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**PACKING LIST - KIT CONTENTS**

**KIT33794DWBEVM**  
**Electric Field Imaging Device**

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## **EVM IMPORTANT NOTICE**

### **KIT33794DWBEVM**

#### **Electric Field Imaging Device**

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#### **Motorola provides the enclosed product(s) under the following conditions:**

This evaluation kit is intended for use of ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY. The goods provided may not be complete in terms of required design, marketing, and or manufacturing related protective considerations, including product safety measures typically found in the end product incorporating the goods. Due to the open construction of the product is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge.

In order to minimize risks associated with the customers applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards. For any safety concerns, contact Motorola sales and technical support services.

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## INSTRUCTIONS

**KIT33794DWBEVM**

**Electric Field Imaging Device**

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### Using the EVM

#### Introduction to the E-Field Device

The 33794 allows the sensing of objects in an electric field it generates by driving a voltage through an internal resistance to electrically conductive electrodes and measures the voltage at the electrode pin. An object moving into the field with a dielectric constant different than the medium it is in will change the capacitance between the electrodes creating the field. The amount of capacitance between the electrodes and conductive elements connected to the circuit ground return will effect the measured voltage because the voltage drop across the resistor is proportional to the current through it, and the current through it is proportional to the capacitance.

The 33794 can drive and sense up to nine electrodes, one at a time. The field will exist between the selected electrode and other objects with a different voltage. The unselected electrodes are connected to ground by the 33794 so a field will exist between the selected electrode and those which are not selected. The voltage waveform at the electrode is relative to the common ground of the board. A field will exist between the selected electrode and anything connected to the board common ground. This includes the power supply connections and anything connected to either terminal of the power supply.

The device includes a shield driver which generates a copy of the selected electrode's voltage waveform. Since it is at the same voltage as the selected electrode, there will be no current flow between the selected electrode and something connected to the shield driver. This allows the electrodes to be connected through coaxial cables and mounted remote from the board. If the shield driver is connected to the shield of the coax, the effective capacitance of the coax is reduced to nearly zero. This also makes the coax "invisible" to the selected electrode because no voltage difference exists between it and the coax shield. However, the voltage is not exactly the same between the shield driver and the selected electrode so the accuracy of the measurement is reduced as the cable is made longer. Normal practice is to limit the cables to a meter or less.

Please, reference the E-Field device datasheet included in this package for more information

## Setting up the Board

**Warning: Always wear Safety Glasses when working around electronic modules and when soldering.**

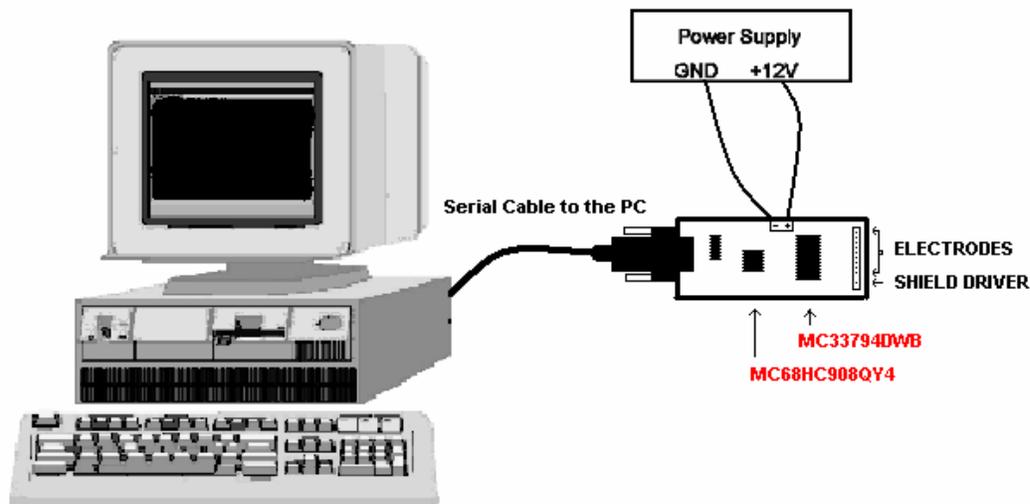
### POWER:

A battery connector with two slots is provided to connect a power supply. The positive terminal of a DC source capable of supplying up to 50mA should be connected to the +12V slot and the negative terminal of the power source should be connected to the GND slot. A diode is provided on the board in series with the positive path to the 33794 to prevent damage in the case of a reversal of the connection polarity. The 33794 requires a minimum of 9V for normal operation. The diode voltage drop is added to this and results in a minimum of 9V plus a diode drop required for operation. The upper limit of operation is 18V at the 33794.

### COMMUNICATIONS:

On board firmware allows communications with a PC using either the included Graphical User Interface or a terminal emulation package such as Hyper Terminal. To use it connect a cable from a comm. port on your PC to the DB9 connector on the board. The female end of the cable connects to the PC and the male end to the board. The communications protocol is:

- 9600 Baud
- 8 Bits
- No Parity
- 1 Stop Bit



### ELECTRODES

Connect your electrodes to the pins marked E1-E9 on the board. The electrode design is up to you. Connections to the electrodes are made either directly to the pads at the end of the PWB or you can add a connector (standard 0.1" pin spacing) to the board. DC paths from the electrode connections to ground or a source of voltage can cause errors in the measurements. If the electrodes are not insulated from these paths, capacitors should be added in series with the electrodes to block the DC. 1nF or larger capacitors are adequate. The inputs to the 33794 have been designed to handle up to 2KV human body model ESD and 200V machine model.

If ESD higher than this is anticipated, more protection is needed. This protection is usually in the form of some series resistance (1K to 4K) and an ESD diode such as the MMBZ27VCLT1. The drawback to using these components is that the capacitance of the ESD diode will reduce the sensitivity of the measurements at low capacitance values and the series resistor will cause more non-linearity in the relationship between capacitance change and output level which results in reduced sensitivity at higher capacitance. The normal range of capacitance the electrode should have to the common return for best operation of the EVM is in the range of 10pF to 100pF.

## OPERATION AND USER INTERFACE

This kit can be used in two ways. The first is as an evaluation tool using the on-board firmware programmed into the MCU and the included PC Graphical User Interface (GUI). This provides a simple means to evaluate various electrode designs and configurations right out of the box. The second is as a low cost development tool.

### Using the on-board firmware for device evaluation and electrode design

The on-board firmware contains a simple command set that allows for serial communications with the PC, electrode selection, electrode measurement, and control of other features of the device. When combined with the included GUI you can be making electrode measurements within minutes of opening the box.

To use the board in this way, configure the board as follows:

- \* Short positions 1 and 2 on jumpers JP1, JP2, JP3, and JP6 and open JP5
- \* Connect the EVM to the host PC using the DB9 modem connector
- \* Connect one or more electrodes
- \* Install the GUI interface to the firmware by executing the setup.exe file in the EFLD folder
- \* Launch the GUI software
- \* Apply power to the board
- \* Click the RUN button on the GUI interface

You are now making E-Field measurements! The GUI includes several menu options to make it easy to evaluate the device and electrode performance.

### COMMANDS

You can also interact directly with the firmware using a PC terminal emulator package such as Hyper Terminal by doing the following:

- \* Short positions 1 and 2 on jumpers JP1, JP2, JP3, and JP6 and open JP5
- \* Connect the EVM to the host PC using the DB9 modem connector
- \* Connect one or more electrodes
- \* Launch your terminal emulator program
- \* Apply power to the board

When the power source is connected, the board goes through a startup procedure and completes it by sending a ">" to the PC. The board is then ready to accept commands from the PC. The board will echo the characters sent to it so the echo at the PC should be set to off. Carriage returns from the EVM include linefeeds so linefeeds should also be turned off at the PC. If the option to "send line ends with line feeds" is offered by your terminal software, make sure this is not on. Any characters other than the carriage return added to the sent data will cause a decode problem at the module. There is no handshaking so the PC should wait for a response to a command before sending another command. A list of available commands and some information on using the commands can be obtained by sending a question mark ("?") followed by pressing the "enter" key. The "Enter" sends a carriage return and linefeed to complete the command.

Commands will be recognized by typing in the entire word for it or by typing enough letters to make it distinguishable from another command. For instance, "s 1" and "select 1" will result in electrode 1 being selected. No other command starts with "s" so it is unique by itself.

The source code for the firmware in the MCU is included in this documentation package for your use and reference.

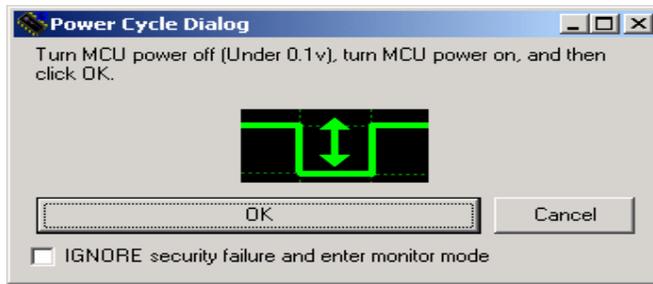
**Using the EVM and the User Mode On-Board Monitor Access Program as a low cost development tool.**

When you are ready to develop your own application software you can use the User Mode Monitor Access program, already programmed in the MCU to program and debug your code through the RS232 connector and a host PC. All you need to get started is an appropriate software development environment. One that is available for download is from P&E Microcomputer Systems, Inc at [www.pemicro.com](http://www.pemicro.com).

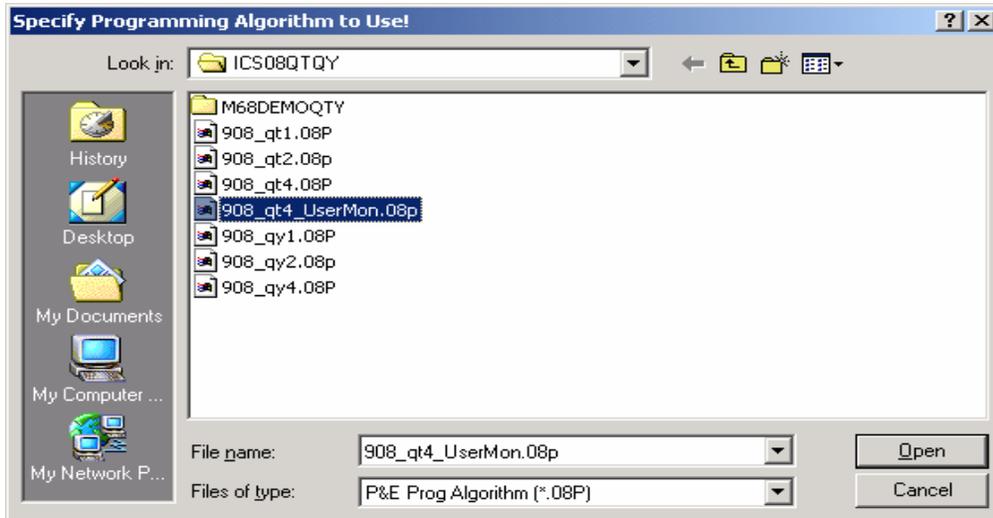
**Note: The user monitor mode firmware is located in a block protected area of the MCU. This allows you to reprogram the MCU multiple times and still maintain a debug environment. In order to do so you must place your user vectors in a pseudo-vector location in the memory. Please read the included Application Note AN2305 before starting your software development to understand how your software will work with this user mode monitor.**

To set up a development environment using the P&E software do the following:

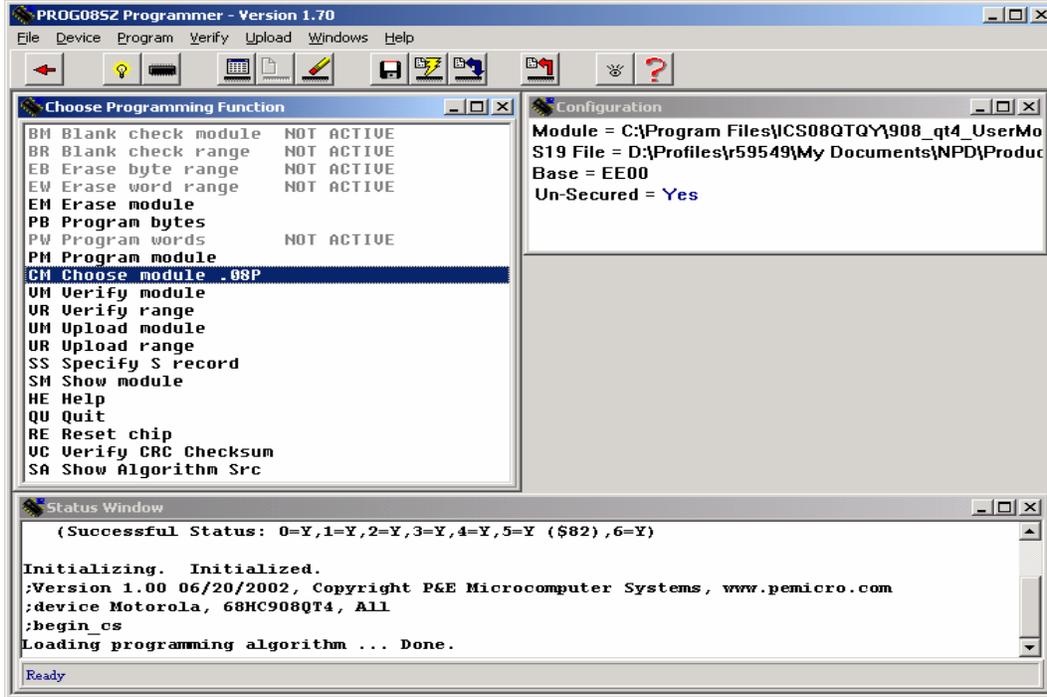
- \* From the P&E website, download the ICS08QTQY In-Circuit Simulator software package  
This package provides the development environment to write the code, simulate it, debug it and when ready, Flash program it into the MCU using the RS232 and the User Mode Monitor Access program.
- \* Develop the new customized solution by writing the required code for it. This code needs to follow the guidelines of the User Monitor Mode outlined in AN2305 so it would be executable through this mode.
- \* Assemble the written code to create the ".S19" record file that will be flashed into the MCU
- \* Flash the new program into the MCU:
  1. Short positions 1 and 2 in JP1, JP2, JP3 and JP6. Leave JP5 Open.
  2. Connect the RS-232 to the PC Host.
  3. Turn on the power to the board
  4. From the ICS08QTQY program menu, choose the PROG08SZ Flash Programmer. The following window displays
  - 4a. Turn the Power off, push and hold switch SW1\_IRQB, turn the Power on then release the Switch, click OK.



5. A window displays to specify the programming algorithm to be used. Choose the 908\_qt4\_UerMon.08p



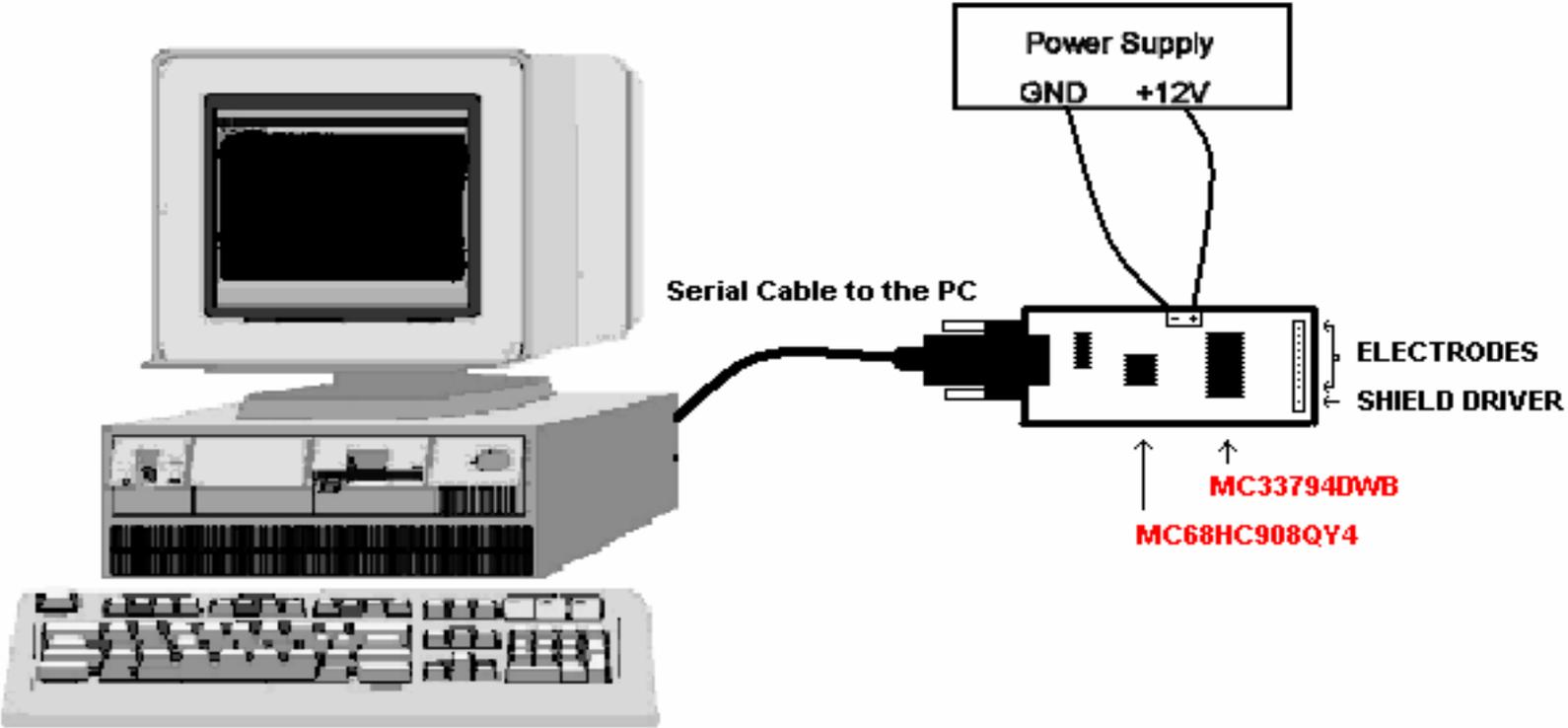
6. After that the PROG08 programmer window appears and you are ready to flash program the processor  
The PROG08 window looks like this:



7. Choose the "SS" command to specify the S record to be flashed and load it.  
8. Choose the "PM" Program module to flash the program into the MCU.  
\* Now, the MCU is equipped with the new program and is ready to be used.

**Note:** For more information on how to use the ICS08QTQY software package, consult with its user manual.

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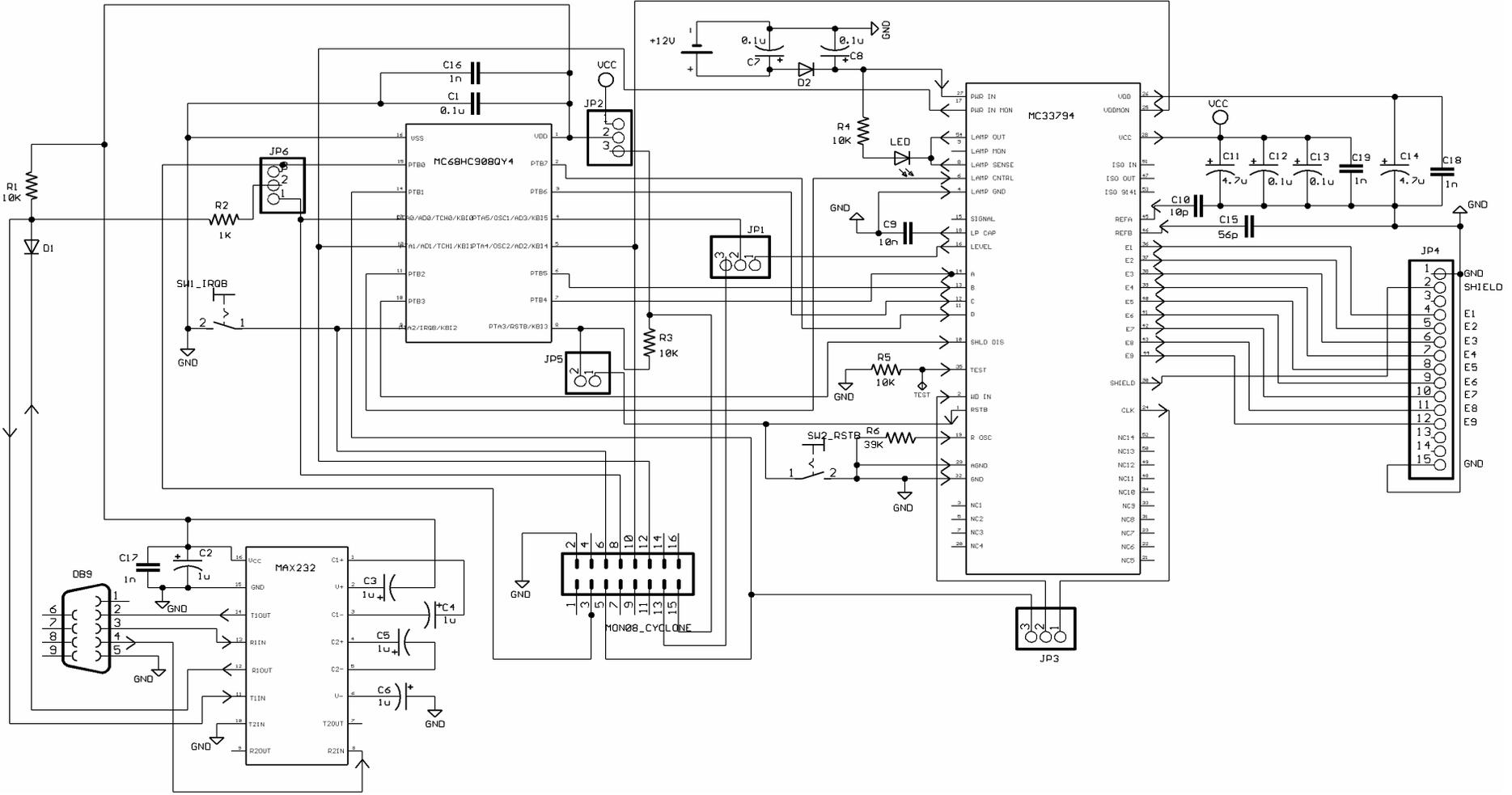
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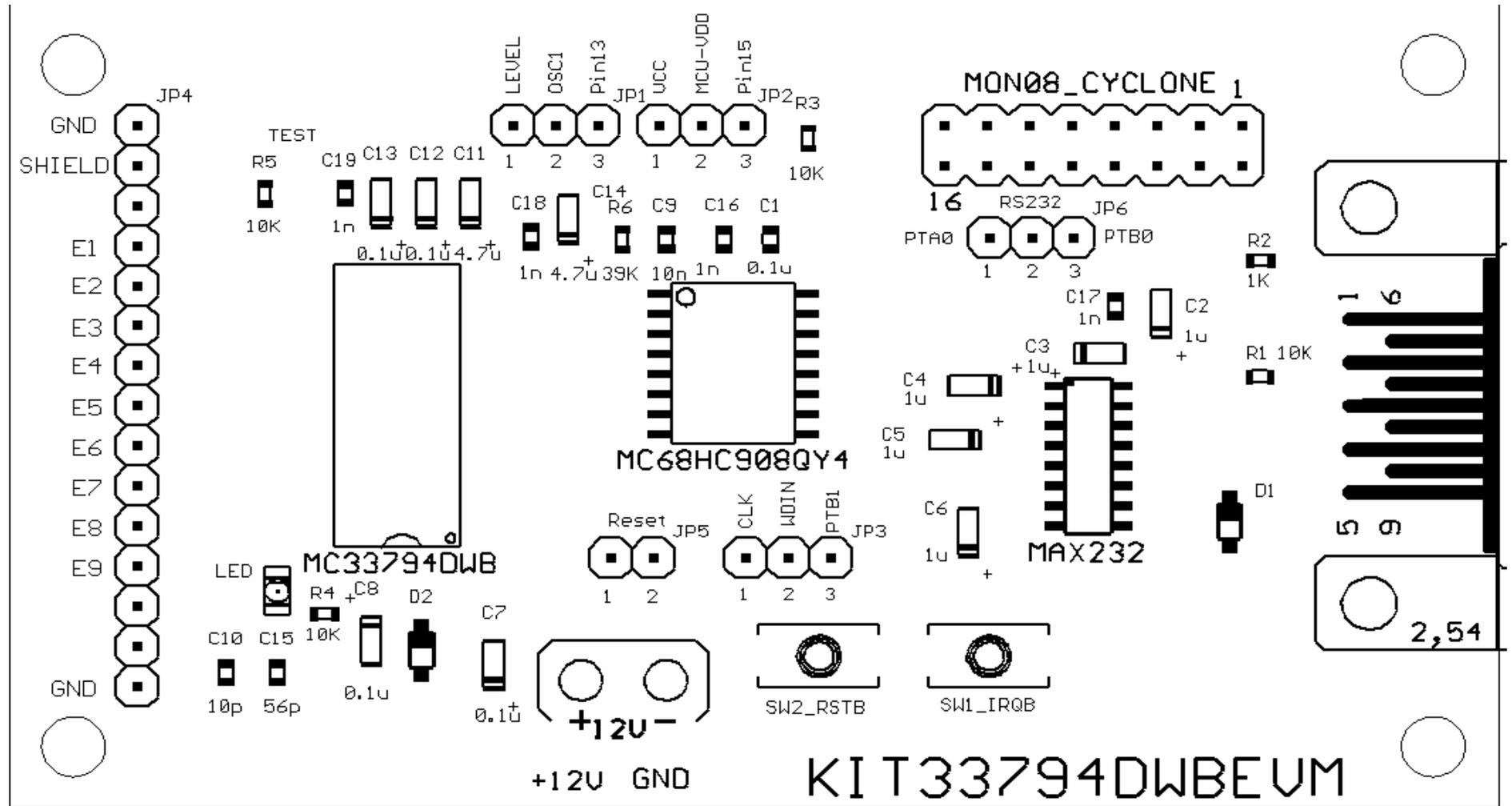
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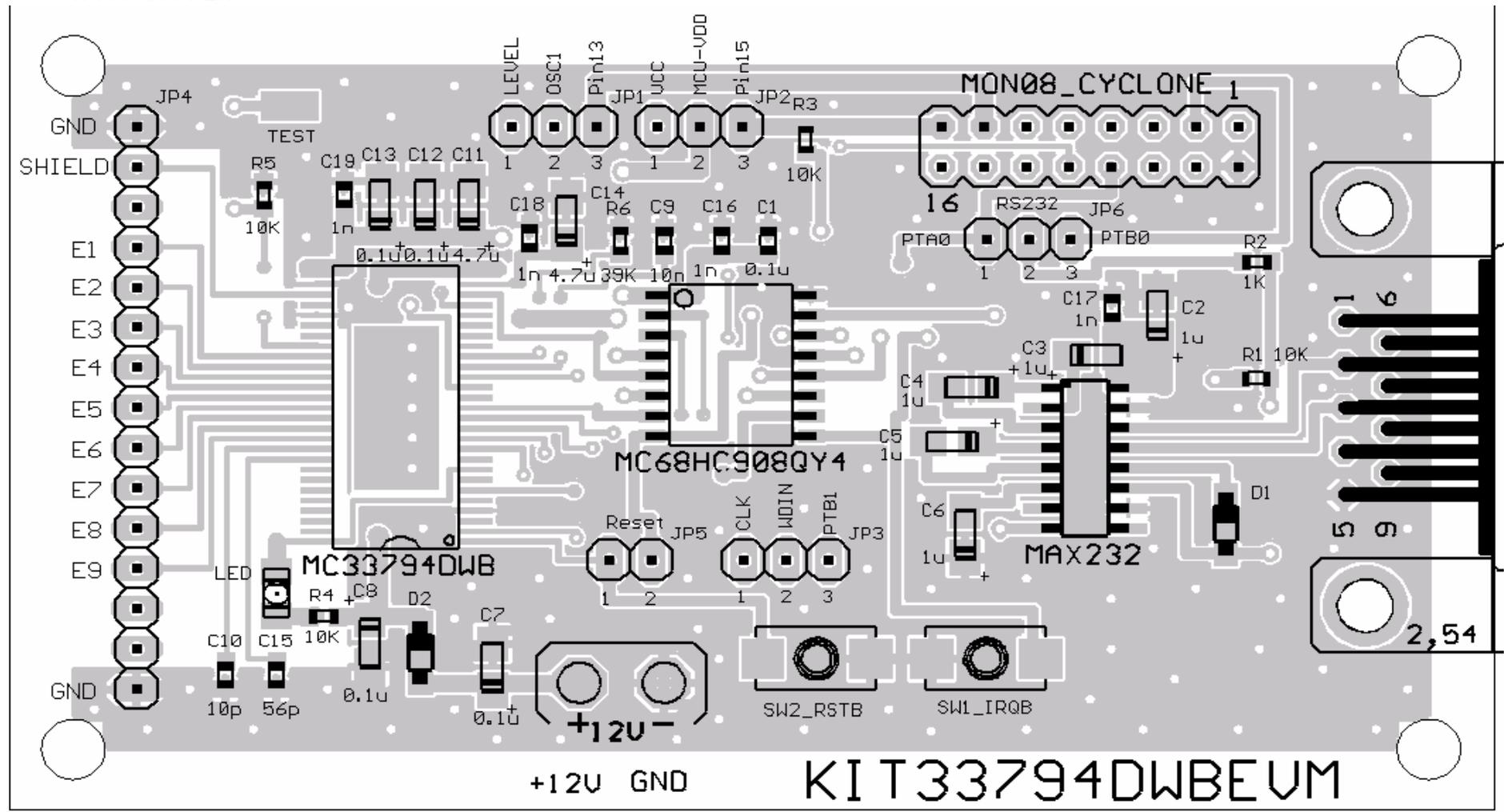
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 ASSEMBLY DRAWING**

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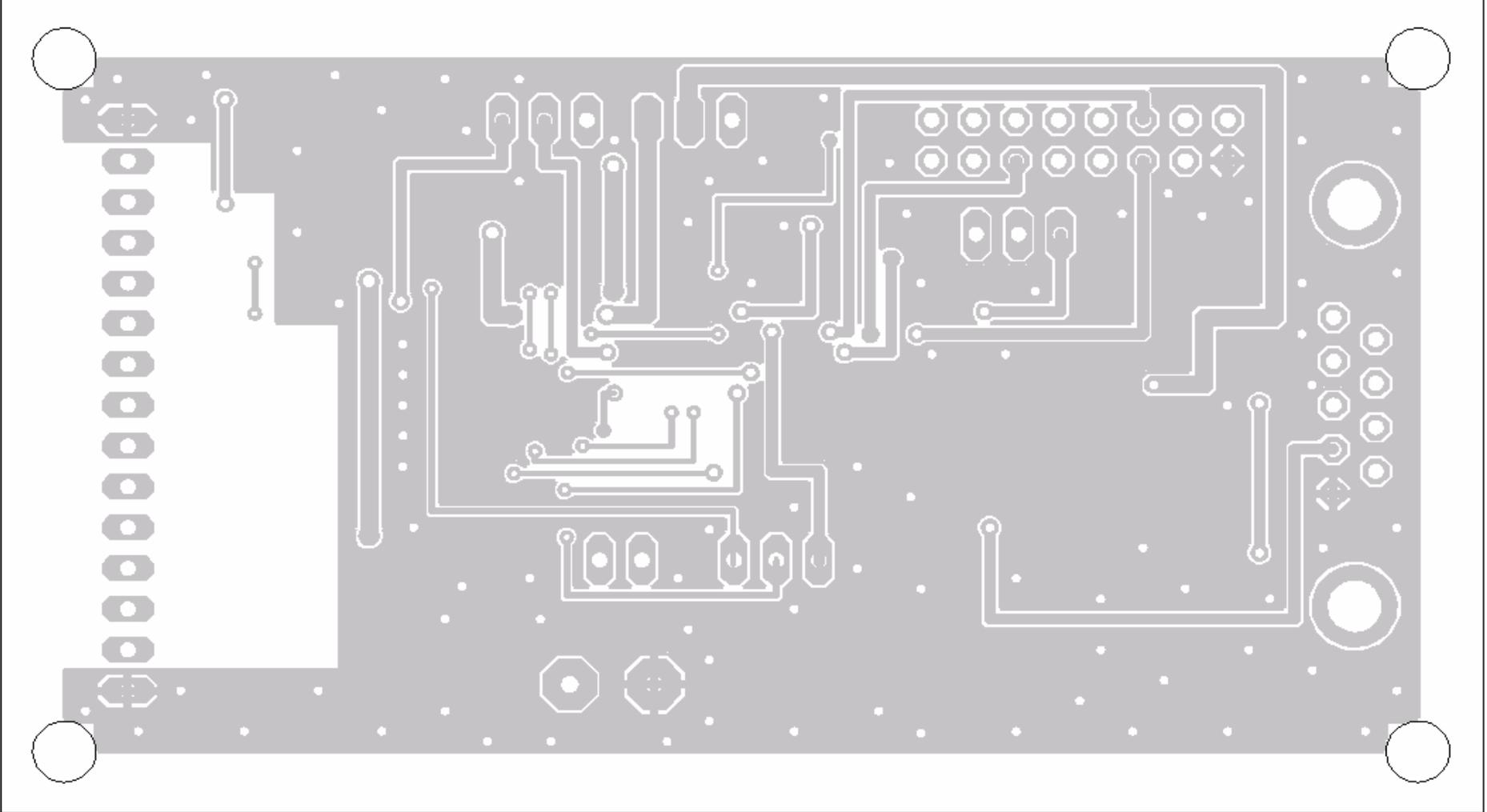
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**BILL OF MATERIAL**

**KIT33794DWBEVM**

REVISION 0.0

Electric Field Imaging Device

QTY	VALUE.	Name	Manufacturer Part #	PACKAGE	DESCRIPTION	MANUFACTURER
1	-	<b>MC33794DWB</b>	<b>MC33794DWB</b>	<b>54-pin SOIC</b>	<b>Electric Field Imaging Device (ODS)</b>	<b>Motorola</b>
1	-	<b>MC68HC908QY4</b>	<b>MC68HC908QY4CDW</b>	<b>16-pin SOIC</b>	<b>8-bit Microcontroller Unit</b>	<b>Motorola</b>
1	-	MAX232	MAX232CSE	16-pin SOICN	RS232 Interface	MAXIM
1	10 pF	C10	0603CG100J9B200	0603	Surface Mount Ceramic ChipCap	Yageo America
1	56 pF	C15	0603CG560J9B200	0603	Surface Mount Ceramic ChipCap	Yageo America
4	1 nF	C16, C17, C18, C19	06032R102K9B20D	0603	Surface Mount Ceramic ChipCap	Yageo America
1	10 nF	C9	06032R103K9B20D	0603	Surface Mount Ceramic ChipCap	Yageo America
1	0.1 uF	C1	06032R104K7B20D	0603	Surface Mount Ceramic ChipCap	Yageo America
4	0.1 uF	C7, C8, C12, C13	ECS-T1VY104R	A-EIA	Surface Mount Tantalum Electrolytic Capacitor	Panasonic-ECG
5	1 uF	C2, C3, C4, C5, C6	ECS-T1CY105R	A-EIA	Surface Mount Tantalum Electrolytic Capacitor	Panasonic-ECG
2	4.7 uF	C11, C14	ECS-T1AY475R	A-EIA	Surface Mount Tantalum Electrolytic Capacitor	Panasonic-ECG
1	1 kohm	R2	ERA-V33J102V	0603	Surface Mount Resistor	Panasonic-ECG
4	10 kohm	R1, R3, R4, R5	ERJ-3GEYJ103V	0603	Surface Mount Resistor	Panasonic-ECG
1	39 kohm	R6	ERJ-3GEYJ393V	0603	Surface Mount Resistor	Panasonic-ECG
2	-	D1, D2	1N4148W-7	SOD-123	Surface Mount Fast Switching Diode	Diodes Inc.
1	-	LED	LNJ311G8TRU	1206	Surface Mount Green LED	Panasonic-SSG
2	-	S1, S2	KSR221J	-	Surface Mount MOM (N/O) Tact Switch	ITT Industries
1	-	Power (12V)	1729128	-	CONN TERM BLOCK 2POS 5.08MM PCB	Phoenix Contact
1	-	Test	5015	-	PC Test Point Miniature SMT	Keystone Electronics
1	-	DB9	182-009-212-531	D-type Female	RS232 Connector	Norcomp Inc.
1	-	JP5	ANY	-	1x2 Pin Header	ANY
3	-	JP1, JP2, JP3, JP6	ANY	-	1x3 Pin Header	ANY
1	-	JP4	ANY	-	1x15 Pin Header	ANY
1	-	MON08_CYCLONE	ANY	MON08	2x8 Pin Header	ANY



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## **Efield Firmware**

**SDK33794DWBEVM**

**Electric Field Imaging Device**

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The MC68HC908QY4 contains firmware to allow communications from a COM port on a PC or other RS232 device to be used to control the 33794 and make and return measurements to the PC or other device.

Only a small portion of the Flash program memory in the MC68HC908QY4 is used by this program. With a suitable development system such as the ICS08QT/QY from P&E Microcomputers Systems, Inc., the firmware can be enhanced or replaced with application specific code.

Refer to the "33794DWB\_Efield.ASM" in the Embedded Firmware folder for the listing of version 0.0 of the firmware in the MC68HC908QY4: