



# CRD5490-Z Power Monitor

## **Features**

- Easy-to-use Power Monitoring Reference Design
  - Plug one side into a wall outlet and an electric load into the other side.
  - Read real time measurements on the PC GUI via USB in seconds.
- Real Time Measurements:
  - Line Voltage
  - Load Current
  - Active Power
  - Reactive Power
  - Apparent Power
  - Power Factor
  - Fundamental Line Frequency
  - Temperature
- Operational Voltage 90VAC to 260VAC
- Maximum RMS Load Current 15A
- Factory Calibrated and Recalibration Capable
- Compact AC/DC Buck Converter
- **Onboard PIC18 Microcontroller**
- Windows<sup>®</sup> GUI Software

#### Overview

The CRD5490-Z is designed to evaluate the functionality and performance of the CS5490 power/energy measurement device. The CRD5490-Z integrates an efficient and compact AC/DC drop capacitor/buck power supply, voltage and current sensors, and low-cost USB MCU. This compact, complete power monitor system integrates easily in any design evaluation.

The CRD5490-Z was designed with a graphical user interface (GUI) for power measurements and calibration execution. A full-featured GUI is provided to access real time line voltage, load current, active power, reactive power, apparent power, power factor, and temperature. The software provides full access and control of the CS5490 calibration and configuration without having to learn specialized commands.

#### **ORDERING INFORMATION** CRD5490-Z Reference Design





Danger

High Voltage



# **M** IMPORTANT SAFETY INSTRUCTIONS

#### Read and follow all safety instructions prior to using this demonstration board.

This Engineering Evaluation Unit or Demonstration Board must <u>only be used for assessing IC performance in a</u> <u>laboratory setting</u>. This product is not intended for any other use or incorporation into products for sale.

This product must <u>only be used by qualified technicians or professionals</u> who are trained in the safety procedures associated with the use of demonstration boards.

## A DANGER Risk of Electric Shock

- The direct connection to the AC power line and the open and unprotected boards present a serious risk of electric shock and can cause serious injury or death. Extreme caution needs to be exercised while handling this board.
- Avoid contact with the exposed conductor or terminals of components on the board. High voltage is present on exposed conductor and it may be present on terminals of any components directly or indirectly connected to the AC line.
- Dangerous voltages and/or currents may be internally generated and accessible at various points across the board.
- Charged capacitors store high voltage, even after the circuit has been disconnected from the AC line.
- Make sure that the power source is off before wiring any connection. Make sure that all connectors are well
  connected before the power source is on.
- Follow all laboratory safety procedures established by your employer and relevant safety regulations and guidelines, such as the ones listed under, OSHA General Industry Regulations Subpart S and NFPA 70E.

**WARNING** Suitable eye protection must be worn when working with or around demonstration boards. Always comply with your employer's policies regarding the use of personal protective equipment.

**A WARNING** All components and metallic parts may be extremely hot to touch when electrically active.

#### **Contacting Cirrus Logic Support**

For all product questions and inquiries contact a Cirrus Logic Sales Representative. To find the one nearest to you go to <u>www.cirrus.com</u>

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# **1. CHARACTERISTICS AND SPECIFICATIONS**

# 1.1 Recommended Operating Conditions

Parameter	Symbol	Min	Тур	Max	Unit
Reference					
Line Voltage	V <sub>AC</sub>	90	-	260	V
Load Current	I <sub>RMS</sub>	-	-	15	А
Peak Current	I <sub>PEAK</sub>	-	-	22	А
Fundamental Frequency	Freq	5	-	2000	Hz
Ambient Operating Temperature	T <sub>A</sub>	-40		85	°C

# **1.2 Electrical Characteristics**

Parameter	Symbol	Min	Тур	Max	Unit		
Reference							
Power Consumption (V <sub>AC</sub> = 240V, 50Hz)	P <sub>AC</sub>	-	0.6	-	W		
Accuracy (PF=1, Sample Count 8000 - 2 second, Temp Compensation Enabled)							
RMS Voltage (90-260V <sub>AC</sub> )	$\Delta v_{\rm RMS}$	-	±0.1	-	%		
RMS Current (15mA-15A)	$\Delta I_{\rm RMS}$	-	±0.1	-	%		
Active Power (1.5W-3900W)	$\Delta {\sf P}_{\sf AVG}$	-	±0.1	-	%		







## 2. HARDWARE OVERVIEW

The CRD5490-Z includes sensors (line voltage and current shunt), a power supply, a CS5490 power monitor calculation engine, isolation, and an MCU. Figure 1 shows connections of each block.



#### Figure 1. System Block Diagram

Make sure that the power source is off before wiring any connection. The AC source is connected to plug IEC 60320 C14, and the AC load is connected to connector IEC 60320 C13. Make sure that all connectors are well connected before the power source is turned on. Make sure all AC power line wiring is secured to the box and away from contact before the power source is on.



#### 2.1 Line Voltage Sensor

The high-voltage AC line is attenuated using a voltage divider sensor comprised of five 1206 resistors before being supplied to the CS5490 voltage channel input. Figure 2 shows the resistor diagram for line voltage sensing. R1 is actually four large-value resistors, which increases the voltage rating. R2 is one 1K sense resistor. Refer to the vendor's specifications for voltage compliance.



Figure 2. Voltage Sensor Attenuator

The divider ratio is determined by the maximum input range of the CS5490 voltage channel ( $176mV_{RMS}$ ) and the maximum line voltage. The division ratio is determined by Equation 1.

$$V_{OUT} = V_{IN} \times \frac{R2}{R1 + R2} < 176 mV_{RMS}$$
 Eq. 1

For a line voltage,  $V_{IN}$  = 260 $V_{RMS}$ , and R2 = 1K, R1 can be solved. See Equation 2:

R1 = R2 × 
$$\left[\frac{V_{IN}}{V_{OUT}} - 1\right]$$
 = 1000 ×  $\left[\frac{260V}{176mV} - 1\right]$  = 1.47 MΩ Eq. 2

To give a 115% margin and to select common resistor values, R1 =  $115\% \times 1.47M\Omega$  is selected and composed of four resistors:  $4 \times 422k\Omega$ .

The voltage sense resistor (R2) must be referenced to the same potential as the current sensor and CS5490 power supply (located either on the Line or Neutral). By design, the CRD5490-Z is referenced to the Line side after the fuse. To switch the sensor reference, Line and Neutral of both the load and the source could be switched, and the fuse should be placed on the line externally.

#### 2.2 Shunt Current Resistor

The CRD5490-Z implements current sensing using a low-resistance shunt. When a shunt is used, the current channel's signal amplitude will be set by the shunt resistor using Ohm's Law, V = IR. To keep power dissipation low, it is necessary to use a low-resistance shunt. The current channel of the CS5490 provides a high gain setting (50x) to enable the use of a low-valued shunt. The maximum input amplitude for the current channel is  $35mV_{RMS}$  in the 50x gain range.

Applying Ohm's law,  $V_{OUT}$  = I<sub>SHUNT</sub> × R<sub>SHUNT</sub>, use Equation 3 to solve for R<sub>SHUNT</sub>:

$$R_{SHUNT} = \frac{V_{OUT}}{I_{SHUNT}} = \frac{35.36mV}{15A} = 2.35m\Omega$$
 Eq. 3

To give an 85% margin, the shunt should be reduced by  $R_{SHUNT} = 85\% \times 2.35 m\Omega = 2m\Omega$ . The power rating of the shunt should be at least twice the power dissipation on the shunt with the maximum continuous load current. With a maximum 15A load current, the CRD5490-Z uses a 2W shunt resistor.



#### 2.3 Power Supply

The CRD5490-Z contains two separate power supply domains: isolated +5V USB supply and +3.3V non-isolated CS5490 power supply derived from the power line. The +3.3V non-isolated power supply circuit is designed to reduce the overall supply volume by creating a two-stage drop capacitor and buck supply.

By selecting an efficient buck design instead of a simple voltage regulator, the rectified supply voltage is raised, the transferred power is increased, and the drop capacitor value is reduced. Reducing the value substantially reduces the capacitor's size. If size is not a factor, the more expensive buck design could be replaced with a simple voltage regulator. Figure 3 and Figure 4 show the two options evaluated for the CRD5490-Z design. Contact Cirrus Logic sales for assistance with a cost-reduced, regulator-only design.



Figure 3. Power Supply Option 1



Figure 4. Power Supply Option 2

## 2.4 MCU Purpose

The CRD5490-Z is designed to minimize the requirements of the MCU. Virtually any low-cost MCU with non-volatile memory (NVM) can be used with the CS5490 device and software. The microchip MCU has the following purposes in the CRD5490-Z:

- Store and reload calibration coefficients
- Perform USB to UART transactions that mimic a serial COM port

USB transactions are sent from the PC to the MCU. The MCU reads the first byte (character) and determines whether it should transmit the remaining bytes to the CS5490 as a Write/Read/DSP command or store or recall as calibration coefficients into NVM. All responses from the CS5490 are directly translated back to the PC via the MCU.

MCU UART communication transactions can be viewed at the bottom of the GUI. Characters sent or received are displayed in hexadecimal format. Refer to Figure 26.



#### 3. SOFTWARE OVERVIEW

The evaluation board comes with software and a USB cable to link the evaluation board to the PC. The evaluation software was developed with Microsoft<sup>®</sup> Visual Studio<sup>®</sup> and was designed to run with Windows XP<sup> $^{\text{M}}$ </sup> and Windows 7<sup> $^{\text{M}}$ </sup>. The following procedure is based on Windows XP.

## 3.1 Installation Procedure

Follow the steps below to install the GUI and the CDC driver software:

- 1. Access the following web site: http://www.cirrus.com/en/support.
- 2. Click the Energy Measurement link.
- 3. Click the CRD5490 link. The Software License web page is displayed.
- 4. To agree with the terms and conditions, click the Agree button. The File Download window is displayed.
- 5. Click the Save button. The Save As window is displayed.
- 6. Select a location to store the compressed folder.
- 7. Click the Save button. The Download complete window is displayed.
- 8. Click the **Open Folder** button. The location where the compressed folder is stored is displayed.
- 9. Right-click on the compressed folder, and click Extract All.
- 10. Select a location to extract the files.
- 11. Navigate to the location where the extracted files are stored and double-click on the setup.exe file.

😂 CRD5490				
File Edit View Favorites To	ols Help			<u></u>
🕝 Back 👻 🕥 - 🏂 🎾	Search 🌮 Folders 🛄 -			
Address 🗀 C:\Documents and Setti	ngs\stevenh\My Documents\CRD5490			🛩 🋃 Go
	Name 🔺	Size	Туре	Date Modified
File and Folder Tasks 🛛 🕙	Cirrus Power Monitor (CS5490).zip	477 KB	WinZip File	3/1/2012 7:39 PM
	Application Files		File Folder	3/1/2012 7:39 PM
Other Places 🙁	Dinf		File Folder	3/1/2012 7:39 PM
	autorun.inf	1 KB	Setup Information	3/1/2012 7:08 PM
🔛 My Documents	Cirrus Power Monitor (CRD5490), application	6 KB	Application Manifest	3/1/2012 7:08 PM
😼 My Computer	setup.exe	420 KB	Application	3/1/2012 7:08 PM
🧐 My Network Places				
Details				
File and Folder Tasks     Image: Constraint of the second se	Cirrus Power Monitor (CS5490).zip Application Files autorun.inf Cirrus Power Monitor (CRD5490).application setup.exe	477 KB 1 KB 6 KB 420 KB	WinZip File File Folder File Folder Setup Information Application Manifest Application	3/1/2012 7:39 PM 3/1/2012 7:39 PM 3/1/2012 7:39 PM 3/1/2012 7:08 PM 3/1/2012 7:08 PM 3/1/2012 7:08 PM

Figure 5. Location of the Unzipped Files



The application will verify system requirements. The Application Install - Security Warning window is displayed.



Figure 6. Application Install - Security Warning Window

- 12. Click the Install button.
- 13. Follow the instructions of the Microsoft.Net Framework installation.

The Microsoft.Net Framework may need to be installed on the system. Internet access may be required to install the Framework or language packs. The download will start automatically. If installation stops after Framework is installed, select setup.exe from step 11.

The installation program will automatically load the application after installation. If the CDC driver is already installed and the CRD5490-Z is connected (AC power and USB cable), then the CRD5490-Z will be recognized and ready.

If the CDC driver is not installed, connect the USB and AC power source, then install the serial CDC Driver when Windows recognizes the device. Refer to Appendix 2: CDC Driver Installation on page 26 for more details.

14. If necessary, execute the GUI using the next section, 3.1.1 Executing the GUI.

## 3.1.1 Executing the GUI

- 1. From the Start menu, click All Programs.
- 2. Click Cirrus Logic.
- 3. Click Cirrus Power Monitor (CS5490). The GUI is launched.



## 3.2 Using the Software

Before launching the software, ensure that all of the cables connected to the CRD5490-Z are installed (as described in the Hardware Overview section on page 4) and connect the board to an open USB port on the PC using the provided cable. Once the board is powered through the AC line and USB, the software program can be launched.



## 3.3 Start-up Window

When the software is launched, the Cirrus Logic - Power Monitor window is displayed. This window contains information about the software's title, version, and device revision number. See Figure 7.

dirrus Logic - Power monitor		
Connection Quick Measurements Graphics DataTab	e Calibration Register Write/Read	
CR	D5490-Z Power N Device Revision: CS5490 B1 Software Version 1.0	Aonitor
Port Communication	86 DD 44	CIRRUS LOGIC Copyright 2012 Cirrus Logic

Figure 7. Cirrus Logic - Power monitor Window

The tabs in this window provide access to GUI functions. The following subsections describe the tabs in this window.



## 3.3.1 Connection Tab

The Connection tab displays the USB communication with CRD5490-Z board. At startup, the GUI attempts to establish a connection to the CRD5490-Z to the PC through the last USB device connected.

Once the USB communication has been established, the CS5490 serial port will report the Device Revision on the Connection tab. If the software is unable to establish a communication link with the CRD5490-Z board, a message is displayed indicating that the initial communication has failed. This message is displayed in Figure 8.

E Cirrus Logic - Power monitor	
Connection Quick Measurements Graphics Data Table Calibration Register Witke/Read CCRDD54900-Z Poweer Moonitor Device Revision: Unknown or Connection Error. Please close program, reset AC power, reconnect USB, and reload program. Software Version 1.0 Port Port Software Version 1.0 Port Software Versi	
Pot Communication  52.80.23  Copyright 2012 Cirrue Logic  Copyright 2012 Cirrue Logic	

Figure 8. Connection Tab with Communication Error Displayed

## 3.3.1.1 Common Causes of Communication Error

- No AC power
- USB cable is not connected
- · USB cable to the CRD was not the last device connected before loading the GUI
- Windows is not given time to recognize the device and assign a serial port
- The wrong serial port is assigned because the GUI was loaded before the above items were met

## 3.3.1.2 Fixing Communication Problems

- 1. Close the GUI.
- 2. Remove the power to the CRD5490-Z by turning off the AC source.
- 3. Remove the power to the MCU by removing the USB cable from the PC.
- 4. Check that the AC power connections are secure.
- 5. Connect the USB cable to the PC.
- 6. Wait for Windows to detect the CDC Device. Verify the port by opening the Device Manager and reviewing the port assignments (run "devmgmt.msc" at a command prompt or Windows 7 search).
- 7. Apply AC power and wait a second.
- 8. Reload the GUI.



## 3.3.2 Quick Measurements Tab

The Quick Measurements tab displays reported power data from the CS5490 device in real time as continuous conversions are performed. Refer to the CS5490 data sheet, entitled *Two Channel Energy Measurement IC*, for more information about continuous conversion.

😸 Cirrus Logic - Power monitor		
Connection Quick Measurements Graphics DataTable Calibration F	legister Write/Read	
	START	
IRMS (A)		
VRMS (V)		
Active Power (W)		
Reactive Power (VAR)		
Apparent Power (VA)		
Power Factor		
Fund. Frequency (Hz)		
Temperature (C)		Change Sample Count
Sample Count (Conversions)		Change Cycle Count
Crystal (Hz)	4096000	Change Cycle Count
Port Communication 04 52 90 00 04 82 10		
		CIRRUS LOGIC Copyright 2012 Cirrus Logic

Figure 9. Quick Measurements Tab - Idle

🗑 Cirrus Logic - Power monitor		
Connection Quick Measurements Graphics DataTable Calibration Re	egister Write/Read	
	STOP	
IRMS (A)	0.33602864	
VRMS (V)	118.95712167	
Active Power (W)	39.97378051	
Reactive Power (VAR)	-0.28957923	
Apparent Power (VA)	39.97246424	
Power Factor	0.99999988	
Fund. Frequency (Hz)	59.99	
Temperature (C)	29.75	Change Sample Count
Sample Count (Conversions)	3334 <	Change Cycle Count
Crystal (Hz)	4096000	
Port Communication		
72 17 30 00 40		
		Copyright 2012 Cirrus Logic

Figure 10. Quick Measurements Tab - Continuous Convert



The Connection, Graphics, and Quick Measurements tabs may be viewed with the conversions running, but the continuous conversions should be stopped before moving to the Data Table, Calibration, or Register Write/Read tabs.

#### 3.3.2.1 START Button

The START button starts continuous conversions execution until the STOP button is clicked. The power measurements are updated with present values in the CS5490 data registers after each conversion. The refresh rate is configured by the *SampleCount* or *CycleCount* register.

#### 3.3.2.2 Change Sample Count Button

Whether this option is available depends on the CS5490 device revision and configuration. The default low-rate refresh rate for data is 1 second, or 4000 samples. Click the Change Sample Count button to change the *SampleCount* register. Enter a larger number of samples to slow the low-rate refresh rate. It is not recommended to reduce the *SampleCount* below 2000 samples.

#### 3.3.2.3 Change Cycle Count Button

Whether this option is available depends on the CS5490 device revision and configuration. The default low-rate refresh rate for data is 1 second, or 100 line cycles at 50 Hz. The CS5490 counts the samples in a half-line cycle and updates the *SampleCount* register automatically based on the *CycleCount* entered. Click the Change Cycle Count button to change the *CycleCount* register. Enter a larger number of cycles to slow the low-rate refresh rate. It is not recommended to reduce the *CycleCount* 50 cycles.

## 3.3.3 Graphics Tab

The Graphics tab displays the power data of the CS5490 versus low-rate samples in individual charts. To view data in real time, click the START button on the Quick Measurements tab, which initiates conversions, and then click the Graphics tab to bring it forward.







The charts' scales will automatically adjust for the data captured. To zoom in on a portion of a chart, click in the chart and drag a box over the portion to be enlarged. Scroll bars are displayed in the magnified chart. See Figure 12.



Figure 12. Graphics Tab with Chart Zoom Example

It is recommended to stop conversions before clicking on charts. Transactions are stopped when selecting a chart, and samples may be missed.

## 3.3.3.1 Max Samples Field

The charts will display a maximum number of samples based on the value entered in the Max Samples field. It is recommended to stop conversions before entering new values into the Max Samples field. Changes take effect immediately.

The Max Samples field should not be made too large. Otherwise, the window will update slowly and samples will be missed. When using the default sample count, generally the Maximum Samples field should be less than 500 samples and may vary depending on the PC hardware. To view a larger number of samples without missing samples, click the Quick Measurements tab to bring it forward, wait for data to be collected, stop conversions, and then click on the Graphics tab to bring it forward.

#### 3.3.3.2 Clear Chart Button

The Clear Chart button clears all the charts.



## 3.3.4 Data Table Tab

The Data Table tab displays the CS5490 power information in a table. Stop conversions before viewing the Data Table tab.

Time	IRMS (A)	VRMS [V]	Active Power (W)	Reactive Power (var)	Apparent Power (VA)	Temperature (T)	Write Ta
2/29/2012 7:59 PM	0.0130713	119.3563198	0.26193758	-1.32679939	1.55846278	30.02	Clear To
2/29/2012 7:59 PM	0.01302063	119.33781306	0.26062131	-1.32416685	1.5531977	30.02	Clear Ta
2/29/2012 7:59 PM	0.01308918	119.34476296	0.25930504	-1.32679939	1.56109532	30.03	
2/29/2012 7:59 PM	0.01300871	119.35961048	0.25798877	-1.32943193	1.55056516	30.02	
2/29/2012 7:59 PM	0.013116	119.40062543	0.26457012	-1.32679939	1.56372786	30.04	
2/29/2012 7:59 PM	0.01303405	119.42739834	0.25930504	-1.32679939	1.55583024	30.02	
2/29/2012 7:59 PM	0.0129655	119.41960603	0.25535623	-1.32679939	1.54793262	30.02	
2/29/2012 7:59 PM	0.01306087	119.39528137	0.25930504	-1.32943193	1.55846278	30.03	
2/29/2012 7:59 PM	0.01295358	119.38777864	0.2566725	-1.32679939	1.54530009	30.02	
2/29/2012 7:59 PM	0.01310855	119.40046748	0.26457012	-1.32943193	1.56372786	30.04	
2/29/2012 7:59 PM	0.01305491	119.40178374	0.25930504	-1.32416685	1.55846278	30.04	
2/29/2012 7:59 PM	0.01300573	119.40636436	0.26062131	-1.32943193	1.55056516	30.04	
2/29/2012 7:59 PM	0.01301616	119.34692164	0.26588639	-1.32679939	1.5531977	30.05	
2/29/2012 7:59 PM	0.01296699	119.30872351	0.25535623	-1.32416685	1.54530009	30.03	
2/29/2012 7:59 PM	0.01296103	119.30580139	0.25798877	-1.32416685	1.54530009	30.04	
2/29/2012 7:59 PM	0.01298636	119.24838573	0.25535623	-1.32416685	1.54793262	30.02	
2/29/2012 7:59 PM	0.01297891	119.27673817	0.25798877	-1.32416685	1.54793262	30.04	
2/29/2012 7:59 PM	0.01297444	119.29824601	0.25930504	-1.32416685	1.54530009	30.04	
2/29/2012 7:59 PM	0.01304895	119.29277033	0.26193758	-1.32153432	1.55583024	30.02	
2/29/2012 7:59 PM	0.01309812	119.32912568	0.25930504	-1.32416685	1.56109532	30.05	
2/29/2012 7:59 PM	0.01304448	119.35581962	0.26193758	-1.32679939	1.55583024	30.04	
2/29/2012 7:59 PM	0.01309961	119.37432637	0.26193758	-1.32416685	1.56109532	30.05	
2/29/2012 7:59 PM	0.01294166	119.38169748	0.2566725	-1.32679939	1.54266755	30.03	
Communication	Su						
05			25 77 00			1 5	

Figure 13. Data Table Tab

#### 3.3.4.1 Write Table Button

The Write Table button writes the full data table to a comma-delimited file (\*.csv) using Windows' standard file window. Select the directory location and filename in the Save As window.

#### 3.3.4.2 Clear Table Button

The Clear Table button clears the table.



#### 3.3.5 Calibration Tab

The Calibration tab is used to write and display to the CS5490 offset and gain calibration registers. The built-in calibration sequences of the CS5490 that are used to set the calibration register can be initiated from the Calibration tab. AC offset and gain calibration can be performed on the voltage channel, the current channel, or both simultaneously. Refer to the CS5490 data sheet, entitled *Two Channel Energy Measurement IC*, and Application Note AN366, entitled *CS5480/84/90 Energy Measurement IC Calibration*, for more details on calibration. The Calibration tab is illustrated in Figure 14.

🔜 Cirrus Logic - Power monitor				
Connection Quick Measurements Graphics DataTable Calibration Regist	er Write/Read			
		Refresh		
	Current Channe	Voltage Ch	annel	
Reference Meter Reading (Gain Calibration)	15 (	A) 265	(\)	
Gain	400000	400000	Gain	Calibration
Ich Scale	4CCCCC			
Range	50X			
AC Offset	000000		AC Offs	set Calibration
	00000			
	GUI			
	US	в		
		Refere	nce AC	
SOURCE	CRD549	0-Z Mete		
		* (V, A	<u>ه</u>	
D. C.		* Wires should be large	and short.	
52 90 21 00				
00 40				
			Cop	ngin zorz cinus cogic

#### Figure 14. Calibration Tab

To access the Calibration tab, conversion must be stopped. Otherwise, the Quick Measurements tab will be displayed with the error message shown in Figure 15.

onnection Quick Measurements Graphics DataTable Calibration Regis	ter Write/Read	
	STOP	Cirrus Power Monitor (CRD5490)
IRMS (A)	0.00033528	
VRMS (V)	119.17185783	

Figure 15. Quick Measurements Tab with Error Message Displayed (Partially Illustrated)

The Refresh button updates the contents of the screen by reading all the register values from the CS5490. It is recommended to click the Refresh button when entering the Calibration tab or after modifying any registers to reflect the current status of the CS5490.



## 3.3.5.1 AC Offset / Gain Register

In the AC Offset and Gain fields, the AC offset and gain registers for all channels are displayed in hexadecimal format. These registers can be modified directly by typing values in the fields and then pressing Enter on the keyboard. The AC offset register only affects the current channel's I<sub>RMS</sub> register values.

#### 3.3.5.2 Performing Calibrations

To ensure accurate results, Gain calibration should be performed before AC offset calibration. The gain calibration can be performed on both the voltage and current channels of the CS5490. The AC offset calibration can be performed only on the current channel. In the CS5490, the initial values in the calibration registers affect the results of the calibration. The register values are shown in blue in Figure 14. Before calibration, the gain and offset registers should be configured in their default state 0x 40 0000 (gain = 1) for gain registers and 0x 00 0000 (clear = 0) for offset registers.

#### Gain Calibration

For gain calibration, the CRD5490-Z software configures the gain registers prior to setting up calibration based on the reference meter readings. The CRD5490-Z software uses the non-full scale gain calibration techniques and formulas in Appendix 3: Non-Full Scale Gain Calibration (see page 33) to set up the CS5490 voltage and current channel gain registers before calibration. The AC offset register values are not modified by the software, and the current configuration are used. The default AC offset register value should be 0x 00 0000.

1. Attach an AC reference meter as configured in Figure 16. It is important to use short and large gauge wires to attach the reference power meter to reduce error.



Figure 16. Gain Calibration Configuration

- 2. Attach and turn on an AC source.
- 3. Attach and turn on AC load. For this example, a 200W light bulb is used, but it is recommended to use a load that is at a minimum of ½ of the full-scale load current.



4. Confirm that the initial conditions are configured as shown in Figure 17:

Cirrus Logic - Power monitor	er Write/Bead				
		Re	fresh		
	Current Cha	nnel	Voltage C	hannel	
Reference Meter Reading (Gain Calibration)	15	(A)	265	(V)	
Gain	400000		400000		Gain Calibration
Ich Scale	4CCCCC				
Range	50X				
AC Offset	000000				AC Offset Calibration
	G				
	·	USB			
AC -		490-7	Por	ver	AC
SOURCE			* (V,	ter A)	Load
	- 6	×1	Wires should be larg	ge and short.	
Port Communication 52 90 21 00				-	
00 40					
					Copyright 2012 Cirrus Logic

Figure 17. Calibration Tab with Initial Calibration Configuration

- 5. Click the **Quick Measurements** tab to bring it forward, and click the **START** button.
- 6. Wait approximately 5 to 10 seconds for the readings to update.
- 7. Click the **STOP** button.



8. **Record** the reference meter measurements after the setup has settled and before calibration is executed. See Figure 18.

🔜 Cirru	s Logic - Power monitor						
Conne	ction Quick Measurements Graphics DataTable Calibration Regist	er Write/Read					
			Re	fresh			
			-			-	
		Current Cha	annel	Voltage Ch	annel		
	Reference Meter Reading (Gain Calibration)	1.617	(A)	119.9	(∨)		
	Gain	400000		400000		Gain Calibration	
	Ich Scale	4CCCCC					
	Range	50X					
	AC Offset	000000				AC Offset Calibration	
			-0				
		G		1			
		6					
			USB				
	AC			Refere	nce	AC	
	SOURCE		490-Z	Met	er —	Load	
				*(V, #	<u>x)</u>		
Port C	mmunication		*1	Wires should be large	and short.		
52 9	0 21 00			_			
	00 40						~•
						Copyright 2012 Cirrus Logic	-
-						-14-14-14-14-14-14-14-14-14-14-14-14-14-	

Figure 18. Calibration Tab with Reference Meter Reading

- 9. Click the Gain Calibration button.
- 10. A confirmation message is displayed, as shown in Figure 19.

ction Quick Measurements Graphics Data Lable Calibration Regist	ter Write/Head				
		Re	fresh		
	Current Cha	nnel	Voltage Ch	annel –	
Reference Meter Reading (Gain Calibration)	1.617	(A)	119.9	(V)	
Gain	400000		400000		Gain Calibration
Ich Scale	4CCCCC				
Range	50X				
AC Offset	000000				AC Offset Calibration
Please confirm the reference met	er voltage and curren	t readings m	Yes	conditions ent	ered. Do you want to proceed with the calibration proce
Please confirm the reference met	er voltage and curren	t readings m	Natch the calibration	conditions ent	ered. Do you want to proceed with the calibration proce
Please confirm the reference met	er voltage and curren	t readings m	Natch the calibration	conditions ent	ered. Do you want to proceed with the calibration proce
Please confirm the reference met	er voltage and current	t readings m	Yes r	conditions ent	ered. Do you want to proceed with the calibration proce
Please confirm the reference met	er voltage and current	t readings m	Yes Peter	conditions ent	ered. Do you want to proceed with the calibration proce
Please confirm the reference met	er voltage and current	UI USB	Yes P Refere	conditions ent	ered. Do you want to proceed with the calibration proce
Please confirm the reference met	er voltage and current Gi CRD54	t readings in UI USB 490-2	Refere * (V, J	ence er er A)	ered. Do you want to proceed with the calibration proce
Please confirm the reference met	er voltage and current	t readings in UI USB 490-2	Yes realibration Yes realibration Yes realibration Refere Pow Met (V, ) Wres should be large	ence er er er e, and short.	ered. Do you want to proceed with the calibration proce
Please confirm the reference met	er voltage and current	t readings m UI USB 490-2	Yes r Refere Pow Met (V, ) w/res should be large	ence er er er A)	ered. Do you want to proceed with the calibration proce
Please confirm the reference met	CRD54	t readings m UI USB 490-2	Att the calibration Yes Refere Pow Met X, Vires should be large	ence er er A)	AC Load

Figure 19. Calibration Tab with Confirmation Message



If the calibration conditions (voltage and current) match the reference meter readings, click the Yes button.

11. The gain register values automatically update when the calibration is complete.

	ter Write/Head	- PA		
		Refresh		
	Current Char	nnel — Voltage Cl	hannel	
Reference Meter Reading (Gain Calibration)	1.617	(A) 119.9	(V)	
Gain	3DD4D4	3A2342		Gain Calibration
Ich Scale	08476F		- 10	
Range	50X	]		
AC Offset	000000			AC Offset Calibration
	GL	II		
	GL	JI		
AC	GL	JI USB Refer	ence	AC
AC SOURCE	GL CRD54	JI USB I90-Z	ence ver ter	AC Load
AC SOURCE	GL CRD54	JI USB 190-Z * Pov Met * (V)	ence ver ter A)	AC Load
	GL CRD54	JJ USB 190-Z * Refer Pov Met (V, *Wire should be lag	ence ver ter A) re and short.	AC Load
AC SOURCE 9 65 90 00 00	GU CRD54	JJ USB 190-Z * Refer Pov Met (V, *Wires should be larg	ence ver ter A) e and short.	AC Load
AC SOURCE 9 65 90 00 00	GU CRD54	JJ USB 190-Z * Refer Pov Met (V, *Wires should be larg	ence ver ter A) re and short.	

Figure 20. Calibration Tab with Gain Register Updated After Gain Calibration

12. To confirm results click the Quick Measurements tab to bring it forward, and click the START button.

	START		
IRMS (A)	1.61669999		
VRMS (V)	119.91028488		
Active Power (W)	193.86803110		
Reactive Power (VAR)	-0.60285131		
Apparent Power (VA)	193.86013349		
Power Factor	0.99999988		
Fund. Frequency (Hz)	59.98		
Temperature (C)	29.64		
Sample Count (Conversions)	6669	Change Cycle Count	
Crystal (Hz)	4096000		

Figure 21. Quick Measurements Tab Showing Results that Should Match the Reference Meter

13. Results should match the reference meter readings.





#### AC Offset Calibrations

For AC offset calibration, the CRD5490-Z software clears the offset register before calibration begins. The gain register values are not modified by the software, and the current configuration is used from the prior gain calibration. AC calibration only affects the current channel's I<sub>RMS</sub> value.

- 1. Continue from step 13 in the Gain Calibration section on page 16 and keep the AC source on.
- 2. Remove the AC load.
- 3. Open the Quick Measurements tab and click the START button.
- 4. Wait approximately 5 to 10 seconds for readings to update.
- 5. Click the **STOP** button.
- 6. Confirm that the current is as expected during a no-load condition. Inspect the pre-calibrated I<sub>RMS</sub> closely.

🖁 Cirrus Logic - Power monitor		
Connection Quick Measurements Graphics DataTable Calibration Regi	ster Write/Read	
	START	
IRMS (A)	0.00110418	
VRMS (V)	120.25275181	
Active Power (W)	0.03027419	
Reactive Power (VAR)	-0.00526508	
Apparent Power (VA)	0.13162692	
Power Factor	0.22999978	
Fund. Frequency (Hz)	59.92	
Temperature (C)	31.02	
Sample Count (Conversions)	6669	Change Cycle Count
Crystal (Hz)	4096000	
Port Communication		
57 80 57 00 00 80		
1		CIKRUS LOGIC
		Copyright 2012 Cirrus Logic

Figure 22. Quick Measurements Tab - Note I<sub>RMS</sub> before AC Offset Calibration

7. Click the Calibration tab to bring it forward, and click the AC Offset Calibration button.



8. Confirm the load has been removed or turned off, and then click **Yes** from the CONFIRM LOAD window shown in Figure 23.

妃 Cirrus Logic - Power monitor					
Connection Quick Measurements Graphics DataTable Calibration Regist	ter Write/Read				
		Re	fresh		
	Current Char	nnel	Voltage Ch	nannel	
Reference Meter Reading (Gain Calibration)	1.617	(A)	119.9	(V)	
Gain	3DD4D4		3A2342		Gain Calibration
Ich Scale	08476F				
Range	50X				
AC Offset	000000				AC Offset Calibration
		-)/			
	Please confirm the loa	d nas been	removed. Do you v	vant to procee	d with the calibration process?
		L	Yes	No	
	GI	Л	1		
		USB		_	
AC	ODDE	00 7	Refer	ence ver	AC
SOURCE		90-Z	Met	er —	Load
		×1		ray	
Port Communication		v	viles should be large	s anu snon.	
57 80 57 00 00 80				_	
					CIRRUS LOGIC
					Copyright 2012 Cirrus Logic

Figure 23. Calibration Tab with CONFIRM LOAD Window

9. The offset register value automatically updates when the calibration is completed (approximately 5 seconds). The AC Offset register value should change.

	Hegister v	Vnte/Head	-			
			Re	fresh		
	- 0	Current Cha	nnel	Voltage CI	nannel	
Reference Meter Reading (Gain Calibr	ration) 1	.617	(A)	119.9	(V)	
	Gain 3	DD4D4		3A2342		Gain Calibration
lch	Scale 0	8476F				
F	Range	50X	]			
AC	Offset 0	8A6E1				AC Offset Calibration
Ad SOUL	C RCE	G CRD5	UI <sup>USB</sup> 490-7	Refer Pow Met (V,	ence ver ter A)	AC Load
Ad SOUI	C RCE	G CRD5	UI USB 490-2	Z * Refer Pov Met (V, w/res should be larg	ence ver ter A) e and short.	AC Load

Figure 24. AC Offset Register Updated After AC Offset Calibration



10. To confirm results, click the Quick Measurements tab to bring it forward, and click the START button.

🧱 Cirrus Logic - Power monitor	
Connection Quick Measurements Graphics DataTable Calibration Register Write/Read	
START	
IRMS (A) 0.00008792	
VRMS (V) 120.25649001	
Active Power (W) 0.03027419	
Reactive Power (VAR) -0.00526508	
Apparent Power (VA) 0.00789762	
Power Factor -0.16666675	
Fund. Frequency (Hz) 59.99	
Temperature (C) 30.93	
Sample Count (Conversions) 6669 Change Cycle Count	
Crystal (Hz) 4096000	
Port Communication	
57 80 57 00 00 80	
	GIC <sup>®</sup>
Copyright 2012 Cirrus Logic	

Figure 25. Confirm  $\mathrm{I}_{\mathrm{RMS}}$  Reduced After AC Offset Calibration

Results should show a reduction in the  $\mathsf{I}_{\mathsf{RMS}}$  value without the load.



#### 3.3.6 Register Write/Read Tab

The Register Write/Read tab allows access to the CS5490 registers directly. See Figure 26.

🔜 Cirrus Logic - Power monitor		
Connection Quick Measurements Graphics DataTable Calibration Register Wri	te/Read	
	Read Write	Device Configuration Save Load
Page (dec)	0	
Address (dec)	0	
Data Write/Read (hex)	C020A0	
Port Communication 52 80 00 A0 20 C0		
		Copyright 2012 Cirrus Logic

Figure 26. Register Write/Read Tab - Read

There are two types of transactions: Write and Read. The CS5490 memory is organized by pages. In order to properly write a register, it is necessary to set the Page, Address, and Data field and then click the Write button. To read a register it is necessary to set the Page and Address and then click the Read button. Figure 26 shows the read operation. The serial port traffic can be seen in the bottom left corner. The register result is displayed in the Data Write/Read (hex) field. Refer to the CS5490 data sheet, entitled *Two Channel Energy Measurement IC*, for more details on registers and commands. Note that the write data in the Port Communication field has an extra leading command byte - "52" in the example. This is a read command for the MCU. Read data does not contain an extra byte.

Common CS5490 registers can be written to a file using the SAVE button in the Device Configuration panel. The LOAD button is used to recall the common CS5490 registers that were previously saved. It is recommended to configure the device using the Write button, start conversions from the Quick Measurements tab, stop conversions, and then save the current configuration to a file.



# 4. REVISION HISTORY

Revision	Date	Changes
RD1	APR 2012	Initial Release.



# APPENDIX 1: CRD5490 GUI REMOVAL

Follow the steps below to remove the CS5490 GUI software:

1. From the Start menu, click Control Panel. The Control Panel window is displayed.

🕑 Control Panel				
File Edit View Favorites Too	s Help			
🕝 Back - 🕥 - 🍺 🔎	Search 😥 Folders			
Address 🔂 Control Panel		S (2)	Go	
-	Name 🐨	Comments	^	
Control Panel 🛞	Folder Options Flash Player Display Date and Time	Customize the display of files and folders, change fil Manage Flash Player Settings Change the appearance of your desktop, such as t Set the date, time, and time zone for your computer.		
See Also	Automatic Updates	Set up Windows to automatically deliver important u		
<ul> <li>Windows Update</li> <li>Help and Support</li> </ul>	C Autodesk Plotter Manager Administrative Tools Add or Remove Programs Add Hardware Accessibility Options	Adds, removes and changes plotters properties. Configure administrative settings for your computer. Install or remove programs and Windows components. Installs and troubleshoots hardware Adjust your computer settings for vision, hearing, a	×	

#### Figure 27. Control Panel Window

- 2. Click Add or Remove Programs. The Add or Remove Programs window is displayed.
- 3. Highlight to select the Cirrus Power Monitor (CRD5490) item, as shown in Figure 28.

	Currently installed programs:	Show up <u>d</u> ates	Sort by: Name	
Change or Remove Programs	Cirrus Power Measurement Evaluation (CDB5480L	D	Size	21.67MB
-	Cirrus Power Measurement Evaluation (CDB5490L	Ŋ	Size	21.60MB
18 a	Girrus Power Measurement Evaluation (EE5472U)		Size	21.54MB
.dd <u>N</u> ew rograms	Click here for support information.			
-	To change this program or remove it from your co	mputer, dick Change/Remove.	Chang	e/Remove
	to change and program of remote it man your co			
i/Remove	Cirrus Power Monitoring Reference (CRD5463PM)		Size	5.60MB
d/Remove Mindows mponents	Cirrus Power Monitoring Reference (CRD5463PM)		Size	5.60MB 193.00MB

Figure 28. Add or Remove Programs with Cirrus Power Monitor (CRD5490) Displayed

4. Click the Change/Remove button, and follow the instructions. The CS5490 GUI is removed.



## **APPENDIX 2: CDC DRIVER INSTALLATION**

This Appendix includes the procedures for installing the CDC driver for both Windows 7 and Windows XP.

#### 2.1 Installing the CDC Driver Using Windows 7

Follow the instructions below to install the CDC driver on the Windows 7 operating system.

- 1. Connect the provided USB cable from the CRD5490-Z to the PC. Windows will recognize the device.
- 2. From the Start menu, select Devices and Printers.
- 3. Right-click the CDC RS-232 Emulation Demo icon.



Figure 29. Start Menu with Drivers and Printers Selected

The CDC RS-232 Emulation Demo Properties Window is displayed.

4. Click the **Hardware** tab to bring it forward.



#### 5. Click the **Properties** button

	U CDC RS-232 Emulation Demo Properties	23
Add a device Add a p	General Hardware	
Brother Bro MFC-7820N USB Printer	CDC RS-232 Emulation Demo Device Functions:	
	Name	Туре
	CDC RS-232 Emulation Demo	Other devices
Fax M Do		
<ul> <li>Unspecified (1)</li> </ul>		
	Device Function Summary	
0	Manufacturer: Unknown	
	Location: Port_#0002.Hub_#0006	
CDC RS-232 Emulation Demo	Device status: The drivers for this device are	e not installed. (Code 28)
CDC RS-23		
~	ОК	Cancel Apply

Figure 30. CDC RS-232 Emulation Demo Properties Window

6. Click the **General** tab to bring it forward, and click the **Change Settings** button.

1	CDC RS-232 Em	ulation Demo
	Device type:	Other devices
	Manufacturer:	Unknown
	Location:	Port_#0002.Hub_#0006
To fi	nd a driver for this c	device, click Update Driver.
To fi	nd a driver for this o	device, click Update Driver.

Figure 31. General Tab with the Change Settings Button Highlighted



7. Click the **Update Driver** button.

2	CDC RS-232 Em	ulation Demo	
	Device type:	Other devices	
	Manufacturer:	Unknown	
	Location:	Port_#0002.Hub_#0006	
To fi	nd a driver for this o	device, click Update Driver.	+
		Update Driver	

Figure 32. General Tab with the Update Driver Button Active

The Update Driver Software CDC RS-232 Emulation Demo panel is displayed.

8. Click Browse my computer for driver software.





9. Select the extracted file location, then select the. \inf\win2K\_winxp\ directory.



10. Follow the installation instructions. If warnings are displayed, select to continue anyway.



Figure 34. Windows Security Warning

11. Right-click the device. A pop-up menu is displayed.



Figure 35. Pop-up Menu

12. Click Properties. The Communications Port (COM3) Properties window is displayed.

ieneral Hardware	
Commur	nications Port (COM3)
Device Informati	on
Manufacturer:	Unavailable
Model:	CDC RS-232 Emulation Demo
Model number:	Unavailable
Categories:	Unknown
Description:	Unavailable
Device Tasks To view tasks for Devices and Prin	this device, right-click the icon for the device in ters.



The next time this device is used, it will be recognized, and installing the driver will not be necessary.

#### 2.2 Installing the CDC Driver Using Windows XP

Follow the instructions below to install the CDC driver on the Windows XP operating system.

1. Connect the provided USB cable from the CRD5490-Z to the PC. Windows XP recognizes the device, and the Found New Hardware Wizard opens. Select to install from a specific location.



Figure 37. Found New Hardware Wizard Window



2. Locate the driver information file provided with the software installation and browse to the driver file: \inf \win2K\_winxp \



Figure 38. Browse For Folder Window

- 3. Click the **OK** button.
- 4. Click the Next and follow the instructions. If warnings are displayed, select to continue.

Found New Hardware Wizard		
Please wait while the wizard installs th	ne software	
Communications Port		
È	4	
	< Back Next >	Cancel

Figure 39. Found New Hardware Wizard Window Showing Files Being Transferred



5. When the installation is complete, click the **Finish** button.

Found New Hardware Wiz	ard
	Completing the Found New Hardware Wizard The wizard has finished installing the software for: Communications Port
	< Back Finish Cancel

Figure 40. Found New Hardware Wizard Window with a Message that Installation Is Complete

The next time this device is used on the computer, it will be recognized, and the installation of the driver will not be necessary.



#### **APPENDIX 3: NON-FULL SCALE GAIN CALIBRATION**

When resources are limited, it may be necessary to provide non-full-scale amplitudes and perform built-in calibration. To perform a non-full-scale calibration, the initial gain register conditions of the device must be identified before calibration. Usually, initial gain register conditions are set to a default value of one, but this is not required. Instead, the initial gain register conditions are set to accommodate the non-full-scale input calibration. Before calibration is executed, the gain register can be set using the following equations:

$$V_{\text{GAIN}(\text{pre})} = \frac{V_{\text{MAX}}}{V_{\text{REF}}} \times 2^{22}$$
 [Eq: 1]

$$I_{GAIN(pre)} = \frac{I_{MAX}}{I_{REF}} \times 2^{22}$$
 [Eq: 2]

where:

- V<sub>GAIN(pre)</sub> Value stored in voltage gain register (page 16, address 35) before calibration starts
- I<sub>GAIN(pre)</sub> Value stored in current gain register (page 16, address 33) before calibration starts
- V<sub>MAX</sub> Maximum voltage of the meter defined by customer
- I<sub>MAX</sub> Maximum current of the meter defined by customer
- V<sub>REF</sub> Voltage of the line just before calibration as measured with reference meter assumes stable input
- I<sub>REF</sub> Load current just before calibration as measured with reference meter assumes stable input

Follow the steps below to perform a non-full-scale gain calibration:

- 1. Set the line voltage and load current V<sub>REF</sub> and I<sub>REF</sub>, respectively.
- 2. Confirm that the reference meter shows V<sub>REF</sub> and I<sub>REF</sub> of the input.
- 3. Set V<sub>GAIN(pre)</sub> per Equation 1 and I<sub>GAIN(pre)</sub> per Equation 2.
- 4. Send the calibration command.
- After calibration, the meter will be adjusted for a full-scale voltage of V<sub>MAX</sub> and I<sub>MAX</sub> and will currently be measuring the V<sub>REF</sub> and I<sub>REF</sub> measurements.

#### **Reference Limits**

The calibration line voltage ( $V_{REF}$ ) or load current ( $I_{REF}$ ) must not be set too low. It is recommended to keep the register values at a minimum of ½ of the maximum levels. Since the gain register can be set to a maximum value of 4, the input could be set to ¼ of the maximum levels. It is not recommended to set the input to ¼ of the maximum levels due to variations in setup conditions. If the input is too low, the gain register will set the default value of one after calibration.



#### Current Scale Register

To perform calibration with less than full scale load *without using the above procedure*, it is possible to set the current channel's *Scale* register. The current channel calibration data path contains a *Scale* register (page 18, address 63) that can be adjusted before calibration to accommodate the non-full-scale load.

$$I_{\text{SCALE}} = \frac{I_{\text{REF}}}{I_{\text{MAX}}} \times 0.6 \times 2^{23}$$
 [Eq: 3]

where:

I<sub>SCALE</sub> Value stored in the SCALE register before calibration

I<sub>MAX</sub> Maximum current of the meter defined by the customer

I<sub>REF</sub> Load current before calibration, as measured with a reference meter, assuming stable input

Follow the steps below to set the current channel's Scale register.

- 1. Set the load current, I<sub>REF</sub> (assuming V<sub>REF</sub> is set to full scale).
- 2. Confirm that the reference meter shows V<sub>REF</sub> and I<sub>REF</sub> of the input.
- 3. Set I<sub>SCALE</sub> per Equation 3.
- 4. Send the calibration command.
- After calibration, the meter will be adjusted for a full-scale voltage of V<sub>MAX</sub> and I<sub>MAX</sub> and will currently be measuring the V<sub>REF</sub> and I<sub>REF</sub> measurements.
- 6. The *Scale* register is not in the normal data path but instead in the calibration path.

DS988RD1





# ຜູ | 5. BILL OF MATERIALS

BOM#	: 505	5-00554-Z1 F	Rev:	A2 BOM Desc: PWA CRD5490-	Z-NPb	)								
Date Ge	nerated	d: 03/21/2012												
Line Iten	n Part Ass	Cirrus PN	Rev	Description	Status	Qty	<u>UM</u>	Ref Desg	<u>Man'f</u>	Man'f PN	ECO	Effective Date	<u>Notes</u>	<u>LTime</u>
0001	Р	011-00068-Z1	А	CAP 0.33uF ±10% 310V MTL FLM NPb TH	A	1	EA	C1	BC COMPONENTS	BFC233912334				7
0002	Р	011-00051-Z1	А	CAP 10nF ±20% 440V MTL FLM NPb TH	A	1	EA	C2	BC COMPONENTS	BFC233814103				7
0003	Р	012-00198-Z1	A	CAP 100uF ±20% 50V ELE NPb RAD 8X12	A	1	EA	C3	UNITED CHEMI-CON	ELXZ500ELL101MH12D				7
0004	Р	001-02189-Z1	А	CAP 0.1uF ±10% 16V X7R NPb 0603	A	7	EA	C4 C7 C9 C10 C11 C21 C25	KEMET	C0603C104K4RAC	ECO922			0
									KOA	X7R0603CTTD104K				
									VENKEL	C0603X7R160-104KNE				
									PANASONIC	ECJ1VB1C104K				
									NIC COMPONENTS	NMC0603X7R104K16TR				
									WALSIN	PF 0603B104K160CT				
0005	D	001-01997-71	Δ.	CAP 0.010E +10% 25V/ X7P NPb 0603	۸	1	E۸	C5	KEMET	C0603C103K3RAC				7
0000		001 01007 21	~		~		L/ (	00	KOA	X7R0603ETTD103K				,
									PANASONIC	ECJ1VB1E103K				
0006	Р	004-00068-Z1	А	CAP 4.7uF ±10% 10V NPb TANT CASE A	А	1	EA	C6	KEMET	T491A475K010AT				7
									VENKEL	TA010TCM475KAR				
									AVX	TAJA475K010R				
0007	Р	001-10127-Z1	А	CAP 22pF ±10% 50V C0G NPb 0603	A	1	EA	C8	KEMET	C0603C220K5GAC				7
									WALSIN	0603N220K500LT				
8000	Р	001-02068-Z1	А	CAP 0.022uF ±10% 50V X7R NPb 0603	A	2	EA	C12 C13	KEMET	C0603C223K5RAC				7
									PANASONIC	ECJ1VB1H223K				
0009	Р	001-01621-Z1	А	CAP 220pF ±5% 50V X7R NPb 0603	A	4	EA	C14 C15 C19 C20	KEMET	C0603C221J5RAC				7
									KOA	X/R0603HTTD221J				
0040		004 400 40 74		0 A D 00 - E + 5% 50% 000 NDF 0000			<b>-</b> A	010	PANASONIC	ECJIVBIHZZIJ				
0010	Р	001-10048-21	А	CAP 22pF ±5% 50V CUG NPD 0603	A	1	EA	C16	DANASONIC	DE ECTIVC14220 J				
									WALSIN	0603N220.1500LT				
0011	Р	001-02780-Z1	А	CAP 22pF ±10% 50V C0G NPb 0805	А	1	EA	C17	KEMET	C0805C220K5GAC				7
									KOA	NPO0805HTTD220K				
									PANASONIC	ECJ2VC1H220K				
0012	Р	001-10193-Z1	А	CAP 2.2uF ±10% 10V X7R NPb 0805	A	1	EA	C18	KEMET	C0805C225K8RAC				7
0013	Р	001-01937-Z1	А	CAP 4700pF ±10% 50V X7R NPb 0603	A	1	EA	C22	KEMET	C0603C472K5RAC				7
									PANASONIC	ECJ1VB1H472K				
	_								WALSIN	0603B472K500CT				
0014	Р	012-00212-Z1	A	CAP 680uF ±20% 10V ELEC NPb CASE F	A	1	EA	C23	PANASONIC	EEEFKIA681P	ECO937			7
0015	Р	001-10152-Z1	A	CAP 1uF ±10% 50V X7R NPb 1206	A	1	EA	C26	TDK	C3216X7R1H105K				7
0016	Р	001-10192-Z1	А	CAP 0.47uF ±10% 10V X5R NPb 0603	A	1	EA	C27	KEMET	C0603C474K8PAC				7
0017	D	070 00170 71	^		٨	4		D1	DIODES INC	0003X474K100C1	-			- 7
0017	Р	070-00173-21	A		A	1	EA	D1	LITTELEUSE	SP0503BAHTC	-			20 000
0018	P	165-00060-71	A .	LED BLU 470pm 5mA 45MCD NPb 0603	A A	1	EA EA	D2	OSBAM	LB_039G=L2N2=35=1	EC0022		SEE	09.999
0013		103-00000-21	^		^			53	oorani	ID QUUT DEME UU I	LC0322		COMMENTS	1
0020	Р	110-00340-Z1	А	CON TERM .11PCB TAB NPb TH	A	4	EA	E1 E2 E3 E4	TYCO	61968-1				0
0021	Р	303-00008-Z1	A	FUSE CLIP PC MOUNT 5MM NPb	A	2	EA	F1	KEYSTONE	3517	ECO922		SEE	7
0023	Р	115-00162-Z1	A	HDR 6x1 ML .1"CTR 062 S GLD NPb TH	A	1	EA	J1	SAMTEC	TSW-106-07-G-S	1		2.5	19,999
0024	P	115-00258-71	A	HDR 4x2 ML .1" 093BD ST GLD NPb TH	A	1	EA	12	SAMTEC	TSW-104-08-G-D	1		1	7
1	ľ.		ſ		1	1	l		TONGYUEQING	PHED-DS008G1ABONA	1		1	1
0025	Р	110-00263-Z1	А	CON USB RCPT RA 5POS MINI-B NPb TH	A	1	EA	J3	MOLEX	54819-0519				7
0026	Р	145-00040-Z1	А	FE 1.5A 80 ohm@100MHz NPb 0805	A	1	EA	L1	STEWARD	MI0805K400R-10				7
0027	Р	040-00149-Z1	А	IND 1000uH ±10% 300mA NPb RAD	A	1	EA	L2	BOURNS	RLB0914-102KL				7
0028	Р	304-00004-Z1	Α	SPCR STANDOFF 4-40 THR .500"L NPb	A	0	EA	MH1 MH2 MH3 MH4	KEYSTONE	2203	ECO922		NO POP	7
			1						JIAXINGLONG	M3X13	1			
0029	Р	071-00046-Z1	А	TRAN SIG NPN 40V 0.2A NPb TO-92	A	1	ΕA	Q1	FAIRCHILD	2N3904	1		1	7
1		1	1	1	1	1			SEMICONDUCTOR		1	1	1	1

CIRRUS LOGIC

Figure 41. Bill of Materials (Page 1 of 2)

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BOM#:	505	-00554-Z1 F	Rev:	A2 BOM Desc: PWA CRD5490	-Z-NPb									
Date Gen	erated	i: 03/21/2012												
Line Item	Part Ass	Cirrus PN	Rev	<u>Description</u>	<u>Status</u>	<u>Qty</u> L	UM	<u>Ref Desg</u>	<u>Man'f</u>	Man'f PN	ECO	Effective Date	<u>Notes</u>	<u>LTime</u>
0030	Р	031-00054-Z1	A	RES 270 OHM 3W ±5% MTL FLM NPb AXL	Р	1 E	EA	R1	PANASONIC	ERG3SJ271				30.002
0031	Р	020-06493-Z1	A	RES 0.002 OHM 2W ±1% NPb 2512	A	1 E	EA	R2	STACKPOLE ELECTRONICS	CSNL2512FT2L00				7
0032	Р	020-06362-Z1	А	RES 422k OHM 1/4W ±1% NPb 1206	A	4 E	EA	R3 R4 R5 R6	DALE	CRCW1206422KFKEA			1	7
0033	P	020-01016-Z1	A	RES 1k OHM 1/10W ±1% NPb 0603 FILM	A	7 6	EA	R7 R8 R9 R10 R11 R15 R21	DALE	CRCW06031K00FKEA			1	7
									KOA	RK73H1JTTD1001F				
									WALSIN	WR06X1001FTL				
0034	Р	021-00238-Z1	А	RES 680 OHM 1/10W ±5% NPb 0603 FILM	A	1 E	EA	R12	KOA	RK73B1JTTD681J				7
									NIC COMPONENTS	NRC06J681TRF				
									DALE	CRCW0603680RJNEA				
0025	D	021 00259 71	٨	RES 4 7k OHM 1/10W +5% NRb 0602 ELM	^	2		P12 P14 P16	DALE	CRCW06034K70.TNFA				7
0035	F	021-00230-21	A	RE3 4.7K OHM 1/10W ±5% NFD 0003 FEM	A	3	EA	K13 K14 K10	VENKEL	CR0603-10W-472JT				'
									PANASONIC	ERJ3GEYJ472V				
									NIC COMPONENTS	NRC06J472TRF				
									YAGEO	9C06031A4701JLHFT				
									WALSIN	WR06X472JTL				
0036	Р	021-00259-Z1	А	RES 5.1k OHM 1/10W ±5% NPb 0603 FIL	A	2 E	EA	R17 R19	DALE	CRCW06035K10JNEA				7
									KOA	RK73B1JTTD512J				
									PANASONIC	ERJ3GEYJ512V				
0007	-	004 00050 74				4	-	B40	WALSIN	WRU6X512JTL				7
0037	Р	021-00253-21	A	RES 3K OHM 1/10W ±5% NPD 0603 FILM	A	16	EA	R18	PANASONIC	ER.T3CEV.T302V				1
0038	Р	021-00292-71	Δ	RES 120k OHM 1/10W +5% NPb 0603 EII	Δ	2 6	FΔ	R20 R25	DALE	CRCW0603120KJNEA				7
0000	Ľ	021 00202 21	~		~		_/ (	1120 1120	NIC COMPONENTS	NRC06J124TRF				'
									KOA	RK73B1JTTD124J				
									PANASONIC	ERJ3GEYJ124V				
0039	Р	020-00673-Z1	А	RES 0 OHM 1/10W ±5% NPb 0603 FILM	A	3 E	EA	R22 R27 R28	DALE	CRCW06030000Z0EA				7
									NIC COMPONENTS	NRC0606ZOTRF				
									PANASONIC	ERJ3EKF0R00V				
									VENKEL	CR0603-10W-000T				
0040	D	021 00070 71	^	RES 1M OHM 1/2W/ +5% CE NR5 AVI	^	1		B22	STACKPOLE	CEM12.TT1M00	EC0027			7
0040	<u>г</u>	031-00070-21	A	RES TWOHW T/2W ES/6 CF INFD AAL	A			R23	DIACICIONE	CIMIZOIINOO	EC0937		ALT LINE 00	1
		021_00218_71	Δ.	DES 100 OHM 1/100/ +5% ND6 0603 EILM	Δ.	1 1 1	- ^	12 //	DALE	CRCW0603100R.INEA				7
0041	Р	021-00218-Z1	A	RES 100 OHM 1/10W ±5% NPb 0603 FILM	A	16	EA	R24	DALE KOA	CRCW0603100RJNEA RK73B1JTTD101J				7
0041	Р	021-00218-Z1	A	RES 100 OHM 1/10W ±5% NPb 0603 FILM	А	16	EA	R24	DALE KOA YAGEO	CRCW0603100RJNEA RK73B1JTTD101J 9C06031A1000JLHFT				7
0041	٢	021-00218-Z1	A	RES 100 OHM 1/10W ±5% NPb 0603 FILM	А	16	EA	K24	DALE KOA YAGEO NIC COMPONENTS	CRCW0603100RJNEA RK73B1JTTD101J 9C06031A1000JLHFT NRC06J101TRF				7
0041	۲	021-00218-21	A	RES 100 OHM 1/10W ±5% NPb 0603 FILM	A	16	EA	R24	DALE KOA YAGEO NIC COMPONENTS PANASONIC	CRCW0603100RJNEA RK73B1JTTD101J 9C06031A1000JLHFT NRC06J101TRF ERJ3GEYJ101V				7
0041	٢	021-00218-Z1	A	RES 100 OHM 1/10W ±5% NPb 0603 FILM	А	16	EA	R24	DALE KOA YAGEO NIC COMPONENTS PANASONIC WALSIN	CRCW0603100RJNEA RK73B1JTTD101J 9C06031A1000JLHFT NRC06J101TRF ERJ3GEYJ101V WR06X101JTL				7
0041	P	021-00218-Z1 021-00294-Z1	A	RES 100 OHM 1/10W ±5% NPb 0603 FILM RES 150k OHM 1/10W ±5% NPb 0603	A	1 E	EA	R26	DALE KOA YAGEO NIC COMPONENTS PANASONIC WALSIN DALE	CRCW0603100RJNEA RK73B1JTTD101J 9C06031A1000JLHFT NRC06J101TRF ERJ3GEYJ101V WR06X101JTL CRCW0603150KJNEA				7
0041	P	021-00218-21 021-00294-Z1	A	RES 100 OHM 1/10W ±5% NPb 0603 FILM RES 150k OHM 1/10W ±5% NPb 0603	A	1 E	EA	R24	DALE KOA YAGEO NIC COMPONENTS PANASONIC WALSIN DALE KOA	CRCW0603100RJNEA RK73B1JTD101J 9C06031A1000JLHFT NRC06J101TRF ERJ3GEYJ101V WR06X101JTL CRCW0603150KJNEA RK73B1JTTD154J DP3C0FV154J				7
0041	P	021-00218-21 021-00294-Z1	A	RES 100 OHM 1/10W ±5% NPb 0603 FILM RES 150k OHM 1/10W ±5% NPb 0603	A	1 E	EA	R26	DALE KOA YAGEO NIC COMPONENTS PANASONIC WALSIN DALE KOA PANASONIC KEYSTONE	CRCW0603100R,NNEA RK73B1JTD101J 9C06031A1000JLHFT NRC06J101TRF ERJ3GEYJ101V WR06X10JJTL CRCW0603150KJNEA RK73B1JJTD154J ERJ3GEYJ154V 5001				7
0041	P	021-00218-21 021-00294-Z1 110-00045-Z1	A A A	RES 100 OHM 1/10W ±5% NPb 0603 FILM RES 150k OHM 1/10W ±5% NPb 0603 CON TEST PT .1°CTR TIN PLAT NPb BLK	A A A	1 E 1 E 3 E	EA EA	R26 TP1 TP3 TP4	DALE KOA YAGEO NIC COMPONENTS PANASONIC WALSIN DALE KOA PANASONIC KEYSTONE CGG	CRCW0603100RJNEA RK73BiJTD101J 9C06031A1000JLHFT NRC06J101TRF ERJ3GEYJ101V WR06X101JTL CRCW0603150KJNEA RK73BiJTD154J ERJ3GEYJ154V 5001 TP=105(BLK)				7
0042	P P P	021-00218-Z1 021-00294-Z1 110-00045-Z1 175-00030-Z1	A A A	RES 100 OHM 1/10W ±5% NPb 0603 FILM           RES 150k OHM 1/10W ±5% NPb 0603           CON TEST PT .1*CTR TIN PLAT NPb BLK           OPT COUPLER PHOTOTRANS NPb DIP4	A A A	1 E 1 E 3 E	EA EA EA	R26 TP1 TP3 TP4	DALE KOA YAGEO NIC COMPONENTS PANASONIC WALSIN DALE KOA PANASONIC KEYSTONE CGG VISHAY	CRCW0603100RJMEA RK73BiJTD101J 9C06031A1000JLHFT NRC06J101TRF ERJ3GEYJ101V WR06X101JTL CRCW0603150KJNEA CRCW0603150KJNEA RK73BiJTTD154J ERJ3GEYJ154V 5001 TP-105(BLK) SFH610A-3				7
0041 0042 0043 0044 0045	Р Р Р	021-00218-21 021-00294-21 110-00045-21 175-00030-21 065-00334-23	A A A B0	RES 100 OHM 1/10W ±5% NPb 0603 FILM RES 150k OHM 1/10W ±5% NPb 0603 CON TEST PT .1*CTR TIN PLAT NPb BLK OPT COUPLER PHOTOTRANS NPb DIP4 IC CRUS ENER MEAS NPb SOICIAL	A A A I	1 E 1 E 3 E 3 E		R26 TP1 TP3 TP4 U2 U5 U6 U4	DALE KOA YAGEO NIC COMPONENTS PANASONIC WALSIN DALE KOA PANASONIC KEYSTONE CGG UISHAY CIRRUS LOGIC	CRCW0603100RJNEA RK73BiJTD101J 9C06031A1000JLHFT NRC06J101TRF ERJ3GEYJ101V WR06K101JTL CRCW0603150KJNEA RK73BiJTD154J ERJ3GEYJ154Y 5001 TP-105(BLK) SFH610A-3 CS5490-ISZ/B0				7
0041 0042 0043 0044 0045 0046	Р Р Р Р	021-00218-Z1 021-00294-Z1 110-00045-Z1 175-00030-Z1 062-00242-Z1	A A A B0 A	RES 100 OHM 1/10W ±5% NPb 0603 FILM RES 150k OHM 1/10W ±5% NPb 0603 CON TEST PT .1°CTR TIN PLAT NPb BLK OPT COUPLER PHOTOTRANS NPb DIP4 IC CRUS ENER MEAS NPb SOIC16L IC MCU 8b FLASH 768kx16 NPb CPN20	A A A I A	1 E 1 E 3 E 1 E 1 E		R26 TP1 TP3 TP4 U2 U5 U6 U4 U7	DALE KOA YAGEO NIC COMPONENTS PANASONIC WALSIN DALE KOA PANASONIC KEYSTONE CGG VISHAY CIRRUS LOGIC MICROCHIP	CRCW0603100RJMEA RK73BiJTD101J 9C06031A1000JLHFT NRC06J101TRF ERJ3GEYJ101V WR06X101JTL CRCW0603150KJNEA RK73BiJTTD154J ERJ3GEYJ154V 5001 TP=105(BLK) SFH610A-3 CS5490-ISZ/B0 PIC18F14K50-I/MQ				7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7
0041 0042 0043 0044 0045 0046 0047	Р Р Р Р Р	021-00218-21 021-00294-Z1 110-00045-Z1 175-00030-Z1 065-00334-Z3 062-00242-Z1 060-00614-Z1	A A A B0 A A	RES 100 OHM 1/10W ±5% NPb 0603 FILM RES 150k OHM 1/10W ±5% NPb 0603 CON TEST PT .1*CTR TIN PLAT NPb BLK OPT COUPLER PHOTOTRANS NPb DIP4 IC CRUS ENER MEAS NPb SOIC16L IC CONV SW BUCK 0.54 NPb SOIC6	A A A A I A A	1 E 3 E 3 E 1 E 1 E 1 E		R26 TP1 TP3 TP4 U2 U5 U6 U4 U7 U8	DALE KOA YAGEO NIC COMPONENTS PANASONIC WALSIN DALE KOA PANASONIC KEYSTONE CGG VISHAY CIRRUS LOGIC MICROCHIP ON SEMICONDUCTOR	CRCM0603100RJMEA RK73BiJTD101J 9C06031A1000JLHFT NRC06J101TRF ERJ3GEYJ101V WR06X101JTL CRCM0603150KJNEA CRCM0603150KJNEA CRCM0603150KJNEA S001 TP-105(BLK) SFH610A-3 CS5490-ISZ/B0 FIC18F14K50-I/MQ LM2594DADJR2G				7 7 7 7 7 7 7 7 7 7 7
0041 0042 0043 0044 0045 0046 0047 0048	Р Р Р Р Р Р	021-00218-21 021-00294-21 110-00045-21 175-00030-21 065-00334-23 062-00242-21 060-00614-21 060-00614-21	A A A B0 A A A	RES 100 OHM 1/10W ±5% NPb 0603 FILM           RES 150k OHM 1/10W ±5% NPb 0603           CON TEST PT .1"CTR TIN PLAT NPb BLK           OPT COUPLER PHOTOTRANS NPb DIP4           IC CRUS ENER MEAS NPb SOIC16L           IC CRUS ENER MEAS NPb SOIC16L           IC CONV SW BUCK 0.5A NPb SOIC6           VARISTOR 275/rms 10MM NPb RAD	A A A A 1 A A A	1 E 3 E 3 E 1 E 1 E 1 E 1 E	EA EA EA EA EA EA EA	R26 TP1 TP3 TP4 U2 U5 U6 U4 U7 U7 U8 VR1	DALE KOA XAGEO NIC COMPONENTS PANASONIC WALSIN DALE KOA PANASONIC KEYSTONE CGG CGG VISHAY CIRRUS LOGIC MICROCHIP ON SEMICONDUCTOR EPCOS	CRCW0603100RJNEA RK73BiJTD101J 9C06031A1000JLHFT NRC06J101TRF ERJ3GEYJ101V WR06K101JTL CRCW0603150KJNEA RK73BiJTTD154J ERJ3GEYJ154V 5001 TP-105(BLK) SFH610A-3 CS5490-ISZ/B0 PIC18F14K50-I/MQ LM2594DADJR2G B7221052271K101				7 7 7 7 7 7 7 7 7 7 7 7
0042 0043 0044 0045 0046 0047 0048	Р Р Р Р Р Р	021-00218-21 021-00294-Z1 110-00045-Z1 175-00030-Z1 065-00334-Z3 060-00614-Z1 036-00018-Z1	A A A B0 A A A A	RES 100 OHM 1/10W ±5% NPb 0603 FILM RES 150k OHM 1/10W ±5% NPb 0603 CON TEST PT .1"CTR TIN PLAT NPb BLK OPT COUPLER PHOTOTRANS NPb DIP4 IC CRUS ENER MEAS NPb SOIC16L IC MCU & FLASH 768kx16 NPb OFN20 IC CONV SW BUCK 0.5A NPb SOIC8 VARISTOR 275Vrms 10MM NPb RAD	A A A A A A A A A	1 E 1 E 3 E 1 E 1 E 1 E 1 E	EA EA EA EA EA EA EA	R26 TP1 TP3 TP4 U2 U5 U6 U4 U7 U8 VR1	DALE KOA YAGEO NIC COMPONENTS PANASONIC WALSIN DALE KOA PANASONIC KEYSTONE CGG VISHAY CIRRUS LOGIC MICROCHIP ON SEMICONDUCTOR EPCOS	CRCW0603100RJMEA RK73BiJTD101J 9C06031A1000JLHFT NRC06J101TRF ERJ3GEYJ101V WR06X101JTL CRCW0603150KJNEA CRCW0603150KJNEA CRCW0603150KJNEA S001 TP-105(BLK) SFH610A-3 CS5490-ISZ/B0 PT128F14K50-I/MQ LM2594DADJR2G B72210S2271K101 S10K275E2				7 7 7 7 7 7 7 7 7 7
0041 0042 0043 0044 0045 0046 0047 0048 0049	Р Р Р Р Р Р	021-00218-21 021-00294-Z1 110-00045-Z1 175-00030-Z1 065-00334-Z3 062-00242-Z1 036-00018-Z1 300-00004-Z1	A A A B0 A A A A	RES 100 OHM 1/10W ±5% NPb 0603 FILM RES 150k OHM 1/10W ±5% NPb 0603 CON TEST PT .1°CTR TIN PLAT NPb BLK OPT COUPLER PHOTOTRANS NPb DIP4 IC CRUS ENER MEAS NPb SOIC16L IC CONV SW BUCK 0.54 NPb SOIC6 VARISTOR 275Vrms 10MM NPb RAD SCREW 4-40X1/4°L PH STEEL NPb	A A A A A A A A A	1 E 3 E 3 E 1 E 1 E 1 E 0 E	EA EA EA EA EA EA EA EA	R26 TP1 TP3 TP4 U2 U5 U6 U4 U7 U8 VR1 XMH1 XMH2 XMH3 XMH4	DALE KOA YAGEO NIC COMPONENTS PANASONIC WALSIN DALE KOA PANASONIC KEYSTONE CGG VISHAY CIRRUS LOGIC MICROCHIP ON SEMICONDUCTOR EPCOS MCMASTER-CARR	CRCW0603100RJMEA RK73BiJTD101J 9C06031A1000JLHFT NRC06J101TR ERJ3GEYJ101V WR06K101JTL CRCW0603150KJNEA CRCW0603150KJNEA CRCW0603150KJNEA S001 TP-105(BLK) SFH610A-3 CS5490-ISZ/B0 FIC18F14K50-I/MQ LM2594DAJR2G B72210S2271K101 S10K27522 90190A106	EC0922		NO POP	7 7 7 7 7 7 7 7 7 7 7 7 7 7
0041 0042 0043 0044 0045 0047 0047 0047 0047 0048	P P P P P P P	021-00218-21 021-00294-Z1 110-00045-Z1 175-00030-Z1 065-0034-Z3 065-0034-Z3 066-00814-Z1 036-00018-Z1 100-0013-Z1	A A A A A A A A A	RES 100 OHM 1/10W ±5% NPb 0603 FILM RES 150k OHM 1/10W ±5% NPb 0603 CON TEST PT . 1"CTR TIN PLAT NPb BLK OPT COUPLER PHOTOTRANS NPb DIP4 IC CRUS ENER MEAS NPb SOIC16L IC CCU & FLASH 768kx16 NPb GFN20 IC CONV SW BUCK 0.5A NPb SOIC6 VARISTOR 275Vrms 10MM NPb RAD SCREW 4-40X1/4"L PH STEEL NPb XTL 4.096MHZ 30ppm 18pF NPb SMD	A A A A A A A A A A	1 E 3 E 3 E 1 E 1 E 1 E 1 E 1 E 1 E 1 E	EA EA EA EA EA EA EA EA EA	R26 TP1 TP3 TP4 U2 U5 U6 U4 U7 U8 VR1 XMH1 XMH2 XMH3 XMH4 Y1	DALE KOA YAGEO NIC COMPONENTS PANASONIC WALSIN DALE KOA PANASONIC KEYSTONE CGG VISHAY CIRRUS LOGIC MICROCHIP ON SEMICONDUCTOR EPCOS EPCOS EPCOS MCMASTER-CARR ABRACON	CRCW0603100RJNEA RK73BiJTD101J 9C06031A1000JLHFT NRC06J101TRF ERJ3GEYJ101V WR06K101JTL CRCM0603150KJNEA RK73B1JTTD154J ERJ3GEYJ154Y 5001 TP-105(BLK) SFH610A-3 CS5490-ISZ/B0 PIC18F14K50-I/MQ LM2594DADJR2G B7221052271K101 S10K275E2 90190A106 ABLS2-4.096MHZ-D4Y	EC0922		NO POP	7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7
0041 0042 0043 0044 0045 0046 0047 0048 0049 0050	P P P P P P P	021-00218-21 021-00294-Z1 110-00045-Z1 175-00030-Z1 065-00242-Z1 066-00614-Z1 036-00018-Z1 300-00004-Z1 100-00132-Z1	A A A A A A A A A A A	RES 100 OHM 1/10W ±5% NPb 0603 FILM RES 150k OHM 1/10W ±5% NPb 0603 CON TEST PT .1"CTR TIN PLAT NPb BLK OPT COUPLER PHOTOTRANS NPb DIP4 IC CRUS ENER MEAS NPb SOIC16L IC MCU 8b FLASH 768kr.16 NPb OFN20 IC CONV SW BUCK 0.5A NPb SOIC8 VARISTOR 275Vrms 10MM NPb RAD SCREW 4-40X1/4"L PH STEEL NPb XTL 4.096MHZ 30ppm 18pF NPb SMD	A A A A A A A A A A	1 E 3 E 1 E 1 E 1 E 1 E 1 E 1 E 1 E 1 E	EA EA EA EA EA EA EA EA EA	R26 TP1 TP3 TP4 U2 U5 U6 U4 U7 U8 VR1 XMH1 XMH2 XMH3 XMH4 Y1	DALE KOA YAGEO NIC COMPONENTS PANASONIC WALSIN DALE KOA PANASONIC KEYSTONE CGG VISHAY CIRRUS LOGIC VISHAY ON SEMICONDUCTOR EPCOS EPCOS EPCOS MCMASTER-CARR ABRACON	CRCW0603100RJMEA RK73BiJTD101J 9C06031A1000JLHFT NRC06J1010TRF ERJ3GEYJ101V WR06X101JTL CRCW0603150KJNEA CRCW0603150KJNEA CRCW0603150KJNEA S001 TP-105(BLK) SFH610A-3 CS5490-ISZ/B0 FTC18F14K50-I/MQ LM2594DADJR2G B72210S2271K101 S10R275E2 90190A106 ABLS2-4.096MHZ-D4YT	ECO922		NO POP	7 7 7 7 7 7 7 7 7 7 7 7 7
0041 0042 0043 0044 0045 0046 0047 0048 0049 0050 0051	Р Р Р Р Р Р Р Р Р Р Р Р	021-00218-21 021-00294-21 110-00045-21 175-00030-21 065-00334-23 062-00242-21 036-00018-21 300-00004-21 100-00132-21 100-00134-21 100-00134-21	A A A B0 A A A A A A A A A A	RES 100 OHM 1/10W ±5% NPb 0603 FILM RES 150k OHM 1/10W ±5% NPb 0603 CON TEST PT .1°CTR TIN PLAT NPb BLK OPT COUPLER PHOTOTRANS NPb DIP4 IC CRUS ENER MEAS NPb SOIC16L IC COUV SW BUCK 0.5A NPb SOIC6 VARISTOR 275Vrms 10MM NPb RAD SCREW 4-40X1/4°L PH STEEL NPb XTL 4.096MHZ 30ppm 18pF NPb SMD XTL 12.0MHZ 18pf 30p NPb HC49/US SM	A A A A A A A A A A A A	1 E 1 E 3 E 1 E 1 E 1 E 1 E 1 E 1 E 1 E 1 E	EA EA EA EA EA EA EA EA EA	R26 TP1 TP3 TP4 U2 U5 U6 U4 U7 U8 VR1 XMH1 XMH2 XMH3 XMH4 Y1 Y2	DALE KOA YAGEO NIC COMPONENTS PANASONIC WALSIN DALE KOA PANASONIC KEYSTONE CGG VISHAY CIRRUS LOGIC MICROCHIP ON SEMICONDUCTOR EPCOS MCMASTER-CARR ABRACON CTS	CRCW0603100RJMEA RK73BiJTD101J 9C06031A1000JLHFT NRC06J101TRF ERJ3GEYJ101V WR06X101JTL CRCW0603150KJNEA CRCW0603150KJNEA CRCW0603150KJNEA STH610A- STH610A- STH610A-3 CS5490-ISZ/B0 FIC18F14K50-I/MQ LM2594DADJR2G B72210S2271K101 S10K275E2 90190A106 ABLS2-4.096MHZ-D4YT T	EC0922		NO POP	7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7
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0041 0042 0043 0044 0045 0046 0047 0048 0048 0048 0049 0050 0051 0052 0054 0055 0055 0055	Р Р Р Р Р Р Р Р Р Р Р Р Р Р Р Р Р Р Р	021-00218-21 021-00294-21 110-00045-21 175-00030-21 065-00334-23 062-0024-21 060-00614-21 036-00018-21 100-00132-21 100-00132-21 100-00134-21 070-00210-21 240-00554-21 603-00554-21 603-00554-21 422-00013-21 180-00024-2	A A A B0 A A A A A A A A A A A A A A A A	RES 100 OHM 1/10W ±5% NPb 0603 FILM           RES 150k OHM 1/10W ±5% NPb 0603           CON TEST PT .1°CTR TIN PLAT NPb BLK           OPT COUPLER PHOTOTRANS NPb DIP4           IC CRUS ENER MEAS NPb SOIC16L           IC COUVEW BUCK 0.5A NPb SOIC16L           IC COUVEW BUCK 0.5A NPb SOIC6           VARISTOR 275Vrms 10MM NPb RAD           SCREW 4-40X1/4"L PH STEEL NPb           XTL 12.0MHZ 18pf 30p NPb HC49/US SM           DIODE ZEN 36V 1W 5% NPb SOD123           PCB CRD5490-Z-NPb           ASSY DWG CRD5490-Z-NPb           SCHEM CRD5490-Z-NPb           LBLS UBASSY PRODUCT ID AND REV           LISE 162 200 TH AG NPD 5520MM	A A A A A A A A A A A A A A A A A A A	1 E 3 E 3 E 1 E 1 E 1 E 1 E 1 E 1 E 1 E 1	EA EA EA EA EA EA EA EA EA EA EA EA EA E	R26 TP1 TP3 TP4 U2 U5 U6 U4 U7 U8 VR1 XMH1 XMH2 XMH3 XMH4 Y1 Y2 Z1 Z3 775	DALE KOA YAGEO NIC COMPONENTS PANASONIC WALSIN DALE KOA PANASONIC KEYSTONE CGG VISHAY CIRRUS LOGIC MICROCHIP ON SEMICONDUCTOR EPCOS EPCOS MCMASTER-CARR ABRACON CTS TAIWAN SEMICONDUCTOR DIODES INC CIRRUS LOGIC CIRRUS LOGIC CIRRUS LOGIC CIRRUS LOGIC	CRCM0603100RJMEA RK73BiJTD101J 9C06031A1000JLHFT NRC061101TR ERJ3GEYJ101V WR06K101JTL CRCM06031S0KJNEA CRCM06031S0KJNEA RK73BiJTTD154J ERJ3GEYJ154V 5001 TP-105(BLK) SFH610A-3 CS5490-I32/B0 FIC18F14K50-I/MQ LM2594DADJR2G B72210S2271K101 S10K275E2 90190A106 ABL52-4.096MHZ-D4Y T ATS120BSM-1 ISSM4753 INS819HW-7-F 240-00554-21 603-00554-21 603-00554-21 600-00554-21 6003.3129	EC0922 EC0922 EC0922 EC0922 EC0922/937		NO POP	7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7
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0041 0043 0043 0045 0046 0047 0048 0049 0050 0051 0052 0053 0054 0055 0055 0055 0055 0056 0056 0056	Р Р Р Р Р Р Р Р Р Р Р Р Р Р Р Р Р Р Р	021-00218-21 021-00294-Z1 110-00045-Z1 175-00030-Z1 065-0034-Z3 066-00814-Z1 060-00814-Z1 030-00018-Z1 100-00132-Z1 100-00132-Z1 100-00134-Z1 070-00209-Z1 070-002054-Z1 603-00554-Z1 180-000254-Z1 180-00024-Z1 001-02189-Z1	A A A A A A A A A A A A A A A A A A A	RES 100 OHM 1/10W ±5% NPb 0603 FILM           RES 150k OHM 1/10W ±5% NPb 0603           CON TEST PT . 1°CTR TIN PLAT NPb BLK           OPT COUPLER PHOTOTRANS NPb DIP4           IC CRUS ENER MEAS NPb SOIC16L           IC CRUS ENER MEAS NPb SOIC6           IC COUPLER PHOTOTRANS NPb DIP4           IC COUV SW BUCK 0.5A NPb SOIC6           VARISTOR 275Vrms 10MM NPb RAD           SCREW 4-40X1/4*L PH STEEL NPb           XTL 4.096MHZ 30ppm 18pF NPb SMD           XTL 12.0MHZ 18pf 30p NPb HC49/US SM           DIODE ZEN 36V 1W 5% NPb SMA           DIODE ZEN 36V 1W 5% NPb SMA           DIODE SCHOTTKY 40V 1A NPb SOD 123           PCB CRD5490-Z-NPb           SCHEM CRD5490-Z-NPb           LBL SUBASSY PRODUCT ID AND REV           FUSE 16A 250V TLAG NPb 5x20MM           CAP 0.1uF ±10% 16V X/R NPb 0603	A A A A A A A A A A A A A A A A A A A	1 E 3 E 3 E 1 E 1 E 1 E 1 E 1 E 1 E 1 E 1	EA EA EA EA EA EA EA EA EA EA EA EA EA E	R26 TP1 TP3 TP4 U2 U5 U6 U4 U7 U8 VR1 XMH1 XMH2 XMH3 XMH4 Y1 Y2 Z1 Z3 Z25 C24	DALE KOA YAGEO NIC COMPONENTS PANASONIC WALSIN DALE KOA PANASONIC KEYSTONE CGG VISHAY CIRRUS LOGIC MICROCHIP ON SEMICONDUCTOR EPCOS MCMASTER-CAR ABRACON CTS TAIWAN SEMICONDUCTOR CIRS DIODES INC CIRRUS LOGIC CIRRUS LOGIC	CRCW0603100RJNEA RK73BiJTD101J 9C06031A1000JLHFT NRC06J101TRF ERJ3GFVJ101V WR06X101JTL CRCW0603150KJNEA RK73BiJTTD154J ERJ3GFVJ154V 5001 TP-105(BLK) 5FH610A-3 CS5490-IS2/E0 FTC18F14K50-1/MQ FTC18F14K50-1/MQ FTC18F14K50-1/MQ FTC210527E2 90190A106 ABL52-4.096MHZ-D4Y T ATS120BSM-1 ISMA753 IN5819HW-7-F 240-00554-21 603-00554-21 603-00554-21 603-00554-21 603-00554-21 603-00554-21 603-00554-21 603-00554-21 603-00554-21 603-00554-21 603-00554-21 603-00554-21 603-00554-21 603-01044RAC X7R0603CTTD104K	EC0922 EC0922 EC0922/937 EC0922		NO POP	7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7
0041 0043 0044 0045 0046 0047 0048 0050 0051 0052 0053 0055 0055 0056 0057 0058 0059	Р Р Р Р Р Р Р Р Р Р Р Р Р Р Р Р Р Р Р	021-00218-21 021-00294-Z1 110-00045-Z1 175-00030-Z1 065-00334-Z3 060-00614-Z1 036-00018-Z1 100-00132-Z1 100-00132-Z1 100-00132-Z1 070-00210-Z1 100-00132-Z1 100-0013-Z1 180-00024-Z1 180-00024-Z1 001-02189-Z1	A A A A A A A A A A A A A A A A A A A	RES 100 OHM 1/10W ±5% NPb 0603 FILM           RES 150k OHM 1/10W ±5% NPb 0603           CON TEST PT .1°CTR TIN PLAT NPb BLK           OPT COUPLER PHOTOTRANS NPb DIP4           IC CRUS ENER MEAS NPb SOIC16L           IC MCU 8b FLASH 768kx16 NPb GPN20           IC CONV SW BUCK 0.5A NPb SOIC3           VARISTOR 275/rms 10MM NPb RAD           SCREW 4-40X1/4"L PH STEEL NPb           XTL 4.096MHZ 30pp NBpF NPb SMD           XTL 12.0MHZ 18pf 30p NPb HC49/US SM           DIODE SCHOTTKY 40V 1A NPb SOD123           PCB CRD5490-Z-NPb           ASSY DWG CRD5490-Z-NPb           SCHEM CRD5490-Z-NPb           LBL SUBASSY PRODUCT ID AND REV           FUSE 16A 250V TLAG NPb 5x20MM           CAP 0.1uF ±10% 16V X7R NPb 0603	A A A A A A A A A A A A A A A A A A A	1 E 3 E 3 E 1 E 1 E 1 E 1 E 1 E 1 E 1 E 1	EA EA EA EA EA EA EA EA EA EA EA EA EA E	R24 TP1 TP3 TP4 U2 U5 U6 U4 U7 U8 VR1 XMH1 XMH2 XMH3 XMH4 Y1 Y2 Z1 Z3 Z25 C24	DALE KOA KOA YAGEO NIC COMPONENTS PANASONIC WALSIN DALE KOA PANASONIC REYSTONE CGG VISHAY VISHAY CIRRUS LOGIC MICROCHIP ON SEMICONDUCTOR EPCOS EPCOS EPCOS CTS TAIWAN SEMICONDUCTOR DIODES INC CIRRUS LOGIC CIRRUS LOGIC SCHURTER INC KOA VENKEL PANASONIC	CRCW0603100RJMEA RK73BiJTD101J 9C06031A1000JLHFT NRC06J101TRF ERJ3GEYJ101V WR06X101JTL CRCW0603150KJNEA CRCW0603150KJNEA CRCW0603150KJNEA CRCW0603150KJNEA CRCW0603150KJNEA CRCW0603150KJNEA CSS490-ISZ/B0 FTP-105(BLK) S7H610A-3 CSS490-ISZ/B0 FT21052271K101 S10K2752 90190A106 BT2210S2271K101 S10K2752 90190A106 BT2210S2271K101 S10K2752 90190A106 BT2210S271K101 S10K2752 90190A106 BT2210S271K101 S10K2752 90190A106 BT2210S271K101 S10K2752 90190A106 BT2210S271K101 S10K2752 C00554-Z1 603-0054-Z1 603-0054-Z1 603-0054-Z1 603-0054-Z1 603-0054-Z1 603-0054-Z1 603-0054-Z1 603-0054-Z1 603-0054-Z1 603-0054-Z1 603-0054-Z1 603-0054-Z1 603-0054-Z1 603-0044-X0 704-0045-X0 704-0045-X0 704-0045-X0 704-0045-X0 704-0045-X0 704-0045-X0 704-0045-X0 7054-X0 7054-X0 704-0045-X0 7	EC0922 EC0922 EC0922/937 EC0922/937		NO POP	7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7
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0041 0043 0043 0045 0046 0046 0047 0049 0050 0051 0052 0051 0055 0054 0055 0055 0055 0056 0056 0056	Р Р Р Р Р Р Р Р Р Р Р Р Р Р Р Р Р Р Р	021-00218-Z1 021-00294-Z1 110-00045-Z1 175-00030-Z1 065-00334-Z3 060-000814-Z1 036-00018-Z1 100-00132-Z1 100-00132-Z1 100-00132-Z1 100-00132-Z1 100-00132-Z1 100-00132-Z1 100-00132-Z1 100-00132-Z1 100-00132-Z1 100-00132-Z1 100-00132-Z1 100-00132-Z1 180-00024-Z1 180-00024-Z1 001-02189-Z1	A A A A A A A A A A A A A A A A A A A	RES 100 OHM 1/10W ±5% NPb 0603 FILM           RES 150k OHM 1/10W ±5% NPb 0603           CON TEST PT . 1°CTR TIN PLAT NPb BLK           OPT COUPLER PHOTOTRANS NPb DIP4           IC CRUS ENER MEAS NPb SOIC16L           IC CRUS ENER MEAS NPb SOIC16L           IC COUPLER PHOTOTRANS NPb DIP4           IC COUDY SUBJECK 0.5A NPb SOIC3C           VARISTOR 275Vrms 10MM NPb RAD           SCREW 4-40X1/4"L PH STEEL NPb           XTL 4.096MHZ 30ppm 18pF NPb SMD           XTL 4.04MHZ 18pf 30p NPb HC49/US SM           DIODE SCHOTTKY 40V 1A NPb SOID123           PCB CR05490-Z-NPb           ASSY DWG CR05490-Z-NPb           SCHEM CR05490-Z-NPb           LBL SUBASSY PRODUCT ID AND REV           FUSE 16A 250V TLAG NPb 5x20MM           CAP 0.1uF ±10% 16V X7R NPb 0603	A A A A A A A A A A A A A A A A A A A	1 E 1 E 1 E 1 E 1 E 1 E 1 E 1 E	EA EA EA EA EA EA EA EA EA EA EA EA EA E	R24 R26 TP1 TP3 TP4 U2 U5 U6 U4 U7 U8 VR1 XMH1 XMH2 XMH3 XMH4 Y1 Y2 Z1 Z3 Z25 C24	DALE KOA KOA YAGEO NIC COMPONENTS PANASONIC WALSIN DALE KOA PANASONIC KEYSTONE CGG VISHAY CIRRUS LOGIC CIRRUS LOGIC CIRRUS LOGIC CTRS TAIWAN SEMICONDUCTOR DIODES INC CTS TAIWAN SEMICONDUCTOR DIODES INC CIRRUS LOGIC CIRRUS LOGIC CIRUS LOGIC CIRUS LOGIC CIRUS LOGIC CIRRUS LOGIC CIRUS CIRUS CIRUS CIRUS CIRUS	CRCW0603100RJNEA RK73BiJTD101J 9C06031A1000JLHFT NRC06J101TRF ERJ3GEYJJ01V WR06X101JTL CRCW0603150KJNEA CRCW0603150KJNEA RK73BiJTTD154J ERJ3GEYJ154V 5001 TP-105(BLK) SFH610A-3 CS5490-152/B0 PT018F14K50-17MQ PT018F14K50-17MQ PT018F14K50-17MQ PT018F14K50-17MQ FT221052271k101 S10K275E2 90190A106 ABL52-4.096MHZ-D4Y T ATS120BSM-1 1SMA4753 1N5819HW-7-F 240-00554-21 603-00554-21 603-00554-21 603-00554-21 422-00013-01 0034.3129 CG603X71810-104KKE ECJ1VB1C104K	EC0922 EC0922 EC0922/037 EC0922/037		NO POP	7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7

Figure 42. Bill of Materials (Page 2 of 2)

CIRRUS LOGIC

CRD5490-Z

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Figure 43. Top Routing



CRD5490-Z

CRD5490-Z



240-00554-Z1 REV A



CRD5490-Z



Figure 45. Silkscreen

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