

Process Instrumentation

12

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CVD and PVD

Two major in-vacuum processes are CVD and PVD (described in Section 15, Vacuum Systems). The list of products using a CVD/PVD step to make a thin film is both exceptionally large and diverse and includes all IC products made by the semiconductor industry, computer hard disk drives and their read-heads, anti-reflective coatings on camera lenses and reflective coatings on architectural glass, aluminized plastic films used in food packaging and thermal insulation in superconducting magnets, "mirror" sunglasses, hard coatings on machine tools, body-fluid compatible materials on prosthetic joints, OLED displays, aircraft canopies, and car rear-view mirrors and headlamp reflectors.

Often a chamber is evacuated to low pressure to ensure "clean" initial conditions for some product-making process. *Process instrumentation* is used here to cover ancillary equipment that monitors or controls the process's progress or the supply of some essential "utility."

Controlling Gas Flows

All CVD and many PVD processes require a gas or vapor flowing through the chamber at a relatively low pressure and controlled rate. A few examples are (a) sputter deposition that requires a constant flow of pure Ar at a fixed low pressure; (b) reactive thermal evaporation, which needs a reactive gas (O_2 or N_2) to form the final product; (c) dry etching that may use a single gas (Ar, O_2 , CF_4) or a mixture; and (d) CVD depositions using vapors and separately supplied gases (tetraethoxysilane + O_2 to produce SiO_2 films).

Thin Film Growth

Among the many factors that affect thin films made by PVD methods, the material's deposition rate and the film's final thickness are often critical. The deposition rate can affect morphology and the film's thickness determines its electrical, optical, and mechanical functioning. Quartz crystal thickness monitors are frequently chosen to determine film growth rate and instantaneous thickness in PVD processes.

Power Supplies

Most vacuum processes require electrical power as a utility inside the vacuum chamber. Examples from thin film processes might be: (a) evaporating a material; (b) raising a substrate's temperature so that a particular CVD reaction works; (c) heating a substrate to manipulate a film's morphology during a PVD process; and (d) sputtering. The various types of power supplies required for these processes are discussed later.

Mass Flow Controllers/Mass Flow Meters

The name describes the function—mass flow controllers (MFCs) control (or for "meters," measure) the flow rate of gas passing through them. More specifically, they control the mass flow in units of pressure \times volume/unit time. They do not control the volumetric flow in units of volume/unit time. The distinction is important. Mass flow rate is actually the number of molecules passing through the device per second. For a stated volumetric flow rate, the number of molecules passing through the device might be 10^5 or 10^{25} per second... it all depends on the pressure. Clearly, when considering chemical or physical processes, the critical parameter is more likely to be the number of molecules available per unit time than the volume they occupy.

To lower equipment costs, leak valves are sometimes chosen to control gas flow. But as explained in Section 2, Valves, this is not really flow control. The flow rate through a leak valve depends on the specific gas, up-stream pressure, down-stream pressure, and ambient temperature. Within a very wide range of working conditions, MFCs are unaffected by these factors.

Permanent Gases

Any gas that cannot be converted to a liquid by increasing the pressure at room temperature ($20^\circ C$) is called a *permanent gas*. Examples are N_2 , O_2 , Ar, He, H_2 , NH_3 , CO, F_2 , CH_4 , etc. To measure the mass flow of a permanent gas, a known fraction of the total gas flow is automatically diverted into a laminar flow sensing tube inside the MFC. The tube may have two or three sensors wrapped around it (at entrance, exit, and mid-point) and an overall heater. Knowing the thermal characteristics of the specific gas and the temperatures at two or three sensor locations, an (gas-specific) algorithm is used to calculate the mass flow in the sensing tube, and from that, the total flow.

The sensing tube's exit flow is re-mixed with the main flow and (in the controller version) passes through a solenoid valve that responds to feedback from the flow measurement circuit. The accuracy of flow control is $\pm 1\%$ of the full scale reading (with all error sources taken into account) with repeatability at $\pm 0.2\%$ full scale.

Vapors

As used here, vapor is the gaseous phase of a chemical that also exists as liquid or solid at, or near, normal temperatures and pressures. As an example from everyday experience, the atmosphere always contains water vapor. Reducing the air's temperature causes water vapor to change to liquid water—as in cloud formation or fogging of bathroom mirrors. One example of vapor-solid transitions is iodine crystals. At room temperature, iodine's vapor pressure (VP) is ~ 0.4 Torr. Cool a trapped I_2 vapor volume to $0^\circ C$ and the VP drops to 0.05 Torr—the vapor condensing as solid iodine.

In practical vacuum processes used in the semiconductor industry, vapors such as: tetraethoxysilane (TEOS), VP ~ 2 Torr at $25^\circ C$; titanium tetrachloride ($TiCl_4$), VP ~ 10 Torr at $20^\circ C$; and hexamethyldisiloxane (HMDSO), VP 55 Torr at $30^\circ C$, are commonly used. To measure the mass flow of these vapors, two factors must be addressed: (a) the MFC must handle the vapor without causing reaction or decomposition; and (b) the temperature of the tubes/valves containing the vapor must be above the temperature at which condensation will occur (see *Vapors and Temperature sidebar*).

Unlike gases, vapor flows cannot be measured or controlled using MFCs that work on the principles described in "Permanent Gases." The pressure differential used in gas MFCs are not available from most vapor sources and gas MFCs may have elastomer/polymer seals that may be incompatible with the vapors. A vapor MFC's design centers around (a) all metal surfaces in contact with the vapor, (b) a constant body temperature well in excess of $25^\circ C$, and (c) using a flow measurement method that works at low inlet pressures and, therefore, low pressure differential.

The first measurement method uses *choked flow*. If a vapor or gas flowing through an orifice (or short pipe) is in viscous flow and has an upstream pressure roughly twice its downstream pressure, the orifice goes into choked flow. The mass flow through the orifice depends *only* on the upstream pressure. From a reverse viewpoint, if the downstream pressure is between high vacuum and $\sim 1/2$ the upstream pressure, it has *no effect* on the mass flow rate through the orifice. By measuring the orifice's inlet pressure with a capacitance manometer, by controlling that inlet pressure with an upstream solenoid valve, and by using appropriate values for vapor molecular weight, etc., in the algorithm, vapor mass flow rates can be controlled to an overall accuracy $\pm 5\%$ of the full scale reading.

The second method depends on laminar flow (in the viscous regime) through a tube. If the upstream and downstream pressures are accurately measured using capacitance manometers, then $(P_u^2 - P_d^2)$ is directly proportional to the mass flow through the tube. With a solenoid-operated control valve positioned before the upstream capacitance manometer, vapor mass flow rates can be controlled with an overall accuracy $\pm 5\%$ of the full scale reading.



Vapors and Temperature

With a particularly low vapor pressure (VP) material, like TEOS (VP 2 Torr at 25° C), the bulk material's temperature must be raised so the VP is at least high enough to support the required flow rate. The bulk temperature for TEOS, for example, might need to be 70° C, which will give a VP of ~24 Torr.

Obviously, all tubing from the bulk material's container to the MFC and the MFC itself must be maintained at a temperature well above 70° C to prevent TEOS condensing to liquid. Since mass flow measurement methods are temperature sensitive, it is important that the MFC is maintained at a *constant* higher temperature.

What is needed after the MFC depends on its outlet pressure. For TEOS, if the pressure is considerably less than 2 Torr, then the tubing after the MFC does not need to be heated, although it may still be prudent. But if the pressure exceeds 2 Torr, or even approaches it, then the tubing from MFC to chamber and chamber itself must be heated above 25° C to avoid condensation.

Thin Film Monitors/Controllers

The thickness of a deposited film is often critical to its proper functioning. Clearly, measurement after deposition is complete is too late. It must be measured *in situ* during the deposition which can then be terminated at the appropriate instant. Of the two-thickness measurement methods presently available, ellipsometry and quartz crystal monitoring, the latter is much more widely used and is the subject of these notes.

Quartz Crystal Monitors and Controllers

When a voltage is applied to a quartz plate, the piezoelectric effect causes the plate to bend. If the voltage is removed, the quartz's elasticity makes it mechanically vibrate at its natural frequency and, while flexing, give out microvolt piezoelectric signals. If a thin quartz crystal is combined in a special "free running" oscillator circuit, the RF voltage output from the crystal can be amplified and used to determine its frequency.

One key parameter determining the crystal's natural frequency is its mass. For film thickness measurement, the quartz crystal's mass is selected to make the natural frequency ~6 MHz. The crystal monitor is positioned in the deposition chamber to intercept some fraction of the vapor "plume". As material condenses on the monitor, the crystal's mass changes, whereby changing its natural frequency.

Comparing the crystal's frequency an instant ago and its current frequency, and using an appropriate algorithm, gives a measure of the mass deposited and, from the time interval, a measure of deposition rate and thickness. This is the primary information reported by a quartz crystal monitor (also known as quartz crystal microbalance) that, with a feedback loop to the deposition source power supply, becomes a quartz crystal controller. (The initials QCM used below, imply both monitors and controllers).

QCMs are used in measuring and controlling deposition rates of metal, alloys, semiconductors, and insulators. The more sophisticated models can monitor up to six separate crystal sensors and control the deposition rate from six separate sources, one at a time. For co-deposition, up to two sources can be simultaneously controlled. However, recent developments in organic and polymeric light emitting devices (OLEDs and PLEDs) that require multiple simultaneous

depositions have led to QCMs that control up to six crystals and sources simultaneously.

Making accurate and precise thickness measurements involves many subtleties—some addressed by the QCM manufacturer's design, while others demand operator attention. The more constraining characteristics are listed below, together with one manufacturer's techniques to overcome the constraints.

Tooling Factor

Obviously, during deposition, the QCM cannot occupy the same geometric position as the substrate. But placing the QCM to one side of the vapor plume means the crystal sees a different deposition rate. The *tooling factor* corrects this geometric factor and is determined by calibration: (1) measuring the rate of a (stable and reproducible) thermal evaporation with the QCM in the substrate's position, and (2) measuring the rate for the same thermal evaporation with the QCM in its side-position. Because the tooling factor depends on the specific geometry of the chamber, the QCM's location, and the source's plume, this factor can only be addressed by the operator.

Acoustic Impedance

A material's acoustic impedance, often quoted as 'Z', is density x longitudinal velocity of sound (with a numerical factor). When the Z value is compared to that of quartz (the piezoelectric material used as basis of deposition rate monitoring) it is quoted as 'Z-ratio'. The material's Z-ratio is used to correct the signal when the quartz crystal sensor is used to detect deposition rate or thickness. Tables of Z-ratio values for common materials are available on the internet or from the monitor/controller manufacturer's manual. For materials not listed, the operator should calibrated actual thickness vs measured thickness as appropriate.

INFICON™ Auto Z Circuitry

Unfortunately, acoustic impedance issues do not end with applying the right value. The Z-ratio changes with layer thickness and number of different material layers deposited on a single crystal. The INFICON™ Auto Z circuitry monitors and stores the crystal's history and applies corrections for total thickness and layer changes. Results for In/MgF₂ indicate that, at total thicknesses approaching 20 micrometers, the uncorrected error per layer exceeds 20%, while the error with Auto Z is ~0%.

Mode Hopping

Crystals only accept a certain mass of deposited material before they no longer oscillate appropriately. When they reach their limit, they may cease operation, jump to a harmonic frequency, or start oscillation in another (non-fundamental) mode, hence the term *mode hopping*. Hopping occurs only when deposition is occurring and causes a step-change in frequency. The thickness monitoring circuitry, designed to recognize incremental frequency changes, is unable to resolve the information and fails, causing ruined products and wasted time. Although "certain mass" implies a known mass, this is not the case. An individual crystal's mass load before it starts mode hopping is unpredictable.



■ INFICON's Patented ModeLock™ Technology

As explained earlier, in a conventional QCM the crystal determines the RF power supply's frequency—the crystal's free-running resonant frequency. Mode hopping limits the crystal's life and failure invariably occurs during deposition.

INFICON's patented *ModeLock™* technology overcomes this failure mode. It forces the crystal to remain in its fundamental frequency for its useful life, extends that life to a known cut-off point, virtually eliminates mode hopping, and gives crystal-frequency data of a higher precision than conventional QCM systems.

ModeLock uses a separate, internal oscillator for the RF and drives the crystal by delivering a packet of fixed-frequency sine waves. Then, through a feedback link, the phase and voltage characteristics of the crystal's return signal are examined. When the phase between the outgoing packet and incoming signals changes, the ModeLock circuitry corrects the frequency of the next packet to match the crystal's new resonant frequency. With an update rate of 0.15 MHz (roughly every 7 microseconds), ModeLock response time is much faster than significant film thickness changes.



CrystalTwelve Sensor

■ Crystal Sensors

While the "traditional" water-cooled housing with a single crystal is still the standard for monitoring depositions in R&D evaporations, a variety of crystal sensors have been developed for process applications. Sensors carrying multiple crystals provide backup should one crystal fail, or are used separately during sequential multi-component depositions. The "next" crystal is either rotated from a covered position into the active position or uncovered by flipping a shutter.

■ Sputtering Sensors

A sputter deposition process is an electrically noisy environment. The crystal sensor recommended for some sputtering applications is housed in gold-plated beryllium copper (beryllium copper to maximize heat removal, and gold-plated to aid in corrosion resistance). This sensor also features a permanent magnet behind the crystal to divert electrons escaping from the plasma that could impinge on the sensor, in turn raising the temperature and causing erratic thickness measurements.

■ Power Supplies

The generic term "power supplies" covers a whole array of products. Here, the scope is limited to supplies used in thin film deposition—more specifically, to the processes of thermal evaporation and sputtering.

The information needed before selecting and installing a power supply for thermal evaporation is not extensive. By contrast, selecting and installing an RF power supply for sputter deposition requires a reasonable understanding of: RF transmission, RF grounding, maximizing RF power transfer to plasmas using auto impedance matching tuners, RF plasma potentials, DC self-biasing, and potential drops between the plasma and grounded/capacitively coupled electrodes. While relevant, these issues are too complex for these notes.

■ RF Supplies

In the context of thin film technology, RF power is used (a) to sputter poorly conducting or insulating targets; (b) for plasma cleaning of substrate or chamber surfaces; (c) to apply a DC bias to a substrate; and (d) to sputter metals and other conductors. (As noted in the introduction, only brief explanations are given here.)

Sputtering Insulating Targets

Attempting to sputter an insulating target with DC power—by putting a negative DC potential on a (conducting) base-plate behind the target—causes the plasma's positive ions to bombard the target's surface. Since its resistance prevents electron flow from the base-plate, the ion charge is not neutralized and the target's surface quickly reaches a high positive voltage, stopping further ion bombardment.

If the base-plate is RF powered, during the negative half-cycle ions bombard the target and sputtering occurs. During the positive half-cycle, electrons bombard the target and neutralize the ion charge. As is clear, sputtering occurs half the time power is applied, leading to relatively low sputter rates.

Plasma Cleaning

Film adhesion to any substrate's surface is, in part, determined by the surface's cleanliness. Adsorbed vapors and contaminant's must be removed just before film deposition begins. One method is to position an (moveable-under-vacuum) electrode to face the substrate and apply an RF voltage. In the best arrangements, the electrode is hollow and connected to a gas supply. Tiny holes in the side facing the substrate provide the gas flow in which the plasma is lit and with which desorbed products are carried to the pumps.

Removing vapors from the chamber's inner surfaces require a more "global" plasma made by an RF voltage on a central electrode in a low pressure gas flow.

Substrate DC Bias

Without attempting to describe details, the substrate can be maintained at a negative potential with respect to the plasma. This prevents electron-bombardment but allows ion-bombardment from the plasma.

Sputtering Metals

Given the lower sputter rates of metals using RF, the question is: *Why do this?* The answer is implicit in the previous paragraph. In effect, this gives *ion-assisted deposition* (see the technical notes in Section 15) without an additional ion source. Metal films deposited with RF power tend to have better adhesion and a more compacted morphology compared to similar films made using DC power.



■ DC Supplies

Conducting (and some semiconducting) targets are sputtered, often at high rates, with DC power supplies. The wiring of source and supply are simple interconnections because there are no plasma impedance matching issues. However, it is not possible to use "any" DC power supply for sputtering. As a minimum, the supply should: (a) have a high maximum voltage (1 kV or higher) to start the plasma, (b) give 100% of its rated power at any voltage throughout its total range, not just at some optimum design voltage, (c) detect arcs and quickly suppress them, (d) have its output switchable to constant power, constant voltage, or constant current, and (e) have the selected power output controllable by an analog signal feedback from a thickness monitor.

■ Pulsed DC Supplies

Using DC supplies for reactive sputtering (conductive metal target and active gas such as O_2 to produce oxide films) often leads to the target surface being 'poisoned' with an oxide layer that stops the sputter process. Using RF power supplies is an option but the reduced sputtering rate of RF sputtering is sometimes unacceptable.

A better solution in terms of sputter rate and control of the deposition is obtained by using a pulsed power DC supply. Such supplies provide a negative voltage to the target that is reversed (to a positive voltage) with a variable frequency and variable duration. Target is sputtered during the negative voltage cycle but any high resistivity oxide formed on the surface is neutralized during the voltage reversal.

Pulsed DC supplies have user-adjusted negative voltage output and positive voltage reversals (that reach about 10% of the set voltage in the positive direction). The voltage reversal can be varied for frequency and duration (duty cycle) over some appropriate range. The reversal switch time is fast to prevent plasma collapse. By varying voltage, frequency, and duty cycle optimum sputtering conditions for a particular target material can be found.

■ AC Supplies

A variety of AC power supplies are needed for applications such as: Resistively heating various sources for evaporating materials, substrate temperature control, and internal chamber backout heaters.

Boats, Boxes, Filaments, Baskets, etc.

Thermal evaporation sources, shown in Evaporation Sources, are resistively heated refractory metal boats, boxes, filaments, etc. powered by a variable high-current, low voltage supplies. To get the source to the appropriate evaporation temperature for the material of interest, power supplies are built to deliver 2kW, 4kW, or 6kW. The maximum current available depends on maximum power output and the voltage tap selected on the transformer secondary. For example, the 2kW power supply has 5V, 10V, 20V, and 40V taps giving max currents of 400A, 200A, 100A, and 50A respectively.

Effusion Cells—High Temperature

An effusion cell is a crucible surrounded by tungsten filament heater coil. It needs relatively low voltages and modest currents to reach (maximum) operating temperatures ($\sim 1,500^\circ C$). A controllable power supply able to deliver 40 amps at 24 volts is sufficient for many effusion cell designs. Such cells, and power supplies, are used in applications where high melting point metals and compounds are evaporated.

Effusion Cells—Low Temperature

These are constructed like the high temperature effusion cells, but the temperature range of interest is $100^\circ C$ to $500^\circ C$ for evaporating organic or high vapor pressure inorganic materials. The allowable temperature error—in absolute degree terms—is very stringent, and precise control demands special circuits to minimize temperature overshoots and undershoots. Typical power supplies for this application have outputs of 15 amps at 12 volts.

Substrate/Bakeout Heaters

The most frequently used heater types for these applications are quartz halogen lamps or resistance heaters made from bare Kanthal®, nichrome, or other resistance wire. Such heaters are usually made to operate at standard line voltage (115 and 240VAC being common) and need power supplies with controlled outputs at that line voltage.



➤ Mass Flow Meters (Gas)— Elastomer Seals

■ MKS M10MB

An economical alternative for processes not requiring the control of gas flow. This meter is appropriate for general-purpose analytical and experimental use.

MKS Instruments economical M10MB mass flow meters are designed to measure gas flows in a wide variety of analytical, industrial, and experimental applications. They are available with full-scale flow ranges from 10 sccm up to 30 slm of nitrogen.

The M10MB features the industry standard 3" footprint and a variety of gas connection fittings. They can often replace existing mass flow meters in existing gas lines without modification to the line. A unique and patented interchangeable bypass enables the instrument to easily be retrofitted for a different flow range.

Features:

- Elastomer-sealed, 316L stainless steel construction
- 1% F.S. accuracy for most flow ranges
- MTBF rating for electronics over 100 years ensures reliability



Choose the base unit, full-scale flow range, fittings, no valve, connectors, and metal seals. Next, compose the order code as shown, below.

Example Configuration Part No.: **M10MB 004 11C R 3 B V**

	Base Part No. Prefix	Base Price
Base Unit	M10MB	Call
Gas to be Calibrated (SEMI Gas Number)*	Optional Part No.	Base Price
Helium, He	001	N/C
Argon, Ar	004	N/C
Hydrogen, H ₂	007	N/C
Nitrogen, N ₂	013	N/C
Oxygen, O ₂	015	N/C

*Don't see what you need? Go to www.lesker.com/MFC for more gases

Full-Scale Flow Range (sccm of Nitrogen)		
10	11C	Call
20	21C	N/C
50	51C	N/C
100	12C	N/C
200	22C	N/C
500	52C	N/C
1,000	13C	N/C
2,000	23C	N/C
5,000	53C	N/C
10,000	14C	N/C
20,000	24C	Call
30,000	34C	Call

Fitting (compatible with)

Swagelok® 4 VCR® male	R	N/C
1/4" Swagelok	S	N/C
Swagelok 4 VCO®	G	N/C
1/8" Swagelok**	P	N/C
6 mm Swagelok	M	N/C

No Valve (meter only)

15-pin Type "D"	B	N/C
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Seals***

Viton®	V	N/C
Buna-N	B	N/C
Neoprene®	N	N/C

** 1/8" Swagelok fitting available for flow rates of < 5000 sccm N₂ only.

*** Acetylene and Chlorine are not compatible with Viton, Neoprene or Buna-N. Do not use either CL₂ or C₂H₂ with M10MB.

Interconnect Cables for M10MB

Description	Part No.	Price
10' Cable to Power Supply (M246 or M247)	CB259-5-10	Call
10' Cable to Power Supply (PR4000, M146, M186, M167, or M647)	CB174-1-10	Call

Recommended Power Supply

Power Supply/Display	Benefit	Channels	Reference Pages
647C	Upstream pressure control	Up to 8 channels	12-13
PR4000	Flow control	Up to 2 channels	12-14
246C	Flow control	Single channel	12-15

NOTE: A full range of mass flow controllers and meters can be found at www.lesker.com.

➤ Mass Flow Meters (Gas)—Metal Seals

■ MKS 179A

An economical alternative for processes not requiring the control of gas flow. This mass flow meter with metal seals for corrosive gas applications is available with analog and digital communication (ADC) interfaces.

Features:

- Metal-sealed, 316L stainless steel construction
- 1% F.S. accuracy and 1% of reading for most flow ranges
- MTBF rating for electronics over 100 years ensures reliability
- DeviceNet, Profibus, and RS-485 digital interfaces available (converted from analog signal)

Choose the base unit, full-scale flow range, fittings, no valves, connectors, and metal seals. Next, compose the order code as shown, below.

Example Configuration Part No.: 1179A 001 11C R 3 A M

	Part No. Prefix	Base Price
Base Unit	1179A	Call
Gas to be Calibrated (SEMI Gas Number)*	Optional Part No.	Base Price
Helium, He	001	N/C
Argon, Ar	004	N/C
Hydrogen, H ₂	007	N/C
Nitrogen, N ₂	013	N/C
Oxygen, O ₂	015	N/C
*Don't see what you need? Go to www.lesker.com/MFC for more gases.		
Full-Scale Flow Range (sccm of Nitrogen)		
10	11C	Call
20	21C	N/C
50	51C	N/C
100	12C	N/C
200	22C	N/C
500	52C	N/C
1,000	13C	N/C
2,000	23C	N/C
5,000	53C	N/C
10,000	14C	N/C
20,000	24C	Call
Fittings (compatible with)		
Swagelok® 4 VCR® male	R	N/C
Swagelok 4 VCO®	G	N/C
Swagelok™ 1/4"	S	N/C
No Valve (meter only)	3	N/C
Connectors		
9-pin Type "D"	A	N/C
15-pin Type "D"	B	N/C
20-pin Edge Card	C	N/C
15-Pin Type "D" Alternate (Brooks)	E	N/C
RS485	5	Call
DeviceNet™	6	Call
Metal Seals	M	N/C



NOTE: All Digital Equivalents of the 179A Model are available. Contact our Process Equipment Division at ped@lesker.com for MKS 180A options, pricing, and availability.

Interconnect Cables for MKS 179A

Description	Part No.	Price
Connect 179 9-pin Type "D" to PR4000, 146, 186, 246, 247, 167, 647, 660	CB147-12-10	Call
Connect 179 15-pin Type "D" to 246, 247, 660	CB259-5-10	Call
Connect 179 15-pin Type "D" to PR4000 146, 186, 167, 647, 660	CB147-1-10	Call
Connect 179 20-pin edge card to 246, 247, 660	CB259-10-10	Call
Connect 179 20-pin edge card PR4000 146, 186, 167, 647	CB147-7-10	Call

Recommended Power Supply

Power Supply/Display	Benefit	Channels	Reference Pages
647C	Upstream pressure control	Up to 8 channels	12-13
PR4000	Flow control	Up to 2 channels	12-14
246C	Flow control	Single channel	12-15

NOTE: A full range of mass flow controllers and meters can be found at www.lesker.com.

➤ Mass Flow Controllers (Gas)— Elastomer Seals

■ MKS M100B

Low cost, entry-level mass flow controller

MKS Instruments economical M100B mass flow controllers are designed to control gas flows in a wide variety of analytical, industrial, and experimental applications. They are available with full-scale flow ranges from 10 sccm up to 30 slm of nitrogen.

The M100B features the industry standard 3" footprint and a variety of gas connection fittings. They can often replace existing mass flow controllers or meters in existing gas lines without modification to the line. A unique and patented interchangeable bypass enables the instrument to be retrofitted easily for a different flow range.

Features:

- Elastomer-sealed, 316L stainless steel construction
- 1% F.S. accuracy for most flow ranges
- MTBF rating for electronics over 100 years ensures reliability



Choose the base unit, full-scale flow range, fitting, no valve, connector, and metal seals. Next, compose the order code as shown, below.

Example Configuration Part No.: **M100B 004 11C R 1 B V**

	Part No. Prefix	Base Price
Base Unit	M100B	Call
Gas to be calibrated (SEMI Gas Number)*	Option Part No.	Additional Price
Helium, He	001	N/C
Argon, Ar	004	N/C
Hydrogen, H ₂	007	N/C
Nitrogen, N ₂	013	N/C
Oxygen, O ₂	015	N/C
*Don't see what you need? Go to www.lesker.com/MFC for more gases.		
Full Scale Flow Range (sccm of Nitrogen)		
10	11C	Call
20	21C	N/C
50	51C	N/C
100	12C	N/C
200	22C	N/C
500	52C	N/C
1,000	13C	N/C
2,000	23C	N/C
5,000	53C	N/C
10,000	14C	Call
20,000	24C	Call
50,000	34C	Call
Fittings (compatible with)		
Swagelok® 4 VCR® male	R	N/C
1/4" Swagelok	S	N/C
Swagelok 4 VCO®	G	N/C
1/8" Swagelok**	P	N/C
6mm Swagelok	M	N/C
Normally Closed Valve (controller)	1	N/C
15-Pin Type "D"	B	N/C
Seals***		
Buna-N	B	N/C
Neoprene®	N	N/C
Viton®	V	N/C
Metal Seals	M	N/C

* 50K sccm device available with 4 VCR and 1/4" Swagelok compression fitting only.

** 1/8" Swagelok fitting available for flow rates of < 5000 sccm N₂ only.

*** Acetylene and Chlorine are not compatible with Viton, Neoprene or Buna-N. Do not use either CL₂ or C₂H₂ with M10MB.

Interconnect Cables for M100B

Description	Part No.	Price
Connect M100B 15-pin Type "D" to PR4000, 146, 186, 167, 647	CB147-1-10	Call
Connect M100B 15-pin Type "D" to 246, 247	CB259-5-10	Call

Recommended Power Supply

Power Supply/Display	Benefit	Channels	Reference Pages
647C	Upstream pressure control	Up to 8 channels	12-13
PR4000	Flow control	Up to 2 channels	12-14
246C	Flow control	Single channel	12-15

NOTE: A full range of mass flow controllers and meters can be found at www.lesker.com.

➤ Mass Flow Controllers (Gas)— Elastomer Seals

■ MKS 1179A

Ideal for applications needing repeatability and available with analog and digital communication (ADC) interfaces.

MKS Instruments 1179A mass flow controllers are designed to control gas flows in a wide variety of applications, particularly where repeatability is important. They are available with full-scale flow ranges from 10 sccm up to 20 slm of nitrogen.

Both analog and digital (converted from analog signal) versions feature the industry-standard 3" footprint and a variety of gas connection fittings. They can replace existing mass flow controllers or meters in existing gas lines without modification to a line. A unique and patented interchangeable bypass enables the instrument to be retrofitted easily for a different flow range.

Features:

- Elastomer-sealed, 316L stainless steel construction
- 1% F.S. accuracy and 1% of reading for most flow ranges
- Repeatable flow control to as low as 0.2 sccm
- MTBF rating for electronics over 100 years ensures reliability

Interconnect Cables for 1179A

Description	Part No.	Price
Connect 1179 9-pin Type "D" to PR4000, 146, 186, 246, 247, 167, 647	CB147-12-10	Call
Connect 1179 15-pin Type "D" to 246, 247	CB259-5-10	Call
Connect 1179 15-pin Type "D" to PR4000, 146, 186, 167, 647	CB147-1-10	Call
Connect 1179 20-pin edge card to 246, 247	CB259-10-10	Call
Connect 1179 20-pin edge card to PR4000, 146, 186, 167, 647	CB147-7-10	Call

Recommended Power Supply

Power Supply/Display	Benefit	Channels	Reference Pages
647C	Upstream pressure control	Up to 8 channels	12-13
PR4000	Flow control	Up to 2 channels	12-14
246C	Flow control	Single channel	12-15

NOTE: A full range of mass flow controllers and meters can be found at www.lesker.com.



Choose the base unit, full-scale flow range, fittings, no valves, connectors, and metal seals. Next, compose the order code as shown, below.

Example Configuration Part No.: 1179A 11C R 1 A V

	Part No. Prefix	Base Price
Base Unit	1179A	Call
Gas to be calibrated (SEMI Gas Number)*	Option Part No.	Additional Price
Helium, He	001	N/C
Argon, Ar	004	N/C
Hydrogen, H ₂	007	N/C
Nitrogen, N ₂	013	N/C
Oxygen, O ₂	015	N/C
*Don't see what you need? Go to www.lesker.com/MFC for more gases.		
Full Scale Flow Range (sccm of Nitrogen)		
10	11C	Call
20	21C	N/C
50	51C	N/C
100	12C	N/C
200	22C	N/C
500	52C	N/C
1,000	13C	N/C
2,000	23C	N/C
5,000	53C	N/C
10,000	14C	N/C
20,000	24C	Call
Fittings (compatible with)		
Swagelok® 4 VCR male	R	N/C
Swagelok 4 VCO tube	G	N/C
Swagelok 1/4" tube	S	N/C
Normally Closed Valve (controller)	1	N/C
Connectors		
9-pin Type "D"	A	N/C
15-pin Type "D"	B	N/C
20-pin edge card	C	N/C
15-Pin Type "D" Alternate (Brooks)	E	N/C
Unit Instruments 15-pin Type "D"	N	N/C
Millipore 15-pin Type "D"	T	N/C
RS-485	5	Call
DeviceNet™	6	Call
Seals**		
Viton®	V	N/C
Neoprene®	N	N/C
Buna-N	B	N/C
Kalrez®	K	Call

** Acetylene and Chlorine are not compatible with Viton, Neoprene or Buna-N.
Do not use either CL₂ or C₂H₂ with M10MB.

➤ Mass Flow Controllers (Gas)—Elastomer Seals

■ MKS 2179A

An integral shut-off valve is available with analog and digital communication (ADC) interfaces.

MKS Instruments 2179A mass flow controllers are designed to control gas flows in a wide variety of applications and available with full-scale flow ranges from 10 sccm up to 20 slm of nitrogen.

The normally closed, pneumatic shut-off valve provides positive shut-off to 10⁻⁹ scc/sec. He. Both analog and digital (converted from analog signal) versions feature the industry-standard 3" footprint and various gas connection fittings. It can replace existing mass flow controllers or meters in existing gas lines without modification to the line. A unique and patented interchangeable bypass enables the instrument to be retrofitted easily for a different flow range.

Features:

- Elastomer-sealed, 316L stainless steel construction
- 1% F.S. accuracy and 1% of reading for most flow ranges
- Integral pneumatic diaphragm shut-off valve (70–100 psi needed to actuate)
- Repeatable flow control to as low as 0.2 sccm
- MTBF rating for electronics over 100 years ensures reliability



Choose the base unit, full-scale flow range, fittings, no valves, connectors, and metal seals. Next, compose the order code as shown, below.

Example Configuration Part No.: 2179A 004 11C R 1 6 V

	Part No. Prefix	Base Price
Base Unit	2179A	Call
Gas to be calibrated (SEMI Gas Number)*	Option Part No.	Additional Price
Helium, He	001	N/C
Argon, Ar	004	N/C
Hydrogen, H ₂	007	N/C
Nitrogen, N ₂	013	N/C
Oxygen, O ₂	015	N/C

*Don't see what you need? Go to www.lesker.com/MFC for more gases.

Full Scale Flow Range (sccm of Nitrogen)		
10	11C	Call
20	21C	N/C
50	51C	N/C
100	12C	N/C
200	22C	N/C
500	52C	N/C
1,000	13C	N/C
2,000	23C	N/C
5,000	53C	N/C
10,000	14C	N/C
20,000	24C	Call

Fittings (compatible with)

Swagelok® 4 VCR® male	R	N/C
Swagelok 4 VCO® male	G	N/C
Swagelok 1/4" tube	S	N/C
Normally Closed Valve (controller)	1	N/C

Connectors

9-pin Type "D"	A	N/C
15-pin Type "D"	B	N/C
20-pin edge card	C	N/C
Unit Instruments 15-pin Type "D"	N	N/C
Millipore 15-pin Type "D"	T	N/C
RS485	5	Call
DeviceNet™	6	Call

Seals**

Viton®	V	N/C
Neoprene®	N	N/C
Buna-N	B	N/C
Kalrez®	K	Call

** Acetylene and Chlorine are not compatible with Viton, Neoprene or Buna-N.
Do not use either CL₂ or C₂H₂ with M10MB.

12

Process Instrumentation

Interconnect Cables for 2179A

Description	Part No.	Price
Connect 1179 9-pin Type "D" to PR4000, 146, 186, 246, 247, 167, 647	CB147-12-10	Call
Connect 1179 15-pin Type "D" to 246, 247	CB259-5-10	Call
Connect 1179 15-pin Type "D" to PR4000, 146, 186, 167, 647	CB147-1-10	Call
Connect 1179 20-pin edge card to 246, 247	CB259-10-10	Call
Connect 1179 20-pin edge card to PR4000, 146, 186, 167, 647	CB147-7-10	Call

Recommended Power Supply

Power Supply/Display	Benefit	Channels	Reference Pages
647C	Upstream pressure control	Up to 8 channels	12-13
PR4000	Flow control	Up to 2 channels	12-14
246C	Flow control	Single channel	12-15

NOTE: A full range of mass flow controllers and meters can be found at www.lesker.com.

➤ Mass Flow Controllers (Gas)—Metal Seals

■ MKS 1479A

Metal-sealed mass flow controller, ideal for high-purity semiconductor applications involving corrosive gases, is available with analog and digital communication (ADC) interfaces.

MKS Instruments 1479A mass flow controllers are designed to control gas flows in high-purity applications. They are available with full-scale flow ranges from 10 sccm up to 20 slm of nitrogen.

Both analog and digital (converted from analog signal) versions feature the industry standard 3" footprint and a variety of gas connection fittings. They can often replace existing mass flow controllers or meters in existing gas lines without modification to the line. A unique and patented interchangeable bypass enables the instrument to be retrofitted easily for a different flow range.

Features:

- Metal-sealed, electropolished 316L stainless steel construction
- 1% F.S. accuracy and 1% of reading for most flow ranges
- Repeatable flow control to as low as 0.2 sccm
- MTBF rating for electronics over 100 years ensures reliability

NOTE: All Digital Equivalents of the 1479A Model are available. Contact our Process Equipment Division at ped@lesker.com for MKS 1480A options, pricing, and availability.

Interconnect Cables for 1479A

Description	Part No.	Price
Connect 1179 9-pin Type "D" to PR4000, 146, 186, 246, 247, 167, 647	CB147-12-10	Call
Connect 1179 15-pin Type "D" to 246, 247	CB259-5-10	Call
Connect 1179 15-pin Type "D" to PR4000, 146, 186, 167, 647	CB147-1-10	Call
Connect 1179 20-pin edge card to 246, 247	CB259-10-10	Call
Connect 1179 20-pin edge card to PR4000, 146, 186, 167, 647	CB147-7-10	Call

Recommended Power Supply

Power Supply/Display	Benefit	Channels	Reference Pages
647C	Upstream pressure control	Up to 8 channels	12-13
PR4000	Flow control	Up to 2 channels	12-14
246C	Flow control	Single channel	12-15

NOTE: Full range of mass flow controllers and meters can be found at www.lesker.com.



Choose the base unit, full-scale flow range, fittings, no valves, connectors, and metal seals. Next, compose the order code as shown, below.

Example Configuration Part No.: 1479A 004 11C R 1 6 M

	Part No. Prefix	Base Price
Base Unit	1479A	Call
Gas To Be Calibrated (SEMI Gas Numbers)*	Option Part No.	Additional Price
Helium, He	001	N/C
Argon, Ar	004	N/C
Hydrogen, H ₂	007	N/C
Nitrogen, N ₂	013	N/C
Oxygen, O ₂	015	N/C
*Don't see what you need? Go to www.lesker.com/MFC for more gases.		
Full-Scale Flow Range (sccm of Nitrogen)		
10	11C	Call
20	21C	N/C
50	51C	N/C
100	12C	N/C
200	22C	N/C
500	52C	N/C
1000	13C	N/C
2000	23C	N/C
5000	53C	N/C
10000	14C	N/C
2,000	24C	Call
Fittings (compatible with)		
Swagelok® 4 VCR® male	R	N/C
Swagelok 4 VCO® tube	G	N/C
Swagelok 1/4" tube	S	N/C
C-Seal surface mount as per SEMI 2787.1	C	Call
W-Seal surface mount as per SEMI 2782.3F	H	Call
Normally Closed Valve (controller)	1	N/C
Connectors		
9-Pin Type D	A	N/C
15-Pin Type D	B	N/C
20-Pin Edge Card	C	N/C
RS485	5	Call
DeviceNet™	6	Call
Metal Seals	M	N/C
Kel-F valve plug 200 sccm and below, Teflon Valve Plug 500 sccm and above		

➤ Mass Flow Controllers (Vapor)

Mass flow controllers for vapors, MKS 1150C and MKS 1152C, are well-suited for semiconductor applications.

■ MKS 1150C

MKS Instruments' model 1150C is a mass flow controller for condensable vapors.

Flow measurement uses the principle of choked-flow orifice with a constant upstream pressure. The orifice size is selected for a particular mass flow range. The absolute pressure upstream of the orifice is measured by a capacitance manometer, and controlled by feedback to a proportioning solenoid valve.

The combination of choked orifice and constant upstream pressure gives highly precise flow control for vapors. The vapor source material can be either solid or liquid, providing its vapor pressure and evaporation rate are high enough (at a temperature below the controlled 150° C of model 1150C) to produce adequate flow through the orifice to meet the application's needs.

Features:

- 316L stainless steel body
- All-metal seals
- Uses precise choked-flow principle (NOTE: upstream pressure must be >2x downstream pressure)
- Upstream pressure measured by capacitance manometer
- Feedback to proportioning solenoid valve for flow control
- Compact assembly temperature-controlled at 150° C
- LED and relay indicates temperature status
- Controls vapor flows, including: TEOS, TEG, and TEAL

■ MKS 1152C

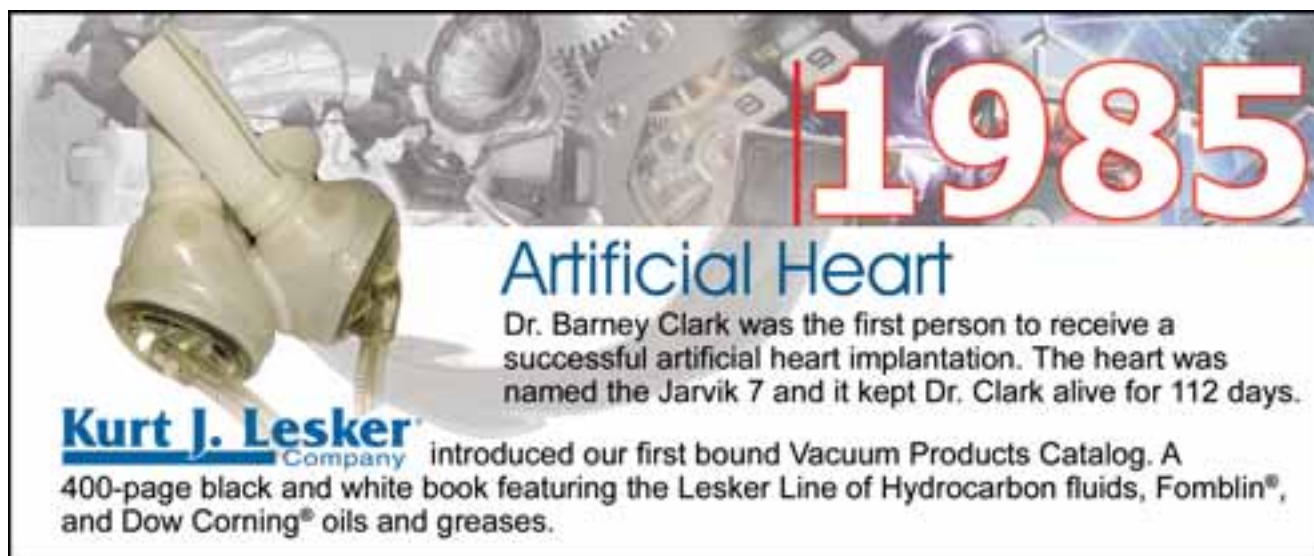
MKS Instruments' model 1152C is a mass flow controller for condensable vapors. Flow measurement is based on a laminar flow tube with capacitance manometers measuring the absolute pressure at each end. Using the average pressure and the pressure difference between the two manometers enables a precise flow measurement. Feedback to a proportioning solenoid valve upstream of the flow element controls that flow.

The vapor source materials can be either solid or liquid, providing its vapor pressure and evaporation rate are high enough (at a temperature below the controlled 150° C of model 1152C) to produce adequate flow through the flow tube to meet the application's needs.

Features:

- 316L stainless steel body
- All-metal seal materials
- Uses principle of laminar viscous flow through a flow tube
- Upstream and downstream pressure measurement using two capacitance manometers
- Feedback to proportioning solenoid valve for (pressure) flow control
- Compact assembly, temperature-controlled at 150° C
- LED and relay indicates temperature status
- Controls vapor flows, including: TEOS, TEG, and TEAL

NOTE: The configurations of these vapor mass flow controllers are application-specific. Please contact our Process Equipment Division at ped@lesker.com with your application requirements.



1985

Artificial Heart

Dr. Barney Clark was the first person to receive a successful artificial heart implantation. The heart was named the Jarvik 7 and it kept Dr. Clark alive for 112 days.

Kurt J. Lesker[®] Company introduced our first bound Vacuum Products Catalog. A 400-page black and white book featuring the Lesker Line of Hydrocarbon fluids, Fomblin[®], and Dow Corning[®] oils and greases.

➤ Readout Modules, Power Supplies, & Cables

■ MKS 647C

A multipurpose, mass flow and pressure programmer, controlling up to 8 gas flow and 1 pressure sources

The MKS 647C is a full-rack, multi-channel controller, providing both pressure and flow control. Up to 8 gas mass flow channels and 1 pressure channel enable independent or ratio-based gas flow control. One pressure and 4 gas flow channels can be displayed simultaneously on the informative LCD readout and are controlled locally from the front panel keypad or remotely using the standard RS232 (ADC) interface. See pages 12-6 to 12-11 for appropriate mass flow controllers and meters.

Features:

- Available in 4- or 8-channel gas flow versions
- Up to 5 programmable and selectable gas recipes reduce process downtime
- 3 modes of operation include upstream pressure, downstream pressure, and gas flow control
- Optional digital PID supports upstream pressure and gas flow ratio control
- Dual-relay option per channel triggers alarm when flow deviates from set point

Interconnect Cables for 647C

Description	Part No.	Price
Connect 647 to 358, 558, 1150, 1152, 1359, 1559, 179 (15-pin)	CB147-1-10	Call
Needed to connect 647 to 1150, 1152	CB260-3-10	Call
Connect 647 to 250 (PCS)	CB147-25-3	Call
Connect 647 to 647 (Daisy-Chaining)	CB147-22-3	Call
Connect 647 to 121, 221	CB147-30-10	Call
Connect 647 to 179 (9-pin)	CB147-12-10	Call
Connect 647 to 179 (20-pin Card Edge)	CB147-7-10	Call
Connect 647 to 9-pin 700/800 Series	CB647-19-10	Call
Connect 647 to 270	CB647-4-3	Call
Connect 647 to 626, 627	CB147-1-10	Call
Connect to 1480	CB1480-1-10	Call

Recommended Mass Flow Meter

Mass Flow Meter	Benefit	Reference Pages
M10MB	Economical mass flow meter	12-6
179A	Metal sealed mass flow meter	12-7
M100B	Economical mass flow controller	12-8
1179A	Repeatable MFC with analog and digital communication interfaces	12-9
2179A	MFC with integral shut off valve	12-10
1479A	Meta-sealed mass flow controller	12-11



MKS 600 Series (shown for reference only)
110/220 V Switchable

Choose the base unit, gas flow channel, RS-232 interface, control option, and relay option. Next, compose the order code as shown, below.

Example Configuration Part No.: 647C 4 R 1 T

	Part No. Prefix	Base Price
Base Unit	647C	Call
Gas Flow Channels	Option Part No.	Additional Price
4	4	N/C
8	8	Call
RS232 Interface	R	N/C
Control Option		
None	0	N/C
PID Pressure Control	1	Call
Relay Option		
None	N	N/C
Dual-Relays for 4-Channel Models	T	Call
Dual-relays for 8-Channel Models	T	Call

NOTE: Full range of readout suppliers can be found at www.lesker.com.

➤ Readout Modules, Power Supplies, & Cables

■ MKS PR4000

Digital readout and power supply module available in a dual-channel configuration.

The MKS PR4000 is a half-rack, digital power supply and readout module, available in either a 1- or 2-channel version featuring a 4.5 place digit LCD display. Single-channel versions support internal or external set points and one mass flow controller or meter (or capacitance manometer). Dual-channel versions support two mass flow meters or controllers. See pages 12-6 to 12-11 for appropriate mass flow controllers and meters.

Features:

- Versatile LCD display featuring menu-driven operation
- User-selectable engineering units for flow controllers and pressure transducers
- 2 fully adjustable relay outputs for limit monitoring triggers alarm when flow deviates from set point
- Digital RS-232 communications interface standard (RS-485 available)



MKS PDR2000 Series (shown for reference only)
110/220 Switchable

Choose the base unit, functionality/channels, communications interface, power supply, and isolation. Next, compose the order code as shown, below.

Example Configuration Part No.: PR4000B F 5 V 2 I

	Part No. Prefix	Base Price
Base Unit	PR4000B	Call
Functionality/Channels	Option Part No.	Additional Price
1 Channel	S	N/C
1 Channel with Totalizer	E	Call
2 Channels	F	Call
Communications Interface		
RS232 Interface	2	N/C
RS485 Interface	5	N/C
Input Range		
0-50 VDC and 0-10 VDC	V	N/C
Power Supply		
+/-15 VDC @ 1.5 amps (total)	2	Call
+/-24 VDC @ 1.0 amps (total)	3	N/C
Isolation		
None	N	N/C
Isolation Included	I	Call

NOTE: Full range of readout suppliers can be found at www.lesker.com.

Interconnect Cables for PR4000

Description	Part No.	Price
Connect to PR4000 to 120 (for Dual Channel models only)	CBE120-96-3M	Call
Connect PR4000 223, 622, 623	CB112-2-10	Call
Connect PR4000 to 624, 625, 626, 627, 628	CB259-5-10	Call
Connect PR4000 to 220	CB112-10-10	Call
Connect PR4000 to 121	CB112-14-10	Call
connect PR4000 to 722 with 9-pin D connectors	CB7000-1-10	Call
Connect PR4000 to all MKS MFCs and MFMs with 9-pin connectors	CB147-12-10	Call
Connect PR4000 to all MKS MFCs and MFMs with 15-pin connectors	CB147-1-10	Call
Connect PR4000 to all MKS MFCs and MFMs with 20-pin card edge	CB147-7-10	Call

Recommended Mass Flow Meter

Mass Flow Meter	Benefit	Reference Pages
M10MB	Economical mass flow meter	12-6
179A	Metal sealed mass flow meter	12-7
M100B	Economical mass flow controller	12-8
1179A	Repeatable MFC with analog and digital communication interfaces	12-9
2179A	MFC with integral shut off valve	12-10
1479A	Metal sealed mass flow controller	12-11

➤ Readout Modules, Power Supplies, & Cables

■ MKS 246C

A single-channel readout and power supply module.

The MKS 246C single-channel readout and power supply module controls most MKS mass flow controllers. The front panel controls are simple, yet provide all necessary setup and operating functions.

Features:

- Local front-panel control or remote analog operation
 - Flow set point adjusted with a precision 10-turn potentiometer
- See pages 12-6 to 12-11 for appropriate mass flow controllers and meters.



MKS 246C
110/220 Switchable

Interconnect Cables for MKS 246C

Description	Part No.	Price
MSK 246C Readout & Power Supply Module	246C	Call
Mounting Panel Fascia for Mounting (2) M246C Modules (half rack)	246MF-1	Call
Mounting Panel Fascia for Mounting (5) M246C Modules (19" full rack)	246MF-2	Call
Black Mounting Panel Fascia	246P-1	Call

Description	Part No.	Price
Connect 246 to 358, 558, 1150, 1152, 1359, 640, 641, 179 (15-pin)	CB259-5-10	Call
Connect 260PS-1 to 1150, 1152	CB260-3-10	Call
Connect 246 to 250 (PCS)	CB246-2-3	Call
Connect 246 to 246	CB396-1-2	Call
Connect 246 to 179 (9-pin)	CB147-12-10	Call
Connect 246 to 649	CB649-1-M1	Call
Connect 246 to 1480	CB1480-1-10	Call

Recommended Mass Flow Meter

Mass Flow Meter	Benefit	Reference Pages
M10MB	Economical mass flow meter	12-6
179A	Metal sealed mass flow meter	12-7
M100B	Economical mass flow controller	12-8
1179A	Repeatable MFC with analog and digital communication interfaces	12-9
2179A	MFC with integral shut off valve	12-10
1479A	Metal sealed mass flow controller	12-11

NOTE: Full range of readout suppliers can be found at www.lesker.com.

Kurt J. Lesker
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THE Source of Solvay Solexis Vacuum Fluids and Greases in North America and Europe.

► Deposition Monitor & Controller Selection Guide

Monitoring vs. Controlling

The quartz crystal microbalance (QCM) monitor displays the deposition rate and total thickness of a depositing thin film but has no outputs or feedback to control the power applied to the deposition source during the deposition. However, some monitors have set-point relays that allow a particular deposition to be stopped when the predetermined film thickness is reached.

The QCM controller also displays the deposition rate and total thickness but by contrast provides instantaneous feedback about the deposition rate to the deposition source's power supply. That is, during the

process, any variation in the deposition rate can be corrected by automatic adjustments to the power supply. Most controllers have internal PID logic that allows the operator to adapt the control characteristics to suit most deposition sources available.

Film Thickness Monitor or Controller Components:

To simplify the ordering process, the following components are required to make up a complete package:

Sensor: Holds the crystal in a position where it will be exposed to the material being deposited.

Crystal (gold, silver, or alloy, based on application): Determines oscillator frequency which changes as the crystal becomes coated.

Optional Sensor Shutter: Air-actuated cover exposes or shields the crystal from the material being deposited. Required for dual sensors. Appropriate feedthrough and shutter control valve needed.

In-Vacuum Cable: Coaxial cable connects the sensor to the feedthrough. (*Not required for Cool Drawer sensors and Front Load Bakeable Sensors*)

Deposition Monitor & Controller Selection Guide

	FTM-2400-S & FTM-2400-H Monitors (p. 12-18)	FTC-2800 & FTC-2800C Controller (p. 12-18)
Measurement Resolution	0.146(S); 0.037(H)	0.037
Max. Crystal Frequency Shift	2.0 MHz	2.0 MHz
Crystal Range	1.0 to 6.5 MHz	6.0 to 4.0 MHz
Crystal Precision	± 0.12 Hz(S); ± 0.03 Hz(H)	± 0.030 Hz
Thickness Accuracy	—	—
Measurement Frequency	0.5-10 Hz	1-10 Hz
Multiple Sensor Measurement	Yes (up to 6 sources)	Yes (up to 4 sources)
Auto Z	No	No
Auto Tune	No	No
Co-Deposition	N/A	Yes (up to 4 sources) FTC-2800C Only
Film Programs	99	50
Processes	N/A	100
Process Layers	N/A	1000
Data Logging	Yes	Yes
On-Board Disk Drive	No	No
Single Sensors	2 Standard, 6 Optional	2 Standard, 4 Optional
Dual Sensors	1 Standard	1 Standard, 2 Optional
CrystalTwelve™ Sensors	0	2 Standard, 4 Optional
Number of Sources	N/A	2 Standard, 4 Optional
Inputs	2 Standard	8 Standard, 16 Optional
Outputs	4 Standard	8 Standard, 16 Optional
Communications Interface	RS-232 Standard (TCP/IP or USB optional) Add-On	RS-232 and USB Standard (RS-232 and TCP/IP optional)
Dimensions (height x width x depth)	3.5" x 8.5" x 7.75" 8.9 cm x 21.3 cm x 19.7 cm (half rack)	5.23" x 8.4" x 10.0" 13.3 cm x 21.4 cm x 25.4 cm (half rack)

➤ Deposition Monitor & Controller Selection Guide

Feedthrough: Carries electrical signals, cooling water, and/or air through the vacuum chamber wall.

6-inch BNC Cable: Coaxial BNC cable connects feedthrough to oscillator.

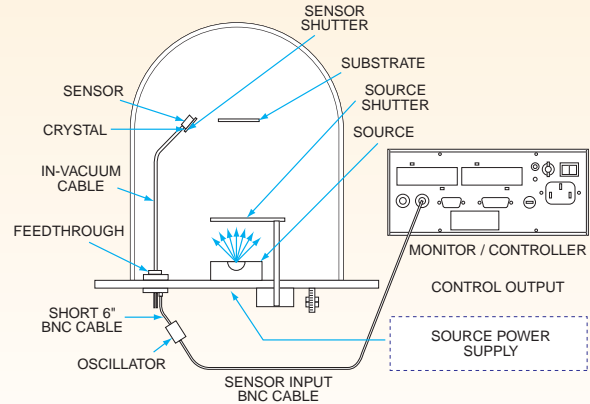
Oscillator*: The electronics that operate the crystal.

Sensor Input Cable: Coaxial BNC or Multi-Conductor cable connects the oscillator to the input of the Monitor/Controller.

Monitor/Controller: The electronics and software that operate the system.

A monitor measures deposition rate and thickness. A controller also provides an output signal to control source power supply and deposition rate.

*** Oscillators are not interchangeable; they are tuned to a specific monitor or controller**



XTC/3M & XTC/3S Controllers (p. 12-21)

0.034
1.0 MHz
6.0 to 5.0 MHz
± 0.028 Hz
0.50%
4 Hz
No
No
No
No
1 (XTC/3S); 99 (XTC/3M)
9 (XTC/3S); 32 (XTC/3M)
1 (XTC/3S); 999 (XTC/3M)
Yes
No
2 Standard
2 (with XTL2 optional)
2 Standard
2 Standard
14 standard (up to 28)
9 TTL
16 standard (up to 24)
12 relays + 8 TTL
RS-232 Standard
(TCP/IP optional)
3.5" x 8.0" x 12.0"
8.9 cm x 20.3 cm x 30.5 cm
(half rack)

IC/5 Controller (p. 12-23)

0.00577
1.5 MHz
6.0 to 4.5 MHz
± 0.0047 Hz
0.50%
10 Hz
Yes (up to 8 sources)
Yes
Yes
Yes (up to 2 sources)
N/A, 50
24 Materials
250
Yes
Yes
2 Standard, 8 Optional
1 Standard, 4 Optional
0
up to 6
14 standard (up to 28)
TTL/CMOS logic compatible
or closure to ground
16 standard (up to 24)
programmable SPST relays.
(optional TTL available)
RS-232 Standard
(IEEE488 optional)
5.25" x 17.63" x 18.5"
13.3 cm x 44.77 cm x 47 cm
(full rack)

Cygnus Controller (p. 12-24)

0.00577
1.5 MHz
6.0 to 4.5 MHz
± 0.0047 Hz
0.50%
10 Hz
No
Yes
No
Yes (up to 6 sources)
N/A
N/A
Yes
Yes (optional)
2 Standard (6 optional)
2 Standard (6 with XTL2 optional)
2 Standard (6 optional)
up to 6
TTL/CMOS logic compatible
or closure to ground
programmable SPST relays.
(optional TTL available)
RS-232 Standard
(IEEE488 optional)
5.25" x 17.63" x 18.5"
13.3 cm x 44.77 cm x 47 cm
(full rack)

► Thin Film Monitors

■ Multi-Channel Quartz Crystal Monitor

The FTM-2400 is an easy to use instrument for applications where manual control of the deposition process is adequate. This monitor comes standard with (2) Sensor Inputs, (2) Digital Inputs, (4) Relay Outputs, Analog Outputs for Rate & Thickness. Each package includes: User friendly Windows® Software, Power Cord, RS-232 Cable, I/O Connector and User's Manual.

- 2 measurement channels standard, (additional 4 optional)
- Large, bright LED display
- Windows® Software, easy to use, save process data in Excel® format
- Analog outputs for rate/thickness recording
- High accuracy option: 0.03Hz at 10 readings/sec
- RS-232 standard, USB or Ethernet optional
- Two recorder outputs provide analog rate and thickness signals.
- User may press the Xtal Life button at any time to view the remaining crystal life.
- "Etch Mode" sets deposition rate negative for measuring etch rate



Example Configuration Part No.: **FTM2400 S 2 R**

	Part No. Prefix	Base Price
Base Unit	FTM2400	
	Option Part No.	Additional Price
Monitor		
Standard Resolution (+/- 0.12 Hz @ 4 Readings/Sec)	S	Call
High Resolution (+/- 0.03 Hz @ 10 Readings/Sec)	H	Call
Number of Sensor Channels		
2 (Standard)	2	N/C
6	6	Call
Computer Interface		
Standard RS232	R	N/C
RS232 & USB	U	Call
RS232 & Ethernet	E	Call

NOTE: See p.12-38 for accessories and compatible sensors



NOTE: Oscillators and sensors sold separately. Please go to www.lesker.com to view options.

SPECIFICATIONS

FTM-2400 Monitor

Measurement	QCM Sensor Inputs Standard: 2; optional: 4 Frequency Range 1-10 MHz Frequency Resolution Standard: ± 0.12 Hz at 4 readings/sec Optional: ± 0.03 Hz at 10 readings/sec Frequency Stability ± 2 ppm total, over 0° to 50°C Selectable Measurement Period 0.10 to 2 sec (in .05 sec increments) Measurement Filter 1 to 20 readings
Control	Stored Films 99 Analog Outputs Two 0 to 10 VDC, rate & thickness Digital Inputs/Outputs Two inputs, four relay outputs Digital Interface Standard: RS-232 Optional: USB or Ethernet
General	Power 100-120/200-240 VAC, 50/60 Hz, 20 W CE Compliance Class 1 equipment, 73/72/EEC LVD, 89/336/EEC ECD 1/2-rack cabinet, 3 1/2" high, Dimensions 89 x 213 x 197mm (3 1/2" x 8 1/2" x 7 7/8") Weight 2.7 Kg (6 lbs) Windows Software (included) Provides remote setup and operation, data logging functions

➤ Thin Film Controllers

■ Multi-Channel Quartz Crystal Controller

The FTC-2800 deposition controller provides an economical way of doing sequential deposition. This affordably priced controller comes standard with (2) Sensor Inputs, (2) Source Outputs, (8) Digital I/O, RS-232 and USB Serial Ports, a bright 1/4VGA Active Matrix Color LCD Display. Included with each package is user friendly Windows® Software, Power Cord, RS-232 Cable, I/O Connector and User's Manual.

- Bright, 1/4 VGA active matrix color LCD display – available in English or Chinese.
- Standard RS-232 and USB (with Ethernet option).
- Easy setup and operation with a "Quick Setup" Menu
- Windows® program for developing, testing, and downloading processes, and for logging instrument data to your PC
- Accurate process control, especially for low deposition rates, with ± 0.03 Hz resolution at 10 readings/second
- Storage capacity for up to 100 processes, 1,000 layers, 50 films.
- Monitoring of source material with a single sensor or with multiple sensors to provide accurate source distribution monitoring.

NOTE: See p12-38 for oscillators, sensors, cables and accessories

SPECIFICATIONS

	FTC-2800 Controller	FTC-2800C Co-Deposition Controller
Measurement	QCM Inputs 2 (4 optional)	QCM Inputs 4
	Frequency Range 4 to 6 MHz Frequency Resolution ± 0.03 Hz at 0.10 sec measurement period Frequency Stability ± 2 ppm total, 0 to 50C Measurement Rate 1 to 10 Hz Rate Display 0.01 Å/sec	
Control	Storage 100 processes, 1000 layers, 50 films Control Outputs 2 (4 optional)	Control Outputs 4
	Output Signal ± 0 to 10 VDC, 15 bits Digital Inputs/Relays 8 (16 optional) Digital Inputs 5 VDC non-isolated Relays SPST Form 1A, 30V, 2A max Interface(s) RS-232 and USB (Ethernet optional) Remote Power Control Optional	
Display	Type 1/4 VGA 320 x 240 active matrix color LCD Graphs Rate, deviation, power or full screen numeric	
General	Power 100-240 VAC, 50/60 Hz, 25 W Compliance CE Windows® Software Included Housing / Mounting 5 1/4" half-rack	



Example Configuration Part No.: **FTC2800 2 R 1**

	Part No. Prefix	Base Price
Base Unit	FTC2800	
	Option Part No.	Additional Price
2 QCM Channels	2	Call
4 QCM Channels	4	Call
Computer Interface		
RS-232 & USB	R	N/C
RS-232 & Ethernet	E	Call
Display		
English	1	N/C
Chinese	2	N/C

The FTC-2800C Co-deposition controller provides an economical way of doing co-deposition of up to 4 materials. This low cost controller comes standard with (4) Sensor Inputs, (4) Source Outputs, (16) Digital I/O, RS-232 and USB Serial Ports, and a bright 1/4VGA active matrix color LCD display – available in English or Chinese.

Example Configuration Part No.: **FTC2800C 4 R 1**

	Part No. Prefix	Base Price
Base Unit	FTC2800C	
	Option Part No.	Additional Price
4 QCM Channels	4	Call
Computer Interface		
RS-232 & USB	R	N/C
RS-232 & Ethernet	E	Call
Display		
English	1	N/C
Chinese	2	N/C

➤ FTM-2400 & FTC-2800 Accessories

■ FTM-2400 & FTC-2800 Oscillators & Cables

Description	Part No.	Price
FTC-2800 Oscillators and Cables		
Oscillator kit incl: 782-900-010, 782-902-011, and 782-902-012-10	782-934-003-10	Call
Oscillator kit incl: 782-900-010, 782-902-011, and 782-902-012-25	782-934-003-25	Call
Oscillator kit incl: 782-900-010, 782-902-011, and 782-902-012-50	782-934-003-50	Call
Oscillator kit incl: 782-900-010, 782-902-011, and 782-902-012-99	782-934-003-99	Call
Remote Oscillator	782-900-010	Call
BNC Cable, male/female, 6" (150mm)	782-902-011	Call
10' (3m) BNC Cable, male/male	782-902-012-10	Call
25' (7.7m) BNC Cable, male/male	782-902-012-25	Call
50' (15.4m) BNC Cable, male/male	782-902-012-50	Call
100' (30.7m) BNC Cable, male/male	782-902-012-99	Call
BNC to Microdot. Adapter Cable, 6" (150mm)	782-902-022	Call
1/8" to 3/16" Compression Adapter	782-932-022	Call
1/8" Compression Union	782-932-020	Call
3/16" Compression Union	782-932-021	Call

Accessories & Replacement Parts

Description	Part No.	Price
Handheld Power Control, 25ft (7.6m) coiled cable for FTC-2800	782-900-017	Call
Rack Extender - mounts one 5 1/4" instrument in 19" rack for FTM-2400	782-900-007	Call
Rack Adapter - mounts two 5 1/4" instruments in 19" rack for FTM-2400	782-900-016	Call
3 1/2" Full Rack Extender -FTM-2400 Hardware to mount one instrument in a 19" rack	782-900-008	Call
3 1/2" Half Rack Adapter -FTM-2400 Hardware to mount two instruments in a 19" rack	782-900-014	Call
Ethernet Option Card for FTC-2800	782-900-026	Call

12

Process Instrumentation



Did You Know?

We are a leading manufacturer of Thin Film Deposition Tools for Solar.

OPVs

CPVs

CIS/CIGS

Se Evap Source

Thin Film PV

➤ Thin Film Controllers

■ XTC/3S Single Layer Deposition Controller

Economical quartz crystal deposition controller engineered for user-programmed software control.

The XTC/3S quartz crystal deposition controller provides a single layer closed-loop controller. This controller is intended for those applications where the process recipe resides on the customer's computer and each layer of the process is downloaded into the thin film controller as needed.

Features:

- PLUG-AND-PLAY replacement for XTC/2 controllers*
- TFT color LCD with graphics
- Membrane keypad
- 9 programmable films
- 2 sensor measurement channels
- 2 source control channels
- 8/12 dedicated I/O Circuitry
- RS-232 computer communications
- Interface connectors
- Operations manual on CD-ROM

- Patented Modelock Measurement System

Options:

- Ethernet computer communications
- Handheld power controller for manual operation
- Rack mount kit for 1 or 2 units

* Limited to XTC/2 features and command set



Choose the base unit, voltage options, communications interface, remote handheld power control and rackmount kits. Next, compose the order code as shown, below.

Example Configuration Part No.: XC3S-1000

	Part No. Prefix	Base Price
Base Unit	XC3S-	Call
	Option Part No.	Additional Price
Voltage Options		
115V @ 50/60 Hz	1	N/C
230V @ 50/60 Hz	2	N/C
Communications Interface		
RS-232	0	N/C
Ethernet Module	1	Call
Remote Handheld Power Control		
None	0	N/C
Remote Control	1	Call
Rackmount Kits		
None	0	N/C
1 Unit Rackmount Kit	1	Call
2 Unit Rackmount Kit	2	Call

■ XTC/3M Multi-Layer Deposition Controller

Advanced quartz crystal deposition controller for multiple sequential depositions.

The XTC/3M quartz crystal deposition controller is a multiple layer closed-loop controller for sequentially depositing layers from multiple materials, sources, and crucibles. This controller is intended for those applications where the entire process recipe resides in the thin film controller.

Features:

- TFT color LCD with graphics
- Membrane keypad
- 32 programmable films
- 99 processes
- 999 layers per process
- 2 sensor measurement channels
- 2 source control channels
- 8/12 event selectable I/O circuitry
- RS-232 computer communications
- Interface connectors
- Operations manual on CD-ROM

- Patented Modelock Measurement System

Options:

- Ethernet computer communications
- Handheld power controller for manual operation
- Rack mount kit for 1 or 2 units



Choose the base unit, voltage options, communications interface, remote handheld power control and rackmount kits. Next, compose the order code as shown, below.

Example Configuration Part No.: XC3M-1011

	Part No. Prefix	Base Price
Base Unit	XC3M-	Call
	Option Part No.	Additional Price
Voltage Options		
115V @ 50/60 Hz	1	N/C
230V @ 50/60 Hz	2	N/C
Communications Interface		
RS-232	0	N/C
Ethernet Module	1	Call
Remote Handheld Power Control		
None	0	N/C
Remote Control	1	Call
Rackmount Kits		
None	0	N/C
1 Unit Rackmount Kit	1	Call
2 Unit Rackmount Kit	2	Call

➤ Crystal Two Switch, XTC/3 XIU Packages & Interconnect Cables

■ Crystal Two Switch

The CrystalTwo Switch allows for a single XIU to be used with two single sensors or one dual sensor. Only one crystal may be read at a time. Each CrystalTwo comes with two BNC cables, either 6" or 20". The CrystalTwo is designed for use only with the XTC/3 or Cygnus. Limited use with other controllers is possible - consult factory.

Description	Part No.	Price
Xtal 2 Switch w/ 6 in. BNC Cables	779-220-G1	Call
Xtal 2 Switch w/ 20 in. BNC Cables	779-220-G2	Call

■ XTC/3 XIU (Oscillator) Packages & Interconnect Cables

An XIU (oscillator) package includes the cable between the controller and XIU (oscillator), an XIU, and the cable between the XIU and the vacuum feedthrough. One XIU (oscillator package) is required for each crystal sensor assembly connected to the controller.

NOTE: The Dual Crystal sensor assembly when used with the XTC/3 requires either one XIU package and one CrystalTwo Switch (part # 779-220-G1 or -G2) OR two XIU packages.

Description	Part No.	Price
XTC/3M and XTC/3S XIU (Oscillator) Packages		
XTC/3 XIU PKG with 15 ft. (4.6m) cable	780-611-G15	Call
XTC/3 XIU PKG with 30 ft. (9.1m) cable	780-611-G30	Call
XTC/3 XIU PKG with 50 ft. (15.3m) cable	780-611-G50	Call
XTC/3 XIU PKG with 100 ft. (30.5m) cable	780-611-G100	Call
XTC/3 XIU PKG w/ 15 ft. (30.5m) XTC/3 to XIU cbl, 4m Sense Head in-vac. cbl. & 6 inch BNC (XIU to Feedthrough) cbl.	780-612-G15	Call
XTC/3 XIU PKG w/ 30 ft. (30.5m) XTC/3 to XIU cbl, 4m Sense Head in-vac. cbl. & 6 inch BNC (XIU to Feedthrough) cbl.	780-612-G30	Call
XTC/3 XIU PKG w/ 50 ft. (30.5m) XTC/3 to XIU cbl, 4m Sense Head in-vac. cbl. & 6 inch BNC (XIU to Feedthrough) cbl.	780-612-G50	Call
XTC/3 XIU PKG w/ 100 ft. (30.5m) XTC/3 to XIU cbl, 4m Sense Head in-vac. cbl. & 6 inch BNC (XIU to Feedthrough) cbl.	780-612-G100	Call
XTC/3 XIU PKG w/ 15 ft. (30.5m) XTC/3 to XIU cbl, 3.5m Sense Head in-vac. cbl. & 20 inch BNC (XIU to Feedthrough) cbl.	780-613-G15	Call
XTC/3 XIU PKG w/ 30 ft. (30.5m) XTC/3 to XIU cbl, 3.5m Sense Head in-vac. cbl. & 20 inch BNC (XIU to Feedthrough) cbl.	780-613-G30	Call
XTC/3 XIU PKG w/ 50 ft. (30.5m) XTC/3 to XIU cbl, 3.5m Sense Head in-vac. cbl. & 20 inch BNC (XIU to Feedthrough) cbl.	780-613-G50	Call
XTC/3 XIU PKG w/ 100 ft. (30.5m) XTC/3 to XIU cbl, 3.5m Sense Head in-vac. cbl. & 20 inch BNC (XIU to Feedthrough) cbl.	780-613-G100	Call
XTC/3M and XTC/3S XIU ONLY (No Accessories)		
XTC/3M or XTC/3S XIU (Oscillator) for XIU to Sensor Head cable lengths of 6 to 72 inches (15cm to 183cm)	780-600-G1	Call
XTC/3M or XTC/3S XIU (Oscillator) for XIU to Sensor Head cable lengths of 118 to 157 inches (3 to 4 Meters)	780-600-G2	Call
XTC/3M and XTC/3S Interconnect Cables		
6 in. (5.2 cm) cable, XIU to vacuum feedthrough	755-257-G6	Call
15 ft. (4.6m) cable, XTC/3 controller to XIU	600-1261-P15	Call
30 ft. (9.1m) cable, XTC/3 controller to XIU	600-1261-P30	Call
50 ft. (15.3m) cable, XTC/3 controller to XIU	600-1261-P50	Call
100 ft. (30.5m) cable, XTC/3 controller to XIU	600-1261-P100	Call

XTC/3 XIU (Oscillator) Accessories & Replacement Parts

Description	Part No.	Price
Ethernet Computer Communications Module - A plug-in Ethernet module providing industry standard signaling protocols and connectors for accepting operational commands from remote sources.	780-700-G1	Call
Hand-held Power Controller - A Hand-held unit that allows remote control of deposition power levels while the controller is in manual mode. The hand-held power controller plugs into the control unit front panel	755-262-G1	Call
1 unit rack mount kit - A rack mount kit provides all required materials to mount the control unit into a standard rack. The control units are 1/2 rack	780-702-G1	Call
2 unit rack mount kit - in width, thus 2 units can be mounted side by side in one standard rack width.	780-702-G2	Call
XTC/3M or XTC/3S Editor / Monitor Software, on CD - Windows based applications software that allows complete programming, monitoring, and data logging of an XTC/3M or XTC/3S.	780-032-G1	Call
XTC/3M or XTC/3S Communications Library (DLL), on CD - Contains functions that allow the creation of a program for a remote PC to control either an XTC/3M or XTC/3S via an RS232 or TCP/IP connection.	780-038-G1	Call

➤ Thin Film Controllers



■ INFICON IC/5 Deposition Controller

Versatile quartz crystal deposition controller is ideal for complex processes and co-depositions.

INFICON's versatile IC/5 deposition controller is ideal for deposition rate and thickness control in vacuum systems with multiple sources, crucibles, materials, and processes. Its enhanced functionality, including initiating pumpdown, controlling valves, and activating substrate heaters, often eliminates the need for ancillary instruments — reducing system complexity and costs. The IC/5's extensive recipe management for complex processes and multiple sensor data logging ensures reproducibility and uniformity.

- Patented ModelLock™ measurement system (refer to Technical Notes for more information)
- Sensor measurement modules control two sensors each
- DAC module consisting of six analog outputs for source control or recorder outputs
- I/O relay module
- 100 internal programmable logic statements
- Recipe storage for 50 processes, 24 materials, and 250 layers
- Co-deposition capable
- Multiple sensor control
- Handheld power controller for manual operation
- Rackmount hardware

Choose the base unit, voltage options, sensor measurement modules, communications interface, I/O relay module, optional TTL relay module. Next, compose the order code as shown, below.

Example Configuration Part No.: IC5-12111

	Part No. Prefix	Base Price
Base Unit	IC5-	Call
	Option Part No.	Additional Price
Voltage Options		
100V @ 50/60 Hz	1	N/C
120V @ 50/60 Hz	2	N/C
220V @ 50/60 Hz	3	Call
240V @ 50/60 Hz	4	Call
Sensor Measurement Modules		
1 Module (controls 2 sensors)	1	N/C
2 Modules (controls 4 sensors)	2	Call
3 Modules (controls 6 sensors)	3	Call
4 Modules (controls 8 sensors)	4	Call
Communications Interface		
RS-232	1	N/C
IEEE488	2	Call
I/O Relay Module		
1 Module (8 relay outputs, 14 TTL inputs)	1	N/C
2 Modules (16 relay outputs, 28 TTL inputs)	2	Call
Optional TTL Relay Module		
None	1	N/C
1 Module (8 relay outputs, 14 TTL inputs)	2	Call

ORDERING NOTES: A complete deposition control system requires five components: deposition controller, XIU (oscillator) package, vacuum feedthrough, crystal sensor, and crystals. This ordering table is for the controller only—please refer to Accessories pages 12-25 to order the additional components.

➤ Thin Film Controllers



■ INFICON Cygnus Controller

High-end quartz crystal deposition controller ideal for OLED manufacturing processes and other simultaneous co-deposition applications.

INFICON's Cygnus deposition controller for OLED manufacturing maximizes production throughput. Its enhanced functionality, including initiating pumpdown, controlling valves, and activating substrate heaters, often eliminates the need for ancillary instruments—reducing system complexity and costs.

Features:

- Auto Z - improve accuracy by automatically determining the z-ratio
- Patented Modelock measurement system (refer to Technical Notes for more information)
- **Co-deposition of up to 6 sources ideal for OLED applications**
- DAC module consisting of 6 analog outputs for source control or recorder outputs
- Optional DAC module for additional 6 analog recorder outputs for rates or thicknesses
- I/O relay module
- 100 internal programmable logic statements
- Rackmount hardware
- Multiple measurement averaging - each control channel can be averaged over multiple measurements, providing the increased rate resolution necessary when depositing at very low rates
- Display resolution to 0.001 Å/sec

ORDERING NOTES: A complete deposition control system requires five components: deposition controller, XIU (oscillator) package, vacuum feedthrough, crystal sensor, and crystals. Ordering table is for the controller only.

Choose the base unit, voltage options, sensor measurement modules, communications interface, I/O relay module, optional TTL relay module, optional 3.5" floppy disk drive, and optional offline editor software. Next, compose the order code as shown, below.

Example Configuration Part No.: OCD5-1 1 0 1 0 1 0 0

	Part No. Prefix	Base Price
Base Unit		
Cygnus 100V, 50/60 Hz	<u>OCD5-1</u>	Call
Cygnus 120V, 50/60 Hz	OCD5-2	Call
Cygnus 220V, 50/60 Hz	OCD5-3	Call
Cygnus 240V, 50/60 Hz	OCD5-4	Call
	Option Part No.	Additional Price
Sensor Measurement Module		
One Standard Module		
(each controls two sensors)	<u>1</u>	N/C
Two Standard Modules	2	Call
Three Standard Modules	3	Call
Additional Computer Communications Module (RS232 is standard)		
None	<u>0</u>	N/C
IEEE 488 PARALLEL	1	Call
I/O Relay Module (8 Relay Outputs, 14 TTL Inputs)		
One (included in base unit)	<u>1</u>	N/C
Two	2	Call
Optional TTL Relay Module (8 Relay Outputs, 14 TTL Outputs)		
None	<u>0</u>	N/C
8 Relay Outputs	1	Call
Digital to Analog Converter Board, 6 Output per Board		
One (included in base unit, 6 BNC connectors)	<u>1</u>	N/C
Two (second board has 15 pin miniature D-Sub connector)	2	Call
Optional 3.5 inch (1.44 Mb) Floppy Drive		
None	<u>0</u>	N/C
3.5" Floppy Disk Drive	1	Call
Cygnus Editor Applications Software		
None	<u>0</u>	N/C
Cygnus Editor Application Software	1	Call

Contact our Process Equipment Division at ped@lesker.com for more information.

➤ Thin Film Controllers

■ IC/5 and Cygnus XIU Packages & Interconnect Cables

Description	Part No.	Price
IC/5 and Cygnus XIU (Oscillator) Packages		
XIU (Oscillator) Package with 15' (4.6m) cable	760-025-G15	Call
XIU (Oscillator) Package with 30' (9.1m) cable	760-025-G30	Call
XIU (Oscillator) Package with 50' (15.3m) cable	760-025-G50	Call
XIU (Oscillator) Package with 100' (30.5m) cable	760-025-G100	Call
XIU (Oscillator only, no accessories)	760-600-G1	Call
IC/5 & Cygnus Interconnect Cables		
6" (15.2cm) cable, XIU to vacuum feedthrough	755-257-G6	Call
15' (4.6m) cable, controller to XIU	600-1039-G15	Call
30' (9.1m) cable, controller to XIU	600-1039-G30	Call
50' (15.3m) cable, controller to XIU	600-1039-G50	Call
100' (30.5m) cable, controller to XIU	600-1357-P100	Call

Choose the base unit, IC/5 and Cygnus interconnect cables, and XIU 4 meter cable kit. Next, compose the order code as shown, below.

Example Configuration Part No.: 4X15-1 1 0

Base Unit	Part No. Prefix	Base Price
4 Meter IC/5 and Cygnus XIU	4X15-1	Call
4 Meter IC/5 and Cygnus XIU with Mounting Bracket	4X15-2	Call
		Option Part No. Additional Price
IC/5 and Cygnus Interconnect Cables		
15' (4.6m) cable, controller to XIU	1	Call
30' (9.1m) cable, controller to XIU	2	Call
50' (15.3m) cable, controller to XIU	3	Call
100' (30.5m) cable, controller to XIU	4	Call
XIU 4 Meter Cable Kit		
None	0	N/C
6" BNC with 4 Meter In-Vacuum Cable	1	Call
20" BNC with 3.5 Meter In-Vacuum Cable	2	Call

■ 4 Meter In-Vacuum Cable for IC/5 and Cygnus XIU

IC/5 and Cygnus XIU Accessories & Replacement Parts

Description	Part No.	Price
Sensor Measurement Module - A plug-in module capable of simultaneously interfacing two sensors via rear panel connectors	760-1132-G1	Call
IEEE488 Computer Communications Module - A plug-in module providing industry standard signaling protocols and connectors for accepting operational commands from remote sources	760-142-G2	Call
I/O Relay Module - A plug-in module with eight programmable relay outputs and 14 programmable TTL outputs	760-162-G1	Call
TTL Relay Modules - A plug-in module with eight programmable relay outputs and 14 programmable TTL inputs	760-162-G2	Call
Floppy Disk Drive Kit - A kit including a 3.5" 1.44 Mb floppy drive for storage of process recipes and data and all hardware, cables and instructions needed to install it into either an IC/5 or Cygnus	760-023-G2	Call
Replacement Floppy Disk Drive - A 3.5" 1.44 Mb floppy drive for either the IC/5 or Cygnus. For installation as a replacement part only for an IC/5 or Cygnus controller with the disk drive already installed.	035-0013	Call
Optional Cygnus DAC Board (Cygnus Only) - A plug-in module for the Cygnus deposition controller expanding the number of DAC outputs for monitoring Rate or Thickness	760-1112-G2	Call
Software & Prom Upgrades		
IC/5 Offline Editor Software - A software package providing the capability to create and edit processes, define material, and enter all parameters for an IC/5 at a PC. (DOS-based)	760-030-G1	Call
IC/5 Prom Kit - A set of IC/5 EPROMs to upgrade IC/5 firmware	760-026-G1	Call
Cygnus Editor Application Software - A software package providing the capability to create, edit, and monitor the Cygnus thin film deposition controller from a PC (Windows® compatible)	779-032-G1	Call
Cygnus PROM Kit - A set of Cygnus EPROMs to upgrade Cygnus firmware	760-029-G1	Call

➤ INFICON Front Load Sensors

■ Crystal Sensors

All of the following crystal sensors are compatible with all INFICON quartz crystal controllers, except where noted. One or more of these sensors should be purchased with each controller. Each sensor comes completely assembled and includes integral water tubes, in-vacuum coaxial cable (Front Load) or in-vacuum conduit (Cool Drawer), water tube bending tool, crystal snatcher (Front Load), and operating

NOTE: Orders for sensors welded to feedthroughs cannot be entered without signed-off dimensional drawing (KJLC to provide). Once special length or manufactured order is confirmed, it can not be canceled.

NOTE: Sensor lengths are measured from center of the crystal to the vacuum side (sealing surface) of the feedthrough.

instructions. All air and water tubes (except the bakeable sensor) are 1/8 inch (0.32cm) O.D. **All shuttered sensors require the 750-420-G1 pneumatic control valve.** Xtal 2 Switch is designed for use only with the XTC/3 and Cygnus Thin Film Deposition Controllers. Limited use with other controllers is possible call KJLC or email: ped@lesker.com with any technical questions.

NOTE: For sensors ordered without a weld connection (option "0" or "8"), tubes are made to a length of 29.75" (756mm) for "E" length and Cool Drawer sensors and 44.75" (1137mm) for "G" length sensors.

■ Front Load Single Sensor



■ Front Load Dual Sensor



Example Configuration Part No.: **SL- A 0 E 0 0**

	Part No. Prefix	Price
Base Unit	SL-	
	Option Part No.	
Type of Sensor		
Standard Sensor (water lines parallel)	A	Call
Compact Sensor (water lines perpendicular)	B	Call
Shutter Assembly		
None	0	N/C
Standard Shutter	1	Call
Length of Sensor		
Standard length - 203mm to 711mm Includes 781mm In-vacuum cable	E	N/C
Extended length - Greater than 711mm; maximum 1219mm Includes 1524mm In-vacuum cable	G	Call
Feedthrough		
None	0	N/C
1" Bolt	3	Call
2.75"/CF40	4	Call
Feedthrough Connection		
Sensor not connected to Feedthrough	0	N/C
Sensor Welded to Feedthrough	7	Call
Variable length with Ultra Torr compression fittings. (Allows the sensor length to be variable by using Ultra Torr compression fittings)	8	Call

*The following combinations are not available: SL-A1E38, SL-A1G38, SL-B1E38, SL-B1G38, SL-A1E47, SL-A1G47, SL-B1E47, AND SL-B1G47.

Example Configuration Part No.: **DL- A E 0 0**

	Part No. Prefix	Price
Base Unit	DL-	
	Option Part No.	
Type of Sensor		
Dual Sensor (water lines parallel to crystal face) with shutter	A	Call
Length of Sensor		
Standard length - 203mm to 711mm Includes 781mm In-vacuum cable	E	N/C
Extended length - greater than 711mm; maximum 1219mm Includes 1524mm In-vacuum cable	G	Call
Feedthrough		
None	0	N/C
1" Bolt	3	N/C
2.75"/CF40	4	Call
Feedthrough Connection		
Sensor not connected to Feedthrough	0	N/C
Sensor Welded to Feedthrough	7	Call
Variable length with Ultra Torr compression fittings. (Allows the sensor length to be variable by using Ultra Torr compression fittings)	8	Call

*The following combinations are not available: DL-AE38, DL-AG38, DL-AE47, DL-AG47.

NOTE: Front Load Dual sensors ordered with 1" bolt style feedthrough require a special feedthrough (contact factory for availability). Front Load Dual sensors ordered with a CF40 feedthrough cannot be welded due to dimensional limits of the CF40.

➤ INFICON Front Load Sensors

■ Front Load Bakeable Sensors



Example Configuration Part No.: **BK- A 0 F**

	Part No. Prefix	Price
Base Unit	BK-	
	Option Part No.	
Type of Sensor		
Top load (water lines parallel)	A	Call
Shutter Assembly		
None	0	N/C
Standard Shutter	1	Call
Length of Sensor		
Shuttered Sensors		
Specify from 17.0 cm - 101.6 cm		N/C*
Non-Shuttered Sensors		
Specify from 10.2 cm - 101.6 cm	F	N/C*

*Sensor Lengths over 76.2 cm (30 inches) are subject to an additional charge as well as 2-4 weeks additional lead time.

NOTE: All Bakeable Sensors are welded to a CF40 flange.

■ Front Load Sputtering Sensors



Description	Part No.	Price
Sputtering Sensor 76cm, 30"	750-618-G1	Call
Sputtering Sensor Shutter Module	750-005-G1	Call

NOTE: Includes 78 cm (30.75") in-vacuum cable, crystal snatcher and manual (other length cables ordered separately). Custom parts, special bends and other non-standard parts available - Consult factory.

NOTE: Shutter air tube is connected to the feedthrough tube using VCR fittings for field replacement.

■ CrystalTwelve Sensors

CrystalTwelve Sensors — Twelve crystals contained in one sensor. Provides continuity for long processes by automatically rotating to a back up crystal should a crystal failure occur.

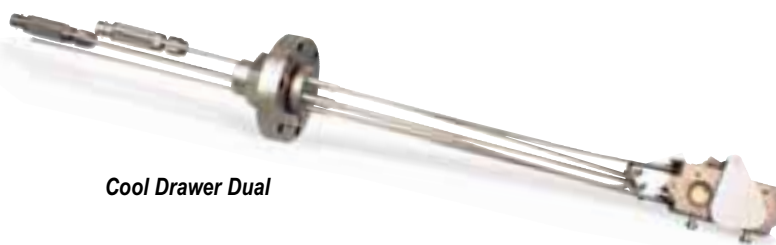


Example Configuration Part No.: **XL12-1 0 0 0 0 0**

	Part No. Prefix	Base Price
Base Unit	XL12-1	Call
	Option Part No.	Additional Price
In-Vacuum Cable Assembly Length		
None	0	N/C
30.75 Inch (78cm)	1	Call
6 Inch (15.2cm)	2	Call
12 Inch (30.5cm)	3	Call
24 Inch (61 cm)	4	Call
36 Inch (91.4cm)	5	Call
48 Inch (121.9cm)	6	Call
60 Inch (152.4cm)	7	Call
72 Inch (182.9cm)	8	Call
Crystal Carousel Assembly		
One (Included in Base Unit)	0	N/C
Spare Crystal Carousel Assembly	1	Call
Front Deposition Shield		
One (Included in Base Unit)	0	N/C
Spare Front Deposition Shield	1	Call
Mounting Post with Hardware		
None	0	N/C
Mounting Post Kit	1	Call
Pneumatic Valve*		
No	0	N/C
Yes	1	Call

*750-420-G1, required for new installations

NOTE: The Crystal 12 sensor can be used only with the Cygnus Thin Film Deposition Controller. The Crystal 12 Sensor requires the 750-420-G1 pneumatic control valve. The Crystal 12 sensor can not be used on the XTM/2. Auto Crystal Switch Only With Cygnus, XTC/3M, and XTC/3S.

➤ **INFICON Cool Drawer Sensors**■ **INFICON Cool Drawer Sensor Selection****Cool Drawer
Single****Cool Drawer
Single - Right
Angle****Cool Drawer Dual**■ **Cool Drawer Single Sensor**Example Configuration Part No.: **CDS A 0 F 3 0**

	Part No. Prefix	Price
Base Unit	CDS	
	Option Part No.	
Type of Sensor		
Side loaded Cool Drawer (water lines parallel)(conductor tube)	A	Call
Right angle Cool Drawer (water lines perpendicular)(conductor tube)	B	Call
Shutter Assembly		
None	0	N/C
Standard Shutter	1	Call
Length of Sensor		
Minimum 102mm to 660mm	F	N/C
Feedthrough		
1" Bolt	3	Call
2.75"/CF40	4	Call
Feedthrough Connection		
Sensor not connected to Feedthrough	0	N/C
Sensor Welded to Feedthrough	7	Call
Variable length with Ultra Torr compression fittings. (Allows the sensor length to be variable by using Ultra Torr compression fittings)	8	Call

* Not available with CF40 feedthrough

** The following combinations are not available: CDS-A1F48, CDS-B1F48

■ **Cool Drawer Dual Sensor**Example Configuration Part No.: **CDD A F 3 0**

	Part No. Prefix	Price
Base Unit	CDD	
	Option Part No.	
Type of Sensor		
Dual Sensor (water lines parallel to crystal face) with shutter	A	Call
Right angle Cool Drawer (water lines perpendicular)(conductor tube)	B	Call
Length of Sensor		
Minimum 102mm to 660mm	F	N/C
Feedthrough		
1" Bolt	3	Call
2.75"/CF40	4	Call
Feedthrough Connection		
Sensor not connected to Feedthrough	0	N/C
Sensor Welded to Feedthrough	7	Call
Variable length with Ultra Torr compression fittings (Allows the sensor length to be variable by using Ultra Torr compression fittings)*	8	Call

* Not available with CF40 feedthrough

** The following combinations are not available: CDD-AF48, CDD-BF48.

NOTE: Orders for non-standard length sensors and sensors welded to feedthroughs cannot be entered without signed off dimensional drawing (INFICON to provide). Once special length or manufactured order is confirmed, it is not cancelable. Sensor lengths are measured from the center of the crystal to the vacuum side (sealing surface) of the feedthrough.

➤ INFICON Feedthroughs

■ INFICON Feedthrough Selection



1" Baseplate



2 1/4" CF Flange

The following vacuum feedthroughs are compatible with all INFICON Quartz Crystal Deposition Controllers. Each feedthrough provides coaxial electrical connections and tubing for air or water connections. One feedthrough type is required for each sensor installation. Choose the appropriate feedthroughs in conjunction with your vacuum mounting ports and sensor types.

Description	Part No.	Price
1 in. (2.54cm) Bolt Hole Mounting (For use with Front Load Sensors Only)		
Contains one coaxial, and two tube connections (VITON o-ring)	002-042	Call
Provides one coaxial, and three tube connections (VITON o-ring)	750-030-G1	Call
Contains one coaxial, and two tube connections with UltraTorr (VITON o-ring)	750-624-G1	Call
2 1/4 in. (NW35 CF) Conflat Flange Mounting (For use with Front Load Sensors Only)		
Contains one coaxial, and two tube connections (copper gasket)	002-043	Call
Contains one coaxial, and three tube connections (copper gasket)	750-685-G1	Call
Contains two coaxial, and three tube connections (copper gasket)	002-080	Call
Contains one coaxial, two water and two air tube connections (copper gasket). The air tubes have a 10-32 fitting welded on for use with the fitting supplies with the 750-420-G1 Pneumatic Actuator Valve. This feedthrough was designed for the Crystal 12 sensors with a shutter, SPS-1039-G1 and SPS-1175-G1, respectively. One line is needed for the pneumatic drive and the other for the shutter.	750-683-G1	Call
Contains one coaxial, and two tube connections with UltraTorr (copper gasket)	206-878-G2	Call
Contains one coaxial, and three tube connections with UltraTorr (copper gasket)	750-685-G2	Call
Contains two coaxial, and three tube connections with UltraTorr (copper gasket)	206-890-G2	Call
KF40 Flange Mountings		
Contains one coaxial and two tube connections (VITON o-ring)	130246	Call
Contains one coaxial and three tube connections (Viton o-ring)	130239	Call

NOTE: Air and water lines 3/16 inch (0.48cm) O.D. Two electrical connections are required for the Dual Sensor Head. All shutter sensors require appropriate Feedthrough and control valve (750-420-G1).

NOTE: Feedthrough configuration varies depending on options selected (Front Load or Cool Drawer, type of feedthrough, and connection). Example: SL-A0E37 uses feedthrough p/n 002-042 while SL-A1E37 uses feedthrough p/n 750-030-G1. CDD-AF40, -AF47, -BF40, and -BF47 use a 2-piece hybrid feedthrough design due to dimensional limits of a standard CF40.

➤ Crystals

■ Standard 6 MHz Crystals

Control quartz crystal, plano-convex, 6 MHz, 0.55 inches (1.4 cm) diameter. Compatible with all 6MHz crystal sensors manufactured by INFICON. Choice of coating (silver, gold, or alloy) determined by the application. For use with all INFICON deposition controllers and monitors. Genuine INFICON crystals are 100% tested and inspected to ensure stable and accurate control of your applicable applications .

Areas Inspected:

- **Resistance** - Indicates electrical contact and electrode adhesion
- **Frequency** - Checked to ensure accurate thickness measurement
- **Curvature** - Checked electrically to assure resonance stability. Poor curvature rapidly degrades measurement stability
- **Visual Inspection** - For electrode uniformity and adhesion, surface flaws, and other imperfections or contamination

Description	Part No.	Price
6 MHz Sensor Crystals		
Gold electrode, non-tarnishing, economy, Flat Pack Carousel, 10 Pack	KJLCRYSTAL6-G10	Call
Silver electrode, in clean-room-compatible dispenser, genuine INFICON, 10 Pack	008-009-G10	Call
Gold electrode, non-tarnishing, in clean-room-compatible dispenser, genuine INFICON, 10 Pack	008-010-G10	Call
Gold electrode, non-tarnishing, Flat Pack Carousel, 10 Pack	LI008010G10	Call
Alloy electrode for high stress materials, in clean-room-compatible dispenser, genuine INFICON, 10 Pack	750-679-G1	Call

NOTE: Gold recommended for low film stress deposition, such as aluminum, gold, silver, etc. Silver or alloy recommended for high film stress deposition, such as chromium, nickel, Inconel, etc. Alloy recommended for dielectric material deposition, such as magnesium fluoride, silicone monoxide, etc.

NOTE: Call KJLC for other crystal options and quantity pricing.

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Process Instrumentation

Kurt J. Lesker[®] Company

Fomblin[®] & Galden

THE Source of Solvay Solexis Vacuum Fluids and Greases in North America and Europe.

➤ Accessories

■ Front Load Crystal Sensor Replacement Parts & Accessories

Description	Part No.	Price
Standard, Compact, & Dual Sensor Replacement Parts & Accessories		
Body Assembly (standard)	750-207-G1	Call
Body Assembly (compact)	750-209-G1	Call
Body Assembly (dual)	750-208-G1	Call
Ceramic retainer	007-023	Call
Crystal Holder (for Front Load Single and Front Load Dual Sensors)	750-172-G1	Call
Crystal Holder (for 007-205, 206, 216, 218, 237 and 750-040-G1, or G3), for use with OLD style sensors	007-083	Call
Finger Spring contact strip	750-171-P1	Call
Shutter	750-216-G1	Call
Sputtering Sensor Replacement Parts & Accessories		
Body assembly	750-619-G1	Call
Front cover assembly	007-047	Call
Ceramic retainer	007-023	Call
Crystal Holder	007-049	Call
For Sensors Listed Above		
In-vacuum cable, 30.75 in. (78.1 cm) long	007-044	Call
Crystal Snatcher	008-007	Call
Bakeable Sensor Replacement Parts & Accessories		
Ceramic retainer	007-064	Call
Crystal Holder	750-218-G1	Call
Shutter	750-216-G1	Call
Shutter Assembly & Accessories		
Pneumatic Shutter Assembly - For "new style" for Front Load Single and Front Load Dual Sensors. A complete shutter assembly that can be added to non-shuttered sensors. Note: Shutter assemblies require the 750-420-G1 pneumatic control valve.	750-210-G1	Call
Pneumatic Shutter Assembly (sputtering) - A complete shutter assembly that can be added to non-shuttered sputtering sensors. Note: Shutter assemblies require the 750-420-G1 pneumatic control valve.	750-005-G1	Call
Pneumatic Shutter Actuator Control Valve - Required for use with all shuttered sensors and with the Crystal12 and Dual sensor, multiple position sensor heads.	750-420-G1	Call
In-Vacuum Cable Assembly (special lengths) - This cable connects between the crystal sensor head and the vacuum feedthrough. These special lengths are replacements for our standard 30.75 (78.1cm) length.		
6 in. (15.2 cm) long	321-039-G12	Call
12 in. (30.5 cm) long	007-252	Call
24 in. (61.0 cm) long	321-039-G11	Call
30.75 in. (78.1 cm) long	007-044	Call
36 in. (91.4 cm) long	007-059	Call
48 in. (121.9 cm) long	007-061	Call
60 in. (152.4 cm) long	321-039-G13	Call
Material Director - The material director assembly is used for co-deposition processing. It replaces the crystal holder with a collimating tube to minimize cross talk deposition. Note: The material director cannot be used with sensors while using the pneumatic shutter feature.		
For Front Load Single Sensors	750-201-G1	Call
Sensor Emulator - A diagnostic tool with multiple connections for emulating all or part of the sensor-crystal circuit from the oscillator connection to the sensor head (for use with Front Load Single and Front Load Dual Sensors)	760-601-G2	Call
Thin Film User Manuals for Instruments and Sensors on CD in .pdf format	074-5000-G1	Call

■ Cool Drawer Sensor Head Replacement Parts and Accessories

Description	Part No.	Price
"The Next Generation" Retainer Assembly with Ceramic Insulator	123259	Call
"The Next Generation" Crystal Drawer and Retainer Assembly	123260	Call
"The Next Generation" Crystal Drawer	123261	Call
Sensor Head Microdot Coaxial (S-50) Connector	213700	Call
PSV-100 Pneumatic Valve for Shutter - Air valve (12 VDC input). Use with Single or Dual Shutter Sensor Head	147202	Call
SS-104 Single Shutter Assembly, 76 cm (30") Air Tube - Provides a shutter for the SH-102 Single Sensor Head	123217	Call
PSV-100 Pneumatic Valve 24 VDC	147202-3	Call
PSV-100 Pneumatic Valve 120 VAC	147202-2	Call

➤ RF Power Supplies

■ KJLC R-Series

Complete packages ready to provide reliable plasma generation and RF biasing to meet your process requirements.

Features:

- CE marked compliance
- Microprocessor-controlled, solid-state construction
- Master and slave mode operations
- Automatic and manual matching networks available
- Electronics constructed to minimize VSWR conditions, extending unit life
- Programmable high-speed pulsing
- Complete power generator packages — includes everything you need, eliminating guesswork

Control modes to regulate power output:

- DC Voltage
- RF Voltage
- Forward Power Leveling
- Load Power Leveling

SPECIFICATIONS

Model	R301	R601
Power Output	High Range: 0–300 Watts	High Range: 0–600 Watts
Output Impedance	50 Ohms, ± 5 Ohms Nominal	50 Ohms, ± 5 Ohms Nominal
Frequency	13.56 MHz, (Fixed)	13.56 MHz, (Fixed)
Metering Accuracy (Forward Power)	± 1% Full Scale ± 3% of Reading	± 1% Full Scale ± 1% of Reading
Output Power Stability	± 0.5% Long Term	± 0.5% Long Term ± 1Watt
Harmonics	-50 dBc	-50 dBc
Input Power	90–125V or 190–264V, 1P 47–63 Hz, (Factory Configured)	90–125V or 190–264V, 1P 47–63 Hz, (Factory Configured)
Output Connector	Type “N” Female	Type “N” Female
Interface Connectors	Serial: DB-9 Female; Analog: DB-25 Female, CEX: Female BNC	Serial: DB-9 Female; Analog: DB-25 Female, CEX: Female BNC
Pulsing	0–1KHz, 1-Hz Steps, 50 micro-sec Minimum Pulse	0–1KHz, 1-Hz Steps 50 micro-sec Minimum Pulse
Cooling	Forced Air, 110 CFM	Forced Air, 110 CFM
Dimensions	5.25" H x 9.50" W x 18.35" D W = 8.00" (w/o Rackmount Kit)	7.00" H x 9.50" W x 18.38" D W = 8.00" (w/o Rackmount Kit)
Weight	43 lbs. (19.5 kg)	37 lbs. (16.8 kg)



R301 300W RF Power Generator

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Process Instrumentation

RF Power Generator Kits

Description	Voltage	Part No.	Price
RF Power Generator Kit, 300W, Auto Match Components Included: Power Supply, 300W, Automatic Matching Network, 300W Matching Network Controller, Cable Assembly, 2ft. MC2 to R301 Cable, Interconnect, MC2 CNTRL to Tuner, 12ft. Cable, Coaxial, Power Supply to Tuner, 12ft. Cable Assembly, Tuner Output, RG393, 3ft. Rackmount Kit, MC2 to R301	120V	RF03A12XX300	Call
RF Power Generator Kit, 600W, Auto Match Components Included: Power Supply, 600W, 13.56MHz, RS232, CE, “N” Output Automatic Matching Network, 600W, Matching Network Controller Cable Assembly, 2ft. MC2 to R601 Cable, Interconnect, MC2 CNTRL to Tuner, 12ft. Cable, Coaxial, 12ft. OAL Cable Assembly, Tuner Output, RG393, 3ft. Rackmount Kit, MC2 to R601	220V	RF06A22XX300	Call

➤ RF Power Supplies

■ KJLC AT-Series

Features:

- CE Marked
- Automatic Gain Control
- Programmable Presets
- DC Probe Standard
- High Voltage Variable Capacitors
- Displays Forward Power, Reflected Power, and DC Bias
- Analog or Serial Interface
- Low Loss Design
- Single Point System Integration



AT3 Matchbox

SPECIFICATIONS

Model	EJAT3	EJAT6
Power Output	300 Watts @ 20 Amps, 2.5KV pk	600 Watts @ 35 Amps, 4.5KV pk
Output Impedance	1.5 to 35 Ohms -100 to +75 Ohms	1.5 to 35 Ohms -100 to +75 Ohms
Input Connector	Type "N" Female	Type "N" Female
Output Connector	Type "HN" Female	Type "HN" Female x2
Cooling	Convection/Air	Water, 1/4" Swagelok
Dimensions	5" H x 9" W x 15" D	5" H x 9" W x 15" D
Weight	10 lbs. (4.53 kg)	10 lbs. (4.53 kg)

NOTE: A DC Voltage probe is included within the AT Series Matching Networks. The probe provides a means to measure the developed DC Voltage within the chamber. The DC Voltage probe's output signal is proportional to the developed DC within the chamber.

■ MC2 Controller

Independent selection of Auto/Manual operation of either or both Load and Tune Capacitors, Record Strike Preset, Programmable Internal and External Presets, Back-Out Feature, Probe Select, Probe Attenuation Factor and Programmable Limits. The MC-2 front panel controls and indicators are logically grouped, with operational status displayed on a four line Vacuum Fluorescent Display.



**Automatic Matching
Network Tuner**

SPECIFICATIONS

Model	MC2 Controller CE-Marked (EMC and Safety)
Input Power	98-125/196-250 VAC Selectable, 47-63 Hz
Dimensions	3.5" H x 9.5" W x 12.8" D
<i>*I/O Connections match (DB15F), Analog (DB25F), RS232 (DB9F), Loop-Thru (DM25M/F)</i>	

NOTE: Full range of RF Power Suppliers from 300W to 10,000 W can be found at www.lesker.com.

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Process Instrumentation



Kurt J. Lesker

Company

- Quality Products & Services
- On-time Delivery
- Continual Improvement
- Effective Employee Training
- Customer Satisfaction



Providing Quality You Can Trust for Over 55 Years!

➤ DC & Pulsed-DC Power Supplies

■ AE MDX Series

These proven DC power supplies are ideal for laboratory use where superior arc control during sputtering is required.



Advanced Energy's MDX Series DC power supplies range in power levels from 500W to 80kW. They are intended primarily for DC magnetron sputtering, but are also used in cathodic arc deposition and as DC bias sources. They are compact and over 90% efficient. As a safety feature, they have low stored energy at the outlet. Special circuitry enables arc suppression for arc-sensitive applications and arc control for sustained arcing applications. Front panel controls switch regulation between constant power, current, or voltage while permitting the power to be ramped to the set point. The higher power outputs (5kV and above) have extensive secondary controls and displays for target life, remote operation, RS-232 interfacing, self-diagnostics, etc.

NOTE: Contact us at ped@lesker.com for pricing and availability of higher output power supplies and accessories.

MDX 500W Series

The MDX 500 is intended for continuous hard use in a vacuum environment. It's a leading performer in basic magnetron sputtering, DC sputtering with RF bias, and DC-biased RF sputtering. Its small size makes it well-suited for laboratory systems and small-scale production environments.

- Built-in protection
- Reliability and serviceability
- User I/O access

MDX 1.0kW and 1.5kW Series

MDX Series 1 kW and 1.5 kW supplies are ideal for continuous hard use in a vacuum environment. They are most commonly used as DC magnetron sputtering drives where tight regulation, superior arc quenching, and low stored output energy make them an industry leader. They are also used as tightly regulated bias supplies in RF sputtering and etching systems. Their small size has made them the primary choice for laboratory systems.

- Two configurations for standard Z and low Z applications
- Switchmode conversion module provides over 90% efficiency from line to load
- Arc-out suppression circuitry

Power Supply Model	Voltage	Recommended Sputter Source	Part No.	Price
MDX 500W DC Power Supply	115 VAC	TORUS® 1, TORUS 2	EJMDX500	Call
MDX 1.0kW DC Power Supply	115 VAC	TORUS 2, TORUS 3, TORUS 4	EJMDX1K	Call
MDX 1.5kW DC Power Supply	208 VAC	TORUS 3, TORUS 4	EJMDX1500	Call

➤ **DC & Pulsed-DC Power Supplies**

■ **AE Pinnacle® Series**

Advanced Energy's Pinnacle® Series DC power supplies range in power levels from 6kW to 20kW. Their field-proven platform of DC power supplies delivers remarkable process consistency and control for significantly reduced variation and higher yields. This compact, versatile package offers the lowest stored energy, fastest arc response, and widest full-power operational impedance range in the industry. These unprecedented capabilities, combined with superior efficiency and the highest power factor available, deliver process benefits you can bank on.

Features:

- Fast and configurable arc response
- Efficient process control
- Lowest stored energy (less than 1mJ per 1kW output)
- No tap changes required
- 4:1 impedance ratio
- Target conditioning cycle (TCC) minimizes new target conditioning time
- Output repeatability to ± 1 0.1%
- Joule Mode for optimized energy delivery

NOTE: Contact us at ped@lesker.com for pricing and availability of higher output power supplies and accessories.

■ **AE Pinnacle Plus+ Series**

Advanced Energy's Pinnacle Plus+ power supply provides all of the advantages of a pulsed-DC solution for your reactive processes—in a one-box package that delivers additional benefits in the form of ease of use, cost savings, and superior flexibility. Combining standard DC technology and process-proven pulsed-DC technology patented by AE in the 1990s, the Pinnacle Plus+ power supply provides higher deposition rates, more repeatable performance, and exceptional film quality compared to complicated and expensive AC-power solutions. The Pinnacle Plus+ product line consists of single-output 5kW and 10kW models, as well as a dual-output 5kW model.

Features:

- Compact package
- Adjustable frequency range from 5 kHz to 350 kHz
- Variable duty cycle up to 45%
- Wide voltage and impedance ranges (single-tap)
- Superior arc control
- Dual output for multichamber use
- Reactive sputtering closed-loop control

NOTE: Please visit www.lesker.com for current DC Power Supply Options.



iPod®

On October 23, 2001 Apple Computers publicly announced their portable music digital player — the iPod, created under project codename *Dulcimer*.

Kurt J. Lesker
Company moved into their new 60,000 square foot factory in Southwestern Pennsylvania. This facility would accommodate manufacturing expansion, as well as sales and marketing.

➤ AC Power Supplies

■ KJLC® M.A.P.S. Overview



HTR Series



EVP Series

The KJLC® Modular Adaptive Power Supplies (M.A.P.S.) line of AC power supplies incorporates a modular design that can be tailored to meet a wide variety of vacuum processing applications. This innovative design is built around a common base unit that provides optimal performance and reliability. Standard features include a phase-angle fired SCR for optimal control, and an integrated current transducer for assistance with manual control and unit diagnostics.

Features:

- Safety interlocked power output switch
- LED status indicators for internal power, safety interlock, and power output status
- Selectable scaled bar-graph display for power output level and set-point position
- Main circuit breaker, control fuses, and optional limit controller for device protection
- RS-232 communications interface
- Remote user interface connection
- Optional closed-loop process temperature controller

Four Basic M.A.P.S. Configurations

HTR Series—Process Heating

- Line Voltage (120/240 VAC)
- Substrate heating with quartz lamps and other types of resistive elements
- Bakeout heating with quartz lamps or external heater tapes

EVP Series—Basic Thermal Evaporation

- Low voltage/high current control (40V/15A–5V/1200A) using step-down transformer
- Used with thermal evaporation sources, including boats, crucible heaters, filaments, etc.

LTE Series—Low-Temperature Evaporation

- Load-specific design (200W output/12V@15A)
- Low-temperature effusion cells for organic materials

HTE Series—High-Temperature Evaporation

- Low voltage/moderate current (<50A)
- High-temperature effusion cells for metals and inorganic materials

➤ AC Power Supplies

■ **M.A.P.S. HTR Series**

Power supply suited for process heating up to 8kW.

The M.A.P.S. HTR is a complete temperature controller and power supply for use with HV and UHV sample heaters, as well as other resistive heating elements. These units can provide manual output control, as well as programmable temperature control of ramp rate, presoak, and soak times via an integrated PID controller. This closed-loop control can be initiated locally from the controller on the front panel of the supply, or remotely from a PC or PLC.

Features:

- Microprocessor-based programmable temperature controller
- Microprocessor-based limit controller for over-temperature protection
- Controllers preprogrammed for Type-K thermocouple interface
- Type-K thermocouple input connectors
- Digital temperature, set point, and over-temperature readout
- Phase-angle fired SCR output
- Integrated current transducer
- RS-232 interface for remote PID control
- BNC connection for rate control
- Includes:
 - 10' Power Cord
 - 20' Inter Connect Cable (trim length to suit)
 - 20' Type K Thermocouple Wire (trim length to suit)

**SPECIFICATIONS**

Output Power	2kW	4kW	8kW
Input Voltage	120/240 VAC	240 VAC	240 VAC
Output Voltage	120/240 VAC	240 VAC	240 VAC
Input Current	Up to 20 amps		Up to 40 amps
Output Current	Up to 20 amps		Up to 40 amps
Frequency	50/60 Hz		
Weight	9.5 lbs. to 20 lbs., based on configuration		
Dimensions	5.22" H x 8.37" W x 16" D (not including connections)		
Power Output Connector	PowerCon® locking 3 conductor		Terminal Block

Cables and Rackmount Kits for EVP Power Supplies

Power Supply	Part No.	Price
19" Rackmount Kit for M.A.P.S. Power Supplies	APRACKMNTKIT	Call
Cable Assembly, Power Output, 12 AWG SO, Conn./Leads, 10 ft., 20A	CA6310PWOPWO	Call
Cable Assembly, Power Output, 12 AWG SO, Conn./Leads, 20 ft., 20A	CA6320PWOPWO	Call
Cable Assembly, Power Output, 10 AWG SO, Conn./Leads, 10 ft., 30A	CA6410PWOPWO	Call
Cable Assembly, Power Output, 10 AWG SO, Conn./Leads, 20 ft., 30A	CA6420PWOPWO	Call
Cable Assembly, Power Output, 8 AWG SO, Conn./Leads, 10 ft., 40A	CA6910PWOPWO	Call
Cable Assembly, Power Output, 8 AWG SO, Conn./Leads, 20 ft., 40A	CA6920PWOPWO	Call

HTR Power Supplies

Power Supply Model	Voltage	Part No.	Price
M.A.P.S. EVP Series			
2 kW	120 VAC	APR211W1K110	Call
2 kW	240 VAC	APR222W1K110	Call
4 kW	120 VAC	APR411W1K110	Call
4 kW	240 VAC	APR422W1K110	Call
8 kW	240 VAC	APR822E1K110	Call

➤ AC Power Supplies

■ M.A.P.S. EVP Series

Power supply suited for basic thermal evaporation. Outputs up to 4kW. Contact us for higher power requirements.

The EVP Series is configured for use in conjunction with a step-down transformer to provide superior, high-current, low-voltage control of most resistive thermal evaporation sources. Front panel controls include manual output control via a potentiometer and an LED level meter that displays percentage of output power or current.

Features:

- Phase-angle fired, SCR controller with soft-start
- 0–100% adjustable voltage/power output
- Over-current trip response within 10 ms of event
- Near 1 second ramp-up of SCR control signal reduces cold start surge
- Local and remote setpoint control
- Bar graph display on front panel shows level of control signal to SCR
- Optional RS-232 interface for remote PID control
- BNC connector allows the user to directly connect the internal SCR setpoint to an external controller (INFICON or Sigma, for example) for closed loop rate control applications



NOTE: All EVP Series power supplies requires a step-down transformer. Cables sold separately below.

NOTE: See the Materials Deposition Table on page 17-12 for important vapor pressure and temperature information for the material you wish to deposit.

Remote User Interface: Provides the user with PLC-type remote control of the power supply (i.e. on/off, remote setpoint and feedback). The remote setpoint on this connector is identical to the Source/Rate input signal. The remote off signal on this connector works in series with the front panel remote off switch, while the remote on signal works in parallel with front panel switch.

SPECIFICATIONS

Output Power	1kW	2kW	4kW
Input Voltage	240 VAC	120/240 VAC	240 VAC
Output Voltage	240 VAC	120/240 VAC	240 VAC
Input Current		Up to 20 amps	
Output Current		Up to 20 amps	
Frequency		50/60 Hz	
Weight		9.5 lbs. to 20 lbs., based on configuration	
Dimensions		5.22" H x 8.37" W x 16" D (not including connections)	
Power Output Connector		Terminal Block	

*Rating is for power supply only and does not include step-down transformer.

EVP Power Supplies

Power Supply	Part No.	Price
M.A.P.S. EVP Series		
1kW 240 VAC Input/240 VAC Output	APE122P00110	Call
2kW 120 VAC Input/120 VAC Output	APE211P00110	Call
2kW 240 VAC Input/240 VAC Output	APE222P00110	Call
4kW 240 VAC Input/240 VAC Output	APE422P00110	Call

Cables and Rackmount Kits for EVP Power Supplies

Description	Part No.	Price
19" Rackmount Kit for M.A.P.S. Power Supplies	APRACKMNTKIT	Call
Cable Assembly, High Current, XFMR to SRC, 40" LG, for 1 KW M.A.P.S. EVP	CA1AWG05SS38DLO	Call
Cable Assembly, High Current, XFMR to SRC, 40" LG, for 2 KW M.A.P.S. EVP	CA262403838	Call
Cable Assembly, High Current, XFMR to SRC, 40" LG, for 4 KW M.A.P.S. EVP	CA444403838	Call

EVP Power Supply Step-Down Transformers

Power Supply Model	Part No.	Price
Use with 1kW Power Supply 6V tap = 150A out	EPSXFMR3	Call
Use with 2kW Power Supply 5V tap = 400A out 10V tap = 200A out 20V tap = 100A out 40V tap = 50A out	APXFMR2	Call
Use with 4kW Power Supply 5V tap = 800A out 10V tap = 400A out 20V tap = 200A out 40V tap = 100A out	APXFMR4	Call

➤ AC Power Supplies

■ **M.A.P.S. LTE Series**

Power supply suited for low-temperature evaporation of organic materials.

The M.A.P.S. LTE is configured for use with our "LTE" OLED deposition sources and designed to provide highly stable low-voltage, low-current control for evaporating organic materials. These units can be operated in one of three modes:

- Manually, in "auto tuning" mode
- Incorporating closed-loop, PID, temperature control
- "Rate control" mode when used with an external thin film controller

Features:

- Microprocessor-based programmable temperature controller
- Ability to store multiple programs for multiple organic materials and vacuum preparation routines
- Controller preprogrammed for Type-K thermocouple interface
- Type-K thermocouple input connectors standard (others available)
- Digital temperature and set point
- Phase-angle fired SCR output
- Integrated current transducer
- RS-232 interface for remote PID control
- BNC connection for rate control

SPECIFICATIONS

Output Power	200 W
Input Voltage	120/240 VAC
Output Voltage	12 V
Input Current	2 amps @ 120 VAC/1 amp @ 240 VAC
Output Current	15 amps
Frequency	50/60 Hz
Fusing	1, 2FU: 5 x 20 mm 250mA for internal component protection 3, 4FU: 10 x 38 mm, amperage rating model specific, branch rated, for power output
Weight	9.5 lbs. to 20 lbs., based on configuration
Dimensions	5.33" H x 8.37" W x 16" D (not including connections)
Power Output Connection	PowerCon [®] locking 3 conductor

LTE Power Supplies

Power Supply Model	Part No.	Price
LTE, 200W, 120 VAC In, 12V Out	APLTE10110	Call
LTE, 200W, 240 VAC In, 12V Out	APLTE20110	Call

Cables & Rackmount Kits for LTE Power Supplies

Power Supply Model	Part No.	Price
19" Rackmount Kit for M.A.P.S. Power Supplies	APRACKMNTKIT	Call

NOTE: LTE Sources can be ordered on page 11-16.

NOTE: PV customers, ask out our Special LTE source for evaporating Selenium

■ **M.A.P.S. HTE Series**

Power supply suited for high-temperature evaporation of metals and inorganic materials.

The M.A.P.S. HTE is configured for the control of medium-voltage, low-current sources. These sources can range from high-temperature Knudsen Cell evaporation sources to small "button-style" sample heaters. These units can be operated in one of three modes:

- Manually, in "auto tuning" mode
- Incorporating closed-loop, PID, temperature control
- "Rate control" mode when used with an external thin film controller

Features:

- Microprocessor-based programmable temperature controller
- Ability to store multiple programs for multiple organic materials and vacuum preparation routines
- Controller preprogrammed for Type-K thermocouple interface
- Type-K thermocouple input connectors standard (others available)
- Digital temperature and set point
- Phase-angle fired SCR output
- Integrated current transducer
- RS-232 interface for remote PID control
- BNC connection for rate control

SPECIFICATIONS

Output Power	1.5 kW
Line Voltage	120/240 VAC
Output Voltage	40 V
Output Current	35 amps
Frequency	50/60 Hz
Fusing	1, 2FU: 5 x 20 mm 250mA for internal component protection 3, 4FU: 10 x 38 mm, amperage rating model specific, branch rated, for power output
Weight	9.5 lbs. to 20 lbs., based on configuration
Dimensions	5.33" H x 8.37" W x 16" D (not including connections)
Power Output Connection	Terminal Block

HTE Power Supplies

Power Supply Model	Part No.	Price
HTE, 1500W, 120/240 VAC In	APHN2BE0K110	Call

NOTE: HTE Sources can be ordered on page 11-16.

NOTE: Contact our Process Equipment Division at ped@lesker.com for Cables and Rackmount Kits for HTE Power Supplies.

Kurt J. Lesker
Company

**Fomblin[®]
& Galden[®]**

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Reduce the number of oil changes and the amount of waste you have to dispose of by switching from a hydrocarbon fluid to Fomblin. Fomblin does not break down in corrosive applications, making it the perfect choice for processes that contain high levels of oxygen.

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The Kurt J. Lesker Company has Fomblin and Galden in stock available for immediate shipment.



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