Quartz Crystal Thickness Monitor Operation Manual

SPI # 12166-AB 12166-AX

Structure Probe, Inc. / SPI Supplies
206 Garfield Ave.
West Chester, PA 19380

Toll-free from USA/Canada: 1-(800)-2424-SPI
Phone: 1-(610)-436-5400
FAX: 1-(610)-436-5755
E-mail: support@2spi.com

Version 1.1 11/15

Structure Probe, Inc. / SPI Supplies
Street address for UPS, FedEx, DHL, other couriers, trucks:
206 Garfield Ave.
West Chester, PA 19380

Mailing address:
P.O. Box 656 West Chester,
PA 19381-0656 USA

Toll-free from USA/Canada: 1-(800)-2424-SPI
Phone: 1-(610)-436-5400
FAX: 1-(610)-436-5755
E-mail: support@2spi.com

For further information regarding any of the other products designed and manufactured by SPI Supplies, contact your local representative or directly to SPI Supplies at the address above, or visit **www.2spi.com**

- Carbon and Sputter Coaters
- Osmium Plasma Coaters
- Ion Mills
- Plasma Etchers/Cleaners
- High Vacuum Bench Top Evaporators
- Critical Point Dryers
- Electron Microscopy Supplies, Consumables and Accessories

Warranty

The SPI Supplies unit you have purchased is guaranteed to be free of defects in workmanship on the day of shipment. This warranty covers parts and labor for a period of one year, excluding shipping charges or consumables. Breakage of glassware is specifically excluded from this warranty.

Proper use of your unit, according to the operation manual, should result in trouble-free operation. Any improper use of the SPI Supplies unit through modifications or unreasonable operating procedures will void this warranty.

Disclaimer

SPI Supplies instruments are designed for simplicity of installation and operation. This manual provides full and complete information in both these areas. SPI Supplies therefore assumes no liability or responsibility of any kind for damage or injury resulting from incorrect installation or operation of the machine.

If any questions arise, call SPI Supplies from the USA/Canada 1-800-2424-SPI or 1-610-436-5400 for assistance. For all other countries, contact our nearest agent or SPI Supplies directly. A listing of our agents may be found on our website at:

http://www.2spi.com/info/agents/

1 Contents

1.1 Manual Layout

This Operation Manual is divided up into the following major sections, each section dealing with specific topics, as follows:

Section 1 – Contents

Section 2 - Health and Safety

General section which applies to all SPI Supplies products detailing the very important issues of Health and Safety applicable when using sample preparation equipment.

Section 3 - Introduction

Introduces this manual.

Section 4 - General Description

Identifies each of the equipment items and provides an overview of their functions and how they work.

Section 5 - Installation

Instructions on how this Instrument should be installed and the connections which should be made between the equipment items.

Section 6 - Operation

Instructions on how to start-up and run the instrument.

Section 7 - Maintenance

Instructions on routine maintenance checks and determining if the system is functioning correctly. Information on how to identify faults in the system and how to rectify these faults.

Section 8 – Technical Diagrams

1.2 Section Contents

1.3 Illustrations

2 HEALTH AND SAFETY

Safety is very important when using any instrumentation and all users of our equipment should read this section.

This section of the Manual applies to all specimen preparation equipment supplied by SPI Supplies, not just the particular instrument for which the manual refers.

Included in this section are details on warning notations and good working practices.

2.1 Safety Policy

This section contains important information relating to all health and safety aspects of the equipment. As such it should be read, and understood, by all personnel using the instrument whether as an operator or in a service capacity.

SPI Supplies is committed to providing a safe working environment for its employees and those that use its equipment.

SPI Supplies regularly reviews its operations to make environmental, health and safety improvements in line with applicable legislation.

The equipment has been designed as a free-standing instrument. SPI Supplies cannot be held responsible for any damage, injury or consequential loss arising from the use of its equipment for any other purposes, or any unauthorized modifications made to the equipment.

All service work carried out on the equipment should only be undertaken by suitably qualified personnel. SPI Supplies is not liable for any damage, injury or consequential loss resulting from servicing by unqualified personnel. SPI Supplies will also not be liable for damage, injury or consequential loss resulting from incorrect operation of the instrument or customer modification of the instrument.

2.2 Service

2.2.1 Disclaimer

All service work on the equipment should be carried out by qualified personnel. SPI Supplies cannot be liable for damage, injury or consequential loss resulting from servicing from unqualified personnel.

SPI Supplies will also not be liable for damage, injury or consequential loss resulting from incorrect operation of the instrument or modification of the instrument.

2.2.2 Operators and Service Engineers

A normal operator of the equipment not trained in or qualified for service work on the equipment and may cause a hazard to himself/herself or others if such work is attempted. Operators should therefore restrict themselves to the normal operation of the equipment and not remove covers from the electronic equipment or dismantling of the instruments, or otherwise attempt to thwart the intent of the safety interlock system.

Service Engineers who are suitably trained to assess and isolate electrical, mechanical and vacuum hazards should be the only personnel who access the equipment.

2.3 Hazard Signals and Signs

2.3.1 Hazard Signal Words - Definitions

WARNING
Warnings are given where failure to observe the instruction could result in injury or death to people.

CAUTION
Cautions are given where failure to observe the instructions could result in damage to the equipment associated equipment and process.

Figure 2.1 - Sample Hazard Warning Symbols

	WARNING **Do NOT remove the instrument cover without first ensuring the unit is unplugged.**

Figure 2.2 - Typical Warning sign as shown in this Manual

	CAUTION **Do NOT depress button "P" as this will change the program.**

2.4 Good Working Practices

It is essential that good hygienic working practices are adopted at all times especially in an ultra high vacuum or cleanroom environment and are generally of the “Common sense” type. Some simple good practice rules are:

- If in doubt, don't.
- If in doubt, ask.
- When handling solvents wear face mask, gloves, apron and work only in a well ventilated area.
- Mop up any spillages immediately, using procedures appropriate for the spilled material.
- When handling or decanting mineral oils wear protective clothing.
- Aerosols of mineral oils, such as that produced by gas ballasting, can prove to be hazardous and an exhaust is recommended.
- Before attempting to service electrical apparatus, isolate from the mains.
- Treat all unknown substances as hazardous.
- Dispose of substances in an appropriate manner.
- Use the correct tool for the job.
- Keep a straight back and bend from the knees when lifting heavy objects.
- Wear protective clothing when using liquid nitrogen.
- Affix pressurized gas cylinders firmly to walls or racks. Use the correct regulating valves on gas cylinders and always transport cylinders using the appropriate specialist trolley.
- Obey safety regulations regarding lifts, hoists and machine tools.
- Always make sure you understand a procedure well before attempting it for the first time.

2.5 Quartz Crystal Thickness Monitor Specific Potential Safety Hazards

The following Safety Hazards are specific to the SPI Supplies Quartz Crystal Thickness Monitor (QCTM).

CAUTION
Be sure to keep the exposed crystal surface clean and free of any debris.

3 INTRODUCTION

This manual provides installation, operation and maintenance instructions for the **Quartz Crystal Thickness Monitor (QCTM)**. You must use the Quartz Crystal Thickness Monitor as described in this manual.

Note that the servicing and maintenance procedures should only be carried out by qualified service personnel and it is essential that all users should read the ***Health and Safety*** section of this manual.

3.1 Return of Goods

If goods are to be returned to SPI Supplies for repair or servicing the customer should contact SPI Supplies or their local distributor before shipment. A "Return Authorization Number" should be obtained in advance of any shipment. This number is to be clearly marked on the outside of the shipment. To obtain an RA#, contact our Customer Service Department and be sure to provide us with the following details:

* SPI Invoice Number and Invoice Date (if applicable)
* Method of shipment if applicable (post office, UPS, FedEx, Air Freight, etc.)
* Product(s) in question
* What is wrong with the product, or why do you want to make this return?

For returns outside the United States, contact either your closest SPI Supplies agent (see http://www.2spi.com/info/agents/) or SPI Supplies in the USA by phone (1-610-436-5400), fax (1-610-436-5755), or by email (support@2spi.com).

3.2 Returns Procedure

Warranty Claim

All components are sold with a **return to factory warranty** (unless otherwise stated), which covers failure during the first 12 months after delivery.

Returns must be sent courier paid, SPI Supplies will cover the return courier costs. This covers defects, which arise as a result of a failure in design or manufacturing. It is a condition of warranty that equipment must be used in accordance with the manufacturer's instructions and not have been subjected to misuse. This warranty does ***not*** cover consumable items or glassware. To make a claim under the terms of this warranty provision contact the Customer Service Department at SPI Supplies.

Chargeable Repairs

Contact the Customer Service Department at SPI Supplies to obtain an estimate of repair costs. Service of equipment is generally completed within twenty working days after receipt of the equipment. A minimum evaluation fee is normally applied. Additional fees are charged as a per hour repair rate in addition to parts.

Returns

All returns to SPI Supplies are required to follow the procedure described above in Section 3.2. All returned items are required to have a Return Authorization Number, which can also be obtained at www.2spi.com/return-number.html.

Packaging and Shipping

All goods shipped to the factory must be sealed and packed in a suitable carton. If the original packaging is not available SPI Supplies should be contacted for advice. **DO NOT SHIP ANY GLASSWARE ASSEMBLED INSIDE THE UNIT.** SPI Supplies will not be responsible for damage resulting from inadequate returns packaging or contamination of delicate structures by stray particles under any circumstances. All non-warranty goods returned to the factory must be sent courier, pre-paid. They will be returned courier, pre-paid and added to the final invoice unless otherwise arranged.

4 DESCRIPTION

4.1 Overview

The SPI Supplies Quartz Crystal Thickness Monitor is an add on module to the SPI Supplies Module Sputter Coater (or other coating device). Purchased as a stand alone device, the module allows a user to interface their coating system to the thickness monitor. This module extends the capabilities of these instruments by allowing the precise control of the amount of material deposited during the sputtering process.

Quartz crystals, when electrically energized, have the property of producing an electrical current which oscillates at a fixed frequency; the frequency depends on the mass of the crystal, and the stability of the quartz crystal allows the design of very precise time measurements. The QCTM consists of two crystals, one in the instrument and the other in the stage. Each crystal oscillates at a slightly different frequency. When a coating is applied to a sample, it is also applied to the sensor of the QCTM, increasing the mass of the crystal, which decreases the crystal's resonant frequency of vibration.

The electronics of the system treat each oscillation cycle of each crystal as a pulse and count the difference in pulses per unit time between the two crystals. This is sometimes referred to as the "frequency counter". At the start of coating, the difference is set as "zero" thickness. The difference between the two oscillation frequencies is compared with the zero value. The system is calibrated by selecting the material to be deposited. The readout is in increments of 1 nm. The built- in calibration can be further refined by coating a test sample, sectioning it and measuring the actual thickness of material deposited. It is also possible to construct a calibration curve which accounts for the material you deposit and the way you deposit it.

4.2 Controls and Indicators

4.2.1 Front Panel

Figure 4.3.1 – Front Panel

“POWER” – Controls the main power to the Quartz Crystal Thickness Monitor.

KEYPAD – Used to enter data and make menu selections.

5 INSTALLATION

5.1 Overview

The position, placement and feed-through lengths are dependent on the system on which the unit is being installed. Installation instructions to retrofit the QCTM onto a Vacu Prep II are provided on a separate supplemental guide included with the QCTM.

6 OPERATION

6.1 Overview

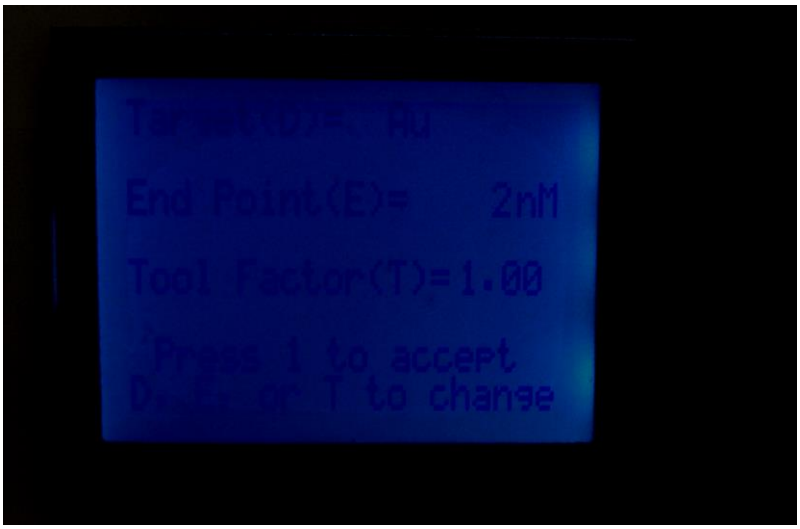
The Quartz Crystal Thickness Monitor is an easy way of tracking the coating thickness applied to samples. User controlled parameters that can be changed include the material density (for choosing the appropriate material), endpoint (for pre-setting the coating thickness to be applied), and a tooling factor, which is a constant based on the location of the quartz crystals in the system, in relation to the source material.

6.2 Operation

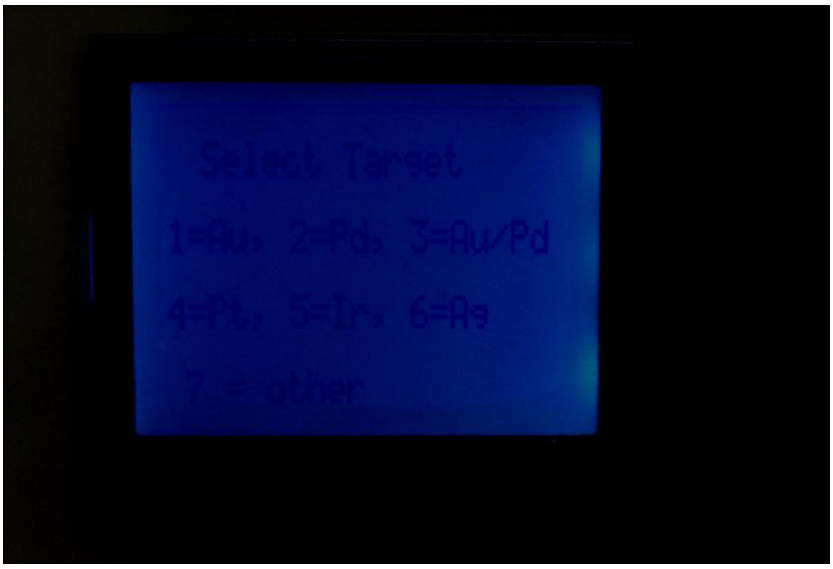
Following the operating instructions for the coater, load samples into the chamber, being sure to leave the quartz crystal exposed. Following the recommended procedure, load samples into the vacuum chamber (ensuring that the quartz crystal is exposed) and proceed to pump the chamber down to the desired vacuum.

Turn the POWER switch for the QCTM to the ON position. You should see the following splashscreen:

After several seconds, the Main Menu will appear.



The Main Menu contains the most recent parameters entered, consisting of: Target material (“D”), Endpoint (“E”), and Tool Factor (“T”). To accept these parameters, press “1”. If you are using a cathode other than gold, press the “D” button. This will bring up the menu to select among the pre-programmed cathode materials, or to enter your own:



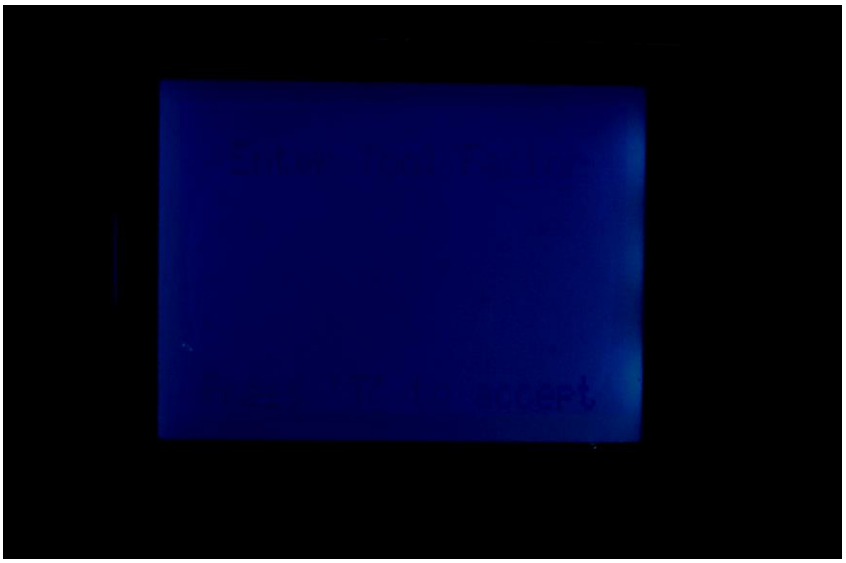
Use the corresponding number to select the desired cathode/evaporative material. If your material is not listed, pressing “**7**” will allow you to manually enter the density of the material (g/cm^3):

Once the desired density has been entered, press “D” to accept the value and store it in memory. The screen will now return to the Main Menu screen.

To continue with stored parameters, press “1”. To change the endpoint, press “E”. This will bring up the endpoint screen:

Enter the desired endpoint (units are in nm). After the endpoint is entered, press “E” to accept the value and return to the Main Menu. Keep in mind that for the Stand Alone unit, unless the relay signal from the module is interfaced with the coating system, the end point function will not work. [Note: When using the QCTM without interfacing the end point function, it is suggested that “999” be entered. This will enable the system to monitor the total cumulative amount of material being deposited up to 1um. If this value is not put into the end point function, the cumulative deposition value may be lost when attempting to continue a previous deposition.

To continue with the stored parameters, press “1”. To change the Tool Factor from the main menu, press “T”. This will bring up the Tool Factor screen:



The Tool Factor is set at the factory at 1.0. Depending upon where the crystal is positioned in the vacuum chamber, it might be necessary to change this value in order to obtain accurate results. Users will have to experiment to determine the proper Tool Factor for their setup.

Enter the new Tool Factor, and then press the “T” button to accept it, and return to the Main Menu screen.

After all of the parameters have been set, from the Main Menu press “1”. The screen will show show that the system is checking the crystal:

Once the system has checked the crystal, the screen will change to show and track the applied coating thickness in real time:

The bottom right of the screen indicates the sputter material selected. The bottom left of the screen shows the endpoint selected. The main part of the screen shows the coating thickness applied.

To begin the coating run, set the conditions for the coater using the appropriate manual, and begin the coating process.

If the pre-programmed end point is reached during the coating process, the sputtering process will stop and the screen will change to show the endpoint has been reached.

If the endpoint has been reached, press “2” to return to the Main Menu. This will set the computer to perform an additional coating using the parameters entered previously.

If the endpoint has not been reached by the time the internal timer (if present) times out, the screen will not change. Repeat the coating as described above, and the counter will continue until the system either times out again or the endpoint is reached.

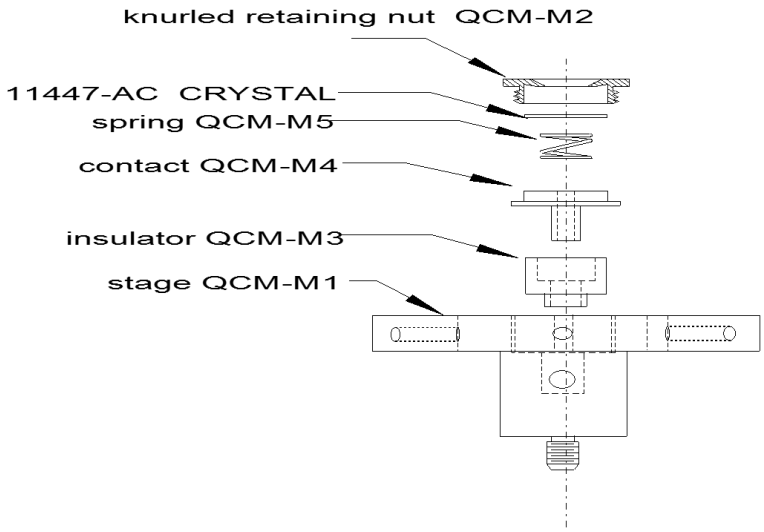
7 MAINTENANCE

7.1 Overview

The Quartz Crystal Thickness Monitoring is system designed for easy routine maintenance. In the event measuring the coating thickness is not necessary, covering the crystal during coating will extend the crystal life. Once the crystal has been coated with a substantial amount of material, it will need to be changed. The computer will notify users when this is necessary during the “Checking Crystal” screen. Instead of proceeding to the coating step, the screen will change to say that the crystal needs to be replaced. See the Installation Section for the procedure for replacing the crystal.

7.2 Crystal Replacement

Once the crystal in the chamber has been coated with enough material, it will need to replaced. The readout screen will indicate when this is necessary (during the “Checking Crystal” screen, it will indicate that the crystal is in need of replacing). To replace the crystal, simply remove the top nut that holds the crystal in place. Replace the crystal with a new one, and replace the nut.



CRYSTAL HOLDER ASSEMBLY

File: HLDRASM4.CAD

Figure 7.2.1 – Crystal Holder Assembly

8 TECHNICAL DIAGRAMS

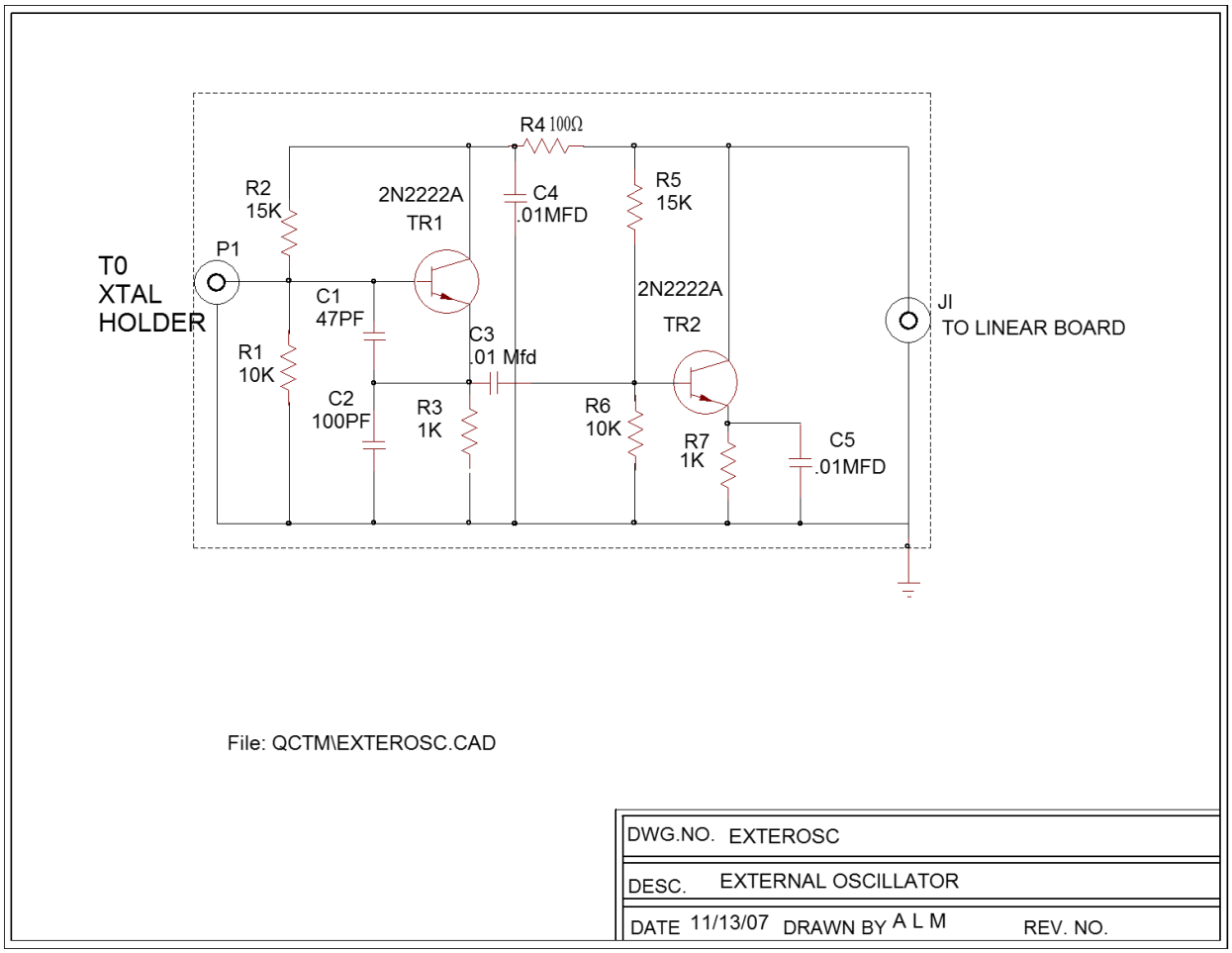


Figure 8.1 – External Oscillator

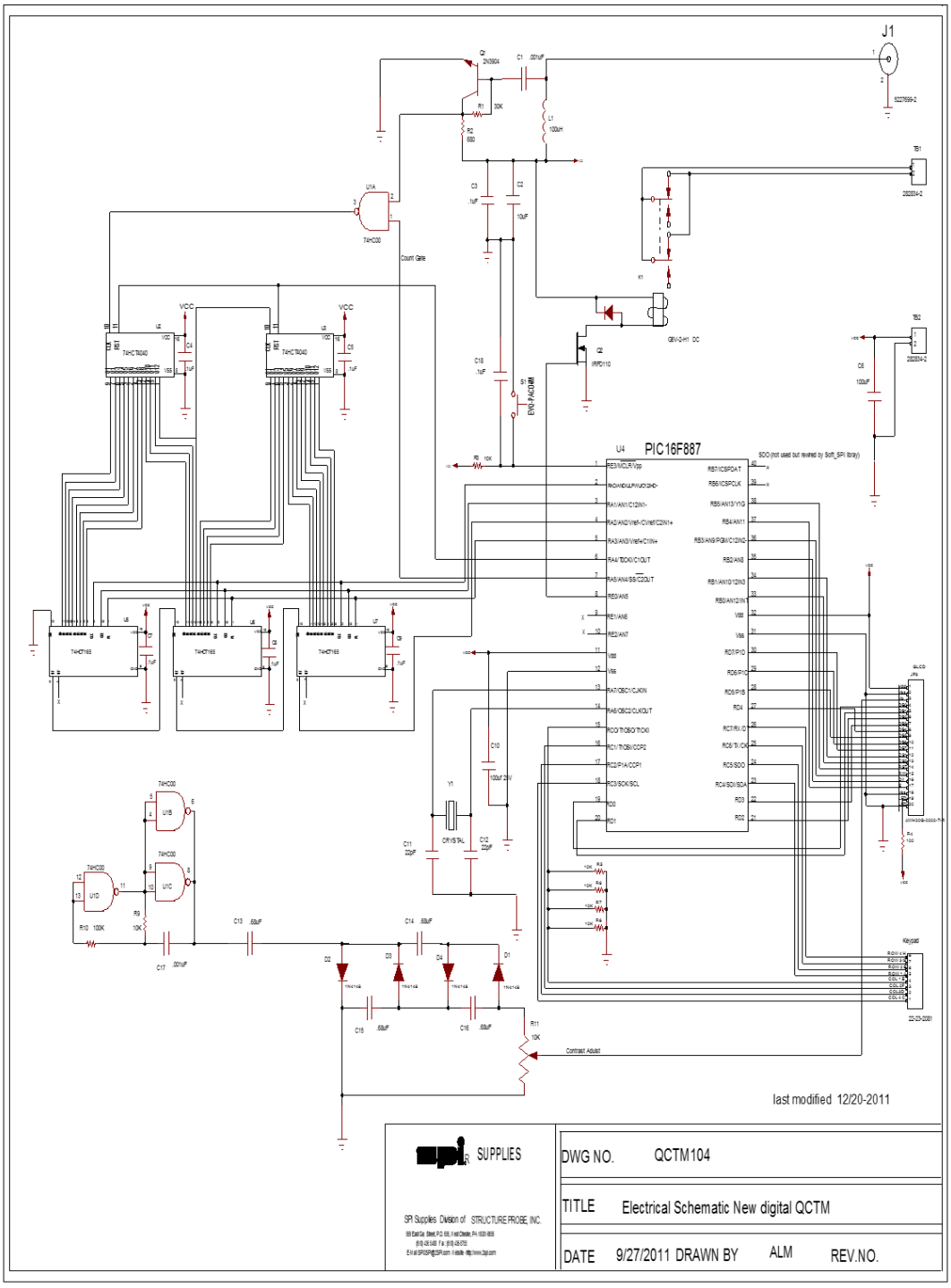


Figure 8.2 – Electrical Schematic