11.1 General Information 218
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Nor-Cal offers an extensive selection of commonly used quartz crystal feedthroughs, sensors and multi-channel monitors, cables, quartz crystals, accessories and replacement parts for use in semiconductor, optical and industrial thermal deposition processes. Custom feedthroughs are available with a variety of flanges in all sizes.

Our coating instrumentation products support one of the more popular methods of thin film measurement and rate control - the crystal monitor, which utilizes the piezo-electric properties of a quartz crystal.

The electrical characteristics of the crystal, which is held in place by the sensor, change during deposition. Single sensors are generally used for short deposition runs, whereas, dual sensors allow for longer runs. Dual sensors require an air line to operate a pneumatic shutter which covers one crystal at a time. The sensor is either welded to the feedthrough or attached with connectors. Most sensors are available with cooling lines.

The application determines the correct choice of sensor. The sensor determines compatible feedthroughs and cabling. The chamber determines the appropriate feedthrough and flange. For application temperatures up to 150°C, electrical connection between the sensor and feedthrough is accomplished with a vacuum coaxial cable. A bakeable, one piece sensor/feedthrough replaces the standard in-vac cable with a stainless steel high-temp coaxial line for high temperature applications up to 300°C.

The feedthrough is the air-to-vacuum connection between the sensor and the oscillator. The feedthrough transfers the quartz crystal’s piezo-electric vibrations to the oscillator via a short coaxial cable. The oscillator conditions the signals and transfers them to the monitor via another coaxial cable. The monitor then measures, interprets and displays the thickness, rate and frequency of deposition. Nor-Cal’s thin film deposition monitors are available with up to six independent channels to read six sensors. Each sensors’ rate, thickness and frequency can be read from the RS-232 port, and placed in a spreadsheet formatted file for later inspection. Each sensor requires its own cabling and oscillator. Contact our sales staff for help with your system configuration.

All dimensions are in inches (mm) & weights are in pounds (kg), unless otherwise noted.

Typical Thin Film Coating System

- **Sensor**
- **Substrate**
- **Feedthrough**
- **Oscillator**
- **Source**
- **Ground Wire**
- **In-Vac Cable**
- **10' Cable**
- **6’ (152.4) Cable**
- **Cabling from Oscillator to Sensor must not exceed 48 inch (1219.2mm) (See page 222 for cable selections)**
- **Monitor**

Ultra-High Vacuum Components Since 1962 • www.n-c.com
Deposition Monitors

Our deposition monitors measure film thickness/rate or frequency using crystals as the sensor device. Independent channels monitor different films or average different sensors together to provide a more uniform deposition measurement. These monitors are Class 1 Equipment CE approved. Included are a RS-232 cable and Windows software. This software will allow you to change the monitor’s parameters, save process readings in Excel formatted files, and operate the monitor remotely. Mounting brackets are included, rack-mount extenders are available on request.

<table>
<thead>
<tr>
<th>MODEL NUMBER</th>
<th>CRYSTAL INPUTS</th>
<th>POWER INPUT</th>
<th>TEMPERATURE RANGE</th>
<th>FREQUENCY RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CM-2</td>
<td>2</td>
<td>120/240 VAC, 20 VA</td>
<td>0º to 50ºC</td>
<td>6.0 to 4.0 MHz</td>
</tr>
<tr>
<td>CM-6</td>
<td>6</td>
<td>120/240 VAC, 20 VA</td>
<td>0º to 50ºC</td>
<td>6.0 to 4.0 MHz</td>
</tr>
</tbody>
</table>

Remote Oscillators

Oscillators condition the signal from the crystal sensor to the controller. They are housed in a die-cast aluminum body. BNC connectors are used to interface with the monitor and sensor. Refer to the diagram on this page for installation and to page 222 of the catalog for cabling and accessories. In-vacuum oscillators are available. Call for information and pricing.

<table>
<thead>
<tr>
<th>MODEL NUMBER</th>
<th>TEMPERATURE RANGE</th>
<th>FREQUENCY RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO-A</td>
<td>10º to 40ºC</td>
<td>6.0 to 4.0 MHz</td>
</tr>
</tbody>
</table>

**SPECIFICATIONS**

Dimensions: 8.38 x 3.50 x 7.75 inches (212.85 x 88.9 x 196.85mm)

Connections

Inputs: 4 digital, 2 or 6 sensor

Outputs: 4 relay, analog rate & thickness

PC: RS-232 port

Display: Alphanumeric LED

Frequency: 6.0 to 4.0 MHz, programmable

Rate averaging: 1 to 20 readings

Frequency resolution: 0.1 Hz

Thickness resolution: 1 Å

Rate resolution: 0.1 or 0.01 Å/s selectable

Measurement rate: 0.15 to 2 seconds

All dimensions are in inches (mm) & weights are in pounds (kg), unless otherwise noted.
**SPECIFICATIONS**

**Materials**
- Feedthrough: 304 stainless steel
- Flanges: 304 stainless steel

**Vacuum range:** $>1 \times 10^{-9}$ mbar (High vacuum)

**Temperature range:** $<150^\circ C$

**Leak rate:** $<10^{-9} \text{ l/sec}$

**Baseplate thickness:** 1 inch (25.4mm) maximum

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**Thin Film Deposition**

**Crystal Feedthroughs**

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### 1 Inch Bolt Crystal Feedthroughs

<table>
<thead>
<tr>
<th>MODEL NUMBER</th>
<th>SENSOR CONNECTIONS</th>
<th>IN VAC CONNECTOR</th>
<th>EXTERNAL CONNECTOR</th>
<th>COOLING LINES</th>
<th>COMPRESSION FITTINGS</th>
<th>AIR LINES</th>
</tr>
</thead>
<tbody>
<tr>
<td>CF-100-1</td>
<td>1</td>
<td>Microdot</td>
<td>BNC</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CF-100-1-W</td>
<td>1</td>
<td>Microdot</td>
<td>BNC</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CFP-100-2-W</td>
<td>2</td>
<td>Microdot</td>
<td>Microdot</td>
<td>2</td>
<td>1</td>
<td>-</td>
</tr>
</tbody>
</table>

**Note:** 1.25 inch (3.175) bolt feedthroughs are available. Call for pricing.

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### CF Flanged Crystal Feedthroughs

<table>
<thead>
<tr>
<th>MODEL NUMBER</th>
<th>FLANGE TYPE</th>
<th>SENSOR CONNECTIONS</th>
<th>IN VAC CONNECTOR</th>
<th>EXTERNAL CONNECTOR</th>
<th>COOLING LINES</th>
<th>COMPRESSION FITTINGS</th>
<th>AIR LINES</th>
</tr>
</thead>
<tbody>
<tr>
<td>CF-133-1</td>
<td>1.33 CF</td>
<td>1</td>
<td>Microdot</td>
<td>BNC</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CF-275-1-W</td>
<td>2.75 CF</td>
<td>1</td>
<td>Microdot</td>
<td>BNC</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CF-275-1-WC</td>
<td>1.33 CF</td>
<td>1</td>
<td>Microdot</td>
<td>BNC</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CFP-275-2-W</td>
<td>2.75 CF</td>
<td>2</td>
<td>Microdot</td>
<td>BNC</td>
<td>2</td>
<td>1</td>
<td>-</td>
</tr>
</tbody>
</table>

**Note:** ISO, NW, and ASA flanged feedthroughs are available upon request. Call for pricing.

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All dimensions are in inches (mm) & weights are in pounds (kg), unless otherwise noted.
### Single Crystal Sensors

<table>
<thead>
<tr>
<th>MODEL NUMBER</th>
<th>SENSORS</th>
<th>MOUNTING BRACKET</th>
<th>SENSOR ORIENTATION</th>
<th>WATER COOLED</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS-1-W-RA</td>
<td>1</td>
<td>✓</td>
<td>90°</td>
<td>✓</td>
</tr>
<tr>
<td>CS-1-W</td>
<td>1</td>
<td>✓</td>
<td>0°</td>
<td>✓</td>
</tr>
<tr>
<td>CS-1</td>
<td>1</td>
<td>✓</td>
<td>0°</td>
<td>✓</td>
</tr>
</tbody>
</table>

### Dual Crystal Sensors

<table>
<thead>
<tr>
<th>MODEL NUMBER</th>
<th>SENSORS</th>
<th>SENSOR ORIENTATION</th>
<th>PNEUMATIC SHUTTER</th>
<th>WATER COOLED</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSP-2-W-RA</td>
<td>2</td>
<td>90°</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CSP-2-W</td>
<td>2</td>
<td>0°</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

### Bakeable Crystal Sensors

<table>
<thead>
<tr>
<th>MODEL NUMBER</th>
<th>FLANGE TYPE</th>
<th>DESCRIPTION</th>
<th>TEMPERATURE RANGE</th>
<th>WATER COOLED</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSH-275-1-W</td>
<td>2.75 CF</td>
<td>Single sensor with feedthrough</td>
<td>≤300°C</td>
<td>✓</td>
</tr>
</tbody>
</table>

**SPECIFICATIONS**

**Materials**
- Body: 304 stainless steel
- Crystals: 6 MHz gold and aluminum alloy

**Vacuum range:** ≥1x10⁻⁹ mbar (High Vacuum)

**Temperature range:** ≤225°C

Custom lengths and bends available for all sensors.

Cables, crystals, and accessories are on page 222.

All dimensions are in inches (mm) & weights are in pounds (kg), unless otherwise noted.
SECTION 11.5

Cables, Connectors, Crystals & Accessories

### Cables and Connectors

<table>
<thead>
<tr>
<th>MODEL NUMBER</th>
<th>DESCRIPTION</th>
<th>LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCV-MM-30*</td>
<td>Microdot to Microdot in-vacuum coaxial cable, metal sheath. Connects feedthrough to sensor.</td>
<td>30.75&quot; (781.05)</td>
</tr>
<tr>
<td>CCV-MM-30T*</td>
<td>Microdot to Microdot in-vacuum coaxial cable, Teflon coated metal sheath. Connects feedthrough to sensor.</td>
<td>30.75&quot; (781.05)</td>
</tr>
<tr>
<td>CCA-BB-6</td>
<td>BNC to BNC cable (Male to Female). Connects feedthrough to oscillator.</td>
<td>6.00 (152.40)</td>
</tr>
<tr>
<td>CCA-BM-6</td>
<td>BNC to Microdot cable. Connects feedthrough to oscillator.</td>
<td>6.00 (152.40)</td>
</tr>
<tr>
<td>CCA-BB-10</td>
<td>BNC to BNC cable (Male to Male). Connects oscillator to monitor.</td>
<td>120.00 (3048)</td>
</tr>
<tr>
<td>CRU-1</td>
<td>Reducing union tube connector 3/16 to 1/8. Connects cooling and air lines between feedthrough and sensor.</td>
<td>Each</td>
</tr>
</tbody>
</table>

*Additional charges will apply for Special Lengths

### Quartz Crystals and Accessories

<table>
<thead>
<tr>
<th>MODEL NUMBER</th>
<th>DESCRIPTION</th>
<th>QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>CQ-G</td>
<td>6MHz gold, 550 (13.97) diameter</td>
<td>Pkg. of 10</td>
</tr>
<tr>
<td>CQ-A</td>
<td>6MHz aluminum alloy, 550 (13.97) diameter</td>
<td>Pkg. of 10</td>
</tr>
<tr>
<td>CH-1</td>
<td>Replacement crystal holder</td>
<td>Each</td>
</tr>
</tbody>
</table>

All dimensions are in inches (mm) & weights are in pounds (kg), unless otherwise noted.
Orders
To place an order, request catalogs or obtain information about our products and services call 800-824-4166 or 530-842-4457. You may also make requests from our website, www.n-c.com.

Minimum Orders
The minimum domestic order that will be processed is $40.00. The minimum international order is $100.00.

Terms of Payment
Terms are net 30 days from the date of invoice once credit has been approved. Otherwise terms are COD. Visa, Mastercard or American Express charges are accepted.

Establishing Credit
Contact our sales department to establish credit with Nor-Cal Products. You may download a credit application from our website under Customer Service.

Discounts
OEM and quantity discounts are available to qualified customers.

Shipment
Ships will be UPS Surface, Prepay and Add, unless quoted otherwise.

FOB Point
All shipments are FOB Yreka, California unless quoted otherwise.

Pricing & Dimensions
In order to meet the changing needs of our customers we periodically make design revisions in our standard product line. As a result, the dimensions, pricing and specifications are subject to change without notice. International pricing may also vary.

Return Policy
Merchandise may be returned at the sole discretion of Nor-Cal Products, but not more than 60 days after shipment. A fee may be charged for restocking the item. An RMA number must be obtained from Nor-Cal before returning any merchandise. RMA forms in printable PDF format can be downloaded from our website under Customer Support.

Cancellations
Any request by customers for cancellation in total or part of any purchase order must be approved at the sole discretion of Nor-Cal Products and shall be subject to the following conditions:
1. Nor-Cal must receive written notice of Request for Cancellation, stating the reasons therefore.
2. Customer shall be liable for payment of the following charges to Nor-Cal in the event of cancellation.
   A. For all charges incurred (including overhead, G&A, and profit) prior to the date that notice of cancellation is received by Nor-Cal for all parts peculiar to customer's requirements. Upon payment by customer of these charges such parts become the property of the customer, Nor-Cal will store said parts for a reasonable period of time pending the receipt of customer's instruction for disposition. Such storage is at the customer's risk and may be subject to storage charges if stored by Nor-Cal for longer than 30 days from the cancellation date; plus
   B. Charges to convert modified standard parts for return to Nor-Cal's inventory; plus
   C. A restocking charge

Warranty
Products manufactured by Nor-Cal Products, Inc. (hereinafter referred to as “Nor-Cal”) are warranted against defects in material and workmanship for a period of twelve (12) months from the date of shipment from Nor-Cal to the buyer. Any modification to the product by the buyer or their agent voids this warranty. Liability under this warranty is expressly limited to replacement or repair (at Nor-Cal's option) of defective parts. Nor-Cal may at any time discontinue its warranty as to any of its products by refunding the purchase price and taking back the products. This warranty applies only to parts manufactured, and labor provided, by Nor-Cal under valid warranty claims received by Nor-Cal within the applicable warranty period and shall be subject to the terms and conditions hereof.

Expendable items such as tubes, heaters, sources, bellows, etc., by their nature may not function for one year; if such items fail to give reasonable service for a reasonable period of time, as determined solely by Nor-Cal, they will be repaired or replaced by Nor-Cal at its election.

All warranty replacement or repair of parts shall be limited to equipment malfunctions which, in the sole opinion of Nor-Cal, are due or traceable to defects in original materials or workmanship. Malfunctions caused by abuse or neglect of the equipment are expressly not covered by this warranty. Nor-Cal expressly disclaims responsibility for any loss or damage caused by the use of its products other than in accordance with proper operating and safety procedures. Reasonable care must be taken by the user to avoid hazards.

In-warranty repaired or replacement parts are warranted only for the remaining unexpired portion of the original warranty period applicable to the parts which have been repaired or replaced.

After expiration of the applicable warranty period, the buyer shall be charged at Nor-Cal's then current prices for parts and labor plus transportation.

Except as stated herein, Nor-Cal makes no warranty, expressed or implied (either in fact or by operation of law), statutory or otherwise: and, except as stated herein, Nor-Cal shall have no liability for special or consequential damages of any kind or from any cause arising out of the sale, installation, or use of any of its products. Statements made by any person, including representatives of Nor-Cal, which are inconsistent or in conflict with the terms of this warranty shall not be binding upon Nor-Cal unless reduced to writing and approved by an officer of Nor-Cal.
Nor-Cal Products, Inc. patents and trademarks:
Genesis Modular Valves are manufactured under patent number 6289932
Intellisys Pressure Control Products are manufactured under patent number 6612331
Genesis is a trademark of Nor-Cal Products, Inc.
Intellisys is a registered trademark of Nor-Cal Products, Inc.

Other registered patents and trademarks:
Magnetic Linear/ Rotary Feedthroughs are manufactured under patent number 5514925
Sample Transfer Systems are manufactured under patent number 5705128
Alumel is a registered trademark of Hoskins Manufacturing Company
Amp Mate-N-Lok is a registered trademark of the Amp Company
AutoCAD is a registered trademark of AutoDesk Corporation
Inventor is a registered trademark of AutoDesk Corporation
Cajon is a registered trademark of The Cajon Company
Chemraz is a registered trademark of Green Tweed Company
Chromel is a registered trademark of Hoskins Manufacturing Company
Conflat is a registered trademark of Varian Associates
DeviceNet is a trademark of the Open DeviceNet Vendor Association (ODVA)
Inconel is a registered trademark of Inco Alloys
KF is a registered trademark of Leybold Vacuum Products
Kalrez is a registered trademark of DuPont Dow Elastomers
Kovar is a registered trademark of Westinghouse Electric Corporation
Macor is a registered trademark of Corning, Inc.
Mate-N-Lok is a registered trademark of AMP Company
Microdot is a registered trademark of Microdot Corporation
Modbus is a registered trademark of Schneider Automation Incorporated
OFHC is a registered trademark of American Metals Climax, Inc.
Omicron is a registered trademark of Omicron Corporation GmbH
Penduroll is a registered trademark of V-Tex Corporation
Perlast is a registered trademark of PPE Limited
Pyrex is a registered trademark of Corning Glass Works
SoftShut is a registered trademark of Thermo Vacuum Generators
SolidWorks is a registered trademark of Dessault Systèmes SolidWorks Corp.
Swagelok is a registered trademark of Crawford Fittings Company
Teflon is a registered trademark of DuPont Dow Elastomers
UL is a registered trademark of Underwriters Laboratories, Inc.
VCR is a registered trademark of The Cajon Company
Viton is a registered trademark of DuPont Dow Elastomers
Windows is a registered trademark of Microsoft Corporation
For the most current listing of our sales representatives visit www.n-c.com or call our corporate office at 800-842-4166.