

## GAL Configuration with *ispEXPERT*

December 6, 1999 / Ed Doering

**Overview** -- This manual describes (1) how to use *ispEXPERT* to create JEDEC fuse map files for GAL programmable logic devices, and (2) how to configure the GAL using the Xeltek ROM Master/2 universal programmer.

**Introduction** -- The ECE Instrument Room maintains stock of GAL20V8A programmable logic devices manufactured by Lattice Semiconductor. The 20V8 is a 24-pin device that requires a fuse map file in JEDEC format to establish the internal configuration. Lattice provides a CAD tool called *ispEXPERT* that starts with an ABEL hardware design language specification and compiles it into a JEDEC fuse map file. *ispEXPERT* also includes simulation capability, so a design can be completely verified in software before taking the additional time to configure and test the hardware.

The remainder of this manual details the three main steps needed to configure the GAL device:

1. Enter and compile ABEL hardware description
2. Verify correct operation of the design using simulation
3. Configure the GAL device with the fuse map file

NOTE: See end of manual for relevant web links and glossary of terms used in this manual.

### Step 1 of 3 -- Enter and compile ABEL hardware description

Start <i>ispEXPERT</i> System Project Navigator	Start → Programs → Lattice Semiconductor → <i>ispEXPERT</i> System
Create new project	<ol style="list-style-type: none"><li>1. File -&gt; New Project</li><li>2. Navigate to desired directory, and enter your project name in the "File name" box</li><li>3. Ensure that "Project Type" is set to "ABEL/Schematic"</li></ol>
Select specific GAL device	<ol style="list-style-type: none"><li>1. Double-click on the "device source" -- it has a chip icon</li><li>2. Select "GAL Device List" for the "Device Family"</li><li>3. Choose "GAL20V8/Z/ZD" (the ECE Instrument Room currently has GAL20V8A devices in stock)</li><li>4. Click "Yes" to confirm change</li></ol>
Create ABEL file template	<ol style="list-style-type: none"><li>1. Click the "New..." button in the lower left corner</li><li>2. Select "ABEL-HDL Module"</li><li>3. Enter 8 characters or less for module name (this text will follow the ABEL 'module' keyword in the ABEL file, and will also be used to identify the ABEL module as a source)</li><li>4. Enter 8 characters or less for file name (this will be the base name of the ABEL file -- recommend using same name as module)</li><li>5. Enter descriptive text for the title</li><li>6. Click 'OK'</li></ol>
Enter your specific ABEL code	<ol style="list-style-type: none"><li>1. Enter text as needed. Note that the editor is "keyword aware," so it will color code your text to help you distinguish comments, keywords, etc.</li><li>2. Do "Help → ABEL HDL Language" to see an on-line syntax manual for ABEL.</li><li>3. Save your file when finished. You may close the editor or minimize its window.</li></ol>
Compile and optimize your ABEL	<ol style="list-style-type: none"><li>1. Go back to the project navigator window</li><li>2. Select your ABEL source to display the available processes for that file</li></ol>

code	<ol style="list-style-type: none"> <li>3. Make sure that "Compile Logic" process is selected</li> <li>4. Click the "Start" button to compile the ABEL code -- you will need to correct all ABEL syntax errors in order to proceed</li> <li>5. Select the "Check Syntax" process and click "Start"</li> <li>6. Select the "Reduce Logic" process and click "Start"</li> </ol>
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### Step 2 of 3 -- Verify correct operation of the design using simulation

Launch waveform stimulus editor	Window → Waveform Stimulus
Enter waveform names	<ol style="list-style-type: none"> <li>1. Edit → New Wave</li> <li>2. Select "Input" radio button in the popup window</li> <li>3. Type input name of a first pin in your ABEL file (use the same case)</li> <li>4. Click "Add"</li> <li>5. Repeat process for remaining ABEL file input pin names</li> <li>6. Close "Add New Wave" popup menu</li> </ol>
Draw waveforms	<ol style="list-style-type: none"> <li>1. Single-click on the desired input signal name</li> <li>2. Highlight an area in the timing diagram (click and drag the cursor). The waveform state is HIGH. Note that you can change to LOW by selecting the appropriate state in the "States" area of the uppermost popup window.</li> <li>3. Highlight the next area. The waveform editor automatically switches to the opposite state to make it easy to enter patterns.</li> <li>4. Experiment a bit! The waveform editor is quite intuitive (for example, you can cut and paste chunks of waveforms using the familiar Windows commands like Ctrl-C and Ctrl-V).</li> </ol>
Save waveforms to a waveform stimulus file (.wdl file)	<ol style="list-style-type: none"> <li>1. File → Save</li> <li>2. Enter a name for your stimulus file. Choose a name that describes the purpose of the waveforms, since you may generate multiple stimulus files for a given project.</li> </ol>
Close the waveform stimulus editor	File → Exit
Add the stimulus file to the project	<ol style="list-style-type: none"> <li>1. Source → Import</li> <li>2. Use the "List files of type:" box to display only the .wdl files, then select the stimulus file you created above</li> <li>3. Select the GAL device to respond to the "Associate With" prompt</li> </ol>
Prepare files for simulation	<ol style="list-style-type: none"> <li>1. Single click the wave stimulus file name in the left panel</li> <li>2. Double click the "Functional Simulation" process in the right panel</li> </ol>
Simulate the design and view outputs	<ol style="list-style-type: none"> <li>1. In Simulation Control Panel, select "Window → Waveform Viewer"</li> <li>2. Select "Edit → Show...", then highlight the desired nets and click "Show" button</li> <li>3. Click "Run" or "Step" to simulate the design and display the input and output waveforms</li> </ol>

### Step 3 of 3 -- Configure the GAL device with the fuse map file

Find a PC that has the Xeltek "ROM Master/2" universal programmer connected.	<ol style="list-style-type: none"> <li>1. Make sure the unit is connected to the PC parallel port</li> <li>2. Make sure that power is on</li> <li>3. Make sure that your GAL is <b>not</b> inserted in the programmer at this time</li> </ol>
Open a DOS window	Start → Programs → MS-DOS Prompt

Start the "ROM Master" user interface program	<ol style="list-style-type: none"> <li>1. cd \rm2\bin</li> <li>2. rm2</li> </ol>
<p>Verify that programmer is configured for the correct device -- look on the "Device" menu on the right hand side of the DOS window. You should see the following:</p> <p>-- manufacturer = LATTICE  -- type = GAL20V8A  -- select mode = PLD</p> <p>If any of these fields are incorrect, then follow the instructions at right...</p>	<ol style="list-style-type: none"> <li>1. Device → Select by Device</li> <li>2. Click "PLD" radio button under "Type" menu on right hand side</li> <li>3. Select "LATTICE" for manufacturer</li> <li>4. Select "GAL20V8A" for device</li> <li>5. Click "Select" when finished.</li> </ol>
Load fuse map file created earlier	<ol style="list-style-type: none"> <li>1. File → Load...</li> <li>2. Navigate to your ispEXPERT project directory, or type in the fuse map filename (.jed extension) directly</li> </ol>
Verify that fuse map file has some information (optional)	<ol style="list-style-type: none"> <li>1. Buffer → Edit</li> <li>2. You should see some "1"s scattered among the "0"s.</li> <li>3. Buffer → Close</li> </ol>
Insert the GAL device into the programmer	<ol style="list-style-type: none"> <li>1. Lift up the lever on the ZIF (zero insertion force) socket.</li> <li>2. Insert GAL device into programmer socket -- make sure that your device has pin 1 at the <i>top</i> and that the device is <i>bottom-justified</i> in the programmer socket.</li> <li>3. Lower the ZIF socket lever.</li> </ol>
Configure the GAL with the fuse map data	<ol style="list-style-type: none"> <li>1. Device → Run</li> <li>2. Select "Program" under "Function Select" menu on left hand side</li> <li>3. Click "Run" button on bottom left.</li> <li>4. You should see a variety of confirmation messages appear to signify that your device has been properly configured.</li> </ol>
Remove GAL from programmer.	

### Web Links

Lattice Semiconductor: [www.latticesemi.com](http://www.latticesemi.com)  
ispEXPERT SYSTEM Starter Kit download site: [www.latticesemi.com/ftp/ispstarter.html](http://www.latticesemi.com/ftp/ispstarter.html)  
GAL20V8A data sheet location: [Novell: \\JUPITER\Amalthea\ECE\DataSheets\20v8.pdf](file://Novell:\JUPITER\Amalthea\ECE\DataSheets\20v8.pdf)  
Xeltek (ROM Master/2 programmer): [www.xeltek.com](http://www.xeltek.com)  
Most recent ROM Master/2 software: Go to Xeltek website, select "Download", and select "Rommaster II"

### Glossary

JEDEC -- Joint Electronic Devices Engineering Council (standards body)  
GAL -- generic array logic  
ROM -- read-only memory  
ROM programmer -- uses information in a user-supplied file to set the internal state of a hardware device such as a ROM or GAL