates debounce timer expired*
*                  DIMPBTIM:    A none zero value written to these start the *
*                  COMTSTPBTIM: respective timer.                           *
*                  EMERGSWTIM:                                              *
*                                                                           *
*                  KEY_LOCKOUT:  Disables the CDU's keys.                   *
*                                                                           *
*                                                                           *
*    OUTPUTS:      VIEWPBREQ:                                               *
*                  SETPBREQ:                                                *
*                  ODOMPBREQ: Flags to indicate pushbutton debounced & ready.*
*                  DIMPBREQ:                                                *
*                  COMTSTPBREQ:                                             *
*                  EMERGSWREQ:                                              *
*                                                                           *
*                                                                           *
*    REVISION #           :  Rev. 2.0                                       *
*    REVISION DATE        :  July 20, 1992.                                 *
*    REVISION AUTHOR      :  Daniel Talbot                                  *
*    REFERENCES           :  Implemented a CDU key lockout for the new      *
*                            CDU's functions (menus).                       *
*                                                                           *
```

```
*    REVISION DESCRIPTION :  The KEY_LOCKOUT variable was added to the      *
*                            module, when set the following switches are    *
*                            disabled:                                      *
*                                        o  ODOM;                           *
*                                        o  DIM;                            *
*                                        o  VIEW; and                       *
*                                        o  SET.                            *
*                                                                           *
*                            Although the above switches are disabled the   *
*                            COMM TEST and EMERGENCY switches are still     *
*                            enabled (read and decoded).                    *
*                                                                           *
*                                                                           *
*                                                                           *
*    REVISION #           :  Rev. 3.0                                       *
*    REVISION DATE        :  October 05, 1992.                              *
*    REVISION AUTHOR      :  Daniel Talbot                                  *
*    REFERENCES           :  Alphanumeric Display Bugs.                     *
*    REVISION DESCRIPTION :  Changed the decoding priorty of the CDU keys   *
*                                                                           *
*                                                                           *
*                                                                           *
*    REVISION #           :  Rev. 4.0                                       *
*    REVISION DATE        :  December 04, 1992.                             *
*    REVISION AUTHOR      :  Daniel Talbot                                  *
*    REFERENCES           :  CLU Messages.                                  *
*    REVISION DESCRIPTION :  Abort decoding the ODOM, DIM, VIEW and SET keys *
*                            if one of the following flags are set:         *
*                                                                           *
*                                 o  ROM_RAM_FLAG;                          *
*                                 o  CLU_MSG_FLAG; and                      *
*                                 o  SONALER.                               *
*                                                                           *
*                            Also forced the above keys to be decoded during *
*                            TESTS_ACTIVE.                                  *
*                                                                           *
*****************************************************************************
```

```
*****************************************************************************
* MODULE NAME:  LED_DRVR.ASM                                                *
*                                                                           *
* REVISION :    1.0                                                         *
*                                                                           *
* DATE:         March 15/91                                                 *
*                                                                           *
* PROGRAMMER:   M. Mandl                                                    *
*                                                                           *
* INPUTS:       The input to this driver is 3 bytes residing in external    *
*               memory with starting location at variable ANNUNC which      *
*               is organized as follows:                                    *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                        7  6  5  4  3  2  1  0                             *
*                       -------------------------                           *
*             ANNUNC:   |  |  |  |  |  |  |  |  |                          *
*                       -------------------------                           *
*                                                                           *
*                       Bit 0 : NOT ARMED                                   *
*                       Bit 1 : LOW PRESSURE                                *
*                       Bit 2 : NO AIR                                      *
*                       Bit 3 : R>F NO COMM                                 *
*                       Bit 4 : F>R NO COMM                                 *
*                       Bit 5 : VALVE FAIL                                  *
*                       Bit 6 : MOVING                                      *
*                       Bit 7 : FORWARD                                     *
*                                                                           *
*                        7  6  5  4  3  2  1  0                             *
*                       -------------------------                           *
*             ANNUNC+1: |  |  |  |  |  |  |  |  |                          *
*                       -------------------------                           *
*                                                                           *
*                       Bit 0: REVERSE                                      *
*                       Bit 1: STOPPED                                      *
*                       Bit 2: LIGHT ON                                     *
*                       Bit 3: REPLACE BATTERY (HVM)                        *
*                       Bit 4: BATTERY WEAK                                 *
*                       Bit 5: REPLACE BATTERY (TELEMETRY)                  *
*                       Bit 6: REPLY PENDING                                *
*                       Bit 7: SPARE BIT                                    *
*                                                                           *
*                        7  6  5  4  3  2  1  0                             *
*                       -------------------------                           *
*             ANNUNC+2: |  |  |  |  |  |  |  |  |                          *
*                       -------------------------                           *
*                                                                           *
*                       Bit 0: "VIEW" PUSHBUTTON LED                        *
*                       Bit 1: "SET" PUSHBUTTON LED                         *
*                       Bit 2: "ODOM" PUSHBUTTON LED                        *
*                       Bit 3: "DIM" PUSHBUTTON LED                         *
*                       Bit 4: "COMM TEST" PUSHBUTTON LED                   *
*                       Bit 5: SPARE                                        *
```

```
*                        Bit 6: SPARE                                          *
*                        Bit 7: SPARE                                          *
*                                                                              *
*                                                                              *
*                                                                              *
* OUTPUTS:       Output is to the bit stream buffer LEDBUFF defined in         *
*                Module B_STREAM.                                              *
*                                                                              *
*                                                                              *
* DESCRIPTION:   This driver decodes the bits at variables ANNUNC, ANNUNC+1,   *
*                and ANNUNC+2 as defined above, sets the respective bits in    *
*                LEDBUFF, and calls module B_STREAM to light the annunciators.*
*                                                                              *
*                Note: Although variable ANNUNC+2 is supported by this         *
*                      driver, it is not used since the pushbutton LEDs are    *
*                      hardwired to be permanently ON.                         *
*                                                                              *
* REVISIONS:     None.                                                         *
********************************************************************************
```

```
*****************************************************************************
*                                                                           *
*    MODULE NAME          :  NUM_DRVR.ASM                                   *
*    TITLE                :  NUMERIC DISPLAY DRIVER.                        *
*    AUTHOR               :  M. Mandl                                       *
*    REFERENCES           :  CDU FIRMWARE                                   *
*    RELEASE DATE         :  Marchr 12/91, Rev. 1.0                         *
*    DESCRIPTION          :  This driver takes the 8 bytes located at       *
*                            NUMBUFFER as defined above, decodes the binary *
*                            values, writes to the appropriate bits in      *
*                            LEDBUFF, and calls module B_STREAM to output to*
*                            the CDU's Numeric Display.                     *
*                                                                           *
*    INPUTS               :  Input to this driver is a 8 byte buffer located*
*                            at variable NUMBUFFER residing in external RAM.*
*                            This buffer is organized as follows:           *
*                                                                           *
*                                                                           *
*                                                                           *
*                               7                                   0       *
*                                ---------------------------------          *
*                               |      FUNCTION DIGIT 1 (MSD)     |         *
*                                ---------------------------------          *
*                               |      FUNCTION DIGIT 2           |         *
*                                ---------------------------------          *
*                               |      FUNCTION DIGIT 3           |         *
*                                ---------------------------------          *
*                               |      FUNCTION DIGIT 4           |         *
*                                ---------------------------------          *
*                               |      FUNCTION DIGIT 5 (LSD)     |         *
*                                ---------------------------------          *
*                               |      PRESSURE DIGIT 6 (MSD)     |         *
*                                ---------------------------------          *
*                               |      PRESSURE DIGIT 7           |         *
*                                ---------------------------------          *
*                               |      PRESSURE DIGIT 8 (LSD)     |         *
*                                ---------------------------------          *
*                                                                           *
*                         WHERE:                                            *
*                                                                           *
*                          BIT 0 - 3: BINARY 0 - 9 DISPLAYS CHARACTERS "0 -9".*
*                                     HEXADECIMAL "A" DISPLAYS "-" (DASH) CHAR.*
*                                     HEXADECIMAL "B" DISPLAYS BLANK CHARACTER.*
*                                     HEXADECIMAL "C" DISPLAYS BLANK CHARCATER.*
*                                     HEXADECIMAL "D" DISPLAYS BLANK CHARACTER.*
*                                     HEXADECIMAL "E" DISPLAYS "-" (DASH) CHAR.*
*                                     HEXADECIMAL "F" DISPLAYS BLANK CHARACTER.*
*                                                                           *
*                          BIT 4:     1 = DIGIT ON  |_  USED FOR FOR FLASHING.*
*                                     0 = DIGIT OFF |                       *
*                                                                           *
*                          BIT 5:     1 = DECIMAL POINT ON.                 *
*                                     0 = DECIMAL POINT OFF.                *
*                                                                           *
*                          BIT 6,7:   SPARE.                                *
```

```
*                                                                              *
*                                                                              *
*    OUTPUTS              :  Output is to Bit Stream Buffer LEDBUFF defined    *
*                            in module CDU_DB.                                 *
*                                                                              *
*                                                                              *
*                                                                              *
*    REVISION #           :  Rev. 2.0                                          *
*    REVISION DATE        :  June 22, 1992.                                    *
*    REVISION AUTHOR      :  Daniel Talbot                                     *
*    REFERENCES           :  Modified for blank ID numbers.                    *
*    REVISION DESCRIPTION :  Character 'E' of the following tables:            *
*                                                                              *
*                                    o  D1_MSKTAB,                             *
*                                    o  D2_MSKTAB,                             *
*                                    o  D3_MSKTAB,                             *
*                                    o  D4_MSKTAB,                             *
*                                    o  D5_MSKTAB,                             *
*                                    o  D6_MSKTAB,                             *
*                                    o  D7_MSKTAB,                             *
*                                    o  D8_MSKTAB.                             *
*                                                                              *
*                                  where changed from a BLANK to a DASH.       *
*                                                                              *
********************************************************************************
```

```
*****************************************************************************
* MODULE NAME:  SER_DRVR.ASM                                                *
*                                                                           *
* REVISION :    1.0                                                         *
*                                                                           *
* DATE:         July 3/91                                                   *
*                                                                           *
* PROGRAMMER:   M. Mandl                                                    *
*                                                                           *
* INPUTS:                                                                   *
*                                                                           *
* OUTPUTS:                                                                  *
*                                                                           *
* DESCRIPTION:  SER_DRVR is the serial port interrupt service driver. It    *
*               processes transmitter and receiver interrupts.              *
*                                                                           *
* REVISIONS:    None.                                                       *
*****************************************************************************
```