More Programming with CUPL

Compiling PLD File

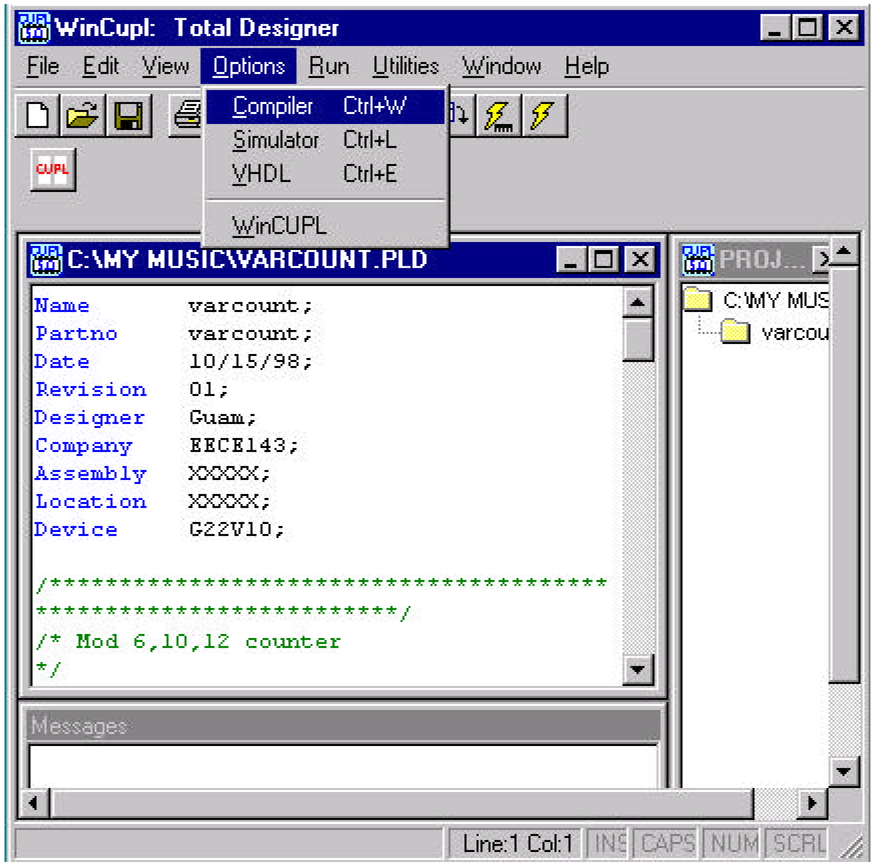
- Use WinCUPL or use another text editor to create your file
- Save your file with the extension .PLD
- Compile using WinCUPL make sure you have no errors.
- Save your .JED file on diskette

Using WinCUPL

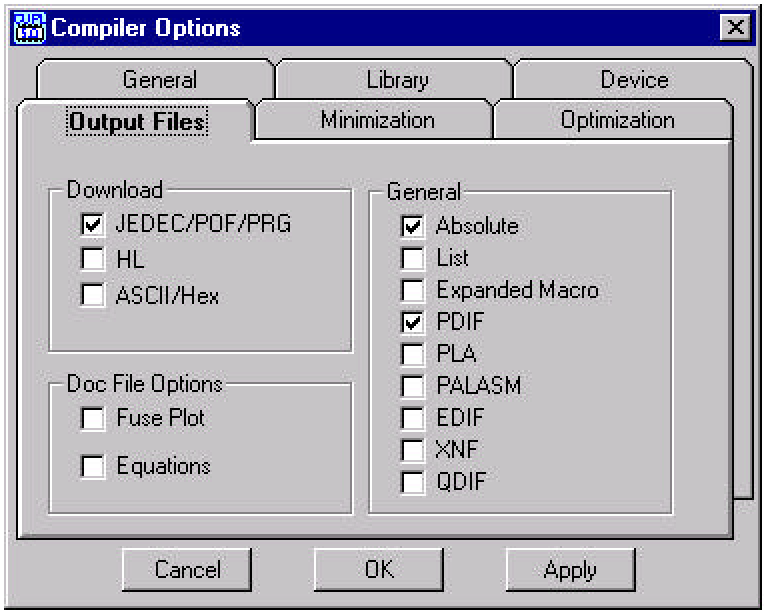
Located in Engineering Applications\ EECE\ Wincupl folder

After creating and editing your PLD file:

Open Options|Compiler menu item or type Ctrl+W



```
Name        varcount;
Partno      varcount;
Date        10/15/98;
Revision    01;
Designer    Guam;
Company     EECE143;
Assembly    XXXXX;
Location    XXXXX;
Device      G22V10;

/****************************************
**************************/
/* Mod 6,10,12 counter
*/
```



Compiler Options

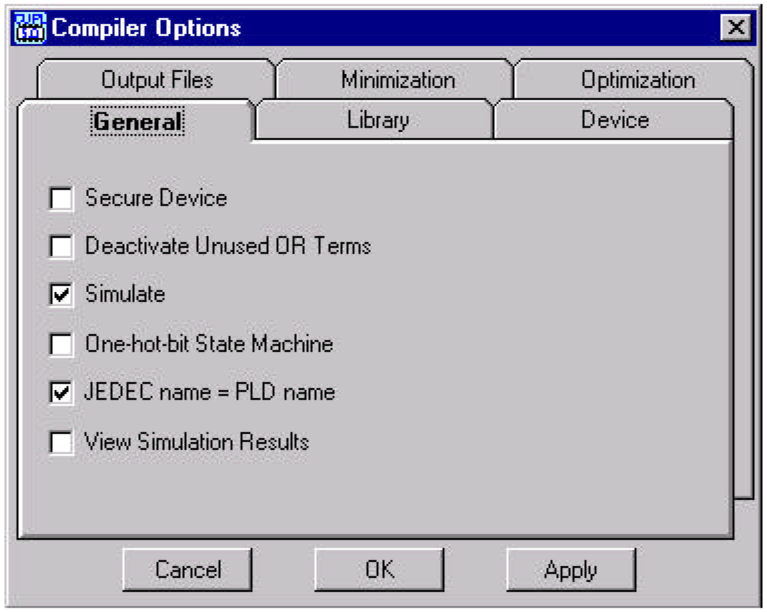
Output Files

Download
- [✓] JEDEC/POF/PRG
- [ ] HL
- [ ] ASCII/Hex

Doc File Options
- [ ] Fuse Plot
- [ ] Equations

General
- [✓] Absolute
- [ ] List
- [ ] Expanded Macro
- [✓] PDIF
- [ ] PLA
- [ ] PALASM
- [ ] EDIF
- [ ] XNF
- [ ] QDIF

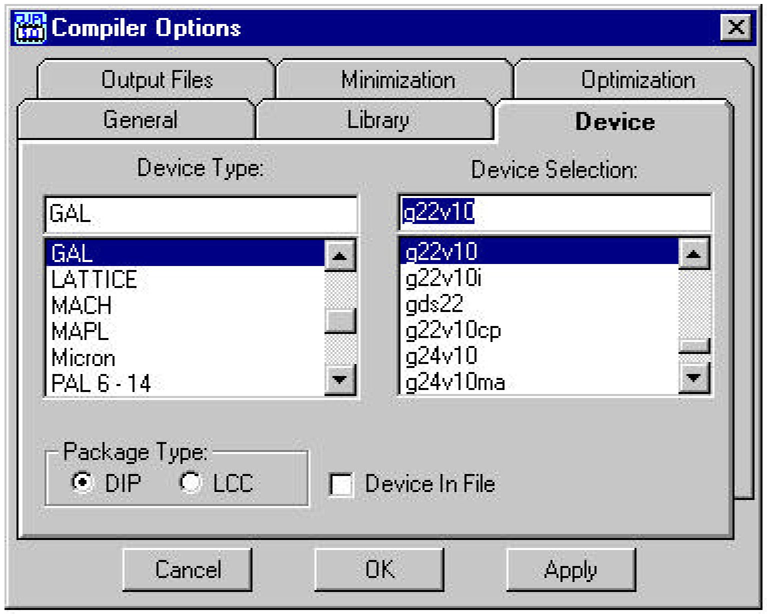
Select Download JEDEC/PDF/PRG



Compiler Options

General
- [ ] Secure Device
- [ ] Deactivate Unused OR Terms
- [✓] Simulate
- [ ] One-hot-bit State Machine
- [✓] JEDEC name = PLD name
- [ ] View Simulation Results

Select JEDEC name = PLD name



Device Type: GAL

- GAL
- LATTICE
- MACH
- MAPL
- Micron
- PAL 6 - 14

Device Selection: g22v10

- g22v10
- g22v10i
- gds22
- g22v10cp
- g24v10
- g24v10ma

Package Type: [✓ DIP] LCC

☐ Device In File

Select Device:

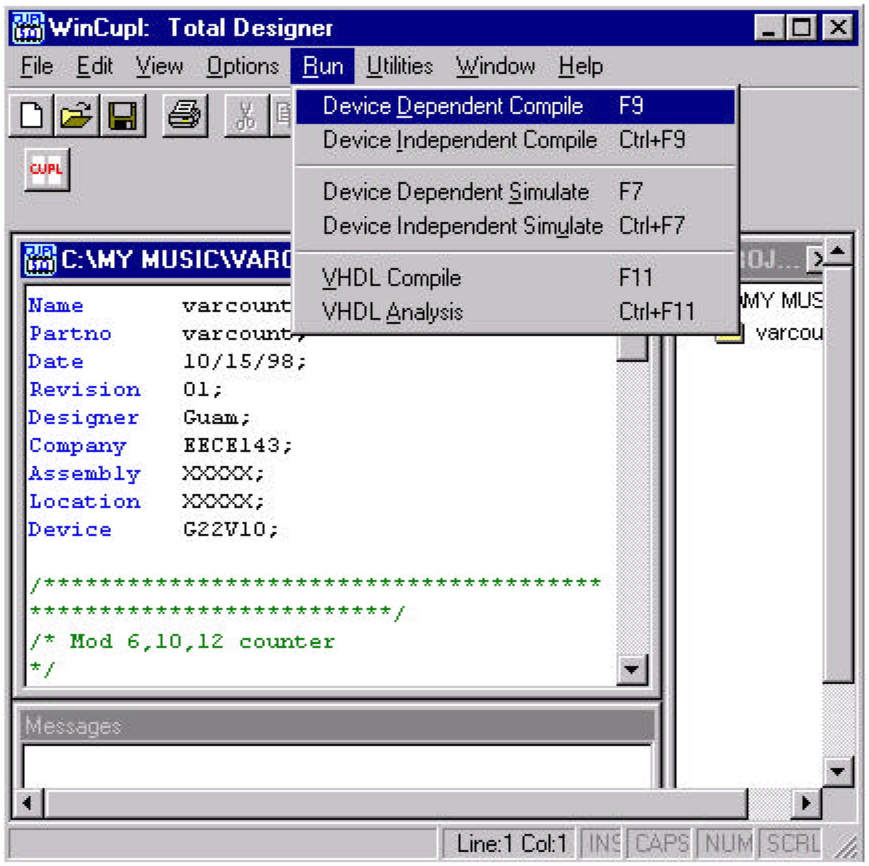
Either g16v8 for GAL16V8

Or g22v10 for GAL22V10

DIP Package

To compile your program, Select Run|Device Dependent Compile menu item

If you get errors, check the Messages window for error locations and make corrections to your code.

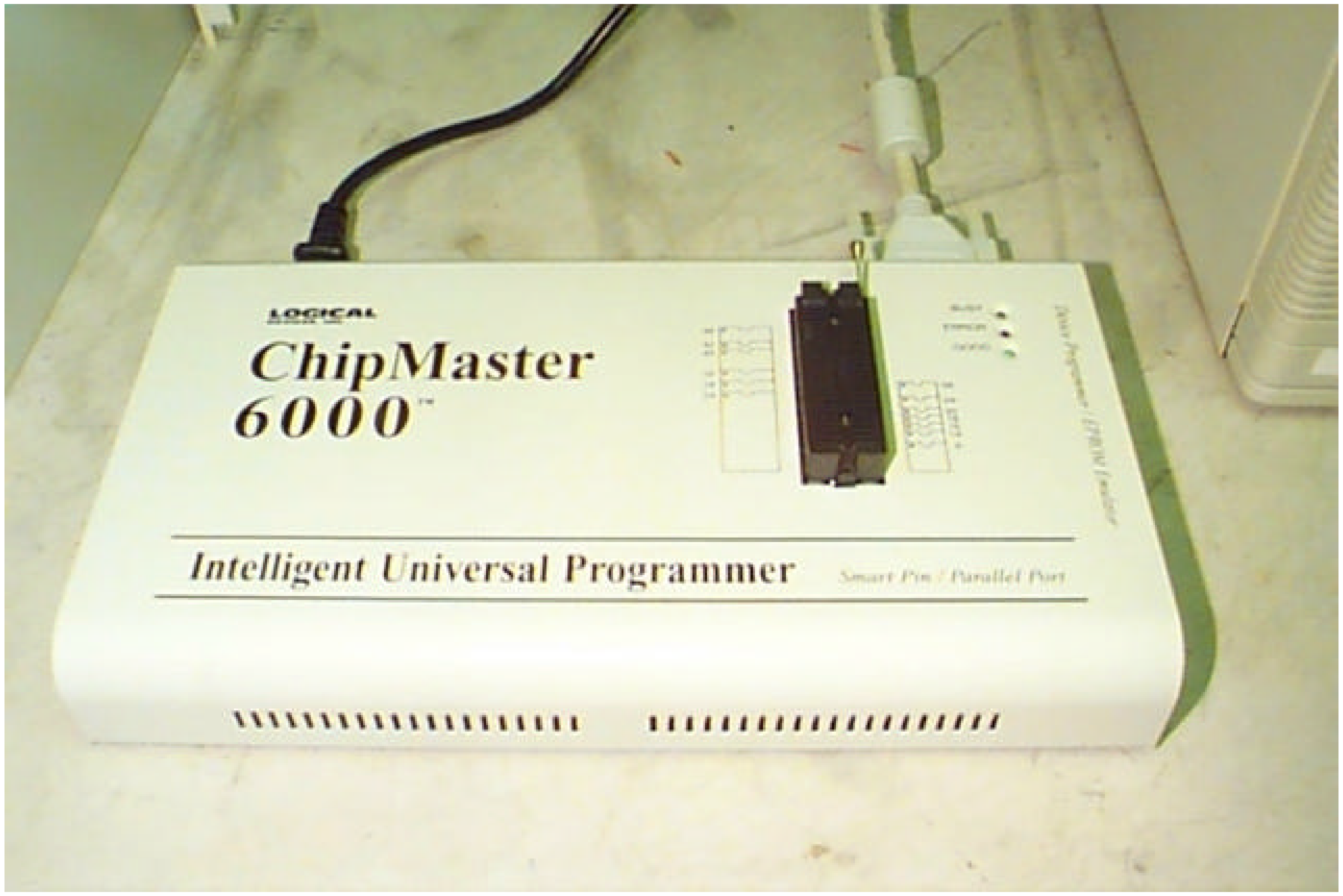

WinCupl: Total Designer
File Edit View Options Run Utilities Window Help
Device Dependent Compile F9
Device Independent Compile Ctrl+F9
Device Dependent Simulate F7
Device Independent Simulate Ctrl+F7
VHDL Compile F11
VHDL Analysis Ctrl+F11
C:\MY MUSIC\VARC
Messages
Line:1 Col:1 INS CAPS NUM SCRL

```
Name       varcount
Partno     varcount;
Date       10/15/98;
Revision   01;
Designer   Guam;
Company    EECE143;
Assembly   XXXXX;
Location   XXXXX;
Device     G22V10;

/*****************************************
**************************/
/* Mod 6,10,12 counter
*/
```

Programming PLD File

- Use Allpro programmer in EN365 or the ChipMaster 88 Programmers in the digital lab or the EECE Open Lab
- Be sure to follow instructions for programming for each programmer.

ChipMaster 6000
Intelligent Universal Programmer

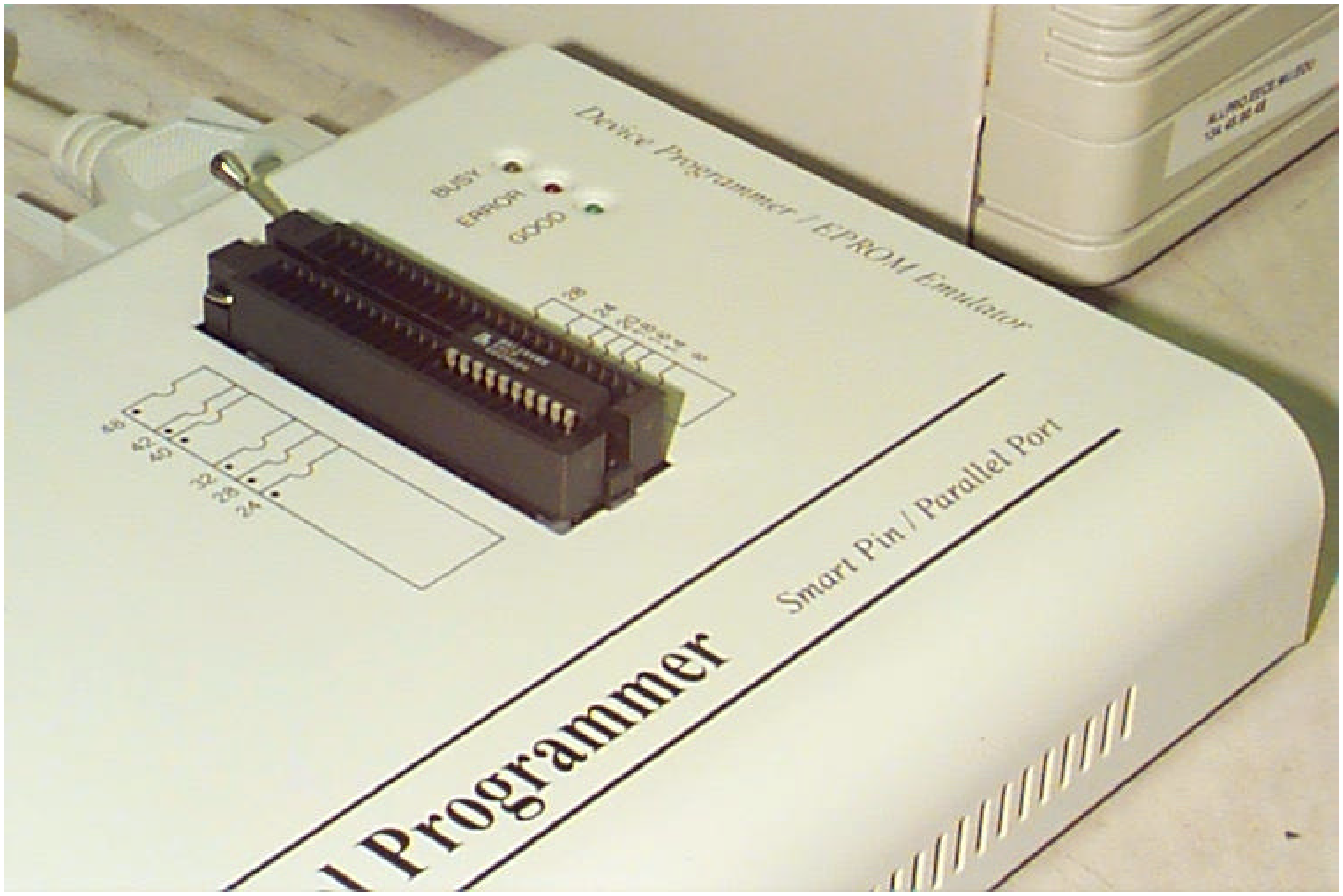


Using the CM6000 Universal Programmer

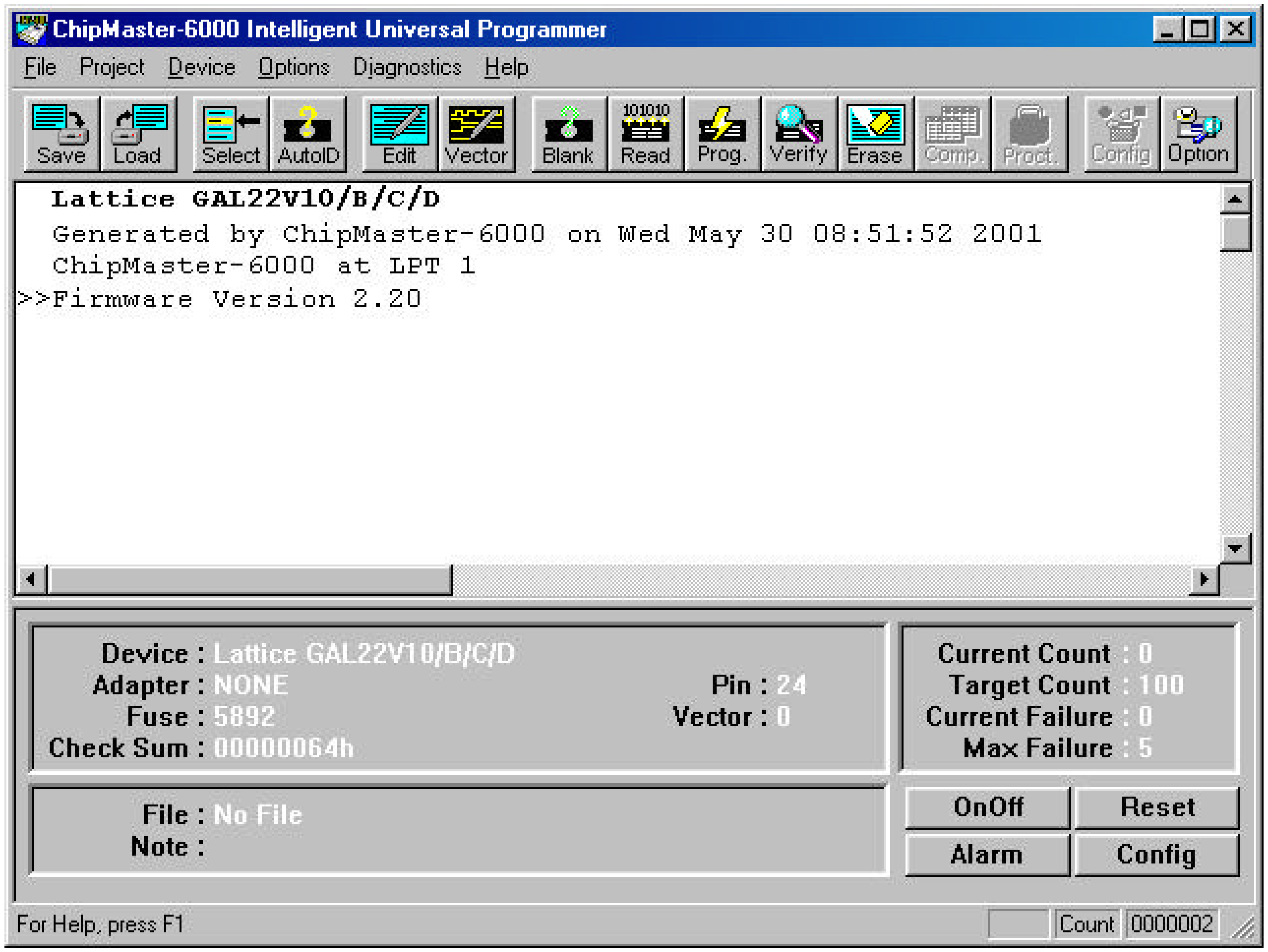
1. Load the device
2. Select a device
3. Perform Blank Check
4. Erase device
5. Read jedec file
6. Program device
7. Verify

Insert Device into the socket

1. Make sure the busy light is off.
2. Lift the lever of the ZIF socket up.
3. Insert the device. Align the device with the bottom of the socket with pin 1 facing the top of the socket.
4. Press the lever of the ZIF socket down.



Startup


ChipMaster-6000 Intelligent Universal Programmer
File Project Device Options Diagnostics Help
Save Load Select AutoID Edit Vector Blank Read Prog. Verify Erase Comp. Proct. Config Option

```
  Lattice GAL22V10/B/C/D
  Generated by ChipMaster-6000 on Wed May 30 08:51:52 2001
  ChipMaster-6000 at LPT 1
>>Firmware Version 2.20
```

Device : Lattice GAL22V10/B/C/D
Adapter : NONE
Fuse : 5892
Check Sum : 00000064h
Pin : 24
Vector : 0

Current Count : 0
Target Count : 100
Current Failure : 0
Max Failure : 5

File : No File
Note :

For Help, press F1
Count 0000002

Select Device

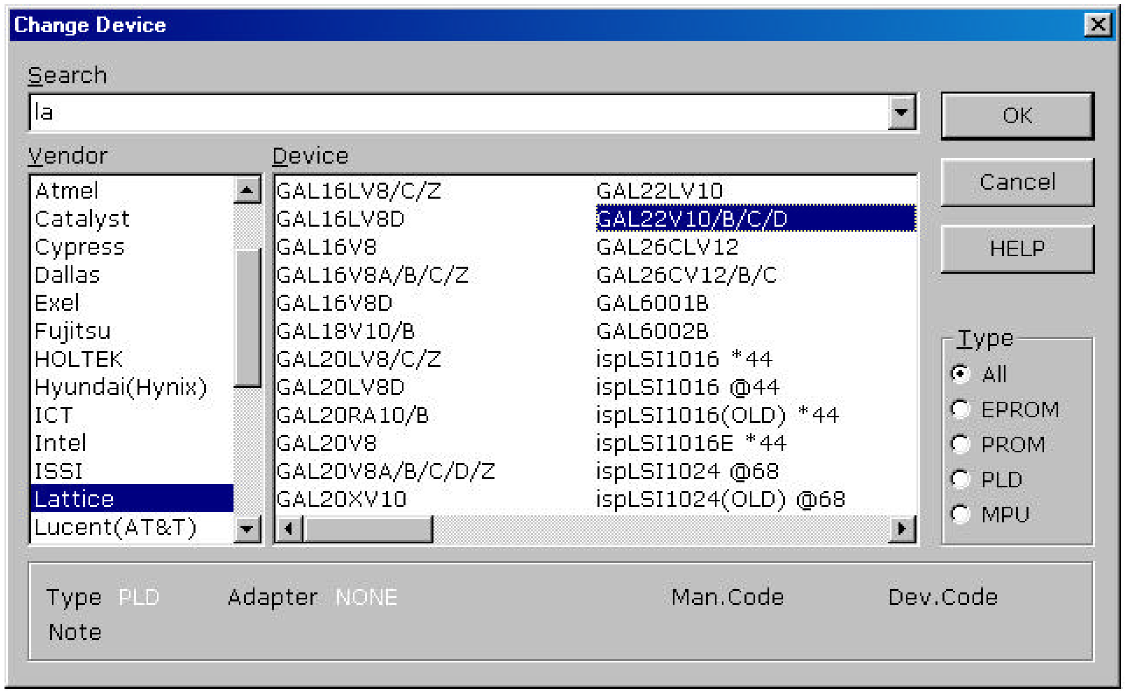
1. Type ALT-C or Select the Device|Change Device menu item.
2. Select the device required:

   Use the mouse: Click on 'All', EPROM', 'PROM', 'PLD', or 'MPU'

   Use the keyboard: Press TAB until the cursor is flashing in the 'Type' box. Use the up and down arrows to go to the appropriate type. Press the space bar to select the type.
3. Enter the part number in the 'Search' box.

   Use mouse: Click on 'Search'

   Use keyboard: Press TAB until the cursor flashes in the 'Search' box. Type in the part number.
4. Use the mouse to select a vendor.
5. Select a device and click 'OK. Use the TAB key to skip between various screens, use the arrow keys to move around each screen. Press <ENTER> to select the vendor/device.



Search: la

Vendor: Atmel, Catalyst, Cypress, Dallas, Exel, Fujitsu, HOLTEK, Hyundai(Hynix), ICT, Intel, ISSI, Lattice (selected), Lucent(AT&T)

Device: GAL16LV8/C/Z, GAL16LV8D, GAL16V8, GAL16V8A/B/C/Z, GAL16V8D, GAL18V10/B, GAL20LV8/C/Z, GAL20LV8D, GAL20RA10/B, GAL20V8, GAL20V8A/B/C/D/Z, GAL20XV10, GAL22LV10, GAL22V10/B/C/D (selected), GAL26CLV12, GAL26CV12/B/C, GAL6001B, GAL6002B, ispLSI1016 *44, ispLSI1016 @44, ispLSI1016(OLD) *44, ispLSI1016E *44, ispLSI1024 @68, ispLSI1024(OLD) @68

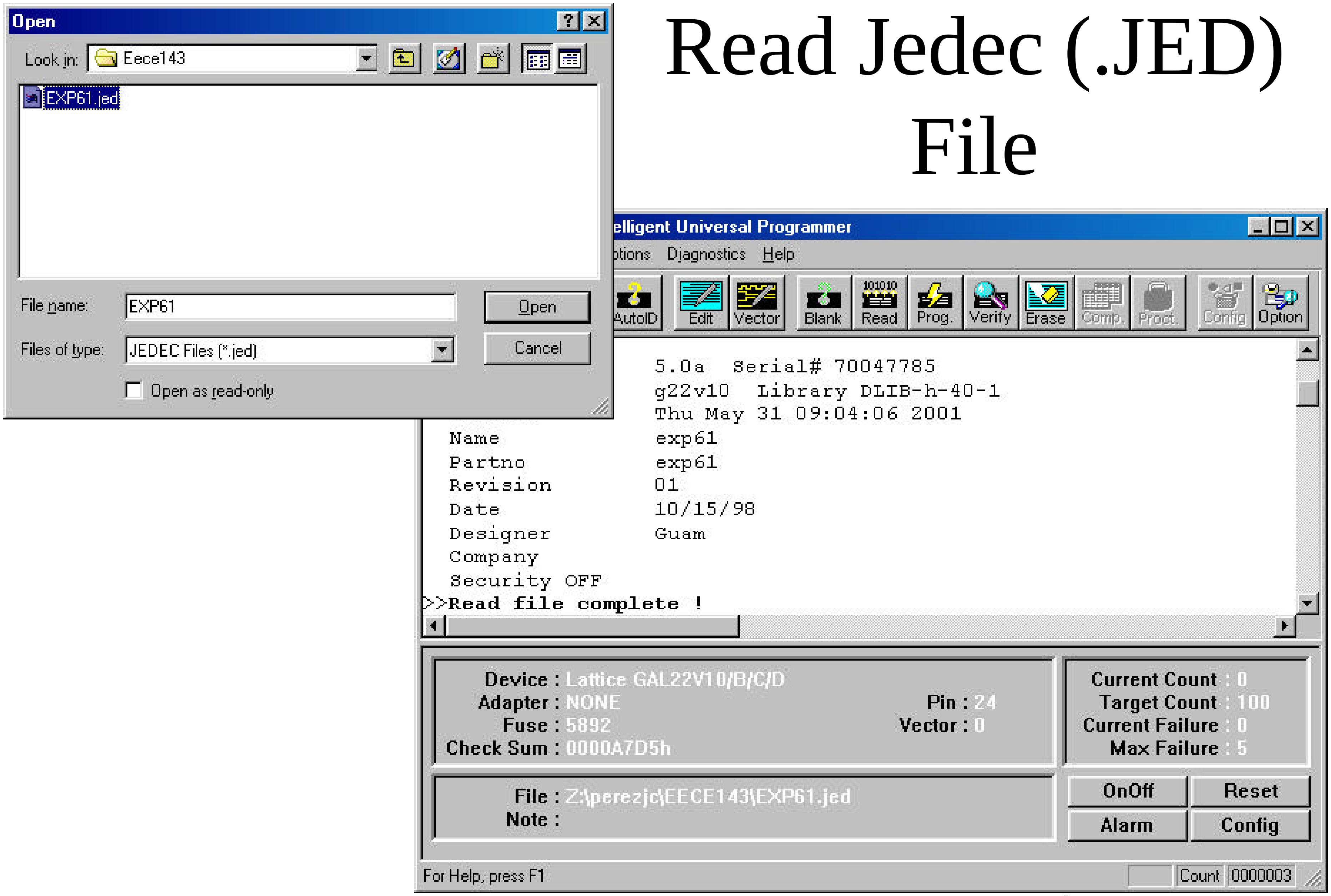
Type: [✓ All] EPROM PROM PLD MPU

Type PLD Adapter NONE Man.Code Dev.Code
Note

Load File into Memory

1. Press ALT-L for Load File or select the File|Load File menu item.
2. Press <TAB> to move the cursor to the list of files in the default directory
3. Select a file with the up and down arrow keys.
4. Press <ENTER>.
5. Select a file type with the up and down arrow keys. You want to select a jedec (.JED) file
6. Press <ENTER> to load the file.

Read Jedec (.JED) File


Open
Look in: Eece143
EXP61.jed
File name: EXP61
Files of type: JEDEC Files (*.jed)
Open
Cancel
Open as read-only
elligent Universal Programmer
ptions Diagnostics Help
AutoID Edit Vector Blank Read Prog. Verify Erase Comp. Proct. Config Option

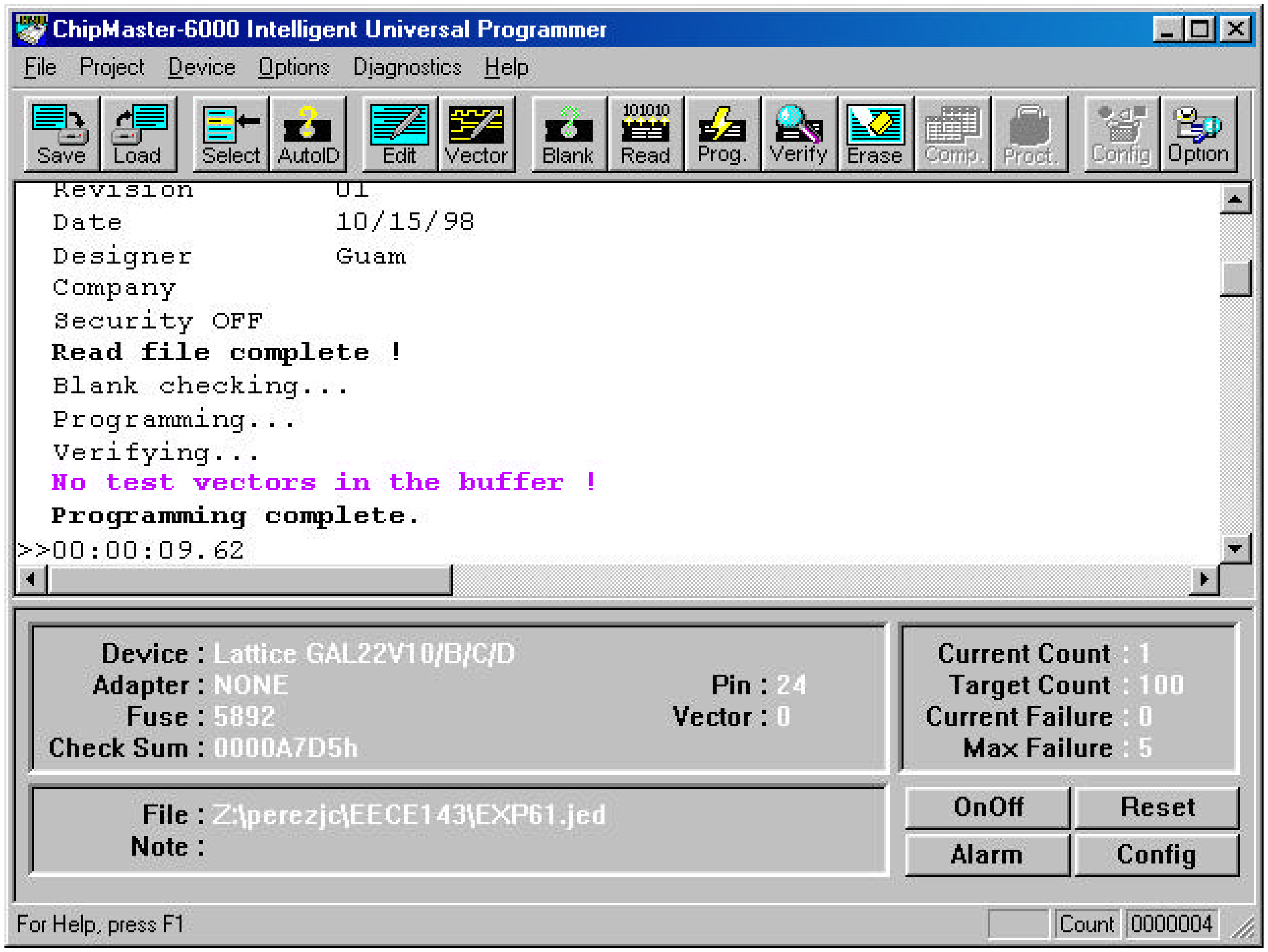
```
                            5.0a   Serial# 70047785
                            g22v10   Library DLIB-h-40-1
                            Thu May 31 09:04:06 2001
  Name                      exp61
  Partno                    exp61
  Revision                  01
  Date                      10/15/98
  Designer                  Guam
  Company
  Security OFF
>>Read file complete !
```

Device : Lattice GAL22V10/B/C/D
Adapter : NONE Pin : 24
Fuse : 5892 Vector : 0
Check Sum : 0000A7D5h

Current Count : 0
Target Count : 100
Current Failure : 0
Max Failure : 5

File : Z:\perezjc\EECE143\EXP61.jed
Note :

Program Device


ChipMaster-6000 Intelligent Universal Programmer
File Project Device Options Diagnostics Help
Save Load Select AutoID Edit Vector Blank Read Prog. Verify Erase Comp. Proct. Config Option
OnOff Reset Alarm Config

```
  Revision          01
  Date              10/15/98
  Designer          Guam
  Company
  Security OFF
  Read file complete !
  Blank checking...
  Programming...
  Verifying...
  No test vectors in the buffer !
  Programming complete.
>>00:00:09.62
```

Device : Lattice GAL22V10/B/C/D
Adapter : NONE Pin : 24
Fuse : 5892 Vector : 0
Check Sum : 0000A7D5h

Current Count : 1
Target Count : 100
Current Failure : 0
Max Failure : 5

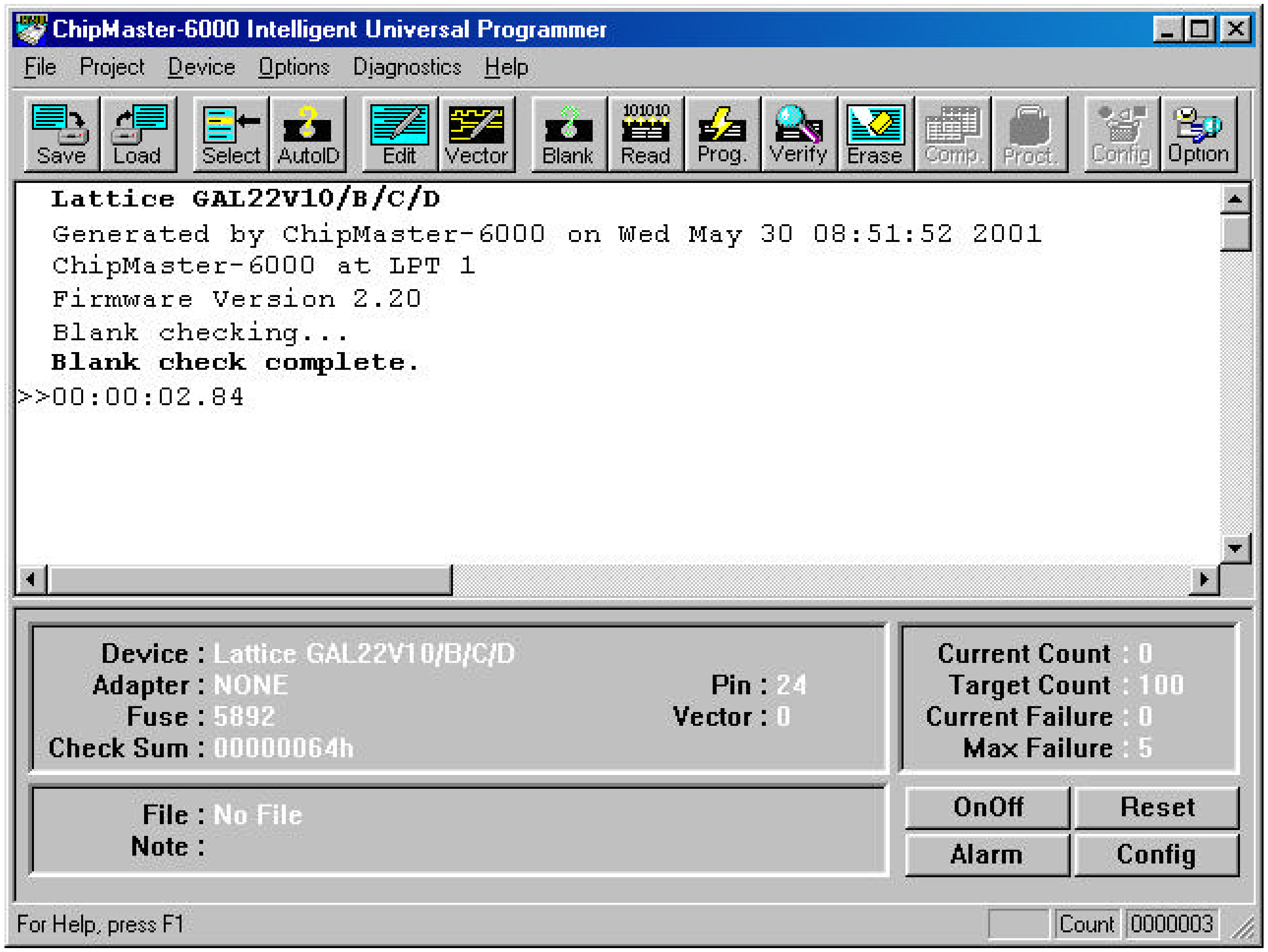
File : Z:\perezjc\EECE143\EXP61.jed
Note :

For Help, press F1 Count 0000004

Blank check the device

Insert the device in the socket.

1. Select the device algorithm.
2. Press the ALT-B.


ChipMaster-6000 Intelligent Universal Programmer
File Project Device Options Diagnostics Help
Save Load Select AutoID Edit Vector Blank Read Prog. Verify Erase Comp. Proct. Config Option

```
 Lattice GAL22V10/B/C/D
 Generated by ChipMaster-6000 on Wed May 30 08:51:52 2001
 ChipMaster-6000 at LPT 1
 Firmware Version 2.20
 Blank checking...
 Blank check complete.
>>00:00:02.84
```

Device : Lattice GAL22V10/B/C/D
Adapter : NONE
Fuse : 5892
Check Sum : 00000064h
Pin : 24
Vector : 0
Current Count : 0
Target Count : 100
Current Failure : 0
Max Failure : 5
File : No File
Note :

OnOff Reset Alarm Config
For Help, press F1
Count 0000003

Erase the device

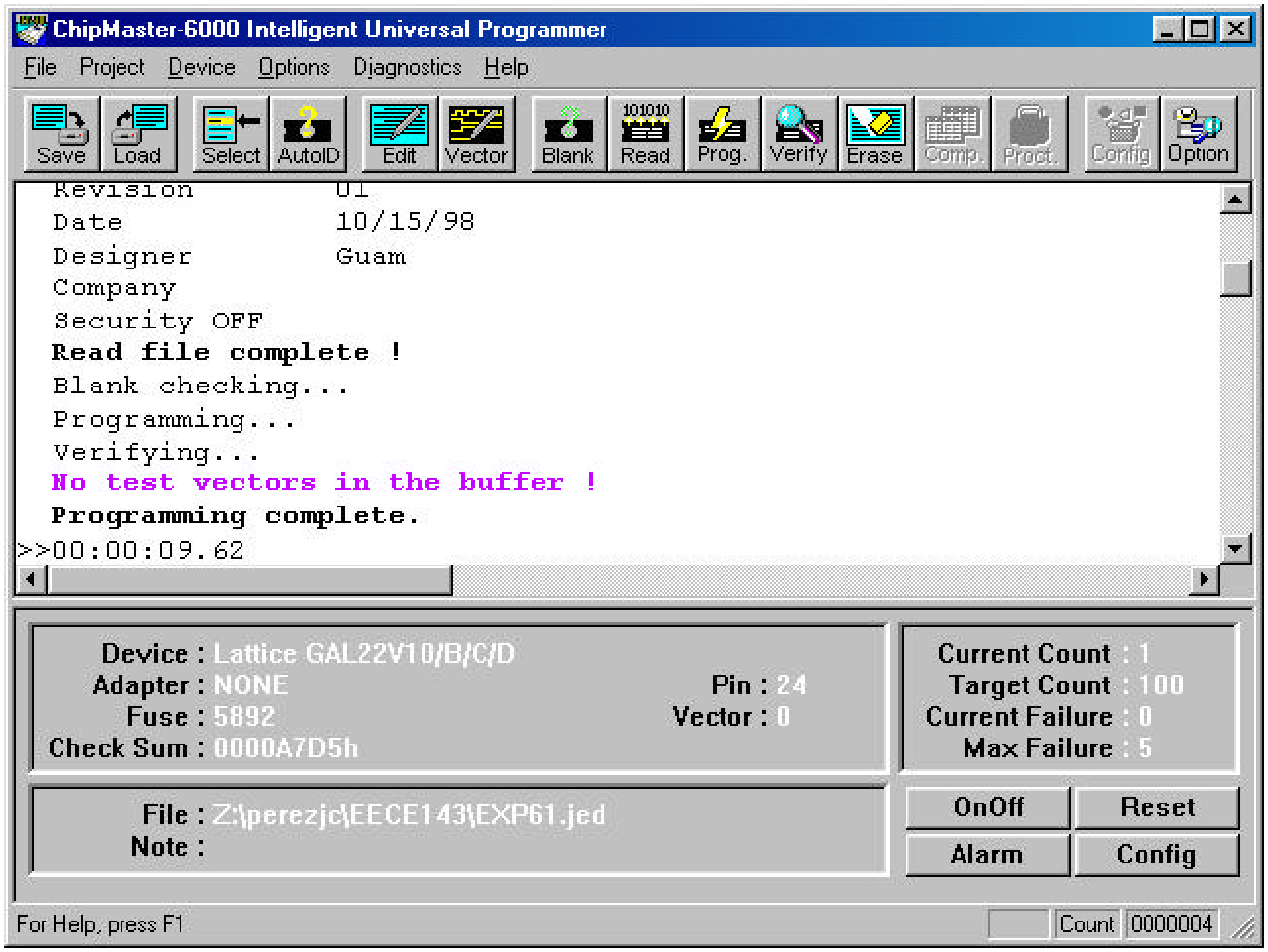
This option is only available for devices that support chip erase.

1. Insert the device in the socket.
2. Select the device algorithm.
3. Press CTRL-F1
4. Click OK at the Are you sure you want to erase the device?

Program the device

Before you program the device you have to load the file into memory.

1. Insert device into the socket.
2. Select the device algorithm.
3. Press ALT-P. or Click on the Prog. Button.


ChipMaster-6000 Intelligent Universal Programmer
File Project Device Options Diagnostics Help
Save Load Select AutoID Edit Vector Blank Read Prog. Verify Erase Comp. Prot. Config Option

```
Revision              01
Date                  10/15/98
Designer              Guam
Company
Security OFF
Read file complete !
Blank checking...
Programming...
Verifying...
No test vectors in the buffer !
Programming complete.
>>00:00:09.62
```

Device : Lattice GAL22V10/B/C/D
Adapter : NONE
Fuse : 5892
Check Sum : 0000A7D5h
Pin : 24
Vector : 0
Current Count : 1
Target Count : 100
Current Failure : 0
Max Failure : 5
File : Z:\perezjc\EECE143\EXP61.jed
Note :

Verify the device

1. If the device is not inserted, insert it into the socket.
2. Select the device algorithm.

   The CM6000 verifies the device with the contents of the memory buffer. If the correct file is not loaded, load it now.
3. Press ALT-V.

After programming, the CM6000 automatically verifies.

You are done programming your chip.

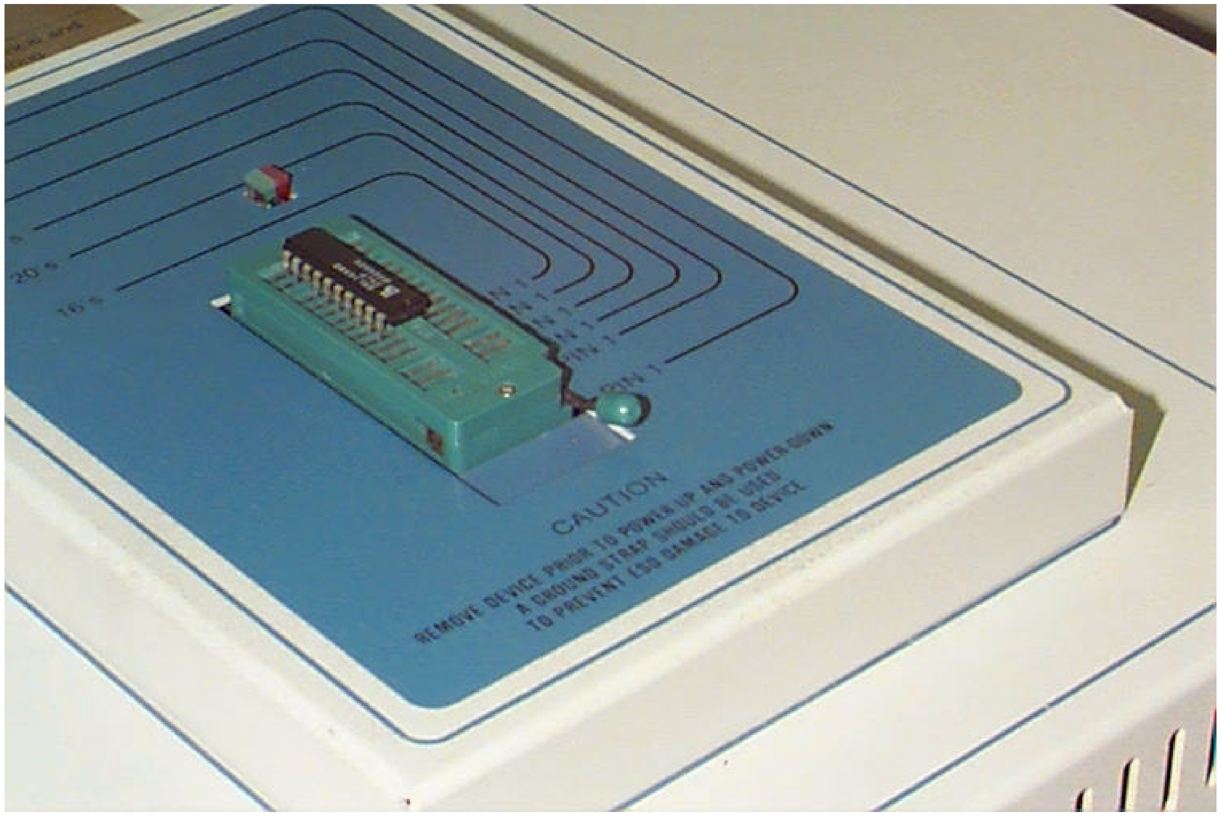
AllPro 88 Programmer

Using the AllPro 88 Programmer

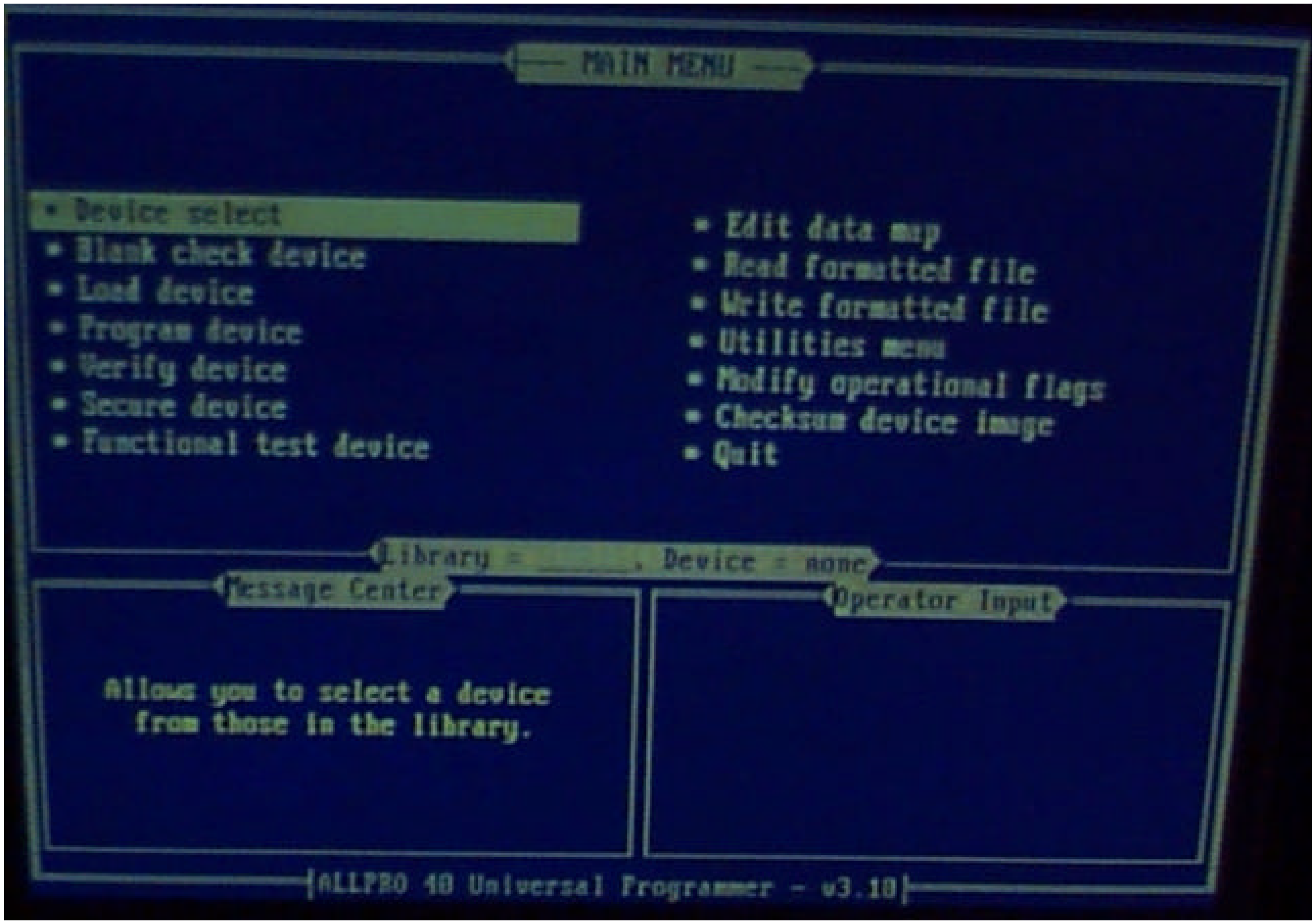
- Load Device into programmer
- Choose Library and Device from library
- Blank Check Device (optional)
- Read Jed file
- Program Device

Load Device in Programmer

Place chip so Pin 1 faces front of programmer.

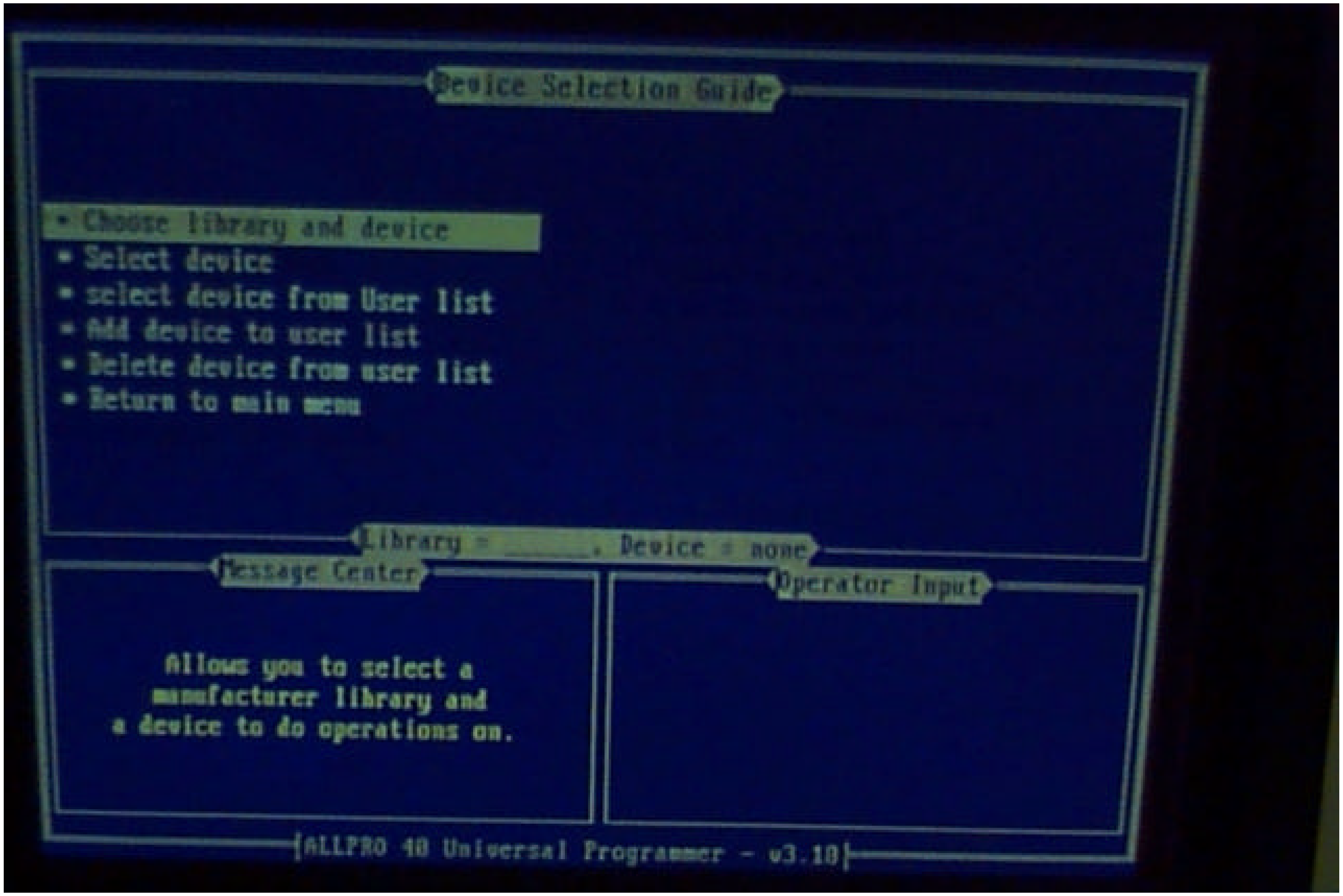

20's
16's
PIN 1
PIN 1
CAUTION
REMOVE DEVICE PRIOR TO POWER UP AND POWER-DOWN
A GROUND STRAP SHOULD BE USED
TO PREVENT ESD DAMAGE TO DEVICE

Choose Library and Device from library



Allows you to select a device from those in the library.

Choose Library and Device from library



Device Selection Guide

- Choose library and device
- Select device
- select device from User list
- Add device to user list
- Delete device from user list
- Return to main menu

Library = ______, Device = none

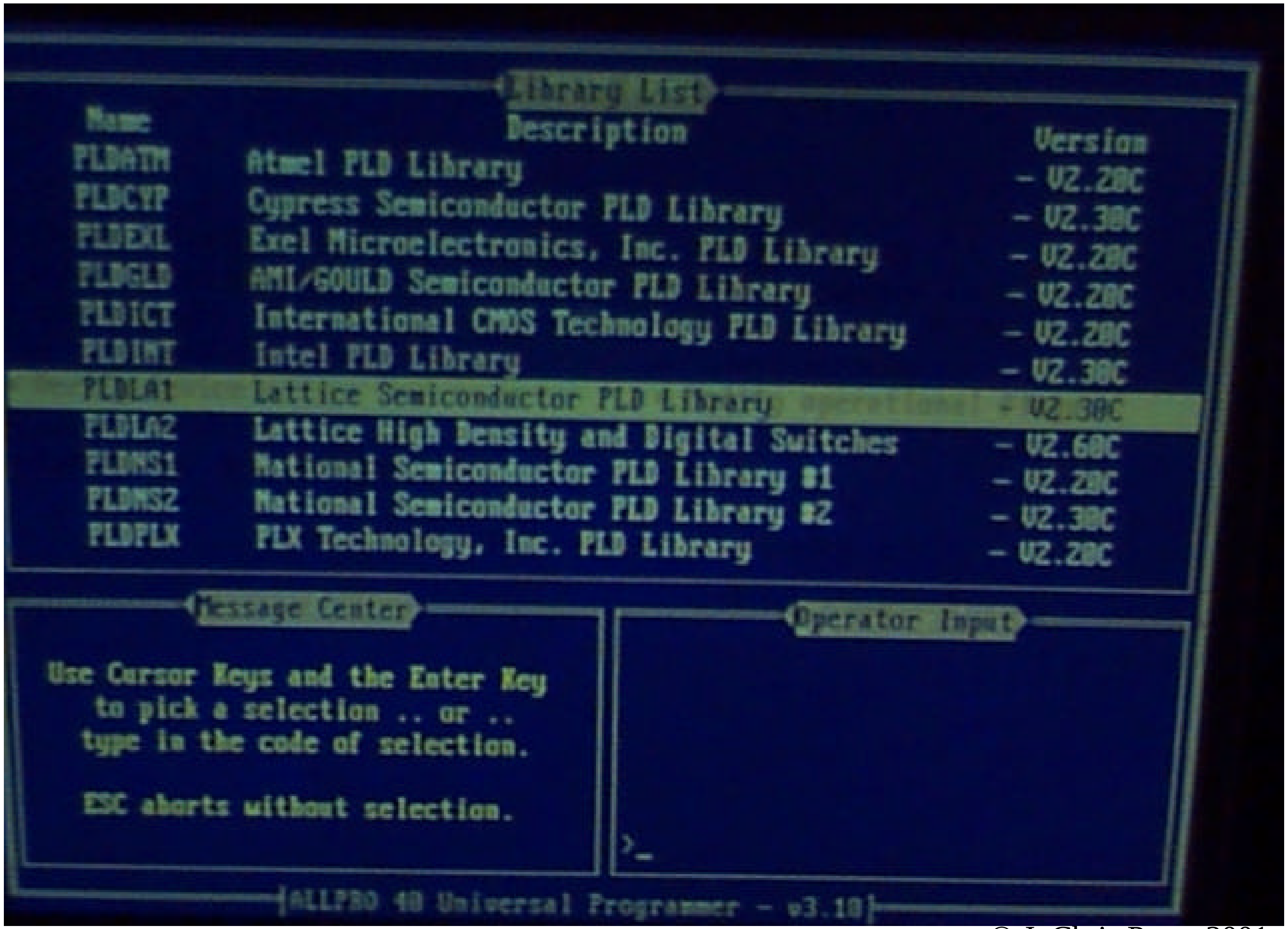
Message Center

Allows you to select a
manufacturer library and
a device to do operations on.

Operator Input

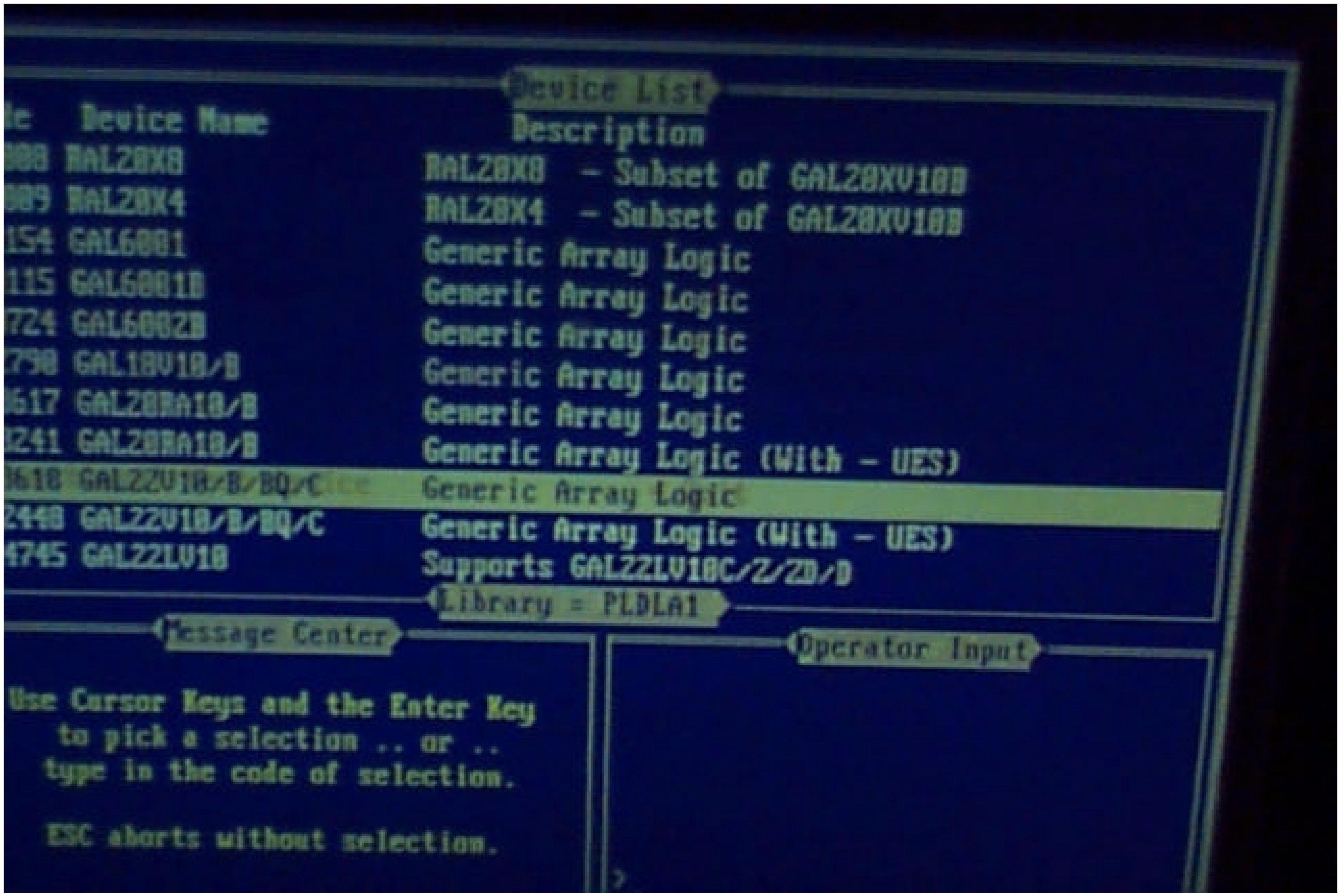
ALLPRO 40 Universal Programmer - v3.10

Choose Library …



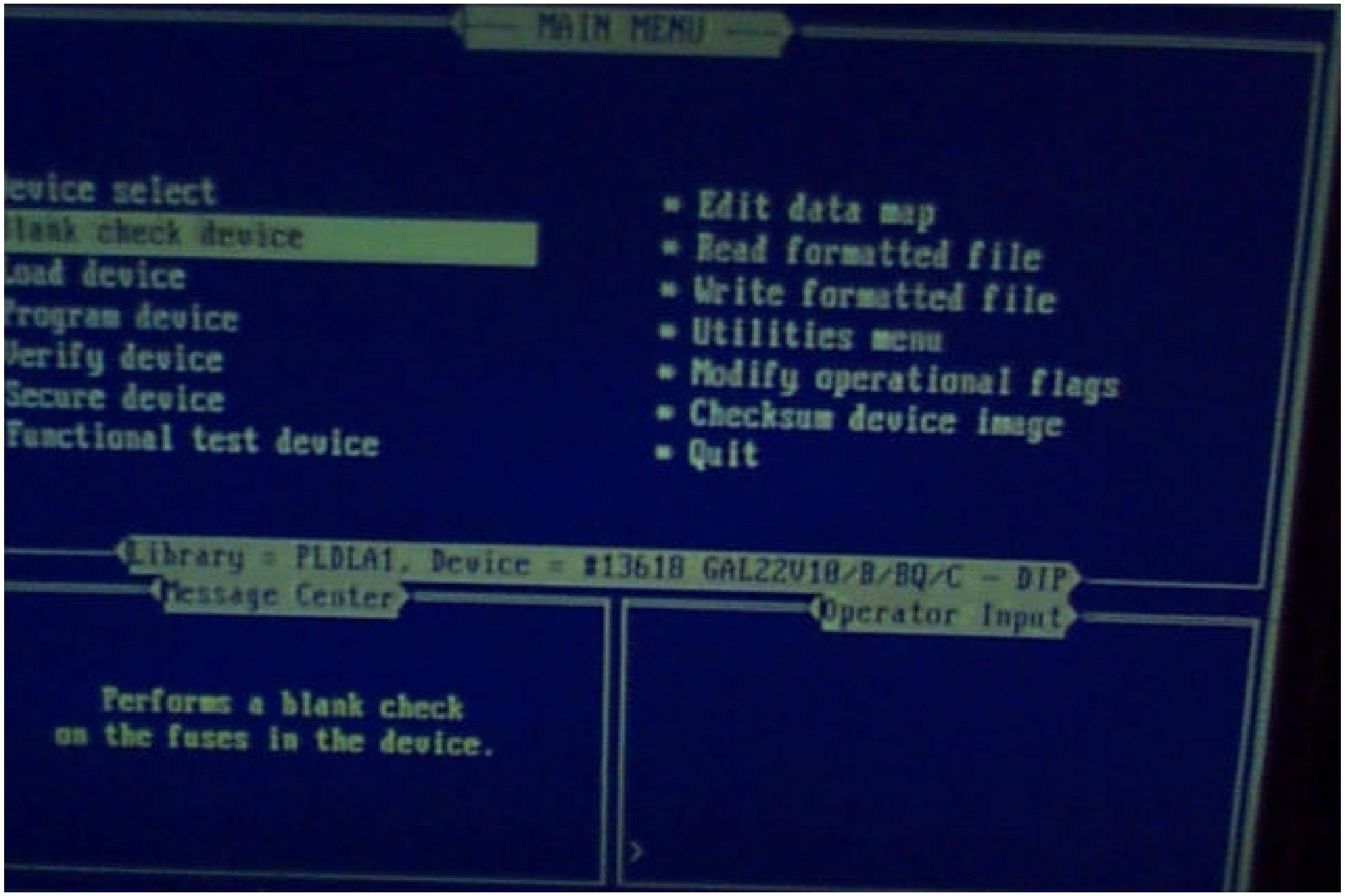
```
                            Library List
Name                        Description                                       Version
PLDATM   Atmel PLD Library                                                   - V2.20C
PLDCYP   Cypress Semiconductor PLD Library                                   - V2.30C
PLDEXL   Exel Microelectronics, Inc. PLD Library                             - V2.20C
PLDGLD   AMI/GOULD Semiconductor PLD Library                                 - V2.20C
PLDICT   International CMOS Technology PLD Library                           - V2.20C
PLDINT   Intel PLD Library                                                   - V2.30C
PLDLA1   Lattice Semiconductor PLD Library [illegible]                       - V2.30C
PLDLA2   Lattice High Density and Digital Switches                           - V2.60C
PLDNS1   National Semiconductor PLD Library #1                               - V2.20C
PLDNS2   National Semiconductor PLD Library #2                               - V2.30C
PLDPLX   PLX Technology, Inc. PLD Library                                    - V2.20C

        Message Center                              Operator Input

Use Cursor Keys and the Enter Key
  to pick a selection .. or ..
 type in the code of selection.

 ESC aborts without selection.
                                              >_

                 ALLPRO 40 Universal Programmer - v3.10
```

Choose Device …



```
                         Device List
de   Device Name            Description
008 RAL20X8            RAL20X8  - Subset of GAL20XV10B
009 RAL20X4            RAL20X4  - Subset of GAL20XV10B
154 GAL6001            Generic Array Logic
115 GAL6001B           Generic Array Logic
724 GAL6002B           Generic Array Logic
790 GAL18V10/B         Generic Array Logic
617 GAL20RA10/B        Generic Array Logic
241 GAL20RA10/B        Generic Array Logic (With - UES)
618 GAL22V10/B/BQ/C    Generic Array Logic
2448 GAL22V10/B/BQ/C   Generic Array Logic (With - UES)
4745 GAL22LV10         Supports GAL22LV10C/2/2D/D
                      Library = PLDLA1
Message Center                            Operator Input
Use Cursor Keys and the Enter Key
  to pick a selection .. or ..
 type in the code of selection.

 ESC aborts without selection.
                                          >
```

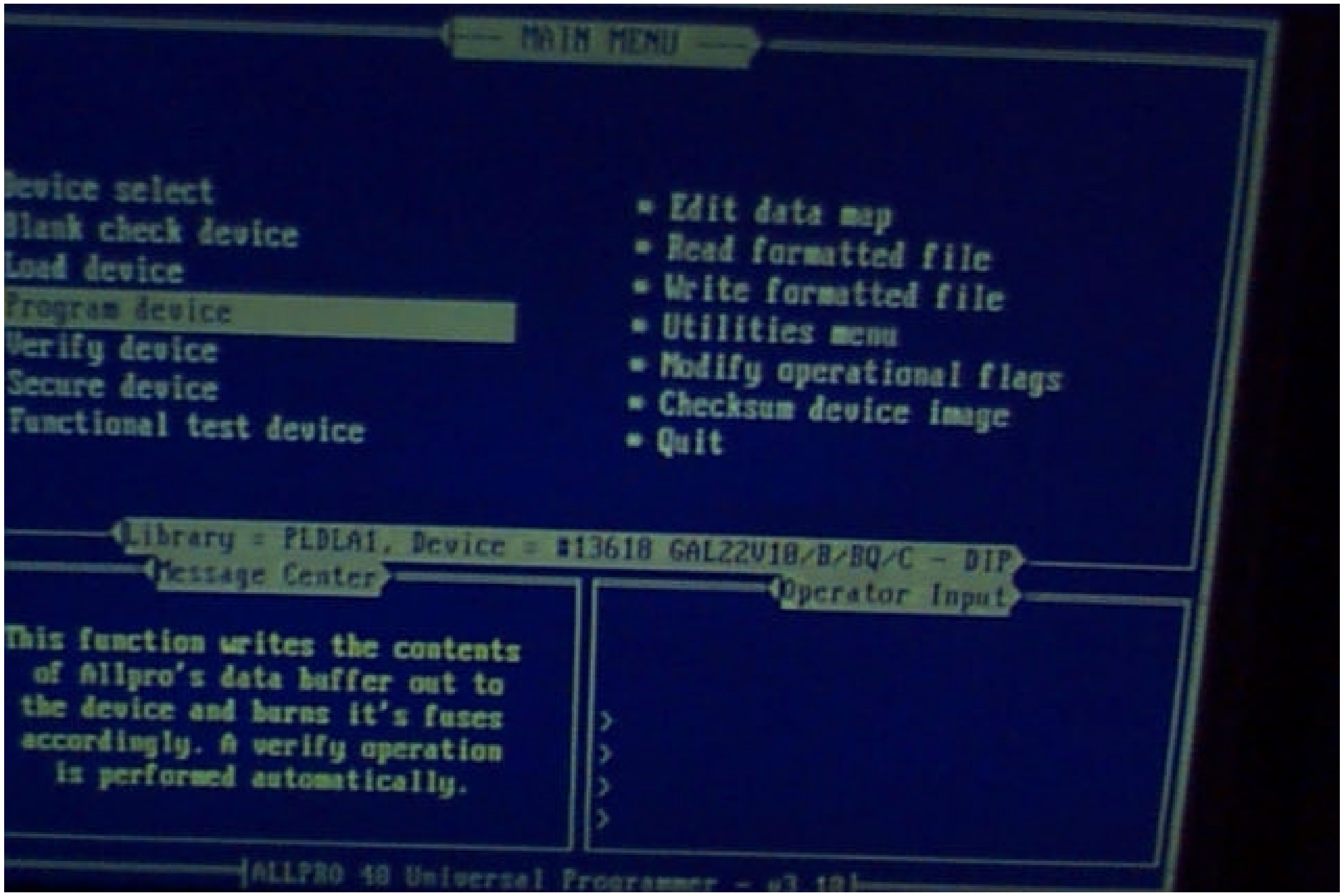
Blank Check Device (optional)



Performs a blank check
on the fuses in the device.

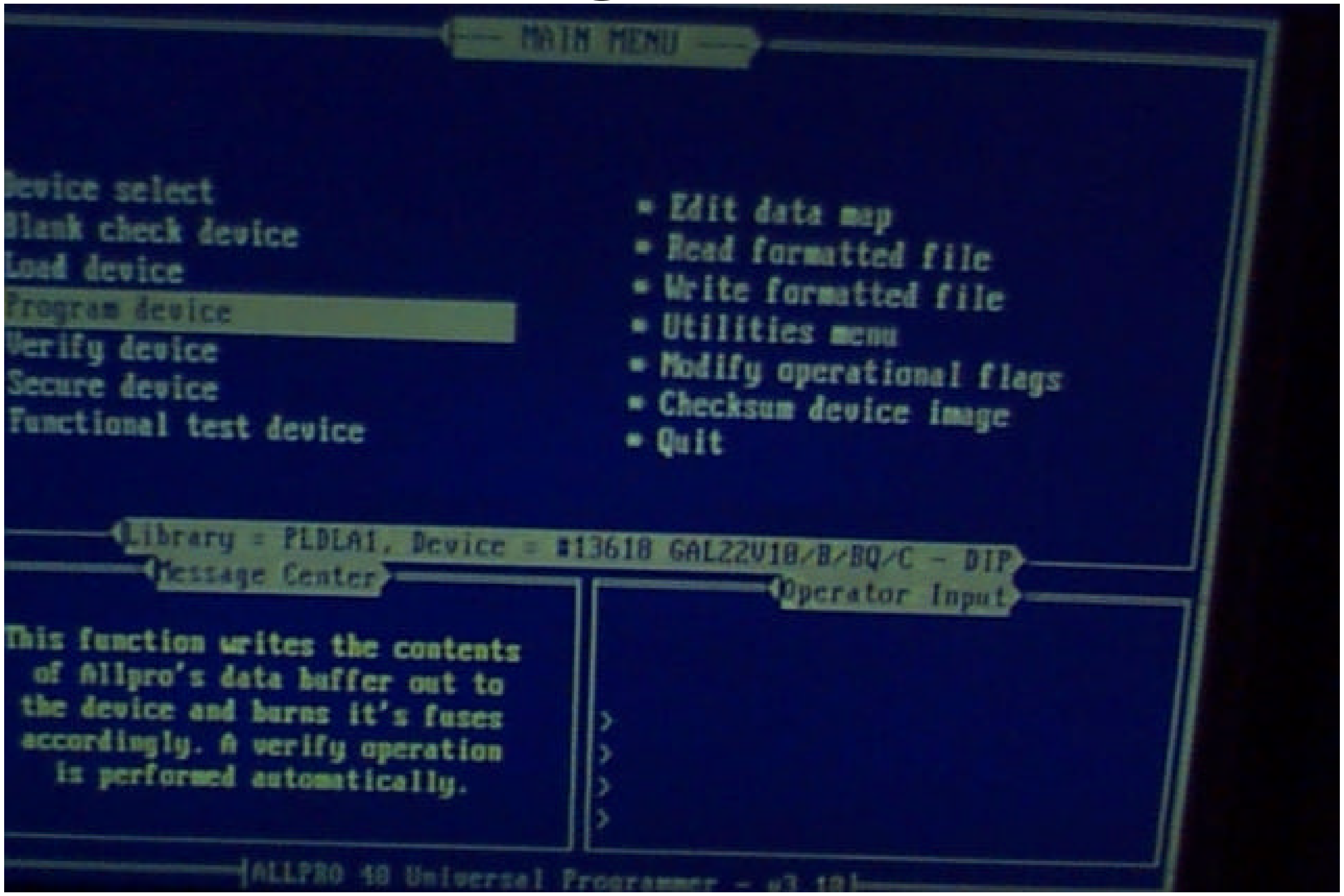
Read formatted File …

Select your .jed file from your floppy diskette



This function writes the contents of Allpro's data buffer out to the device and burns it's fuses accordingly. A verify operation is performed automatically.

Program Device …



```
── MAIN MENU ──

evice select                      * Edit data map
lank check device                 * Read formatted file
Load device                       * Write formatted file
Program device                    * Utilities menu
Verify device                     * Modify operational flags
Secure device                     * Checksum device image
Functional test device            * Quit

Library = PLDLA1, Device = #13618 GAL22V10/B/BQ/C - DIP
Message Center                    Operator Input

This function writes the contents
  of Allpro's data buffer out to
 the device and burns it's fuses   >
 accordingly. A verify operation   >
    is performed automatically.    >
                                   >
ALLPRO 40 Universal Programmer - v3.10
```

… and you are done.

HEX7SEG.PLD

```
Name       hex7seg;
Partno     XXXXX;
Date       03/15/01;
Revision   01;
Designer   J. Chris Perez;
Company    EECE143;
Assembly   XXXXX;
Location   XXXXX;
Device     GAL16V8;

/*******************************************************************/
/* This program takes a 4-bit HEX number input and outputs         */
/* the necessary signals to drive a 7-segment display              */
/*                                                                 */
/*******************************************************************/
/*  Allowable Target Device Types:                                 */
/*******************************************************************/
```

Input	Output
0000	0
0001	1
0010	2
0011	3
…	
1010	A
1011	b
1100	c
1101	d
1110	e
1111	F

```
/**  Inputs  **/

Pin 1 = W;      /*  Msb of HEX input    */
Pin 2 = X;      /*                      */
Pin 3 = Y;      /*                      */
Pin 4 = Z;      /*   Lsb of HEX input   */

/**  Outputs  **/

Pin 19 = a;     /*  Output Segments for 7-segment Display  */
Pin 18 = b;     /*                      */
Pin 17 = c;     /*                      */
Pin 16 = d;     /*                      */
Pin 15 = e;     /*                      */
Pin 14 = f;     /*                      */
Pin 13 = g;     /*                      */
```

Programmable Logic Devices II

```
/**  Logic Equations  **/
FIELD INPUT = [W,X,Y,Z];  /* Defines input array    */

FIELD OUTPUT = [a,b,c,d,e,f,g]; /* Defines output array */

TABLE INPUT => OUTPUT {
'b'0000 => 'b'0000001;
'b'0001 => 'b'1001111;
'b'0010 => 'b'0010010;
'b'0011 => 'b'0000110;
'b'0100 => 'b'1001100;
'b'0101 => 'b'0100100;
'b'0110 => 'b'0100000;
'b'0111 => 'b'0001111;
'b'1000 => 'b'0000000;
'b'1001 => 'b'0001100;
'b'1010 => 'b'0001000;
'b'1011 => 'b'1100000;
'b'1100 => 'b'0110001;
'b'1101 => 'b'1000010;
'b'1110 => 'b'0110000;
'b'1111 => 'b'0111000;
}
```

This is called a “Bit Field” It is a means of grouping several variables into one entity.

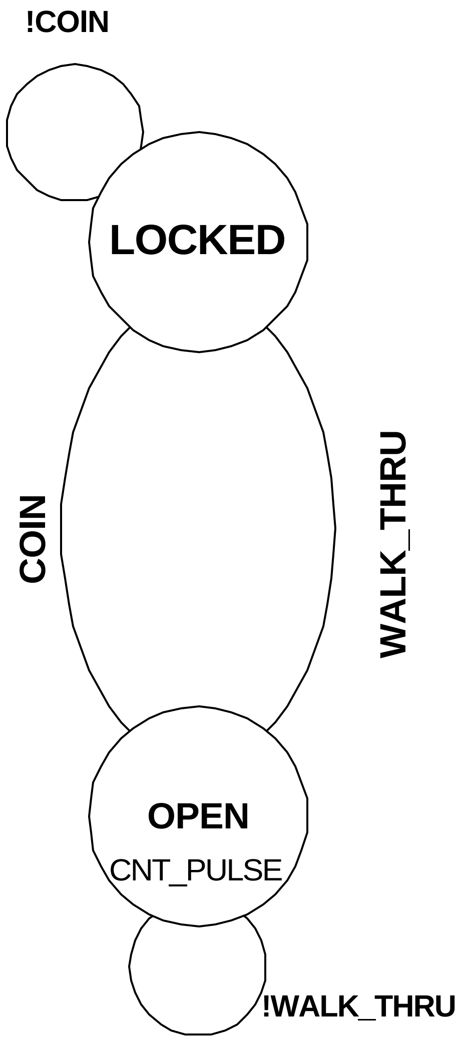
The default base for numbers is HEXADECIMAL.

Use one of the following to denote which base you are using:

Binary	‘b’
Octal	‘o’
Decimal	‘d’
Hexadecimal	‘h’

A Subway Turnstile

- The controller waits for a signal that a coin has been deposited. It then changes state from locked to open. In the open phase, it waits for someone to walk through the turnstile, then it changes from open to locked.
- This two state design cycles between open and locked using a coin detector and a walk-through detector as inputs.



Programmable Logic Devices II

```
Name      Turnstil;
Partno    XXXXX;
Date      6/5/01;
Revision  01;
Designer  Guam;
Company   EECE143;
Assembly  XXXXX;
Location  XXXXX;
Device    G16V8;

/*********************************/
/* Controls a Subway Turnstile   */
/*                               */
/*********************************/
/*  Allowable Target Device Types:  */
/*********************************/

/**  Inputs  **/
Pin 1 = clock;
Pin 2 = WALK_THRU;
Pin 3 = COIN;
Pin 11 = !enable;

/**  Outputs  **/

Pin 14 = CNT_PULSE;
Pin 15 = LOCK;

/** Declarations and Intermediate Variable Definitions
**/

/** Logic: SUbway Turnstile example expressed in CUPL
**/
$define LOCKED 'b'0
$define OPEN 'b'1

/**  State Machine  **/

SEQUENCE LOCK {
Present LOCKED
        if COIN Next OPEN;
        if !COIN Next Locked;

Present OPEN
        if WALK_THRU Next LOCKED;
        Default Next OPEN;
        Out CNT_PULSE;
}
```

One thing to note is that you can define your states so you can use the state variables as outputs. Your state sequence does not have to follow numeric order. That is it does not need to go 0000, 0001,0010,0011…

You can define S1 as 1011, S2 as 1111, S3 as 0110…

This will allow more flexibility for your designs.

Experiment #6: Programmable Logic Devices 2

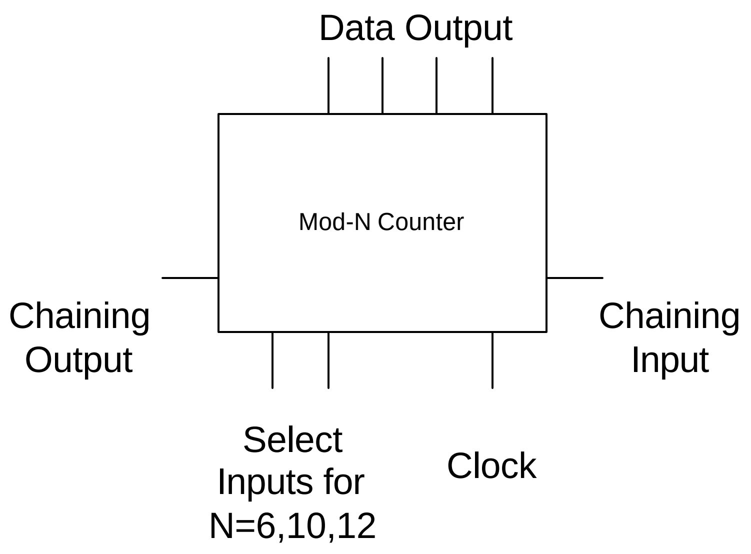
Prelab:

- Create PAL source code that implements a MOD-N counter where N can be 6,10 or 12 depending on 2 or 3 select inputs. ***Include inputs and outputs that allow synchronous chaining of counters.***

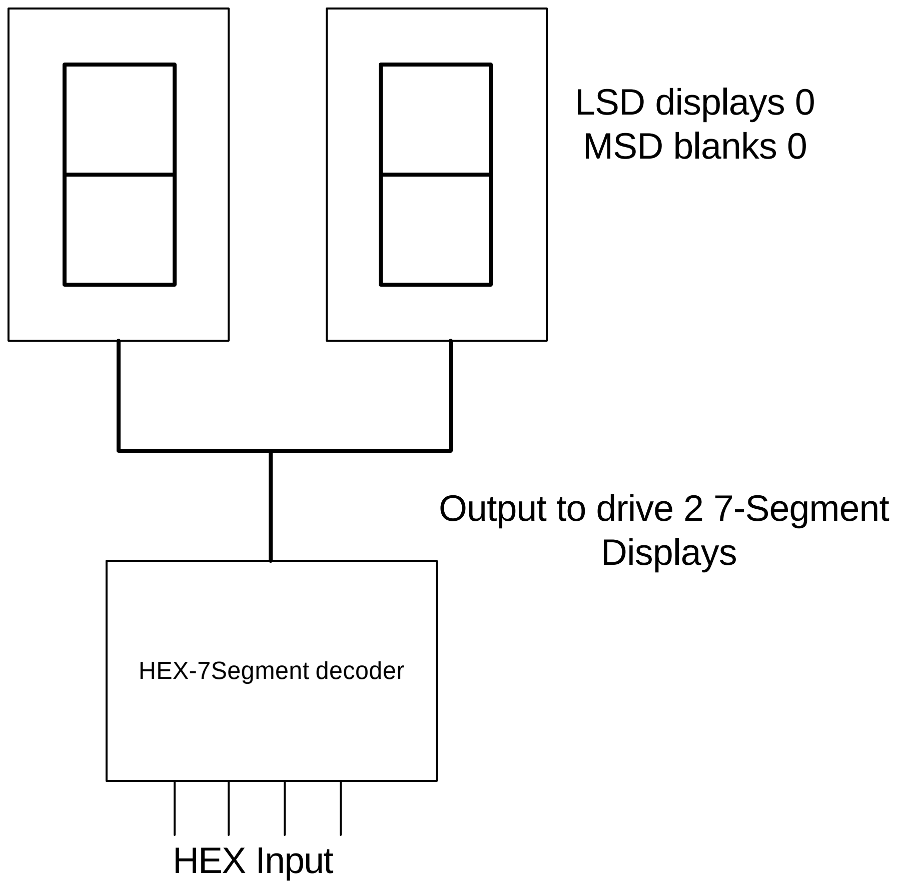
Output will count one of the following sequences depending on Select input:

0,1,2,3,4,5,0,…
0,1,2,3,…,8,9,0,…
1,2,3,…,11,12,1,…

Counter will count when Chaining Input =1 and will not count when Chaining Input=0



Create PAL source code that implements a HEX to 7-segment code converter. The outputs of the code converter should be able to drive two 7-segment displays to display Hex inputs from 0 to F as decimal values from 0 to 15.



Inputs: 0000 - 1111 (0-F Hex)

Outputs: 0-15 decimal

Compile all PAL source codes. Bring source code listings (on paper) and floppy disk containing the files to lab. The files should be error free at the beginning of the lab period.

Remember to show your complete schematic diagrams and to include data tables.