User's Guide

for

MSP430F44x Evaluation System (ES449)

19 January 2004

From

SoftBaugh

Custom Software, Firmware, Hardware,
and Project Management Consulting

4080 McGinnis Ferry Road
Suite 604
Alpharetta, Georgia 30005

Disclaimer:

Table of Contents

Table of Tables

Table of Figures

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

1. ES449 Overview

The MSP430F44x Evaluation System (ES449) allows convenient prototyping of low-power handheld LCD projects. Refer to documentation from Texas Instruments for detailed information for the MSP430F44x variants.

1.1 Features

The key features of this product are:

- Texas Instruments MSP430F449 flash processor
- Our custom 7 digit 3v 4-mux LCD (SBLCDA2)
- Texas Instruments RS232 interface using the MAX3221
- Adjustable TPS7201 LDO for bench top use
- Single-cell AAA 3.3v power supply based on the TPS60310
- 3.3v CR2032 coin cell supply using the TPS60212
- JTAG programming header
- Bootloader header
- 2 user LEDs
- 2 user switches
- Each MSP port pin exposed at IDC headers
- Large prototyping area
- 2Mbit serial flash (not populated on some early models) for data logging applications

1.2 Frequently Asked Questions

Our website contains up-to-date information on all our products, including Frequently Asked Questions at the bottom of each product page. Please visit our website to review the Frequently Asked Questions for this and all our products if you encounter difficulty not addressed in this manual.

1.3 Laboratory Manual

In addition to this User Guide, we also offer a laboratory manual for this product for separate purchase. The last chapter of this User Guide is a preview of the Laboratory Manual. The table of contents and the first chapter of the Laboratory Manual are also available on the webpage for this product.

1.4 Notation

Throughout SoftBaugh documentation, we follow a standard convention to identify boards, jumpers, other components, and pins.

1.4.1 Boards, Components and Pins

The following notation is used to identify boards, components, and pins:

Board:*Component*.*Pin*

Example:

ES449:J12.5 identifies the bootloader header ground pin on the ES449.

Where obvious from the context, the *Board:* portion may be omitted. If an entire component rather than a single pin is being identified, then the *.Pin* portion is omitted.

1.4.2 Jumpers

Unless otherwise noted, pin 1 on a jumper is always square (observed from underneath), and the silkscreen designator for the jumper is near pin 1. Where ambiguity could exist, a small '1' is placed near pin 1. Pins are numbered across the short axis of the jumper first, and then down the long axis.

Jumper settings are indicated by the following notation:

Jumper.Pin-Pin
Jumper.Open

Example:

J20.1-2

A jumper block is to be placed across pin 1 and pin 2 on J20.

In the special case of two-pin jumpers, such as those used to route power or measure current, the entire jumper may be treated as a SPST switch, and "opened".

Example:

J18.Open

J18 is left open, with no jumper block. In other sources this is referred to as "hanging" the jumper.

2. Board Options

The ES449 allows many different user configurations set via jumpers, resistors, and testpoint options.

2.1 Jumper Options

The ES449 contains the following jumper-selected options:

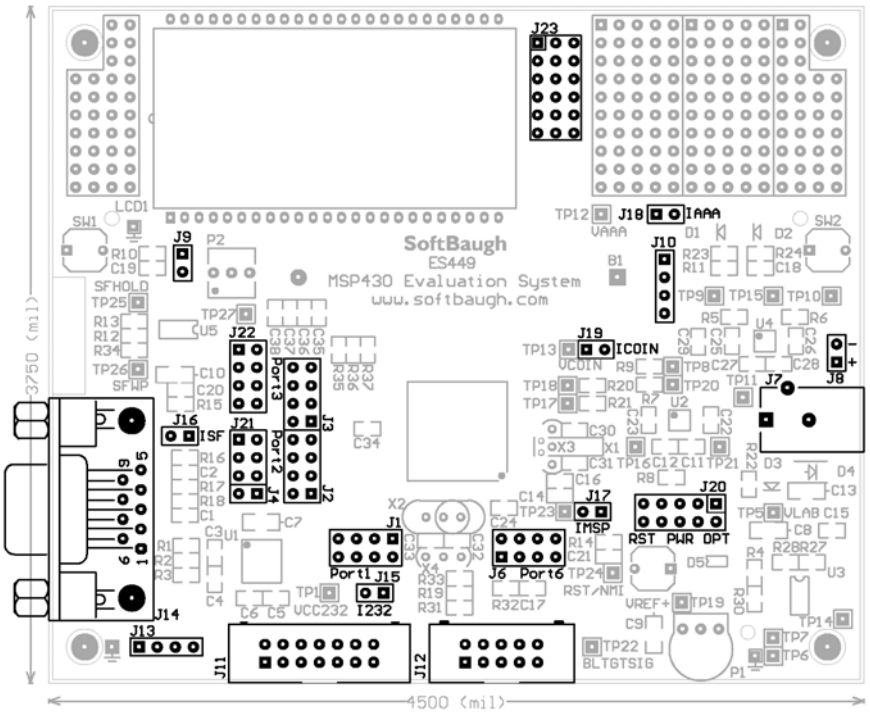


Figure 2-1 ES449 Jumper Options

2.1.1 J1

Port 1 of the MSP430 microcontroller

2.1.2 J2

Port 2 of the MSP430 microcontroller

2.1.3 J3

Port 3 of the MSP430 microcontroller

2.1.4 J4

UART1 of the MSP430 microcontroller

Table 2-1 ES449 J4

Pin	Usage
1	General purpose I/O / Transmit data out—UART mode
2	General purpose I/O / Receive data in—UART mode

2.1.5 J6

Port 6 of the MSP430 microcontroller

2.1.6 J7

Power jack, see section 3

2.1.7 J8

Power terminal, see section 3

Table 2-2 ES449 J8

Pin	Usage
1	Voltage input (+) 3.6v DC to 9.0v, no transients above 9.1v DC
2	Ground (-)

2.1.8 J9

Input/Output header A

Table 2-3 ES449 J9

Pin	Usage
1	Switch 1 output—Normally Vcc, when pressed equals ground (0v)
2	Ground

2.1.9 J10

Input/Output header B

Table 2-4 ES449 J10

Pin	Usage
1	P1.0/ D1—Drive low to illuminate D1. Remove R33 to disconnect from P1.0
2	D2—Drive low to illuminate
3	Switch 2 output-- Normally Vcc, when pressed equals ground (0v)
4	Ground

2.1.10 J11

JTAG header

2.1.11 J12

Bootloader, see section 5

Table 2-5 ES449 J12

Pin	Usage
1	BSLTX
2	TCK
3	BSLRX
4	RST
5	GND
6	VCC
7	TEST
8	NC
9	BLPWOFF
10	BLTGTSIG

2.1.12 J13

RS232 power options for the MAX3221. See Texas Instruments MAX3221datasheet for details (SLLS348G)

Table 2-6 ES449 J13

Pin	Usage
1	U1:10 /INVALID:
2	U1:1 /EN
3	U1:16 /FORCEOFF
4	U1:12 FORCEON

2.1.13 J14

RS232 DB9S connector

Table 2-7 ES449 J14

Pin	Usage
1	NC
2	Data transmit
3	Data receive
4	NC
5	Ground
6	NC
7	NC
8	NC
9	NC

2.1.14 J15

RS232 power, jumper to power RS232

2.1.15 J16

Serial flash power, jumper to power serial flash

2.1.16 J17

MSP430 microcontroller power, jumper to power MSP430 microcontroller

2.1.17 J18

AAA battery jumper, jumper to connect the AAA battery to U4

2.1.18 J19

Coin cell jumper, jumper to connect the coin cell to U2

2.1.19 J20

Power option header, see section 3

2.1.20 J21

Communication configuration header

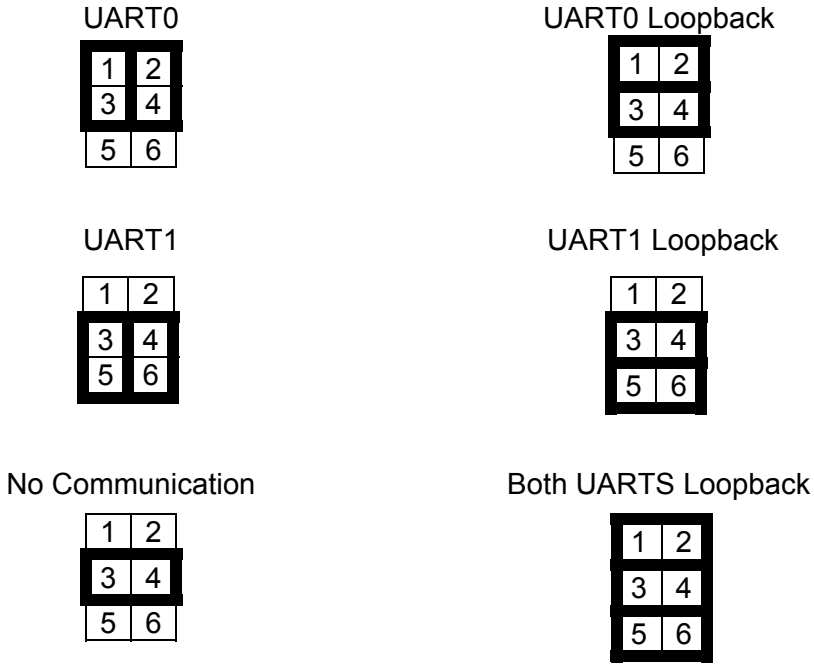
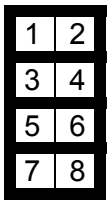


Figure 2-2 ES449 J21

2.1.21 J22

Serial flash isolation

Serial Flash Connected



Serial Flash Isolated

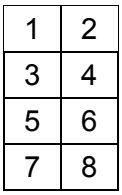
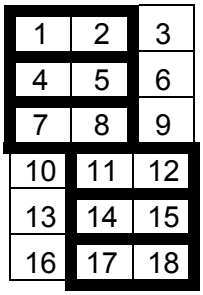


Figure 2-3 ES449 J22

2.1.22 J23

LCD Character Select

Select Character Seven



Select Progress Bar

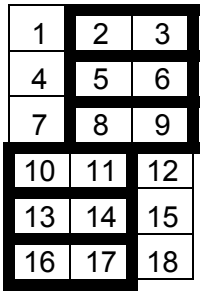


Figure 2-4 ES449 J23

2.2 Test Points

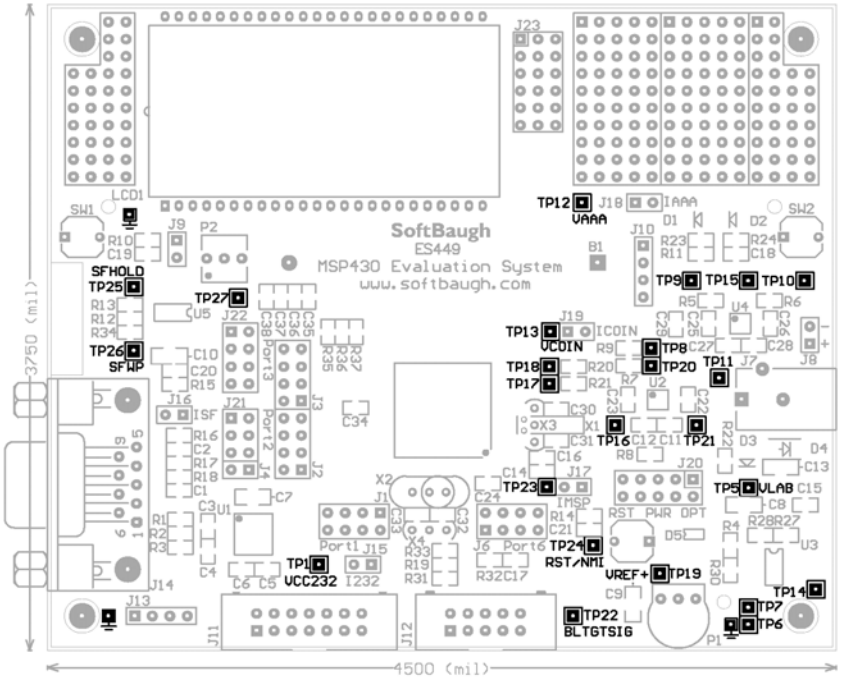


Figure 2-5 ES449 Test Points

Table 2-8 ES449 Test Points

Test Point (TP)	Usage
1	MAX3221 (U1) V_{CC}
2	Ground
3	Ground
4	Ground
5	TPS7201 (U3) Output VLab
6	TPS7201 (U3) PG
7	TPS7201 (U3) /EN
8	TPS60212 (U2) /SNOOZE
9	TPS60310 (U4) /SNOOZE
10	TPS60310 (U4) PG
11	TPS60310 (U4) output voltage 1
12	AAA battery voltage
13	Coin cell battery voltage
14	Board input voltage (J7)
15	TPS60310 (U4) output voltage 2
16	TPS60212 (U2) output voltage
17	VeREF+
18	VREF-
19	VREF+

20	TPS60212 (U2) LBI
21	TPS60212 (U2) LBO
22	BLMSPF2 (J12) BLTGTSIG
23	MSP430 (U6) V_{CC}
24	MSP430 (U6) RST/NMI
25	SST25VF020 (U5) /HOLD
26	SST25VF020 (U5) /WP
27	MSP430 (U6) VR03

2.3 Miscellaneous Board Options

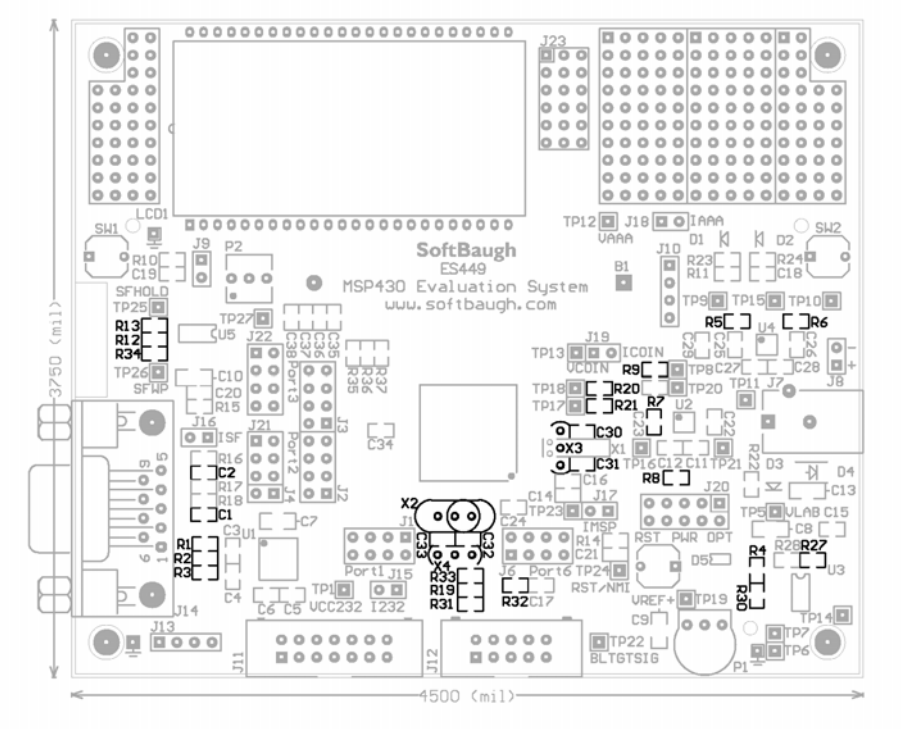


Figure 2-6 ES449 Miscellaneous Board Options

Table 2-9 Miscellaneous Board Options

Component	Usage
C1	Optional filter capacitors. Once populated available baud rate is reduced
C2	
C30	Optional capacitors on X1 and X3
C31	
C32	Optional capacitors on X2 and X4
C33	
R1	Sets default auto-powerdown feature of the MAX3221 (U1). Change as needed to implement other power features. See section 4.

R2	Sets default auto-powerdown feature of the MAX3221 (U1). Change as needed to implement other power features. See section 4.
R3	Sets default auto-powerdown feature of the MAX3221 (U1). Change as needed to implement other power features. See section 4.
R4	Remove or replace to adjust functionality of the TPS7201 (U3) PG pin
R5	Remove or replace to adjust functionality of the TPS60310 (U4) /SNOOZE pin
R6	Remove or replace to adjust functionality of the TPS60310 (U4) PG pin
R7	Remove or replace to adjust functionality of the TPS60212 (U2) LBI pin
R8	Remove or replace to adjust functionality of the TPS60212 (U2) LBO pin
R9	Remove or replace to adjust functionality of the TPS60212 (U2) /SNOOZE pin
R12	Remove or replace to adjust functionality of the serial flash memory (U5)
R13	Remove or replace to adjust functionality of the serial flash memory (U5)
R19	Bootloader port current limiting resistor options. Change R31 to 1.0k before using P1.1 as an output
R31	
R20	Optional pull-down resistor for VREF-/VeREF-
R21	Optional pull-down resistor for VeREF+
R27	Replace to adjust the output voltage of the TPS7201 (U3)
R30	Remove or replace to adjust functionality of the TPS7201 (U3) /EN pin
R32	Optional current limiting resistor for P6.0
R33	Optional current limiting resistor for P1.0
R34	Optional pull-down resistor for the serial flash memory (U5) /WP pin
X2	Optional high frequency crystal
X3	Optional ceramic resonator
X4	Optional ceramic resonator

3. Power Supplies

The ES449 can be operated from a variety of power supplies, depending on the options chosen with jumper J20. This chapter discusses the most common options. In all cases, MSP current can be isolated and measured via J17.

3.1 External Regulated Lab Supply

The ES449 can operate from a regulated 1.8 to 3.6v supply connected at J20.2, .4, .6, .8, or .10. See section 3.7 for details.

3.2 External Unregulated Lab Supply

The ES449 can operate from an unregulated external lab supply (3.6v to 6v) by connecting it to J8, with J20.1-2 jumpered. Refer to the ES449 schematics for details. Adjusting the value of R27 programs the output voltage of the TPS7201.

Table 3-1 TPS7201 Output Voltage Programming Guide

Output Voltage (V)	Divider Resistance	
	R27 (kΩ)*	R28 (kΩ)*
1.8	88.7	169
2.0	118	169
2.7	215	169
3.0	261	169
3.3	301	169
3.6	348	169

*1% values shown

3.3 External Wallmount Supply

The ES449 can be operated from an external wallmount supply via the TPS7201 LDO by connecting it to J7 and jumpering J20.1-2. The power connector is a 2.1 mm barrel connector:

Figure 3-1 DC Power Connector

The board has a 1W zener diode (D6) to protect the on-board voltage regulators against power fluctuations. Please note that most wall-mount power supplies have voltage ratings based on maximum load. It is important to obtain a power supply with an open circuit voltage no greater than 4-6 volts. The SB6V power supply is recommended.

3.4 Single-Cell with Capacitive Charge-Pump

The ES449 can be operated with a single alkaline cell by use of the TPS60310 capacitive charge-pump with J18.1-2 jumpered and J20.3-4 jumpered. B2 is an AAA socket provided for your convenience. Battery current can be measured through J18. The capacitive charge pump can be disabled via TP9. A power good flag is available at TP10. See the TPS60310 datasheet for more details.

If desired, a coin cell backup can be used in conjunction with this supply through D7 by jumpering J20.9-10. When the TPS60310 is disabled, unregulated coin cell power will continue to supply the ES449.

3.5 Unregulated Single-Cell Supply

The ES449 can be operated with a single 3v lithium coin cell by jumpering J20.7-8. B1 is a CR2032 socket provided for your convenience.

3.6 Regulated Single Cell Supply with Capacitive Charge Pump

The ES449 can be operated with a fixed 3.3v output from the coin cell using the TPS60212 charge pump by jumpering J19.1-2 and jumpering J20.5-6. This charge pump can be controlled via TP8 if desired. Battery current to the regulator can be measured through J19.

If desired, a coin cell backup can be used in conjunction with this supply through D7 by jumpering J17.9-10. When the TPS60212 is disabled, unregulated coin cell power will continue to supply the ES449.

3.7 Power Supply Jumper Options J20

LDO

1	**2**
3	4
5	6
7	8
9	10

AAA C/P

1	2
3	**4**
5	6
7	8
9	10

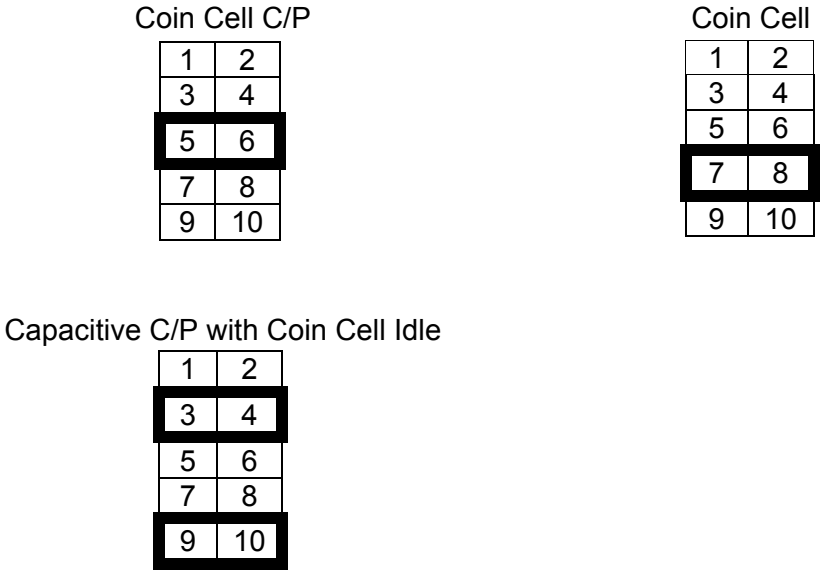


Figure 3-2 ES449 Power Supply Jumper Options

4. RS232 Interface

To implement a UART with the MSP430F44x requires use of either on-chip hardware UART. Use J21 to connect TX and RX to either UART0 or UART1 on the MSP430F44x. Texas Instruments has a variety of software samples for UART communication available on their website. See section 2.1.20 for the communication configuration header jumper options.

The header J21 allows normal communication or loopback operation, as shown in the schematic, for testing either or both ends of the interface.

The ICL3221 RS232 interface allows operation in a wide variety of modes; refer to the datasheet for full details. The most common modes are discussed in this chapter. The header J13 and resistors R1, R2, and R3 configure the ICL3221.

4.1 Always On

As originally shipped, the ICL3221 permits operation with the ICL3221 in "always-on" mode. This mode will not provide the greatest power savings, but is the most convenient for starting projects:

Table 4-1 RS232 Always On

Item	Condition	Remarks
J13.1	Open	0 if no valid RS232 levels applied from host, 1 if host is connected.
J13.2	Open	
J13.3	Open	
J13.4	Open	
R1	100k	
R2	100k	
R3	100k	

4.2 Disabled

If communication is not required, the ICL3221 can be disabled in the lowest-power mode by using the following settings:

Table 4-2 RS232 Disabled

Item	Condition	Remarks
J13.1	Open	N/a
J13.2	VCC	/EN disables receivers when held high
J13.3	GND	/FORCEOFF forces powerdown when held low
J13.4	Open	
R1	Open	
R2	100k	
R3	Open	

4.3 Auto Powerdown

The lowest-power mode for RS232 operation is shown below:

Table 4-3 RS232 Auto-Powerdown

Item	Condition	Remarks
J13.1	Open	0 if no valid RS232 levels applied from host, 1 if host is connected.
J13.2	Open	
J13.3	Open	
J13.4	GND	Bring FORCEON low allows auto-powerdown mode
R1	100k	
R2	Open	
R3	100k	

In this mode, the ICL3221 can wake the processor via J13.1 if a host port is connected. The ICL3221 will manage its own power in this mode.

5. Bootloader Adapter

The target board is to be connected to the BLMSPF using the 10-pin box header J12. The definition of J12 is given below:

Table 5-1 - Target Adapter Signals

Pin	Name	Purpose
1	BSLTX	Bootloader TX from the target. (Note 1)
2	TCK	Bootloader TCK pin. (Note 2)
3	BSLRX	Bootloader RX from the target.
4	RST	Bootloader RST pin.
5	GND	Ground.
6	VCC	Bootloader VCC supplied to the target. (Note 2)
7	TST	Bootloader TEST pin. Not connected.
8	NC	Not connected
9	BLPWOFF	
10	BLTGTSIG	

Refer to the pin marking on the header to orient pin 1.

Note 1: The BLTX pin will be held high by the BLMSPF during normal operation of the target to isolate the host from any non-serial operation of the target's firmware. Should the target require use of this pin on their processor, a 1k resistor must be placed in series between the target connector and the BLTX pin on the target and all target circuitry connected on the target side of the series resistor.

Note 2: The BLMSPF can supply up to 200mA to the target board. This supply is cycled during bootloader access and target resets to ensure a complete reset of the target. This power cycling ensures that firmware using the RST/NMI pin in NMI can still be reset.

IMPORTANT: Your project may require incidental use of the BSLTX (P1.1) and BSLRX (P2.2) pins. If so, attempt to configure these pins as outputs so external devices will not drive them during bootloading.

IMPORTANT: If your project reconfigures the RST/NMI pin, bootloader operations require that the ES449 be powered from the bootloader. Remove J12 during bootloading to ensure the BLMSPF can seize the MSP.

6. SBLCDA2/T LCD Display

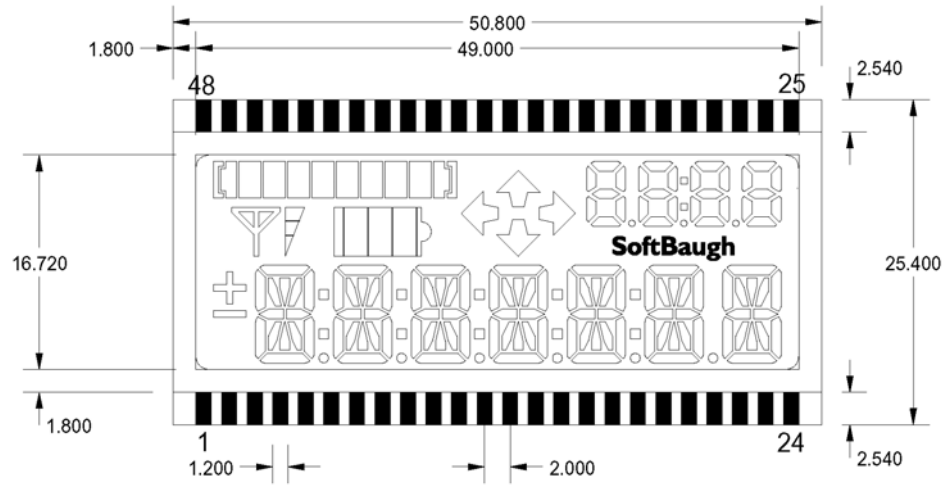


Figure 6-1 SBLCDA2/T

6.1 Overview:

Our advanced SBLCDA2 and SBLCDA2T are compatible with all MSP430F44x devices. The SBLCDA2 is for daytime use only while the SBLCDA2T is transflective, which allows a backlight to be installed for optional nighttime use. These two LCDs offer the following:

- 2.7v to 3.6v operation directly connected to the MSP430 LCD drive
- 4-mux operation
- Seven 14-segment digits with plus/minus symbology allows versatile text
- Supplemental 4-digit 7-segment clock-counter display
- Arrows left, up, right, and down
- Battery with 3-segment meter
- Antenna with 3-segment meter
- Colons for HH:MM:SS operation
- Progress bar for convenient user feedback
- 6 o'clock viewing angle
- Low-cost bias circuit allows adjustment for viewing angle, contrast, and temperature
- Transflective option allows for the addition of a backlight for nighttime viewing (SBLCDA2T only)
- Operating temperature –20C/50C

6.2 Typical Operation:

The following graphs illustrate the SBLCDA2 and SBLCDA2Ts viewing angles for the range of V_{CC} from 2.7v to 3.6v. The voltage was measured on pin 56 (R03) of the MSP430F449. This is the input port of the lowest analog LCD level (V5). The voltage is controlled by P2 on our ES449 development kit and can be measured at TP27.

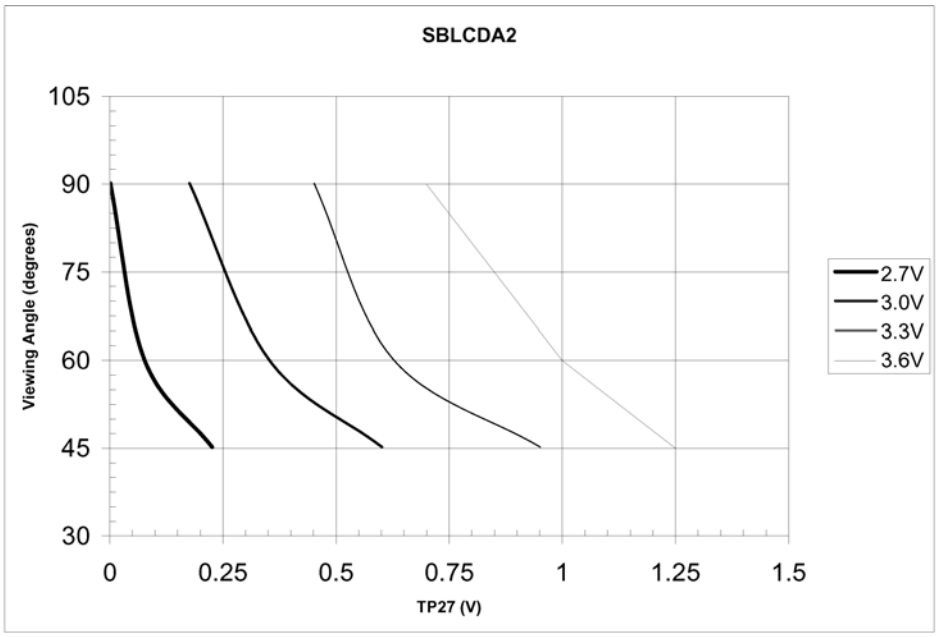


Figure 6-2 SBLCDA2 Contrast Adjustment--Daytime

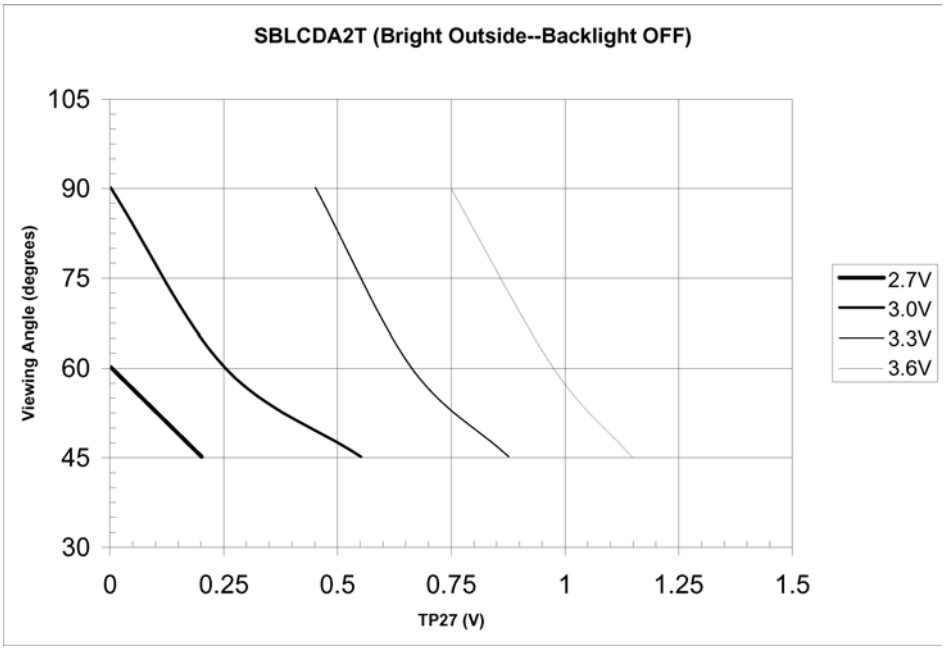


Figure 6-3 SBLCDA2T Contrast Adjustment--Daytime

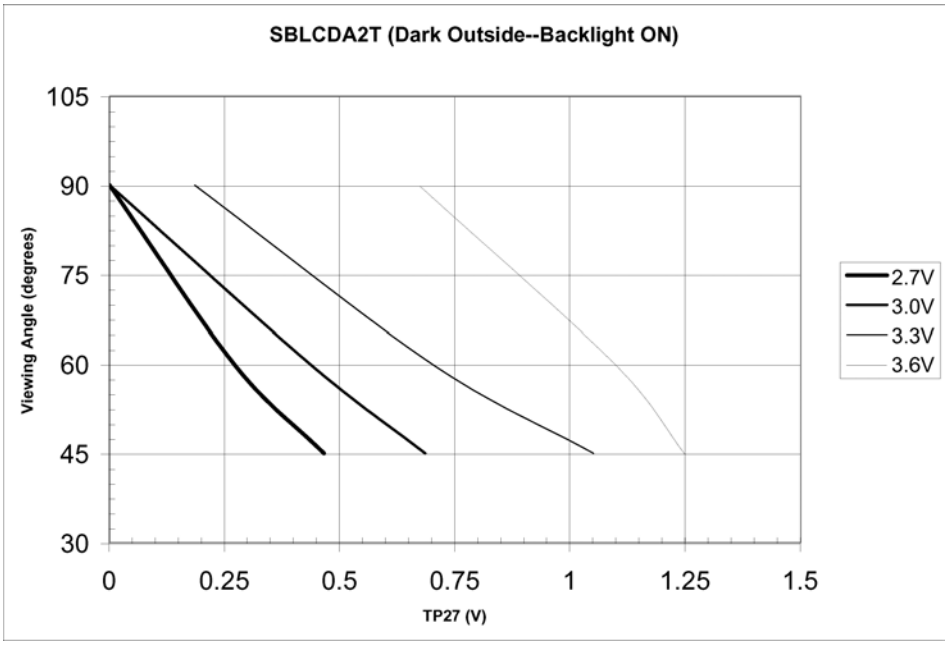


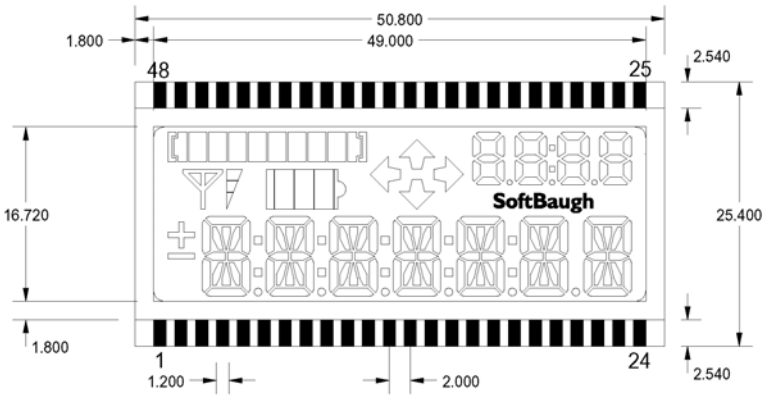
Figure 6-4 SBLCDA2T Contrast Adjustment--Backlit

6.3 SBLCDA2 Segment Mapping

PIN	COM3	COM2	COM1	COM0		COM3	COM2	COM1	COM0	PIN
1	1A	1B	1C	1D		COM3				**48**
2	1J	1K	1M	1N			COM2			**47**
3	2COL	2F	2E	1DP				COM1		**46**
4	2H	2G	2Q	2P					COM0	**45**
5	2A	2B	2C	2D		1H	1G	1Q	1P	**44**
6	2J	2K	2M	2N		PLUS	1F	1E	MINUS	**43**
7	3COL	3F	3E	2DP		A1	A2	ANT	A0	**42**
8	3H	3G	3Q	3P		PL	P0	P1	P2	**41**
9	3A	3B	3C	3D		P6	P5	P4	P3	**40**
10	3J	3K	3M	3N		NC	NC	NC	NC	**39**
11	4COL	4F	4E	3DP		NC	NC	NC	NC	**38**
12	4H	4G	4Q	4P		P7	P8	P9	PR	**37**
13	4A	4B	4C	4D		B0	B1	B2	BRBL	**36**
14	4J	4K	4M	4N		AD	AR	AU	AL	**35**
15	5COL	5F	5E	4DP		8D	8E	8G	8F	**34**
16	5H	5G	5Q	5P		8DP	8C	8B	8A	**33**
17	5A	5B	5C	5D		9D	9E	9G	9F	**32**
18	5J	5K	5M	5N		10DP	9C	9B	9A	**31**
19	6COL	6F	6E	5DP		10COL	10E	10F	10A	**30**
20	6H	6G	6Q	6P		10D	10C	10G	10B	**29**
21	6A	6B	6C	6D		11DP	11E	11F	11A	**28**
22	6J	6K	6M	6N		11D	11C	11G	11B	**27**
23	SB	7F	7E	6DP		7J	7K	7M	7N	**26**
24	7H	7G	7Q	7P		7A	7B	7C	7D	**25**

6.4 ES449 Segment Mapping

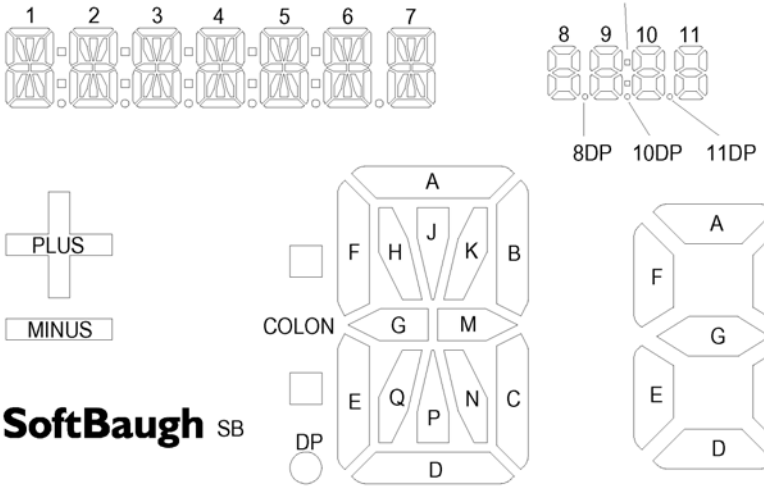
MEM	BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0	
*LCDM1	A1	A2	ANT	A0	0	0	0	0	*S1:S0
LCDM2	AD	AR	AU	AL	B0	B1	B2	BRBL	S3:S2
LCDM3	11DP	11E	11F	11A	11D	11C	11G	11B	S5:S4
LCDM4	10COL	10E	10F	10A	10D	10C	10G	10B	S7:S6
LCDM5	9D	9E	9G	9F	10DP	9C	9B	9A	S9:S8
LCDM6	8D	8E	8G	8F	8DP	8C	8B	8A	S11:S10
**LCDM7									***S13:S12--See below*
**LCDM8									***S15:S14--See below*
LCDM9	6A	6B	6C	6D	6J	6K	6M	6N	S17:S16
LCDM10	6COL	6F	6E	5DP	6H	6G	6Q	6P	S19:S18
LCDM11	5A	5B	5C	5D	5J	5K	5M	5N	S21:S20
LCDM12	5COL	5F	5E	4DP	5H	5G	5Q	5P	S23:S22
LCDM13	4A	4B	4C	4D	4J	4K	4M	4N	S25:S24
LCDM14	4COL	4F	4E	3DP	4H	4G	4Q	4P	S27:S26
LCDM15	3A	3B	3C	3D	3J	3K	3M	3N	S29:S28
LCDM16	3COL	3F	3E	2DP	3H	3G	3Q	3P	S31:S30
LCDM17	2A	2B	2C	2D	2J	2K	2M	2N	S33:S32
LCDM18	2COL	2F	2E	1DP	2H	2G	2Q	2P	S35:S34
LCDM19	1A	1B	1C	1D	1J	1K	1M	1N	S37:S36
LCDM20	PLUS	1F	1E	MINUS	1H	1G	1Q	1P	S39:S38
**Progress Bar Option									
LCDM7	P6	P5	P4	P3	P7	P8	P9	PR	S13:S12
LCDM8	SB	7F	7E	6DP	PL	P0	P1	P2	S15:S14
**Seventh Digit Option									
LCDM7	7A	7B	7C	7D	7J	7K	7M	7N	S13:S12
LCDM8	SB	7F	7E	6DP	7H	7G	7Q	7P	S15:S14
*Note: Always set LCDM1 lower nibble (S0) to 00h to disable unused segments									



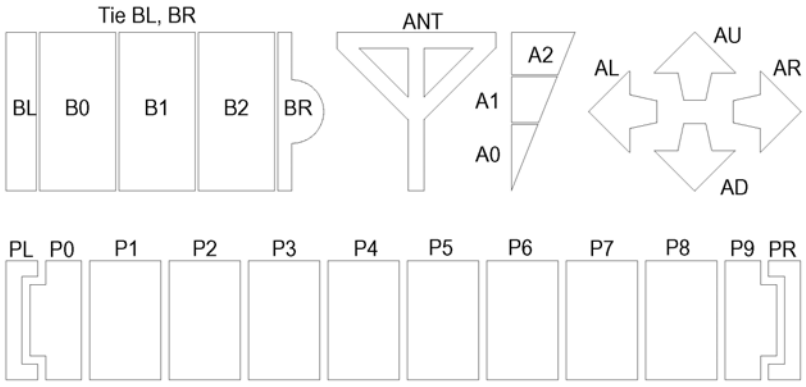
SBLCDA2
Rev 1.1.0, 15 July 2002

SoftBaugh, Inc.
5040 Oakmont Bend Drive
Alpharetta, GA 30004 USA
www.softbaugh.com
(770) 772-8111
(770) 772-9030 (fax)

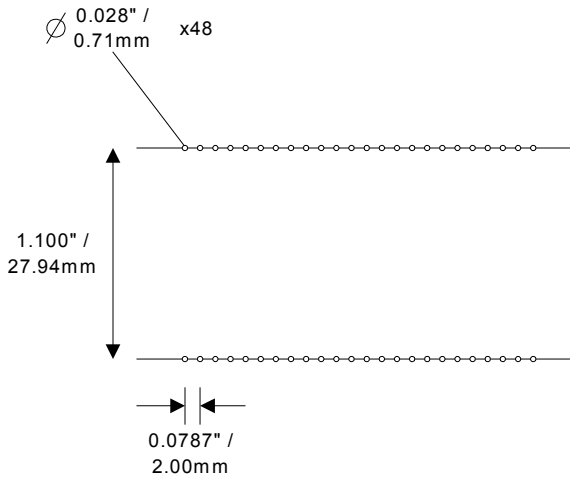
Pins both sides, 2.0mm pitch, .5mm wide at PCB, 6.5mm long overall



SoftBaugh SB



Recommended SBLCDA2 Footprint



7. Software Development Tools

The ES449 is compatible with all third-party MSP430 development tools. The software development tools we recommend are:

Rowley Associates CrossWorks for MSP430
Quadravox AQ430 for MSP430

In this section, we provide instructions for installing each of these tools and preparing for work with the ES449.

7.1 Quadravox AQ430 for MSP430

Quadravox offers three different software development tools for the MSP430F449. First, they offer a free 30-day trial version that has a code limit of 4kB. Next, they offer a full-version compiler that is only compatible with the MSP430F44x family of microcontrollers. Lastly, they offer a full-version software development tool that works with the entire MSP430 family and has no code limit.

7.1.1 Download

1. To download the free version of AQ430 from quadravox go to their website at www.quadravox.com.

2. Click on the 'download free 30 day trial version' link. Select your operating system and click on 'Download.'

3. Save this file onto your hard drive. Note the folder you are downloading the file into.

7.1.2 Installation

1. First open the folder containing the AQ430x.exe file you previously downloaded. Open the AQ430x.exe program by double-clicking the icon.

2. A WinZip self-extractor window should appear, now select 'Setup'.

3. Once the files have been unzipped you will need to select 'Next' four times.

4. Once the files have been installed the installation wizard will ask you to restart the program at this time, go ahead and restart.

5. Open Quadravox AQ430 by selecting Start>Programs>qvarch430tools.

7.1.3 Full Version

To obtain the full version you can purchase a registration key from SoftBaugh. This should be sent to Quadravox along with the challenge string from the 30-day trial version software. You can find the challenge string by opening the AQ430 program and selecting 'Buy.'

7.2 Rowley Associates CrossWorks for MSP430

Rowley offers two different software development tools for the MSP430F449. First, they offer a free 30-day full-version that has no code limit. They also offer a full-version software development tool that works with the entire MSP430 family and has no code limit.

7.2.1 Download

1. To download the free trial version of CrossWorks go to their website at www.rowley.co.uk.

2. Under the heading 'CrossWorks 1.0 is here' select the link. On the next page select the link 'Download CrossWorks for MSP430 1.0 Zip File' at the bottom of the page.

3. Save this file onto your hard drive. Note the folder you are downloading the file to.

4. Once you have downloaded a copy of CrossWorks you will need to get an activation key from them by emailing them the registration key that the installer provides to license@rowley.co.uk. You will be prompted to do this during the installation process.

7.2.2 Installation

1. First open the folder containing the msp430_1_0_0.zip file you previously downloaded. Open the msp430_1_0_0.zip file by double-clicking the icon.

2. Scroll down and double-click on the setup.exe file.

3. Double-click on 'Next.' Read Rowley's license agreement and accept it by selecting the corresponding box. Then select 'Next.'

4. On the next screen insert a checkmark into the box next to the statement 'Set license up manually after installation has completed,' then select 'Next.'

5. Select 'Next' five more times.

6. Lastly select 'Install' on the last window. The file installation will begin at this time. Once the installation is completed, restart your computer.

7. Open Rowley CrossWorks by selecting Start>Programs>Rowley Associates Limited>CrossWorks MSP430 1.0.0>CrossStudio.

8. Select the 'Help' menu then select 'About CrossStudio.' A window will appear, now select the 'Product Activation' tab.

9. You should see the registration key. You need to email the registration key to **license@rowley.co.uk** they will send the activation key back to you that needs to be entered into the activation key field directly below the registration key field.

7.2.3 Full Version

To obtain the full version you can purchase the activation key from SoftBaugh. The registration key of your trial version can be sent to keys@softbaugh.com. SoftBaugh will process your registration key and return a full version activation key that will replace the current activation key.

8. Lab One, MSP430 JTAG Debugging

Once your software development tools are installed, you can begin enjoying the benefits of your ES449. If you haven't yet selected and installed your development tools, please flip back to the previous chapter.

In this chapter, we work through a simple demonstration program called ES449_Jenny, available for download from our website.

This chapter presents the first laboratory exercise available in the ES449 Laboratory Manual available for purchase separately on our website. The laboratory manual is available in two versions, one for Quadravox (LMES449Q) and one for CrossWorks (LMES449CW).

8.1 Step One, Organize Your Materials

For this laboratory exercise, you will need the following:

- ES449 Evaluation System
- SoftBaugh FETP JTAG programmer, or equivalent.
- 14-pin cable supplied with the JTAG programmer.
- 25-pin straight-through parallel port extension cable. Available at most PC outlets.
- Installed Quadravox or CrossWorks software development tools on a compatible PC.

8.2 Step Two, Connect the JTAG Programmer

To program and debug your ES449, the JTAG programmer must be connected. These instructions assume you are using a SoftBaugh FETP JTAG programmer, but other equivalent devices may be used. Warning: If you have a new, very fast, or "green" PC, you may have difficulty with equivalent JTAG programmers on any MSP430 target. Obtaining a genuine SoftBaugh FETP will usually resolve these problems (as of this writing, we haven't seen a case where it hasn't yet!).

Connect FETP:J1 to your PC's parallel port using the 25-pin parallel extension cable. Then, connect FETP:J2 to ES449:J11 using the 14-pin JTAG cable.

For this exercise, the jumper options will be in the following configuration:

Using the 6v lab power supply jumper J20.1-2 and J17.1-2.

Using the AAA battery supply jumper J20.3-4, J17.1-2, and J18.1-2.

Using the coin cell battery supply jumper J20.5-6, J17.1-2, and J19.1-2.

Also J23 will need to be jumpered as follows: J23.1-2, 4-5, 7-8, 11-12, 14-15, 17-18.

8.3 Rowley CrossWorks

Note: If you are using Quadravox skip to section 8.4.

8.3.1 Step Three, Open the Sample Project

1. You will first need to download the Jenny project file from our internet site at www.softbaugh.com/OuterES449.shtml. The download is referenced as ES449 Jenny Demo for CrossWorks. Save this .zip file to your computer.

2. Open Rowley CrossWorks by selecting Start>Programs>Rowley Associates Limited>CrossWorks MSP430 1.0.0>CrossStudio.

3. After the program opens, select File>Open Solution.

4. Now open the file ES449_Jenny.hzp. Note: if you cannot see this file in the folder you placed it, you may need to extract the file out of the .zip file previously downloaded.

8.3.2 Step Four, Build the Code

5. Select Project>Build Solution in the upper taskbar.

6. In the build log at the bottom of the screen it should now say build complete.

8.3.3 Step Five, Program the Target

7. To program the target first select Target>Connect MSP 430 FET in the upper taskbar. This connects the debugger to the flash emulation tool.

8. In the 'Targets' window on the right side of the screen you should see a red check mark next to the MSP430 FET indicating it is connected. Note: if you do not see the red check make sure the JTAG connectors are fastened securely and try again. See section 8.2.

8.3.4 Step Six, Execute the Code

9. Select Debug>Start Debugging to begin executing code.

10. After a few seconds the LCD on the ES449 should become active.

8.3.5 Step Seven, Debug the Code

11. Select Debug>Break to stop executing code.

12. The source code file will automatically open in the main window and a yellow arrow indicates where the code was halted. You should also notice the LCD on the ES449 is steady.

13. Press F11, this is the 'Step Into' function. Each time it is pressed one line of code is executed. "Stepping" is useful for tracing the flow of your code.

14. Press F5, this is the 'Go' function. When pressed the code will be executed continuously until a breakpoint halts it or until you select Debug>Break or Debug>Stop.

15. Breakpoints are useful when debugging your code. After a breakpoint is set to a line of code the debugger will execute the code until it reaches the breakpoint. Once the breakpoint is reached the execution of code will halt on the breakpoint. From there you can step through the code to ensure the proper flow.

16. Set a breakpoint on the following statement by clicking on the small blue arrow next to this line of code:

    xor.b #001h,&P1OUT ; Toggle LED

    This line of code is located on line 90 approximately of the ES449_Jenny.asm file, almost half way down.

17. Once the breakpoint is set a red dot should replace the blue arrow next to that line of code only.

18. Now each time you press F5 or Debug>Go, the code will run to this breakpoint and the LED D1 will toggle off and on.

8.4 Quadravox

8.4.1 Step Three, Open the Sample Project

1. You will first need to download the Jenny project file from our internet site at www.softbaugh.com/OuterES449.shtml. The download is referenced as ES449 Jenny Demo for Quadravox. Save this .zip file to your computer.

2. Open Quadravox AQ430 by selecting Start>Programs>qvarch430tools.

3. After the program opens, select Project>Open.

4. Now open the file ES449_Jenny.qpj. Note: if you cannot see this file in the folder you placed it, you may need to extract the file out of the .zip file previously downloaded.

8.4.2 Step Four, Build the Code and Program the Target

5. Select Build>Rebuild All.

6. A couple of windows will now open including a window showing the source code. A yellow arrow indicates the next line of code to be executed.

7. Your target should now be programmed and ready to execute code.

8.4.3 Step Five, Execute the Code

8. Select Debug>Go to begin executing code.

9. After a few seconds the LCD on the ES449 should become active.

8.4.4 Step Six, Debug the Code

10. Select Debug>Stop to stop executing code

11. Press F7, this is the 'Step' function. Each time it is pressed one line of code is executed. "Stepping" is useful for tracing the flow of your code.

12. Now press F9, this is the 'Go' function. When pressed the code will be executed in real time.

13. Breakpoints are useful when debugging your code. After a breakpoint is set to a line of code the debugger will execute the code until it reaches the breakpoint. Once the breakpoint is reached the execution of code will halt on the breakpoint. From there you can step through the code to ensure the proper flow.

14. Set a breakpoint on the following statement by right-clicking on it and selecting 'Toggle BP.'

    xor.b #001h,&P1OUT ; Toggle LED

    This line of code is located on line 130 approximately of the ES449_Jenny.asm file, almost half way down.

15. Once the breakpoint is set that particular line of code will be highlighted red.

16. Now each time you press F9 or Debug>Go the code will run to this breakpoint and the LED D1 will toggle off and on.