



Thin Film Deposition Controllers and Monitors

PRECISELY THE INSTRUMENTS YOU NEED



Precisely the Right Choices

However simple or complex your system—whether it involves thermal evaporation, sputtering, or ion beam processes—INFICON has precisely the right thin film deposition controller or monitor for you. All five quartz crystal-based instruments use the INFICON revolutionary patented measurement system, ModeLock, making them the most precise, most advanced instruments available.

THE PRECISE INSTRUMENT FOR YOUR PROCESS

- The IC/5 controller provides the ultimate control of deposition rate and thickness in systems with multiple sources, crucibles, materials, and processes.
- Cygnus is the only thin film deposition controller designed specifically for OLED manufacturing.
- The XTC/2 controller provides economical yet powerful control of less complex processes.
- The XTC/C controller operates with your own system computer and custom software interface, saving you the cost of a front-panel display and keyboard.
- The XTM/2 offers superior measurement technology in a monitor-only instrument.

Whatever instrument you choose, you'll be backed by the worldwide technical support and expertise that only INFICON can offer.



MODELOCK—FOR UNSURPASSED PERFORMANCE

ModeLock, the unique measurement system used in all five instruments, provides crystal-frequency information with precision unobtainable from conventional “active oscillator” systems¹. This precision, combined with control algorithms tailored to your deposition process, provides unsurpassed performance for long crystal life, low rate depositions, and overall rate control.

One of the most important benefits of ModeLock is extension of the crystal's useful life. For some materials, such as indium, it nearly doubles crystal life.

ModeLock virtually eliminates “mode hopping,” a failure to maintain crystal oscillation at the fundamental frequency. In the IC/5, ModeLock offers a single-measurement rate resolution of 0.005 Å—even while measuring at 10 times per second. This kind of precision means smoother rate control, especially important for processes with low deposition rates.

HOW MODELOCK WORKS

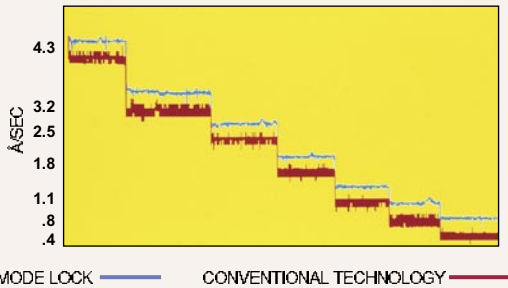
The ModeLock measurement system takes charge, continuously testing the monitor crystal for resonance at the fundamental frequency, thereby eliminating weaknesses inherent in the conventional measurement method.

The conventional measurement method incorporates the quartz monitoring crystal as an active element of the oscillator circuit. Consequently, the crystal controls the oscillator circuit. So, as the electrical characteristics of the crystal change during deposition, the oscillator circuit becomes less stable and may “hop” to another resonant frequency or fail completely, resulting in an inaccurate film thickness.

More powerful and precise—yet faster—than the conventional method, ModeLock continually tests and analyzes the phase-frequency relationship of the crystal. The crystal is not an active part of the oscillator circuit.

¹ ModeLock—Patented in United States, United Kingdom, and Germany. For detailed technical information on ModeLock, contact INFICON for a copy of “The Technology of the Intelligent Oscillator for Quartz Crystal Measurement and its Advantages for Thin Film Processes.”

CONTROL RESPONSE OF ALUMINUM



The rate control provided by INFICON ModeLock technology is far superior to that of conventional technology, as demonstrated in the control of an aluminum deposition. The IC/5, as shown here, provides unsurpassed measurement precision and speed—0.005Å measurement resolution updated 10 times per second.

ModeLock measurement system determines and applies a precise frequency to the crystal, preventing the crystal from “hopping,” or operating at a frequency other than the fundamental. This process takes place thousands of times per second to determine the resonant frequency to a precision of 0.0047/100 ms.

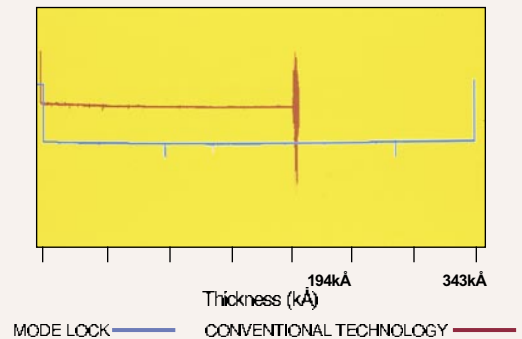
In other words, ModeLock, the fastest measurement system available, provides an intelligent link between the quartz crystal and the instrument, allowing the instrument to enhance the crystal’s performance. ModeLock ensures precision, long crystal life, and freedom from mode hopping. The result is increased process security from beginning to end—improving yield, throughput, and quality.

RATEWATCHER—FOR LONG-TERM RATE CONTROL

The four controllers (IC/5, Cygnus, XTC/2, and XTC/C) come with the INFICON RateWatcher feature, providing long-term rate control for in-line or loadlocked sputtering processes or for thermal evaporation from a resistive source.

The RateWatcher feature takes advantage of the process’ short-term stability by sampling the rate periodically and adjusting source power at programmable intervals. This sampling scheme extends the life of the crystal while automatically correcting for long-term rate changes due to cathode wear or source depletion.

CRYSTAL LIFE FOR COPPER DEPOSITION



INFICON ModeLock measurement technology provides significantly longer crystal life, illustrated here in the deposition of copper.



CRYSTAL 12™ SENSOR—AUTO CRYSTAL SWITCHING MAXIMIZES PRODUCTION TIME

The INFICON Crystal 12 Sensor replaces its crystals automatically without interrupting your process, when partnered with the INFICON Cygnus™ Thin Film Deposition Controller. Whenever a crystal becomes unstable or fails, Cygnus signals the Crystal 12 sensor carousel to immediately rotate a new crystal into position, for continuous deposition rate monitoring. To further minimize downtime, crystals can be preloaded into a second optional carousel, which can then be quickly and easily exchanged with the carousel containing the exhausted crystals, minimizing the time the system is open.

CRYSTALSIX® SENSOR—SECURITY TIMES SIX

INFICON deposition controllers (IC/5, Cygnus, XTC/2, and XTC/C) can be equipped with the optional, patented CrystalSix sensor, which holds six crystals.² Whenever one crystal becomes unstable or fails, the deposition controller signals the CrystalSix sensor to sequence to another crystal automatically, maintaining control without interruption. In addition, the IC/5 offers a CrystalSix “position select” feature; allowing you to choose any of the six crystal positions on demand. By dedicating crystals to specific materials, you can increase long-term deposition rate and thickness accuracy.



²CrystalSix—Patented in the United States, United Kingdom, Germany and Japan.

The IC/5™ Deposition Controller— Ultimate Capability

The versatile IC/5 is ideally suited for control of deposition rate and thickness in systems with multiple sources, crucibles, materials, or processes. The IC/5 meets the needs of even the most complex, demanding, and unique applications. It excels in process control, logic capabilities, program and layer storage capacity, process data management, and especially rate and thickness control.

COMPREHENSIVE PROCESS CONTROL

With its extensive capabilities, the IC/5 can initiate pumpdown, control valves, activate substrate heaters, etc. This enhanced functionality may eliminate the need for ancillary instruments, reducing system complexity and cost.

The IC/5's logic and process control capabilities include 100 programmable logic statements, I/O and TTL relay boards that provide up to 24 relay outputs, 28 TTL inputs, 14 TTL outputs, 20 counters, and 20 timers.

The logic statements can be used in conjunction with external inputs or outputs. Each statement can include up to five functions and can be linked using Boolean logic.

The IC/5 offers six assignable analog outputs for source control or chart recorder outputs for rate, thickness, or rate deviation.

POWERFUL PROCESS RECIPE AND DATA MANAGEMENT

The IC/5 deposition controller offers several features and options to allow you to manage process recipes and data efficiently:

- **Generous on-board storage**—up to 50 processes and 250 layers—allows for instant access to the process data and recipe files you use most. This accessibility is particularly valuable for complex processes involving many layers, for deposition systems that run many types of processes, and for R&D or process development applications.



- **Optional disk drive**—for unlimited storage of process data and recipes.
- **Optional off-line editing software**—for entering or editing parameters at a PC rather than at the IC/5 front panel. Programming with this software is more convenient and efficient, especially for processes with multiple layers and materials.
- **Data logging**—Pertinent process information (final thickness, average rate, run number, layer number, and so on) can automatically be logged in ASCII format to the remote communications port, printer port, or disk.

With the disk drive option, the IC/5 can save data in a spreadsheet format for easy process data storage and manipulation. Data logging allows for convenient post-run analysis and fast corrective action. It is indispensable for companies who need to comply with ISO9000 or QA requirements for process traceability.

AUTO Z—FOR PRECISE DEPOSITION OF MULTIPLE MATERIALS

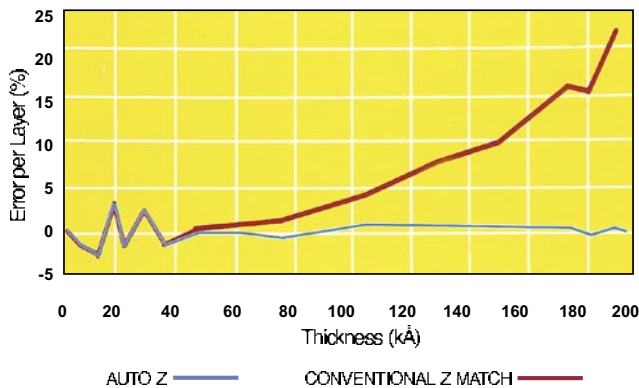
The IC/5's automatic Z-ratio determination, or Auto Z, increases the accuracy of thickness and rate control and eliminates the need for the user to estimate the acoustic impedance (Z) ratio.³

When multiple materials are deposited on a crystal, the Z ratio changes as the ratio of the materials on the crystal changes. Therefore, the value for Z needs

³ Auto Z—U.S. patent #5,112,642

to be dynamic. Auto Z continually updates the Z ratio during the process. This feature is especially important for maintaining thickness and rate accuracy during the deposition of layered or alloyed materials onto a single crystal.

AUTO Z ACCURACY FOR In/MgF₂ DEPOSITION



Auto Z dramatically improves the accuracy of measured thickness for multiple materials and layers.

AUTO TUNE—FOR FAST SETUP

The IC/5's AutoTune feature eliminates trial-and-error evaluation runs and reduces setup time by quickly and automatically determining the source's feedback control loop constants. AutoTune selects the best of several control algorithms—including a three-parameter PID (proportional, integral, derivative) algorithm—to provide smooth source control over a wide range of sources.

MULTIPLE SENSOR MEASUREMENT—FOR REPRODUCIBILITY

For certain optical coatings and other applications in which reproducibility and uniformity are especially important, the IC/5 controller can integrate the measurements of up to eight sensors, minimizing the effects of source distribution variations, and ensuring consistent deposition rate and final thickness from one run to the next.

As substrates rotate in a planetary fixture, the IC/5 collects data simultaneously from various sensor locations, ensuring information that's representative of the current source distribution. Compared with

single-sensor controllers, this configuration significantly improves thickness reproducibility by controlling the deposition at a constant aggregate rate independent of fluctuations in source distribution. As source distribution patterns change, the IC/5 adjusts the power appropriately. While the rate at any one sensor may vary significantly, the aggregate rate is held constant. The total amount of material deposited on each substrate is controlled and accurate; overall thickness accuracy can be two or three times better than that of single-sensor controllers.

By accurately tracking changes in the source's characteristics as it depletes, multiple-sensor measurement allows you to:

- anticipate when to replenish the source
- determine the optimum settings for the e-gun sweep, amplitude, and dither
- reformulate better process recipes

Since all sensors are linked to a single IC/5 controller, rack-space requirements are minimal, and the updates are three to five times faster than with cumbersome multiple controller/computer configurations.

ACCURATE CODEPOSITION

The IC/5 controls the deposition of two materials simultaneously. It even contains a programmable ratio parameter to control alloy percentages over varying rates, as well as a cross-sensitivity (or cross-talk) parameter that automatically compensates for situations in which material from one source is deposited onto sensors used to control the other source.

The Auto Z feature also contributes to the IC/5's codeposition capability by maintaining thickness accuracy even when different materials are mixed on a crystal.

EASY INTEGRATION INTO INSTALLATIONS

Adapter cables are available to easily retrofit the IC/5 into existing installations in place of older INFICON and other manufacturers' deposition controllers. Contact the INFICON technical support department for details.

Cygnus™ Deposition Controller for Maximum Throughput in OLED Applications

Cygnus is the only thin film deposition controller designed specifically for OLED manufacturing. Features important to OLED production allow Cygnus to meet the needs of the most complex, demanding, and unique OLED applications. The patented ModelLock measurement system gives Cygnus the most stable, highest resolution rate and thickness measurement available. OLED manufacturers now have a reliable controller with features essential for maximizing production throughput.

COMPREHENSIVE PROCESS CONTROL

With its extensive capabilities, Cygnus can initiate pumpdown, control valves, activate substrate heaters, etc. This enhanced functionality may eliminate the need for ancillary instruments, reducing system complexity and cost. Cygnus offers up to twelve analog outputs for simultaneous rate control from up to six sources or for rate or thickness tracking and system integration. Cygnus logic and process control capabilities include 100 programmable logic statements, 20 counters, and 20 timers. I/O and TTL relay boards provide up to 24 relay outputs, 28 TTL inputs, and 14 TTL outputs. The logic statements can be used in conjunction with external inputs or outputs. Each statement can include up to five functions and can be linked using Boolean logic.

KEY FEATURES / BENEFITS

- **Up to 6 source co-deposition**—as many as 6 sources can be controlled simultaneously, independently, or in any combination. One Cygnus controller can do what used to take two or three controllers, lowering the cost of ownership.
- **Multiple measurement averaging**—each control channel can be averaged over multiple measurements, providing the increased rate resolution (to 0.0006 Å/s with 10 second averaging) necessary when depositing very low rates.



- **Display resolution to 0.001 Å/s**—the target control rate can be entered to 0.001 Å/s, necessary when controlling low dopant rates.
- **Non-deposit rate control**—the source material can be kept under continuous rate control as substrates are cycled through the deposition chamber. This saves time by eliminating the need to reheat source material with every substrate.
- **Flexible deposition sequencing**—as substrates are cycled through the deposition chamber, the deposition sequence can be toggled between deposit and non-deposit rate control. This exposes the substrate to the deposition material only when needed.
- **Thickness summing**—often OLED materials must be deposited at low rates. Summing the thickness from two or more sources of the same material allows reduced Takt time.
- **Auto Z⁴**—Z-ratios for organic materials are not well known. Using INFICON Auto Z can improve thickness accuracy by automatically determining the Z-ratio.
- **Cygnus Editor Applications Software**—large production systems will have multiple Cygnus controllers. The Cygnus Editor Applications Software allows multiple Cygnus controllers to be programmed and monitored from a single PC.

⁴Auto Z—U.S. patent #5,112,642

The Best of Technology and Economy



XTC/2 DEPOSITION CONTROLLER— POWERFUL AND EASY TO USE

For less complex process requirements, the XTC/2 controller delivers ModelLock measurement technology in an economical, space-saving package. This half-rack unit can control a three-layer process from a choice of nine stored films. It is capable of sequentially controlling two single, one dual, or two CrystalSix sensors and two source outputs.

The XTC/2 offers eight dedicated input functions and 12 relay output functions for system integration, as well as eight outputs for multiple-pocket crucibles.

The recorder output supports the additional functions of power and rate deviation, as well as the normal rate and thickness values.



XTC/C DEPOSITION CONTROLLER— BUILD YOUR OWN INTERFACE

If you prefer to build your own software interface for OEM, research, or other applications, the XTC/C controller gives you the essential technology you need, without the front panel display and keyboard. It offers all the performance and space advantages of the XTC/2 at an even lower price. You provide an additional advantage: custom software that works exactly the way you want.

XTM/2 DEPOSITION MONITOR— EXCEPTIONAL PERFORMANCE AND PRICE

The INFICON XTM/2 extends the unsurpassed measurement speed and precision of ModelLock technology to monitor-only applications—for the price of a conventional “active oscillator” device.



With a frequency resolution of 0.1 Hz in only 250 ms, the XTM/2, when set to 16-second averaging, accurately displays rate resolutions as small as 0.01 Å.

The compact, half-rack XTM/2 operates simply and conveniently with all operating and programming functions accessible from a single screen. This quartz crystal monitor offers a wide range of setup configurations, including etch or deposit mode, chart recorder functions, and multiple measurement averaging. The unit's memory can store programmed parameters for up to nine films.

While its superior measurement capabilities make it suitable for any standard thin film vacuum deposition monitoring application, the XTM/2 can easily be configured for other applications, such as corrosion and contamination studies. The unit can run in either a deposit mode or an etch mode and offers a wide selection of measurement units, as shown below.

UNITS DISPLAYED

Rate	Å/s, ng/s or µg/s
Thickness	kÅ
Frequency	MHz
Mass	µgm, mgm

Precisely the Right Sensors and Crystals

Sensors, feedthroughs, and quartz crystals from INFICON offer proven quality and durability. Our standard, compact, dual, CrystalSix, and Crystal 12 sensors are assembled mechanically rather than soldered together, so you can replace their parts conveniently in the field if necessary.

Our 6 MHz crystals work with all INFICON deposition instruments. Available with gold or silver electrodes, they are 100% factory tested to ensure quality.

Call INFICON, and we'll help you choose precisely the right sensor, feedthrough and crystal for your process.

	Maximum Bake-out Temperature*	Size (Maximum Envelope)	Water Line & Coaxial Length	Body & Holder
Crystal 12 Sensor	130°C	5.12" dia. x 3.46" high (12.1 cm dia. x 8.8 cm high) including optional mounting post	water tubes 30" (76.2 cm) air tube 29.5" (74.9 cm) coaxial cable length specified when ordered	304 SS (plate, holders, & material shield)**
CrystalSix Sensor	130°C	3.5" dia. x 2.0" high (8.9 cm dia. x 5.1 cm high)	30" (76 cm)	304 SS (plate, holders, & material shield)**
Shutter Assembly	400°C	varies w/sensor type	N/A	300-series SS
Dual Sensor	130°C	1.45" x 3.45" x 1.70" high (3.7 cm x 8.8 cm x 4.3 cm high)	30" (76 cm)	304 SS
UHV Bakeable Sensor	450°C	1.35" x 1.38" x .94" high (3.4 cm x 3.5 cm x 2.4 cm high)	30" (76 cm), 20" (50.8 cm), or 12" (30.5 cm)	304 SS
Compact Sensor	130°C	1.11" x 1.06" x 1.06" high (2.8 cm x 2.7 cm x 2.7 cm high)	30" (76 cm)	304 SS
Sputtering Sensor	105°C	1.36" dia. x .47" high (3.45 cm dia. x 1.18 cm high)	30" (76 cm)	Au-plated BeCu
Standard Sensor	130°C	1.063" x 2.24" x .69" high (2.7 cm x 5.7 cm x 1.75 cm high)	30" (76 cm)	304 SS

*For bake only; waterflow is required for actual deposition monitoring.

**Aluminum body.



CHOOSING THE UNIT PRECISELY RIGHT FOR YOU

	IC/5 CONTROLLER	CYGNUS CONTROLLER	XTC/2 & XTC/C CONTROLLERS	XTM/2 MONITOR
Measurement performance				
Resolution (Å/s/M) ¹	0.00577	0.00577	0.06	0.123
Max. crystal frequency shift	1.5 MHz	1.5 MHz	1.0 MHz	1.0 MHz
Crystal range & precision	6.0 to 4.5 MHz ± 0.0047 Hz (per 100-ms sample)	6.0 to 4.5 MHz ± 0.0047 Hz (per 100-ms sample)	6.0 to 5.0 MHz ± 0.05 Hz (per 250-ms sample)	6.0 to 5.0 MHz ± 0.1 Hz (per 250-ms sample)
Thickness accuracy ²	0.5%	0.5%	0.5%	0.5%
Measurement frequency	10 Hz	10 Hz	4 Hz	4 Hz
Multiple measurement averaging		0.1, 0.4, 1.0, 4.0 and 10.0 sec. averaging is allowed		0.25, 1.0, 4.0 and 16.0 sec. averaging is allowed
Design features				
Multiple sensor measurement	yes (up to 8)	no	no	no
Auto Z	yes	yes	no	no
AutoTune	yes	no	no	no
Codeposition	yes (2 source)	Yes (up to 6 sources)	no	no
Process recipe & data management				
Film programs	not applicable	not applicable	9	9
Material programs	24	not applicable	not applicable	not applicable
Process layers	250	not applicable	3	not applicable
Processes	50	not applicable	1	not applicable
Disk drive available	yes	yes	no	no
Data logging	yes	yes	yes	yes
Hardware features				
Sensors ³ Single	8	6	2	1
Dual	4	6	1	0
CrystalSix	8	6	2	0
Crystal 12	0	6	0	0
Source Controls				
Number of sources	up to 6 ⁴	up to 6	2	
Source control voltage	0 to ± 10 V, 0 to ± 5 V, or 0 to ± 2.5 V	0 to ± 10 V, 0 to ± 5 V, or 0 to ± 2.5 V	0 to ± 10 V	not applicable
Output resolution	15 bits over full range (10 V)	15 bits over full range (10 V)	15 bits over full range (10 V)	
Crucible positions	64	64	8	
Input/Output:				
Inputs	14 standard, up to 28 optional; TTL/CMOS logic compatible or closure to ground	14 standard, up to 28 optional; TTL/CMOS logic compatible or closure to ground	9 pre-defined; TTL/CMOS logic compatible or closure to ground	5 pre-defined TTL
Outputs	8 standard, 16 or 24 optional programmable SPST relays rated @ 30 V(dc) or 30 V(ac) RMS or 42 V Peak @ 2.5-amps; 14 optional TTL outputs	8 standard, 16 or 24 optional programmable SPST relays rated @ 30 V(dc) or 30 V(ac) RMS or 42 V Peak @ 2.5-amps; 14 optional TTL outputs	12 SPST 2.5-amp relays rated @ 30 V(dc) or 30 V(ac) RMS or 42 V Peak @ 2.5-amps	4 SPST 2.5-amp relays rated @ 30 V(dc) or 30 V(ac) RMS or 42 V Ppeak @ 2.5-amps
Recorder output	0 to + 10 V ⁴	0 to + 10 V, Qty 6 optional	0 to + 10 V	0 to + 10 V
Logic statements	100 fully programmable; up to 5 actions, 5 events per statement	100 fully programmable; up to 5 actions, 5 events per statement	not applicable	not applicable
Communications: Standard				
Optional	RS232 IEEE488	RS232 IEEE488	RS232 IEEE488	RS232 IEEE488
Display				
Thickness resolution ⁵	1 Å	1 Å	1 Å	0.1 Å, or 1 Å
Rate resolution ⁵	0.1 for 0 to 99.9 Å/s; 1 for 100 to 999 Å/s	0.001 for 0 to 9.999 Å/s; 0.01 for 10 to 99.99 Å/s; 0.1 for 100 to 999.9 Å/s	0.1 for 0 to 99.9 Å/s; 1 for 100 to 999 Å/s	0.01, 0.02, 0.06 for 0 to 9.99 Å/s (depending on averaging used); 0.1 for 10 to 99.9 Å/s; 1 for 100 to 999 Å/s
Operation				
Power requirements 50/60 Hz ± 3 Hz (unless otherwise noted)	100 +10%, -15% V(ac) 120 +10%, -10% V(ac) 220 +10%, -10% V(ac) 240 +10%, -15% V(ac)	100 +10%, -15% V(ac) 120 +10%, -10% V(ac) 220 +10%, -10% V(ac) 240 +10%, -15% V(ac)	90 to 132 V(ac) or 180 to 264 V(ac)	90 to 132 V(ac) or 180 to 264 V(ac)
Operating temperature	0° to 50° C (32° to 122° F)	0° to 50° C (32° to 122° F)	0° to 50°C (32° to 122° F)	0° to 50° C (32° to 122° F)
Dimensions, excluding mounts (h x w x d)	5.25" x 17.63" x 18.5" (13.3 cm x 44.77 cm x 47 cm) full rack	5.25" x 17.63" x 18.5" (13.3 cm x 44.77 cm x 47 cm) full rack	3.5" x 8" x 12" (8.9 cm x 20.3 cm x 30.5 cm) half rack	3.5" x 8" x 12" (8.9 cm x 20.3 cm x 30.5 cm) half rack
Weight	29 lbs (13.2 kg)	29 lbs (13.2 kg)	6 lbs (2.7 kg)	6 lbs (2.7 kg)

¹Material density= 1.0; Z ratio = 1.0; crystal frequency=6 MHz. 0/s/M = angstroms/second/ measurement.

²Varies according to process; figures reflect typical accuracy.

³Maximum configuration of each type.

⁴The IC/5 has 6 DAC outputs that can be selected as source control voltages or recorder outputs.

⁵For the XTM/2 monitor, alternate measurement units appropriately scaled. Multiple measurements.



GLOBAL HEADQUARTERS:

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