

## **SDR2GO Builder's Notes November 2012 Code Version 2.0**

### **Introduction**

This document has been prepared to aid the builder of the SDR2GO board. The SDR2GO board and its documentation have been prepared for the experienced builder of ham radio equipment with surface mount component installation experience. If you have successfully built a SoftRock then you are well on the way to building an SDR2GO board!

### **SDR2GO Board Revisions / Applicability**

So far several batches of kits have been prepared and sold. The original batch of 30 kits have boards marked as version V1.0. The subsequent batches kits have boards marked as V2.1. These notes address both versions of the boards. The following changes have been made to the design of the V2.1 boards:

- Two pull up resistors (R43 & R44) have been added.
- Capacitors C25 thru C29 have been deleted.
- A missing wire for U8 has been added.
- Board mounting hole registration has been improved.
- A number of small layout tweaks have been made.

### **SDR2GO Code Revisions**

The latest version of the dsPIC software is SDR2GO V2.0 These Builder's Notes only address the use of SDR2GO V2.0 code. For a complete history of the SDR2GO code revisions, please see the document entitled "SDR2GO Code Revision History".

Please note that to use the SDR2GO V2.0 code **you must use the Graphics Interface**. Please see the document entitled "SDR2GO Graphics Display Add On Builder's Notes May 2012" for details of implementing this board.

All kits shipped after November 2012 will include a boot loader code. This code allows the user to program the SDR2GO dsPIC with an **3 volt UART**. Please see the document entitled "SDR2GO Boot Loader Instructions".

Programming of the dsPIC using a Microchip PICKit II is still be supported.

If you receive an SDR2GO kit shipped after November 2012 and you do not wish to use a Graphic Display then you will need to re-program your dsPIC with SDR2GO V1.9.2 code.

### **Legacy SDR2GO Boards**

If you have built an SDR2GO rig and you wish to upgrade to the V2.0 code you will need to make the few simple hardware changes as listed below:

- Remove caps from GPIO bit 0 and GPIO bit 1 inputs near J7 to allow boot loader operation
- Connect an 8 position rotary switch to bit 0, bit 1 & bit 2 on J13 to serve as Mode Selector
- Move your Sideband Select Switch input from J13 to GPIO bit 4 on J11
- Make sure you have a Filter Width Select Switch input on GPIO bit 3 on J11

If you wish to use a backlight control feature for your LCD displays, install 2n7000 FET boards (one for each display) between GPIO bit 8 on J13 and the backlight supply pin on your displays.

## Kit Details

- 1) This is basically a SDR design block and experimentation platform. As is, it will perform the functions of a SSB/CW transceiver when used with an I/Q front end such as a SoftRock RxTx Ensemble, SoftRock RxTxV6.3, or UHF SDR. It provides the capability for reprogramming and future functional expansion.
- 2) Many of the component footprints are altered (made longer and narrower) to enhance hand soldering. Component placement and spacing is also designed for hand soldering.
- 3) The CODEC chip used, a TI TLV320AIC3204IRHB, is relatively new and only available in a 32 pin QFN package.
- 4) There are two parts which will be provided programmed on production kits: the dsPIC33FJ128GP804 and the MC9S08SH32CWL. Programmed chips are identified with a white dot which represents the Kees Talen Certification of Programming.
- 5) In future there may be upgrades of the code for the SH32 or dsPIC which you may program yourself. For programming the dsPIC33 you will require a Microchip PICKit or a 3 volt UART. For programming the MC9S08SH32 you will require a BDM programmer such as the USB Multilink.
- 6) One of the major user advantages of the SDR2GO is the flexibility to use a Rotary Encoder and/or PS/2 Keyboard for frequency control. We haven't even figured out all the possibilities :o) .The keyboard provides many unique advantages for data entry and will be covered in another section.

The schematic shows J17 as being an interface to the NUE PSK modem. This port and the Keyboard CLK SW input allow a single user keyboard to be shared between the SDR2GO and a NUE PSK modem. No data or DSP signals are shared between the SDR2GO and a NUE PSK modem.

- 7) This kit is not for the inexperienced. It has one 44 LQFP, a SOT23-6, several SOICs, and a 32pin QFN. The QFN can be hand soldered with flux and "wipe technique". All Kees uses is a set of head magnifiers and a temperature controlled soldering iron (cost less than \$50 on ebay). The most important step is placement and tacking the part in place first. If you solder one side, then the next, then the next, etc ....you will find that the component registration has moved due to the thermal expansion/contraction forces.
- 8) The 16x2 LCD interface is designed for many types of 16x2 LCDs.
  - those requiring positive or negative contrast bias, various bias levels
  - those with Vcc/ and Gnd as pin 1 or 2
  - those with Vcc/ and Gnd as pins 2 and 1

The reason for doing this is that we supply one type of yellow-green backlit LCD with black alphanumeric characters, but you may have your favorite white on blue, black on white, etc. For the positive and negative bias levels, a charge pump made up of D2, D3, C12, C13 is provided. For contrast adjustment, R17 is provided and will supply approximately -2V to +2V.

Note that the LCD interface uses a 10pin connector and is multiplexed using inputs D4, D5, D6, and D7 (inputs D0, D1, D2, and D3 are NOT wired).

- 9) Si570 is the chip of choice for frequency control. You have two options a) wire the I2C interface from the SDR2GO to the I/Q RxTx board which has the Si570 installed or b) locate the Si570 chip on the SDR2GO board and wire the RF signal over to the I/Q RxTx board with a short piece of coax. We recommend option b.
- 10) The two LEDs provide quick confirmation of 5VDC and 3.3VD

- 11) J7 is used for connection to a 3 volt UART for boot loader programming. See "SDR2GO Boot Loader Instructions" for further details.
- 12) J11 is for CW key, Sideband Selection and Wide/Narrow Receive Filter interface.
- 13) J13 supports an 8 position (3 bit selector switch) for mode selection and a Pulse Width Modulation (PWM) signal for adjusting LCD display back light intensity, pin 5 (GPIO bit 8).
- 14) J17 is only for NUE-PSK attachment and need not be populated although headers are provided in the kit.
- 15) For lower power consumption a DC to DC converter (80-85% efficient) may be used to go from 12VDC to 5VDC. These are available for <\$10 and have much less power consumption than a linear 5V regulator. No DC to DC converters are provided with the kit.

### **What to do if you do not have strong SMD skills?**

All is not lost. Surface mount installation and soldering is not as difficult as it may seem. The SDR2GO team members are all over 60 years of age. Each of us have built a number of SMD projects and have learned that SMD can be done successfully using soldering irons and hand soldering techniques. What is required is that you gather a good magnifying glass with light and a vise made for holding circuit boards along with a few basic hand tools and soldering supplies to include small diameter solder, solder flux formulated for SMD and solder wick for removing unwanted solder. Also, a solvent such as 91% isopropyl alcohol is required to remove the solder flux. The flux available today is not corrosive and is much, much easier to remove than the old rosin based solder fluxes.

There are a number of websites which have instructions, guidance and videos on SMD installation. Here are a few:

<http://store.curiousinventor.com/>

<http://www.youtube.com/watch?v=3NN7UGWYmBY>

<http://www.youtube.com/watch?v=wOXhny3R7lk>

[http://www.metacafe.com/watch/2536889/tangent\\_tutorial\\_3\\_surface\\_mount\\_soldering\\_techniques/](http://www.metacafe.com/watch/2536889/tangent_tutorial_3_surface_mount_soldering_techniques/)

### **Reference Documents**

At the back of this document you will find an overall block diagram and two sheets of schematics which define the SDR2GO board.

The SDR2GO board has been designed to provide a great deal of flexibility in how the board is interfaced with the SoftRock of your choice or other SDR RF section such as the UHF SDR board. For example, an SI570 may be installed on the SDR2GO board or the SoftRock board. And, you may use a CMOS or LVDS SI570 with or without direct output, transformer output or broadband buffer output.

Other interface options are provided as well. To best make use of these interfaces we recommend that you spend some considerable time reviewing the schematics in detail and reading and then re-reading this document before you start construction.

## Parts List

You will find below a detailed parts list that you may use to check off each part as it is installed. With SMD components we strongly recommend that you install all components of the same type and value at one go before you start on another type or value. This discipline has helped the author to build five out of five SoftRock transceivers which worked on the first power up.

### SDR2GO Parts List as of April 2011

Capacitors		Resistors		Miscellaneous	
C5	0.1uF	R4 *	0	D1	Not Supplied
C6	0.1uF	R5 *	0	D2	1N4148
C11	0.1uF	R7 *	0	D3	1N4148
C17	0.1uF	R8 *	0	D4	LED
C18	0.1uF	R36	100	D5	LED
C30	0.1uF	R17	10K	L1	47uH
C34	0.1uF	R16	2.7K	Q1	2N7000
C36	0.1uF	R40	2.7K	Q2	2N7000
C38	0.1uF	R41	2K	Q3	2N7000
C40	0.1uF	R42	2K	T1 *	Not Supplied
C41	0.1uF	R11	3.3K	J1	IQ - IN from SoftRock
C43	0.1uF	R14	3.3K	J2	IQ - OUT to SoftRock
C48	0.1uF	R10	4.7K	J3	Mike / Line Input + PTT Input
C49	0.1uF	R13	4.7K	J4	SI570 RF Output
C50	0.1uF	R15	4.7K	J5	I2C IO for SoftRock
C7 *	0.1uF	R18	4.7K	J6	Encoders IO
C8 *	0.1uF	R19	4.7K	J7	dsPIC GPIO
C44	47uF	R21	4.7K	J8	Keyboard Input
C45	47uF	R30	4.7K	J9	LCD IO
C9	10uF	R31	4.7K	J10	BDM Programmer
C10	10uF	R32	4.7K	J11	dsPIC GPIO Access
C12	10uF	R33	4.7K	J12	dsPIC SPI
C13	10uF	R34	4.7K	J13	dsPIC Switch IO
C14	10uF	R20	8.2K	J14	Headphone Outputs
C15	10uF	R35	8.2K	J15	dsPIC ICSP Programmer
C16	10uF	R37	8.2K	J16	BPF IO
C31	10uF	R38	8.2K	J17	NUE Keyboard Input
C32	10uF	R39	8.6K	X1	12MHz Crystal
C35	10uF	R43+	4.7K	U1	TLV320AIC3204
C37	10uF	R44+	4.7K	U2	dsPIC33JF128GP804I/PT
C39	10uF			U3	MC9S08SH32CWL
C42	10uF			U5	24AA128
C46	20pF			U6	24(AA/LC)32AT
C47	20pF			U7	Si570
				U8	SN74LVCIG3157DBVR
				Reset	Reset Pushbutton
				3 V Reg	MCP1703-3302E
<b>Notes:</b>					
<b>1) Items marked with " * " are optional depending on SI570 Configuration. Read Builder's Notes and research SI570 output options before proceeding.</b>					
<b>2) Items marked with " + " are on V2.1 board.</b>					

## **Build Sequence**

We recommend that the parts be installed in the order listed below to provide maximum protection to the semiconductors while providing maximum physical access for hand soldering of SMD devices.

- Install all SMD Capacitors
- Install all SMD Resistors
- Install Semiconductors U1 thru U7
- Install Semiconductors Q1 thru Q3
- Install electrolytic capacitors C44 and C45
- Install Diodes D1 thru D5
- Install L1
- Install T1 if transformer output option is selected
- Install header pins J1 thru J17 as required to support the design options you choose
- Install Reset Push button

## **Design Option Discussions**

For basic operation the following items are deemed essential and will not be discussed in detail in this section.

- IQ Audio Input from SoftRock (J1)
- IQ Audio Output to SoftRock (J2)
- Microphone / Digital Audio Input (J3)
- Power Connections (J5)
- Frequency Tune Encoder (J6)
- DSP Parameter Encoder (J6)
- LCD Connections (J9)
- PTT In Signal Input (J3)
- PTT Out Signal Output (J5)

The following items are discussed in more detail below.

- Mode Selector Switch
- CW Key Input
- Wide/Narrow Receive Filter Switch
- SI570 Installation and Interface
- dsPIC GPIO
- Boot Loader Programming Interface
- MC9S08SH32CWL Programming Interface
- dsPIC33JF128GP804I/PT Programming Interface
- NUE PSK Modem Keyboard Interface
- SPI Interface
- Board Reset

## **Mode Selector Switch**

An eight position (3 bit wide) selector switch is used to set the mode of operation of the SDR2GO code. This switch is connected to bit 0, 1, & 3 on J13. At present, only three of the eight positions are used as follows.

- Position 0: CW
- Position 1: SSB Voice Input
- Position 2: Digital Audio Input

Both the SSB Voice Input and Digital Audio Input are fed into pins 1 & 2 of J3. When in Position 1, a nominal 1.0 volt bias signal is applied to pin 1 to support electret type microphone. When in Position 2 the bias voltage is not applied to pin 1.

Further, three separate audio level adjustments may be made by the user: microphone input audio level for SSB operation, line input audio level for digital operation plus CW input audio level for CW operation. These three audio levels are set using the DSP Parameter Encoder, Encoder #2.

## **PTT Operation**

The PTT\_IN signal, pin 3 of J3 places the software into transmit for SSB, Digital and CW operation. This causes PTT\_Out to go to 5 volts which may be used to drive your SoftRock transceiver.

## **CW Operation**

The SDR2GO software provides for CW operation.

CW / SSB / Digital operation is controlled by the 8 position Mode Selector Switch described above. When the switch is in Position 0, a CW transmit a tone controlled by the CW Key input is fed into the transmit I/Q chain which has a frequency of 600 Hz.

The CW tone is switched on an off by connecting a CW Key to GPIO bit 5, pin 6 of J11. When this input is high no tone is fed into the transmit I/Q chain. When this input is low (connected to pin 1 of J11) a tone is fed into the transmit I/Q chain. Filtering is provided on both the beginning and end of the CW tone to eliminate key clicks. The level of the CW I/Q audio output signals to the SoftRock, J2, may be independently adjusted by the user.

Further, the CW tone is fed out the headphone output on J14 to provide the user with a keying side tone when the SDR2GO is in the CW mode. The audio level of the CW side tone is not user adjustable.

## **Adjustable Bandwidth Receive Filter**

The software incorporates a switch selectable receive band pass filter. The selection of filter width is controlled by GPIO bit 3, pin 4 of J11. When this input is high, the receive bandwidth is approximately 2.1 kHz. When this input is low (connected to ground, pin 1 of J11, the receive bandwidth is much narrower. The narrow filter width is adjustable using the DSP Parameter Encoder. The narrow filter width may be set to 250, 500, 1000 or 2000 Hz.

**Note, the narrow filter width may be adjusted only when GPIO bit 3 is held low.**

### SI570 Installation and Interface

The SI570 may be installed on the SDR2GO board or the SoftRock board.

#### SI570 Installed on SoftRock

In the case of a SI570 installed on a SoftRock board, the items listed below are not installed on the SDR2GO board. And, header J5 is used to interface the 3.3V I2C signals to the SoftRock. It is recommended in this case pull up resistors not be installed on the SoftRock board since pull ups are provided on the SDR2GO board (See R11 & R14).

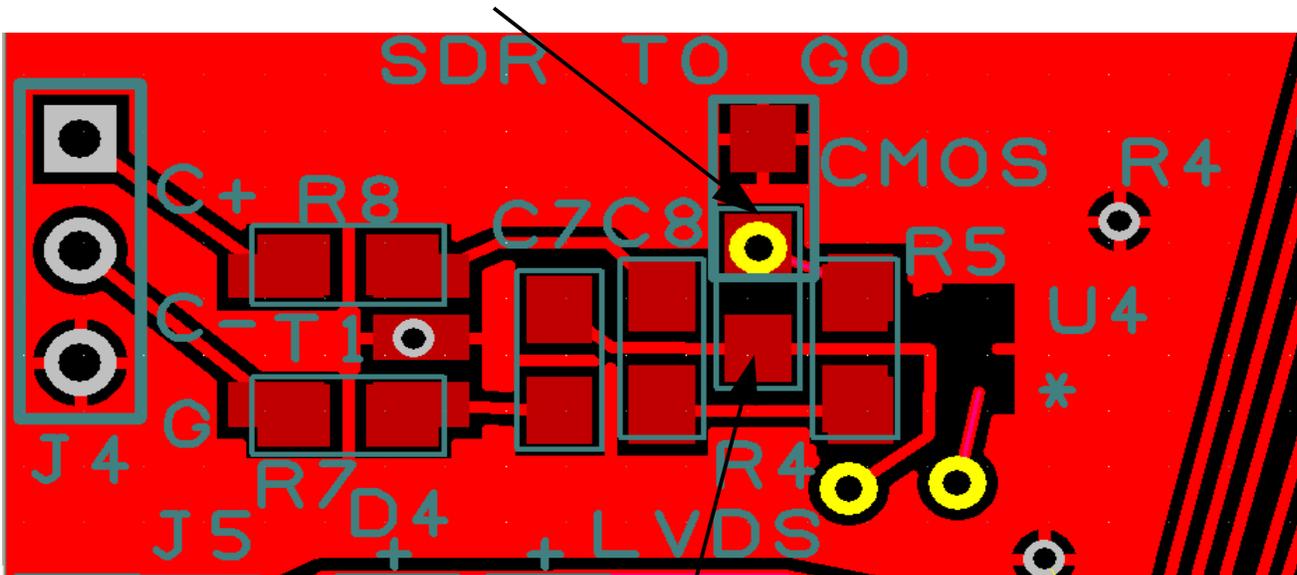
- U4 & U7
- R4,R5,R7,R8
- C5, C6, C7,C8
- T1 & J4 Header

#### SI570 Installed on SDR2GO

In the case of a SI570 installed on the SDR2GO board, U7 plus C5 and C6 should be installed regardless of SI570 output interface design. Three main SI570 output options are supported on the SDR2GO board: direct coupling, coupling using FIN1002 buffer, or transformer coupling.

Please note that R4 may be installed in one of two locations.

**R4 installed for CMOS SI570 with one end grounded.**



**R4 installed for use with FIN1002 Or Transformer Interface**

#### On board SI570 Using CMOS Direct Interface

For an interface using a CMOS SI570 the follow items should be populated with the values listed below:

- R4 50 or 100 ohm to ground (Upper Position)
- R5 0 ohm
- C8 0.1 uf
- R8 0 ohm

### **On-board SI570 Using FIN1002**

For an interface using a LVDS SI570 with the FIN1002 the following items should be populated with the values listed below:

- R4 100 ohm (Lower Position)
- C8 0.1 uf
- R8 0 ohm

### **On-board SI570 Using Transformer Interface**

For an SI570 interfaced with a trifilar transformer the following items should be populated with the values listed below:

- R5 0 ohm
- C7 0.1 uf
- C8 0.1 uf
- T1 Trifilar Transformer ( Not Supplied with kit)
- 

### **dsPIC GPIO**

Three of the dsPIC inputs are connected to the SH32 for future interface between the two processors (see J7 development details). The dsPIC inputs that are connected to J7 are 5 volt tolerant. Please note that not all of the dsPIC IO is 5 volt tolerant. Please see sheet 2 of the schematics for 5 volt tolerant pin identification.

### **SPI Interface**

The four signals of the dsPIC SPI interface plus ground may be accessed via J12. This interface is used to drive the Graphics Interface Board described in the document entitled "SDR2GO Graphics Display Add On Builder's Notes May 2012".

### **Board Reset**

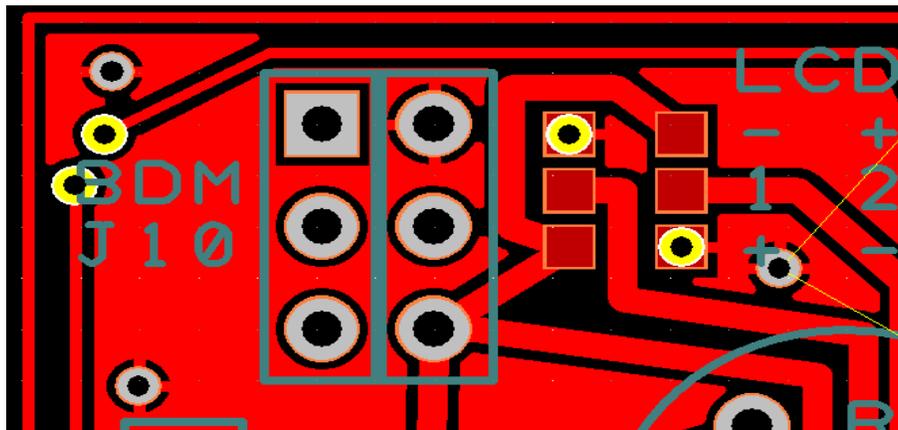
If the user wishes, the push button may be installed as labeled on the board. This input only resets the dsPIC. This reset is normally not required since the dsPIC starts up nicely when power is applied.

## MC9S08SH32CWL Programming Interface

The SH32 will be provided pre-programmed in the production run of kits.

Please note that programming of the SH32 should not be attempted until the Initial Board Start Up procedure outlined below has been completed.

If the user wishes to upgrade SH32 firmware in future the programming interface may be accessed by installing the header pins for J10 which is designed to accommodate the mating plug from a BDM programmer. Please see the figure below which shows the J10 location. The mating BDM programmer cable mates with J10. The mating connector is connected to a USB Multilink programmer via a six conductor ribbon cable. The connecting ribbon cable should extend to the left of J10 with the red edge (wire 1) at the top of the cable.



For details on the USB Multilink programmer please see this link:

[http://www.pemicro.com/products/product\\_viewDetails.cfm?product\\_id=33](http://www.pemicro.com/products/product_viewDetails.cfm?product_id=33)

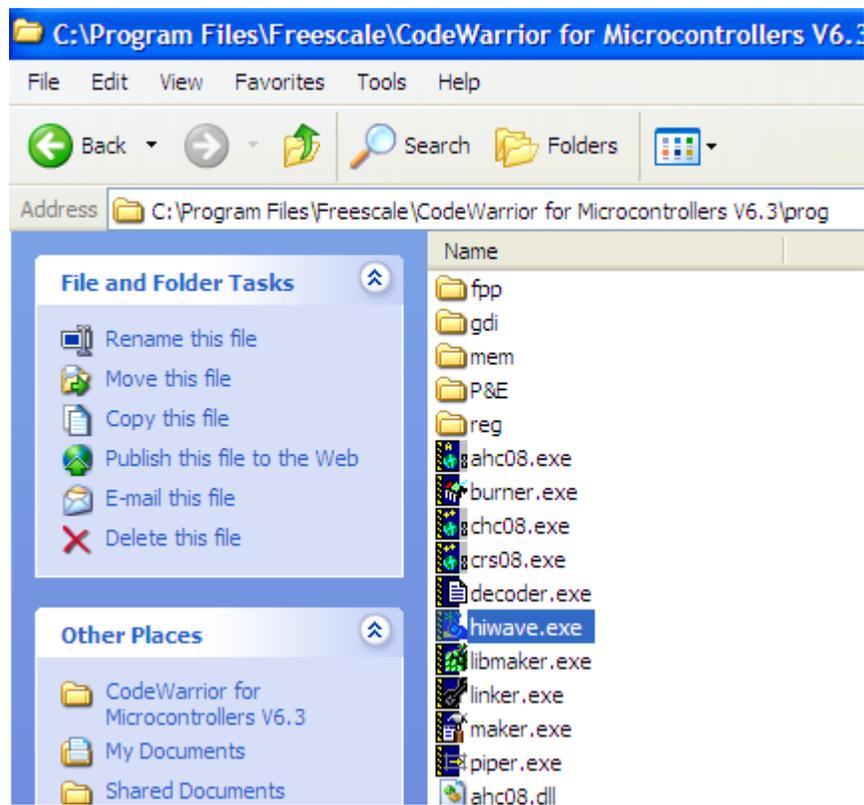
In order to use the Multilink programmer FreeScale's CodeWarrior must be downloaded and installed on your machine. [FreeScale CodeWarriorSpecial Edition Download](#)

Next, download the SDR2GO program files from the AQRP site. The archive should be extracted so that the folder is [C:\SDR2GO\\_Programming](#) folder.

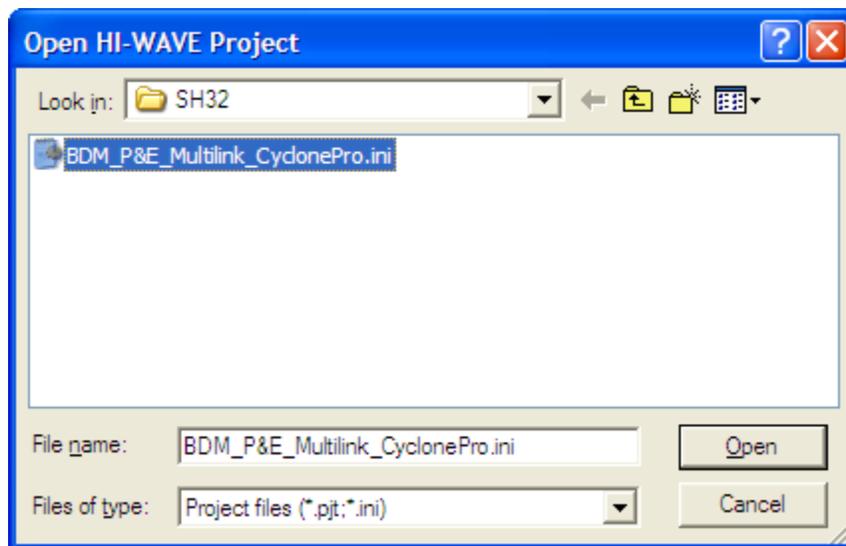
At this point, attach the Multilink programmer and power up the SDR2GO board. Both the blue and yellow LEDs on the Multilink Programmer should be lit.

The CodeWarrior application is not required for programming the SH32. Instead an application called True-Time Simulator & Real-Time Debugger which is part of the CodeWarrior IDE is used.

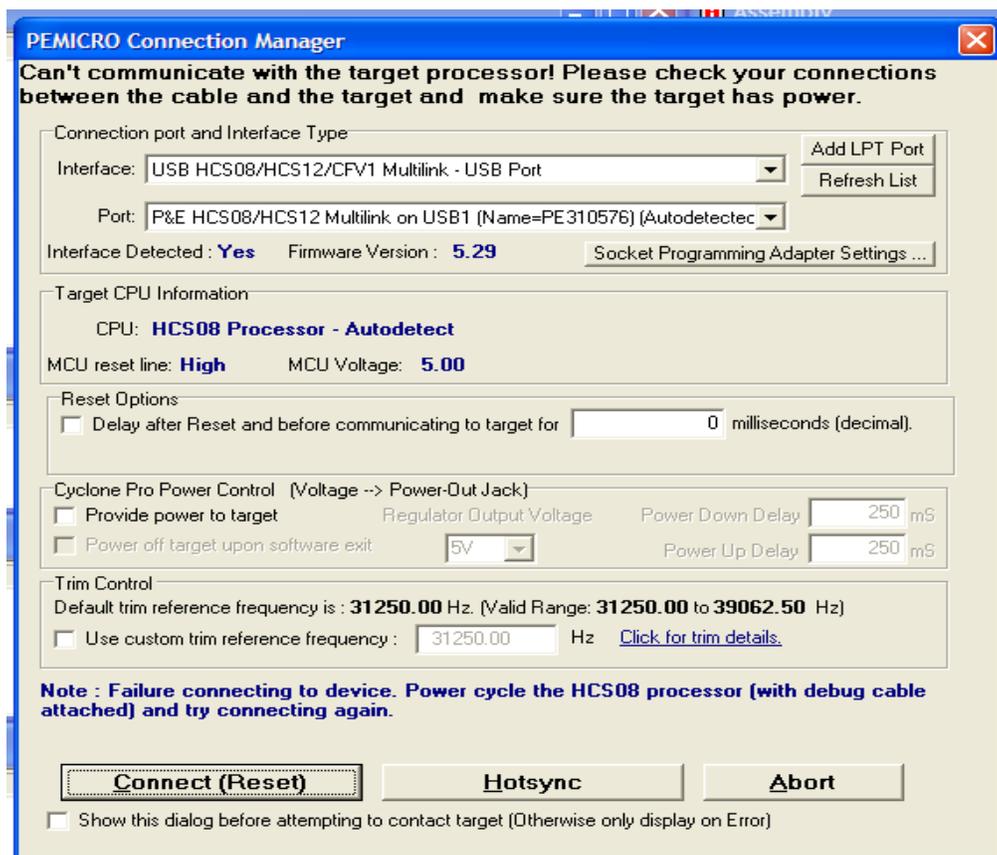
To start this application browse down to the folder: [C:\Program Files\Freescale\CodeWarrior for Microcontrollers V6.3\prog](#) and look for the application called **hiwave.exe** as shown below and double click the icon.



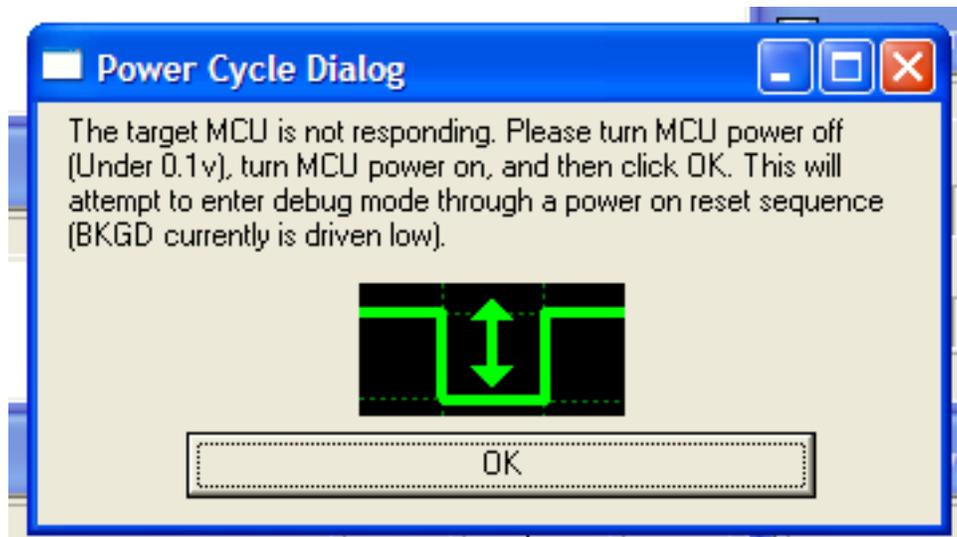




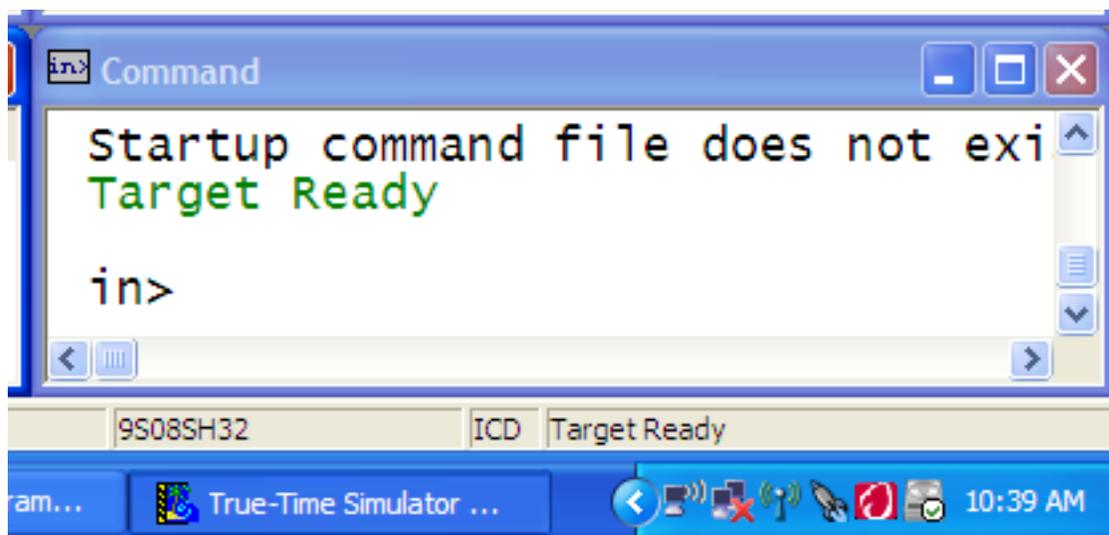
You will then see a connection dialogue box as shown below. Click Connection (Reset).



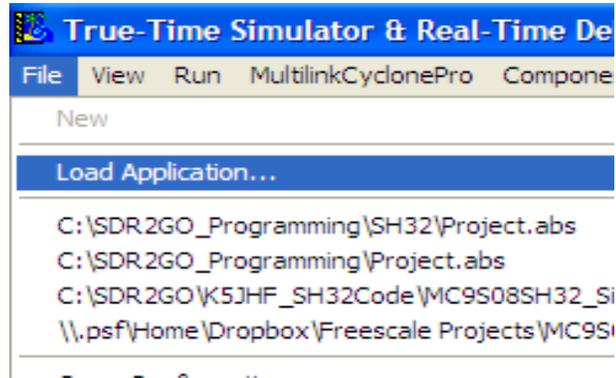
You will then probably get the nasty note shown below:



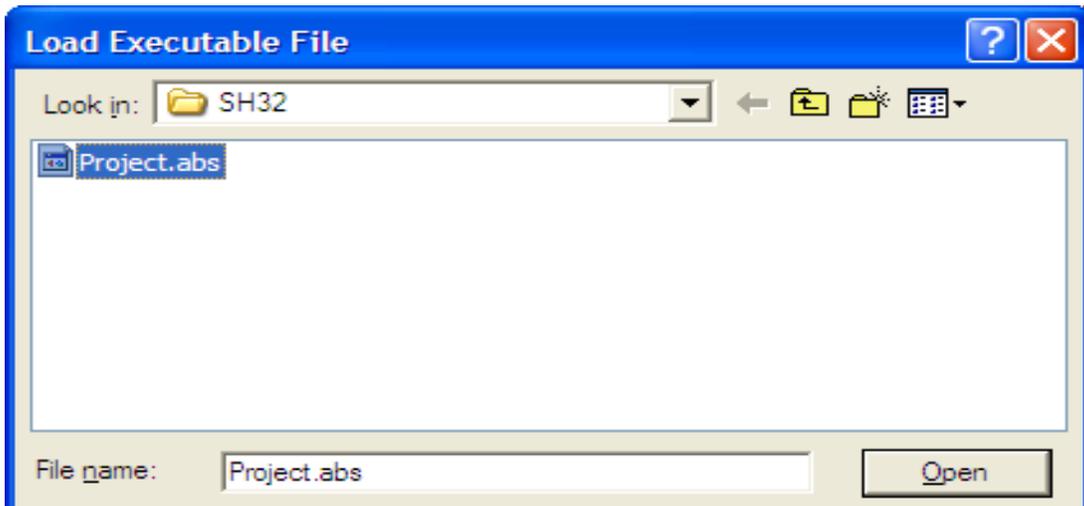
Follow the instructions. You then should get the message shown below in the extreme lower right corner of your display as shown below which says Target Ready:



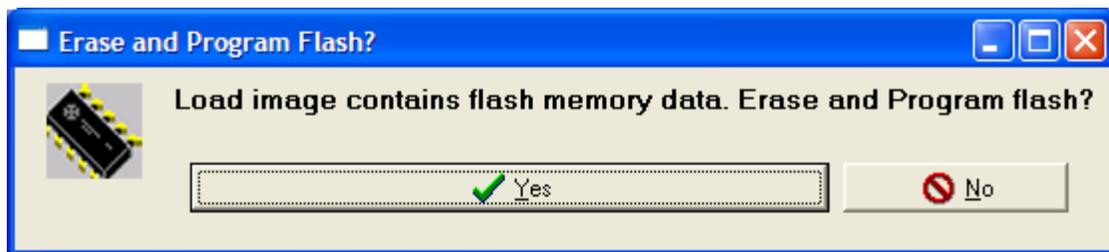
Then, got back to the File Tab and click on Load Application.



Finally, drill down to the [C:\SDR2GO\\_Programming\SH32](C:\SDR2GO_Programming\SH32) folder then select and open the Project.abs file.



You will then be presented with the dialogue box below, click Yes.



You will then see a Status Window open which displays the operations taking place. When this window closes, the programming of the SH32 is completed.

CPROGHCS08 Programmer - Version 1.69.00.04 - [ Status Window]



**X Abort**

<http://www.pemicro.com>

```
CMD>EM
Erasing.  Module has been erased.
CMD>PM
Programming and Verifying Address $0FFBF. Programmed.
CMD>VC
Verifying object file Checksum16+CRC8 to device ranges ...
  block 00008000-0000BC60 ... Ok.
  block 0000FFBD-0000FFBD ...
```

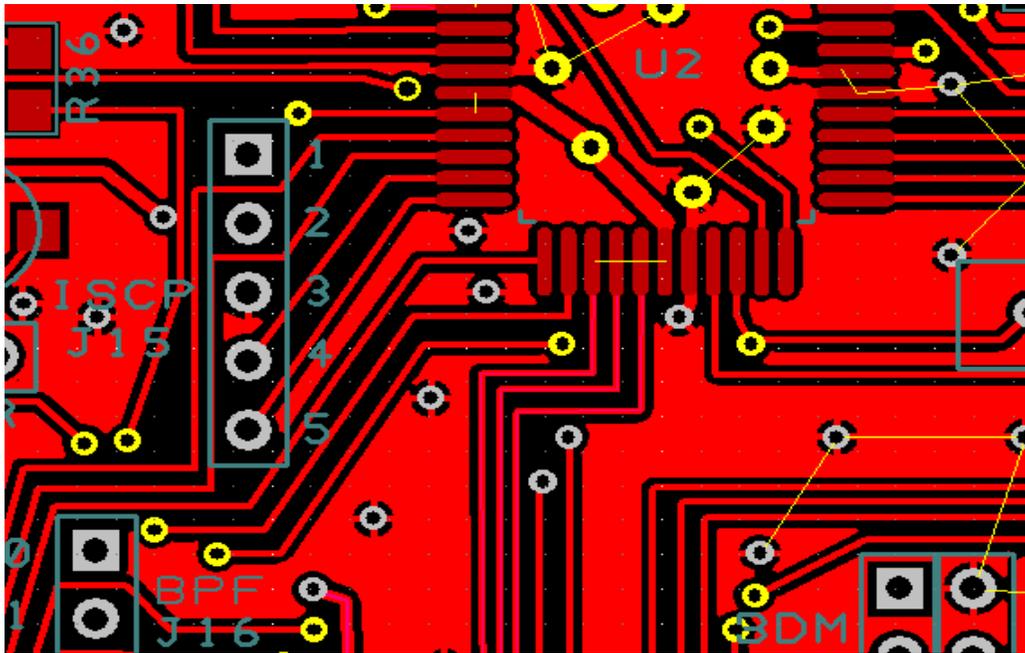
Running programming script ...

## dsPIC33JF128GP804I/PT Programming Interface

The dsPIC will be provided pre-programmed in the production run of kits.

Please note that programming of the dsPIC should not be attempted until the Initial Board Start Up procedure outlined below has been completed.

If the user wishes to upgrade the dsPIC firmware in future the programming interface may be accessed by installing the header pins for J15 which is designed to accommodate the mating plug from a PICKit 2 programmer. Please see the figure below which shows the J15 location.



The PICKit 2 plugs directly onto J15 with the PICKit Label and arrow on PICKit2 facing to the right and the arrow directly above Pin 1 of J15.

For details on the PICKit 2 programmer please use this link:

[http://www.microchip.com/stellent/idcplg?IdcService=SS\\_GET\\_PAGE&nodeId=1406&dDocName=en023805](http://www.microchip.com/stellent/idcplg?IdcService=SS_GET_PAGE&nodeId=1406&dDocName=en023805)

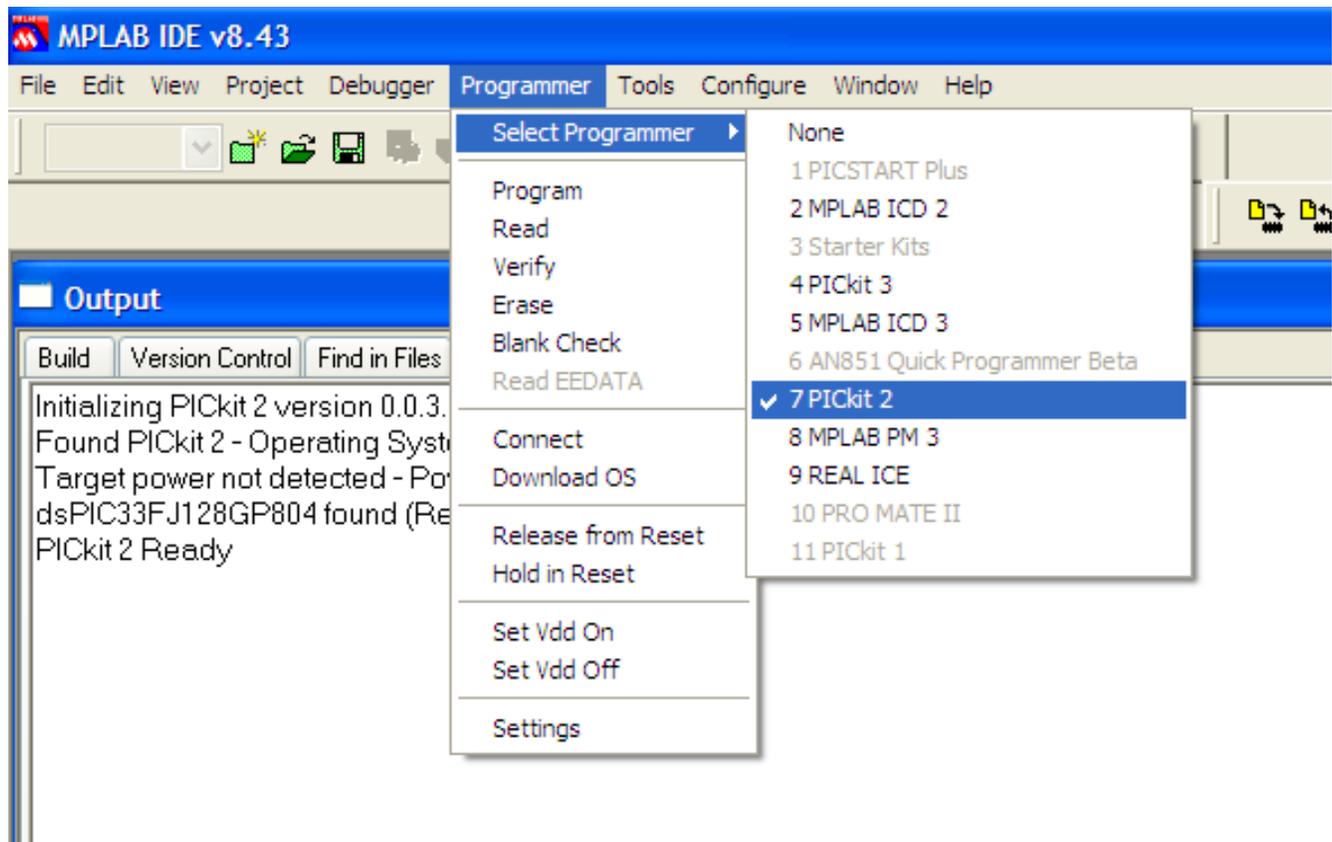
In order to use the PICKit2 programmer Microchip's MPLAB IDE must be downloaded and installed on your machine. Please use this link by depressing Ctrl and clicking this link.

[http://www.microchip.com/stellent/idcplg?IdcService=SS\\_GET\\_PAGE&nodeId=1406&dDocName=en019469&part=SW007002#P175\\_5158](http://www.microchip.com/stellent/idcplg?IdcService=SS_GET_PAGE&nodeId=1406&dDocName=en019469&part=SW007002#P175_5158)

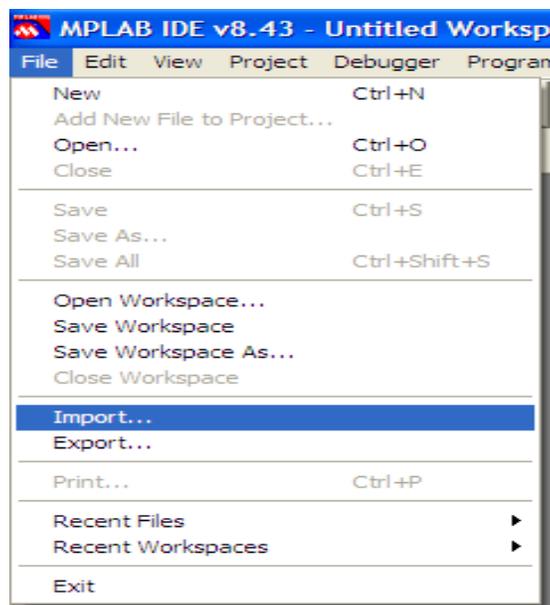
The HEX file required for programming the dsPIC is included in the [C:\SDR2GO\\_Programming](#) folder referenced above.

After you have completed the installation of the MPLAB IDE connect the PICKit 2 to the SDR2GO board. If the SDR2GO board is not powered, the PICKit 2 will supply power via the USB connection. Now, start the MPLAB IDE. When it opens, go to the Programmer Tab and select the PICKit 2 from the drop down list as shown below. You will see the result of the PICKit 2 successful connection to the

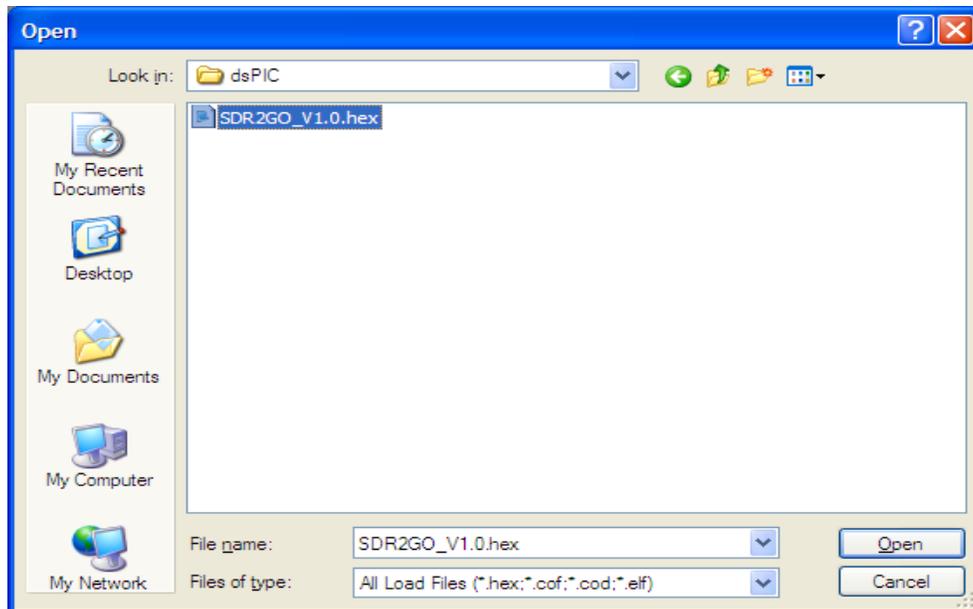
SDR2GO board in the Output Window.



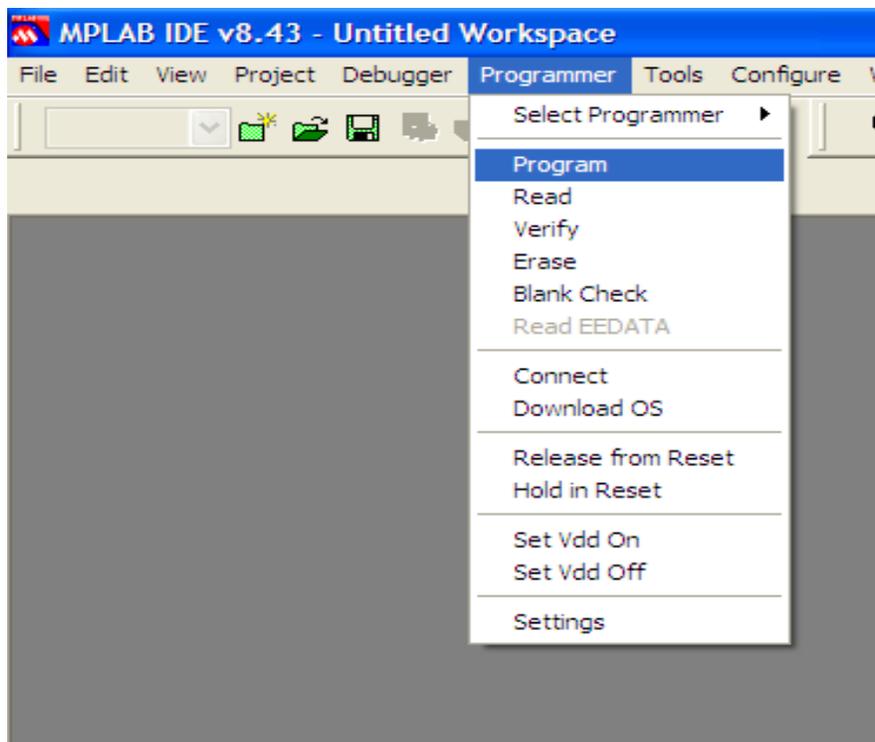
Next, go to the File Tab and select and click on Import as shown below.



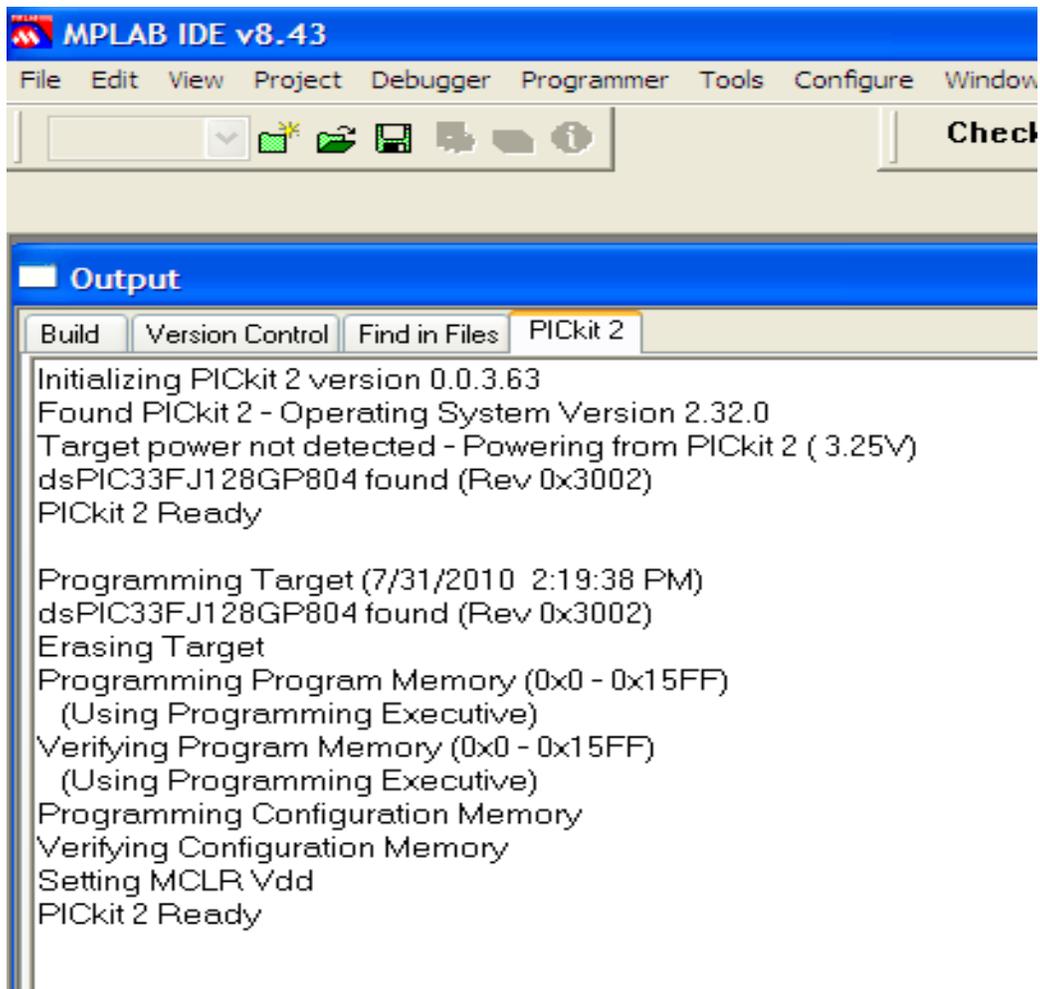
Then, drill down to the [C:\SDR2GO\\_Programming\dsPIC](C:\SDR2GO_Programming\dsPIC) folder and open the SDR2GO\_V1.0.hex file.



Finally, go to the Programmer Tab and click on Program as shown below.



Upon successful programming you will then see the message shown below.



## **NUE PSK Modem Keyboard Interface**

The SH32 may be interfaced with a keyboard via J8 so that the SI570 frequency may be adjusted and the associated control parameters configured. In addition, the same keyboard may be shared with the NUE PSK modem by using header J17. The selection of either the SH32 or the NUE PSK to interface with a connected keyboard is controlled by setting the Keyboard CLK SW input either high or low. This signal input is accessed via pin 6 of J6.

## **Initial Board Start Up**

As with any other board project, take the time to do a thorough clean up of the board and make a careful visual inspection of all solder connections before applying power. The SH32 runs at 5 VDC while the dsPIC33 and the two EEPROMs run at 3.3 VDC. Two voltage translators, Q1 and Q2, provide a 5 volt to 3.3 volt interface for the I2C bus that is controlled by the SH32. The I2C bus controlled by the dsPIC does not require voltage translation.

The inputs to the dsPIC use internal pull up resistors and should be around 2.3 volt when the connected input circuit is open.

The inputs to the SH32 use internal pull up resistors and should be around 4.8 volt when the connected input circuit is open.

Listed below are the voltages that are present on the codec, U1, when it is running properly. Please note that the data signals (Pins 4 &5) will not be present until the dsPIC is programmed and running.

Pin 1:	0.2 to 2.9 volt clock	Pin 18	0.9 volt
Pin 2:	0 to 3.1 volt clock	Pin 19	1.2 volt
Pin 3:	0 to to 3.1 volt clock	Pin 20	0.9 volt
Pin 4:	0 to 3.1 volt data	Pin 21	0.9 volt
Pin 5:	0 to 3.1 volt data	Pin 22	0.9 volt
Pin 6:	3.2 volt	Pin 23	0.9 volt
Pin 7:	0 volt	Pin 24	1.8 volt
Pin 8:	0 volt	Pin 25	1.9 volt
Pin 9:	0 - 3.2 volt	Pin 26	3.2 volt
Pin 10:	0 - 3.2 volt	Pin 27	0.9 volt
Pin 12:	0 volt	Pin 28	0 volt
Pin 15:	0.9 volt	Pin 29	1.8 volt
Pin 16:	0.9 volt	Pin 30	3.3 volt
Pin 17	0 volt	Pin 31	3.3 volt

After you have verified that there are no bolted on faults and the processor plus codec pins are at the expected voltages you may proceed with programming or board start up.

## **PTT Interface and Operation**

The dsPIC is provided with an input for PTT IN. When this input is high, the DSP algorithm will be in the receive mode. When the PTT IN input is set low, the algorithm will be in the transmit mode. The dsPIC controls an output signal called PTT Drive which is fed to Q3 so that a 0 to 5 volt signal may be fed into the SoftRock PTT IN input.

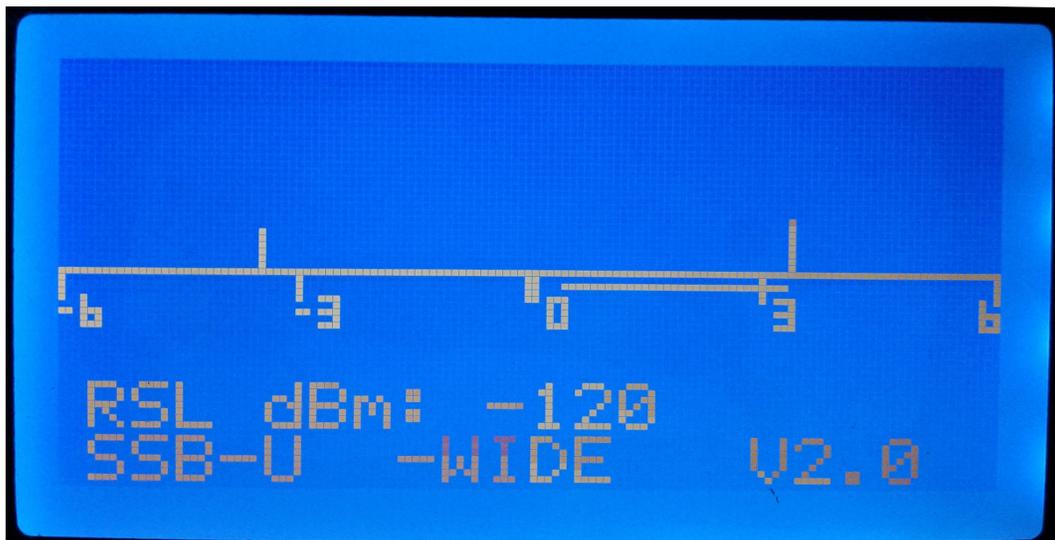
## DSP Initial Start Up

This description assumes that the following items are connected to the SDR2GO Board.

- Graphics Display via the SPI Interface (J12)
- Mode Selector Switch (J13)
- SoftRock Receive IQ Audio Signals (J1)
- SoftRock Transmit IQ Audio Signals (J2)
- Audio Test Line Input Signal (J3)
- PTT Switch (J3)
- DSP Parameter Encoder, Encoder #2 (J6)
- Sideband Select Switch (J11)
- 5 Volt Power (J5)

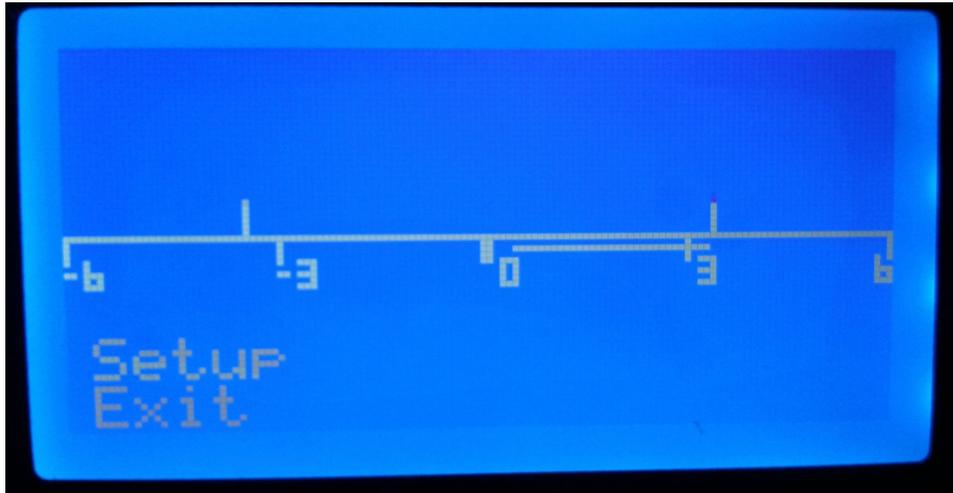
## Power Up Display

When power is applied you should be greeted with the display shown below:



## Set Up Menu

The Set Up Menu is accessed by holding in the DSP Parameter Encoder, Encoder #2 Push button for 2 seconds then releasing. At this point you will be presented with the following display:



When the push button is then “tapped” (i.e. depressed for less than a half second), Setup will be aborted and the SDR2GO will return to normal operation.

When the encoder is rotated (instead of tapping the push button), you can scroll through all of the menu options listed below.

1. Exit (to abort changes)
2. Save Changes—to permanently record the changes you have made into EEPROM
3. RX AMP TRIM—to perform IQ amplitude balance for receive image rejection
4. RX PHASE TRIM—IQ phase balance for receive image rejection
5. TX AMP TRIM—IQ amplitude balance for transmit image rejection
6. TX PHASE TRIM—IQ phase balance for transmit image rejection
7. TX MIC GAIN—Set microphone gain for SSB Mode transmit level
8. TX CW GAIN—Set CW audio level for CW Mode transmit level
9. Line-In Gain—Set Line In gain for Digital Mode transmit level
10. PGAGain0—Set PGA gain (acts like RF Gain)
11. Wide Filt BW—Set bandwidth of “wide” FIR filter
12. Backlight—Set intensity of Backlight (0 to 100%)
13. Restore Defaults

When the desired option shows on the LCD, tapping the push button will then allow the selection of parameter values by rotating the encoder.

When the desired parameter value is displayed, tapping the push button will record that value and the display will revert to Setup/Exit.

You can then tap the push button to abort the changes, or you can rotate the encoder one step Clockwise so that Setup/Save Changes appears.

At this point, tapping the push button will cause the changes to be recorded to EEPROM. Several

changes can be recorded at one time. For example, the Receiver IQ balance adjustments, Back light level, and the PGA gain can be made in succession, and all recorded with “Save Changes”.

It is not necessary to save after each parameter has been adjusted. However, if you do not save changes before exiting the Menu system, your changes will not be remembered during power cycling. Changes that are “saved” will be retrieved at next power-on.

### **Very Important Step!!      Setting Initial IQ Parameters**

The DSP algorithm reads the stored IQ Parameters on boot up of the dsPIC. The EEPROM dedicated to the dsPIC is shipped blank. So, in order to provide the DSP algorithms with useable IQ parameters, you must first initialize the stored IQ parameters. To do so, Select Item 13: Restore Defaults and then depress the Encoder push button before proceeding further.

### **Setting Receive IQ Parameters**

After the IQ Parameters have been initialized, the Receive IQ Parameters may be adjusted to minimize the unwanted signal. This may be done as follows:

First, place the dsPIC in the receive mode (PTT\_In set high) and select the upper sideband operation (GPIO bit 4 set high). Next, feed in a RF signal of known frequency into the SoftRock with an amplitude of 1 to 50 microvolts. Then tune the SoftRock to a receive frequency that is 1500 Hz below the RF signal frequency and then observe the signal in the Head Phone output, J14. Please note that the demodulated signal is fed to both the left and right Head Phone outputs. You should see a strong audio signal at 1500 Hz. Finally, place the dsPIC into the lower sideband mode by setting GPIO bit 4 low.

You should see a reduced amplitude audio signal at 1500 Hz.

Now, using the set up menu above select RX AMP TRIM / RX PHASE TRIM in conjunction with Encoder #2 to adjust the Receive Amplitude and Phase Parameters to minimize the lower sideband audio signal. You will need to alternate between Amplitude and Phase adjustments to get the lowest minimum. The ultimate unwanted signal rejection should be on the order of 50 to 70 dB. When you are satisfied with the amplitude and phase adjustments, select Save Changes from the menu above.

### **Setting Transmit IQ Parameters**

After the IQ Parameters have been initialized, the Transmit IQ Parameters may be adjusted to minimize the unwanted transmit signal. This may be done as follows.

First, place the dsPIC in the transmit mode (PTT\_In set low) and select the upper sideband operation. (GPIO bit 4 set high). Next, use the Mode Selector Switch to place the codec audio input into the Digital Mode. Then, feed in a 1500 Hz audio signal into the codec audio input, J3. At this point you can observe the SoftRock output signal in the frequency region of where the SoftRock frequency is set. You should see a strong upper side band signal and a weaker lower sideband signal. At this point, adjust the amplitude of the audio input signal so that no 1500 Hz harmonics are present in the RF output of the SoftRock. Finally, using the menu above to select TX AMP TRIM / TX PHASE TRIM in conjunction with Encoder #2 to adjust the Transmit Amplitude and Phase Parameters to minimize the observed lower sideband signal. When you are satisfied with the amplitude and phase adjustments, select Save Changes from the menu above.

The Transmit I/Q Parameters stored in the EEPROM are used for all modes of transmission: SSB Voice, Digital PSK, and CW.

### **Setting Receive Audio Level**

Receive audio level to the headphone output, J14 may be adjusted when the DSP algorithm is in the receive mode by using Encoder #2. Encoder #2 only controls receive audio gain when the Set Up Menu is not displayed.

### **Setting Transmit Audio Levels**

As shown above there are three transmit level gain adjustment, one for each mode of operation. To adjust a particular transmit level gain, select it from the menu above and then use the Mode Selector Switch to place the unit in the corresponding mode and then go to transmit using the PTT\_In signal.

## **SI570 Control Set Up and Operating Instructions**

To complete the testing of the SDR2GO board the SI570 control functions are set up and exercised. At this point Encoder #1 should be connected to header J6 and the LCD connected to header J9. Please note the two alternate ways that your LCD may be connected to J9 as explained above and shown on sheet 3 of the schematics.

At this point you are ready to use:

## **Secret Decoder Ring for the New Si570 Controller II**

### **NEW ADDITIONS:**

- 1) Backlit 16x2 LCD
- 2) Keyboard Interface in addition to a Rotary Encoder
- 3) Scanning capability
- 4) Intuitive operation with additional feedback to user
- 5) Offsets selectable on a memory location basis instead of one for the whole controller
- 6) 12 characters of your custom alphanumeric text may be displayed
- 7) The frequency is shown in KHz with 1Hz resolution

Many of the features and operations are as implemented on the current Si570 Controller and Frequency Generator Kit #2.

### **Initialization**

Initialization is done by holding in the Rotary Encoder Push Button (PB) while powering up the SDR2GO board. Keep holding it "in" until the start up memory location is displayed. It will show the code date, "John H. Fisher", count down, and reset all EEPROM locations

The cursor is an underscore and will appear the first time anything on the screen changes. The cursor can be controlled by holding the PB "in" while rotating the knob --or-- the arrow keys on the keyboard.

Data is saved by holding the PB "in" for a few seconds --or-- with the keyboard "Enter" key. Feedback will be seen on the LCD.

Data entry can be locked/unlocked by momentarily pushing the PB --or--with the keyboard "L" key. A "L" will appear in the lower left hand corner of the LCD.

Low memory (location "000" to "040") is divided into three types, "P" prefix for parameters which effect the whole controller, "T" prefix which shows text you have selected, and "M" prefix for memory specific data.

**PARAMETERS:**

- P000 Default Si570 Frequency (set for the part you are using)
- P001 Start up Memory Location (set for where you want to start)
- P002 Start up Cursor Position (set for where you want to start)
- P003 Fout Mult (Frequency out multiplier for SoftRock ...”4”)
- P004 Fout Div (Frequency out divisor for SoftRock)
- P005 Disp Mult (display multiplier when using an external frequency multiplier and you want the output frequency from the multiplier shown correctly on the LCD)
- P006 Disp Div (display divisor when using an external frequency divider and you want the output frequency from the divider shown correctly on the LCD ...handy when using the Si570 circuit at xxx Khz which is well below the Si570 cutoff spec)
- P007 Tune Rate (Rotary Encoder pulses per step)
- P008 Tune Dir (Clockwise or Counterclockwise is “increase”)

**TEXT:**

T009 – T040 The Si570 Controller II has five bits of input (32 possibilities) to define 32 possible “12 alphanumeric character” combinations which will appear on the lower line of the LCD. These five bits are labeled as GPIO bit 0 Rx thru GPIO bit 4 and may be accessed via header J7 on the SDR2GO board.

The text is independent of Frequency, Band, Offset, etc. It’s only dependent on how those 5 bits are set.

The SDR2GO V2.0 software for the dsPIC33 provides for dsPIC33 pins 27, 13 and 12 to be configured as outputs. These output pins are mapped to follow the state of three dsPIC33 inputs as follows:

Pin 27, GPIO bit 2, mirrors Sideband Select input

Pin 13, GPIO bit 7, mirrors Microphone Power input

Pin 12, GPIO bit 10, mirrors PTT\_IN input

Please note that under SDR2GO V2.0 code GPIO bit 0 Rx and GPIO bit 1 Tx no longer serve as outputs to mirror the state of dsPIC bit 0 and bit 1. These pins are now being used to support the boot loader function of the dsPIC. Hence, GPIO bit 0 Rx and GPIO bit 1 Tx are held low during operation of the SDR2go code.



**MEMORY:**

M041 to M999 This is the main display you will see showing the Frequency in KHz with a 1Hz resolution on the top line and Mxxx and whatever text you have on the bottom line. You can move the cursor with the Rotary Encoder or the Keyboard to change frequency. If you move the cursor to the "M" position by rotating the Rotary Encoder or by pushing an arrow key on the keyboard the Memory Setup screen will be toggled. This shows the Frequency, the Offset (+ or -) desired for that memory location, and the Band selection (0-7). All of the data can be changed using the Rotary Encoder or Keyboard. When saved, the Controller will go to the next available memory location carrying those data (but not store it). This is for your convenience setting up many memories.

**SCANNING:**

This is only used with a keyboard. The scan will go from one memory location frequency to the next memory location frequency. After selecting the start memory location, push the "S" key and the LCD will show a "S" where the "M" was, indicating Scan Setup data and a "D" will show the delta step size in Hz. Enter the desired step size and save it. Pushing the "space" bar will initiate the scan and stop the scan. This will also be available to a microcontroller to "stop on receipt of signal".

## **KEYBOARD SUMMARY:**

“l” ....toggles Lock on/off

“r” ....toggles between Radio mode and Data mode

“m” ....selects entry of Memory location

“f” ....selects entry of Frequency data

“o” ....selects entry of Offset data

“b” ....selects entry of Band selection

“d” ....selects entry of Delta Frequency data (step size)

“c” ....copies current data to next available memory location

“s” ....toggles sweep mode on/off

“spacebar” ....sweep stop/start

“Delete” ....deletes/zeros current memory location data

“Enter” ....saves all displayed Data to current Memory location

“Home” ....goes to initial Memory location

Left Arrow ....moves Cursor left

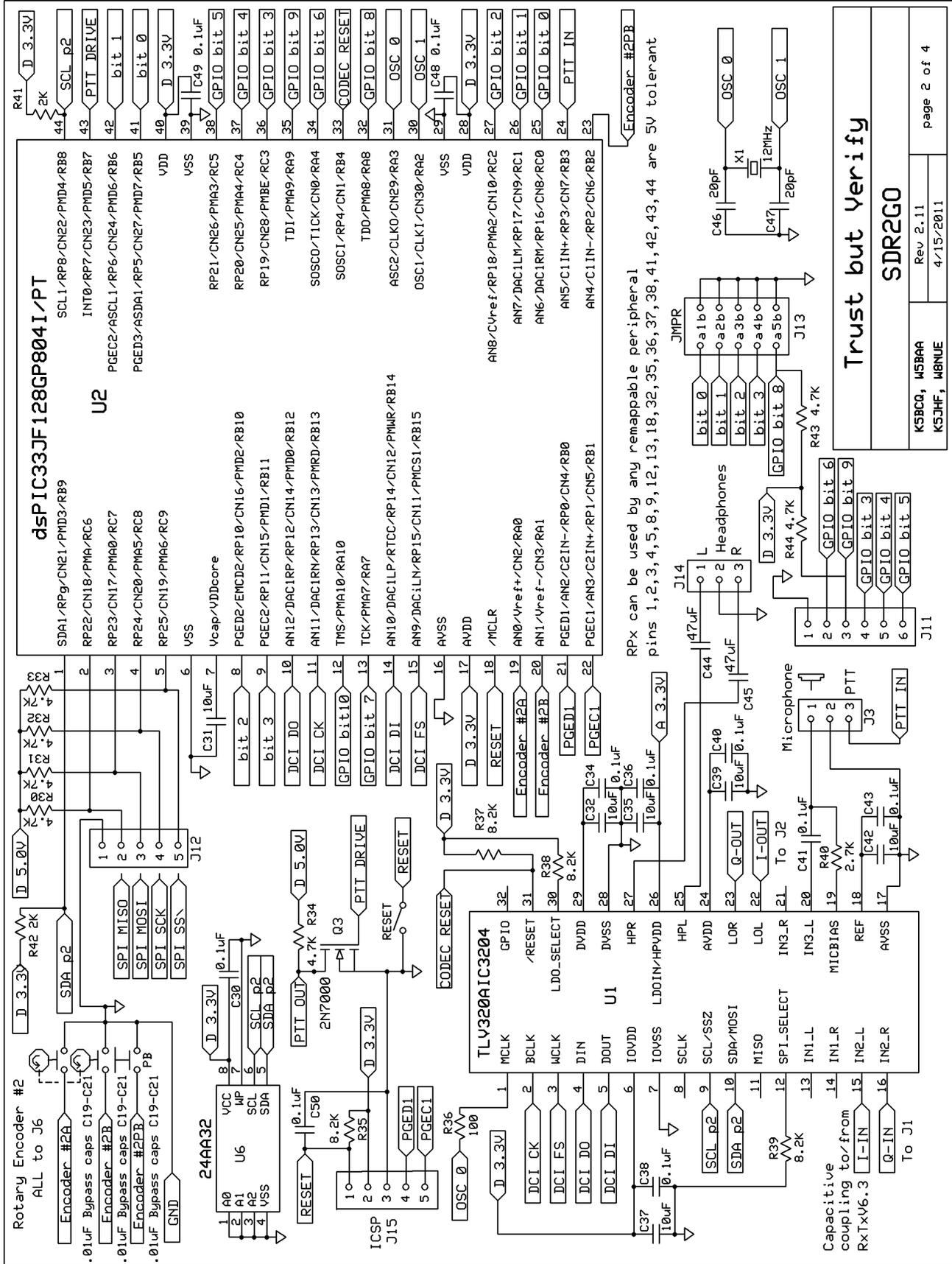
Right Arrow ....moves Cursor right

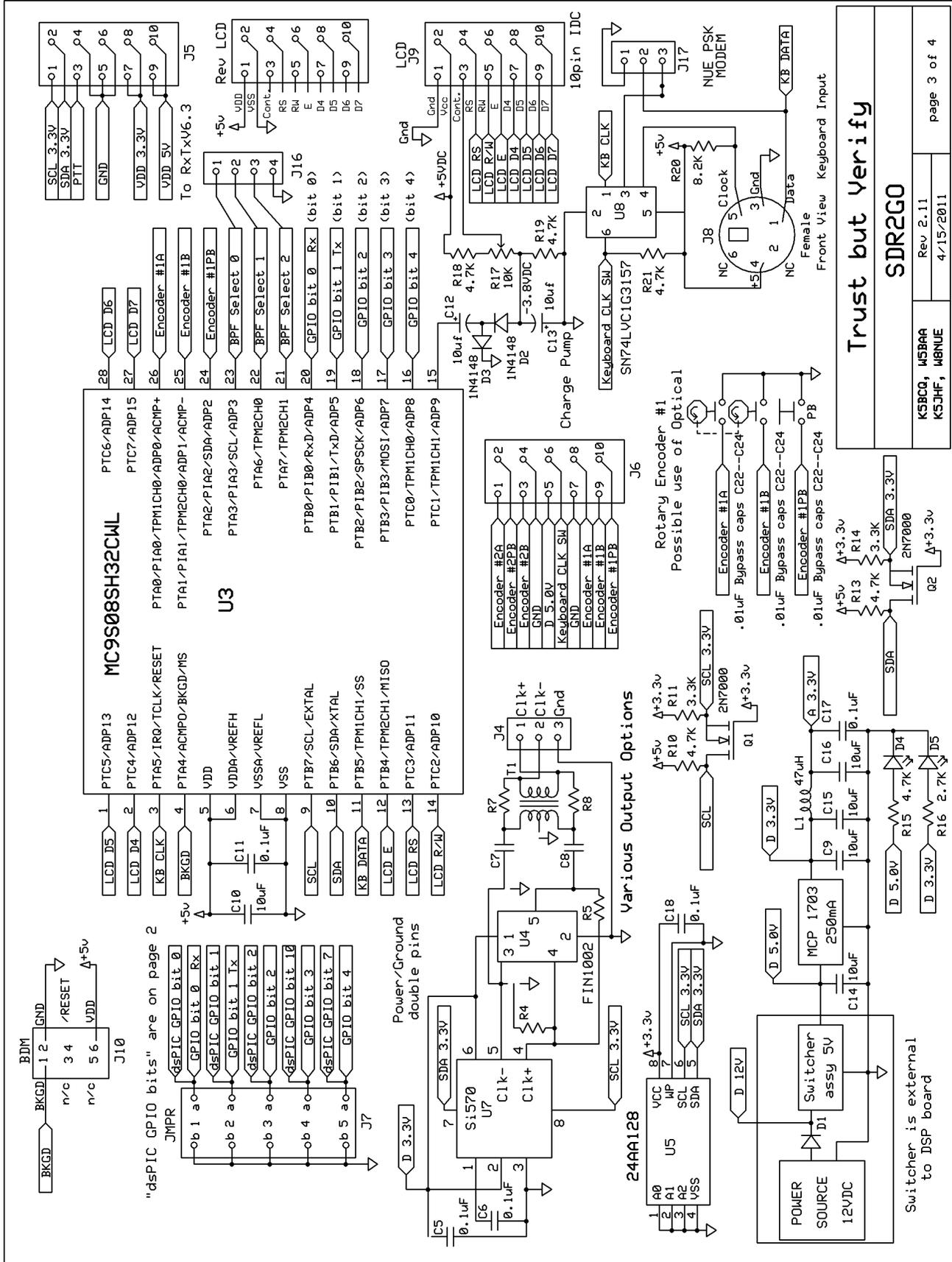
Up Arrow ....increments Data

Down Arrow ....decrements Data



# SDR2GO DSP Schematic – Sheet 2





**Trust but Verify**

SDR2GO

Rev 2.11  
4/15/2011

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