Cat. C6 (~~12.2025~~)

Positioning and Tracking Controls







15Apr2026: E-mail address, Sales-Service@escomaritime-us.com, to be updated on all pages (footer of this document) once we decide the e-mail address we want to use on the new ESCO Maritime website

Measurement Systems Inc.
50 Barnes Park Road, Suite 101
Wallingford, CT 06492 USA
+1 203.949.3500

Sales-Service@escomaritime-us.com
www.ESCOMaritime.com



INTRODUCTION

For decades, our company has evolved to become a world leader in the manufacture of human operated controls for tracking and positioning tasks. We specialize in designing products with emphasis on optimized human factors, performance and reliability.

Many innovative ideas in this catalog were first introduced by Measurement Systems, Inc., and combined with our Joysticks, Trackballs, Control Grips and Interface Circuits. These products are considered the performance and quality standards of the industry.

Our Sales & Applications Engineering, Design Engineering, Quality and Production teams provide our customers with a unique re-source. We offer problem solving skills; reliable, application specific products; volume production capabilities, and long-term Engineering, Quality and Customer Service support.



PRODUCTS

MSI designs and fabricates Joysticks, Track-balls, Grip Controls and Interface Circuits. Our products range from commercial, off-the-shelf to custom, military grade and many combinations between. The purpose of this catalog is to demonstrate some of the ideas our customers have used to solve their unique input device problems. Drawing on a repertoire of thousands of product variations and ideas, our Sales and Applications Engineering Department can provide a cost effective solution to your needs. Contact us with your requirements and ideas so we can work with you.

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50 Barnes Park Road, Suite 101
Wallingford, CT 06492 USA
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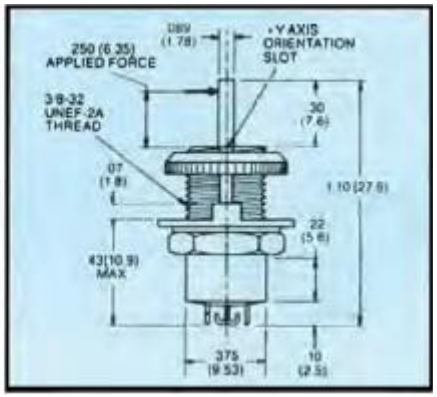
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Force Type, Miniature, Finger Operated

- **High Reliability ... 200,000 Hours MTBF Life 10,000,000 Cycles**
- **Small Size and Light Weight**
- **Infinite Resolution**
- **Variety of Styles and Mounting Configurations**

These force-operated miniature joysticks provide a linear, infinite resolution output voltage which is proportional to the force and voltage applied. Linear force range for a standard device is either 0-3 lbs. or 0-5 lbs. (other ranges available) and input voltages of up to 12 volts DC or AC RMS can be used. For a standard 3 lbs unit and ±6 VDC input voltage, output signal is 0 to ±1.4 VDC. Units utilize semiconductor piezoresistive elements mounted on a cantilever beam. Units return to center when force is removed. Ask for our Miniature Joystick Catalog for more information.



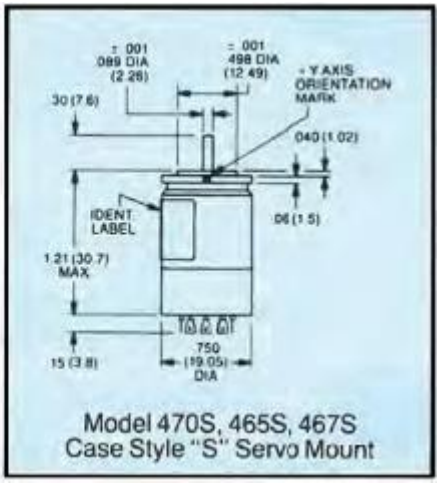


Model 462 Subminiature Joystick

This model incorporates a stainless-steel case, elastomer seal and bushing mount and offers high performance in a small size where space is an important factor. Overall depth behind the panel is .43 inches maximum with a diameter of 3.75 inches



Model 465S



Model 470S, 465S, 467S
Case Style "S" Servo Mount

Model 465 Series

Designed for military applications where humidity requirements per MIL-STD-202 apply. Semiconductor piezoresistive elements are protected by an internal flexible metal bellows. The case is constructed of sturdy brass and black anodized aluminum alloy. A variety of mounting options, finger-tip handles, thumb buttons and boot seals are available.

Model 467 Series

Designed for industrial applications where environmental factors such as humidity, temperature and gasses or solids are a consideration Construction utilizes internal metal bellows and case material similar to Model 465

Model 469 Series

Designed for controlled or other less severe environments The semiconductor elements are sealed by use of proprietary encapsulants Case material is brass. Mounting styles, finger-tip handles, thumb buttons and boot seals similar to Models 465 and 467 are available

Model 470 Series

Designed and proven by qualifications testing for the most severe military equipment environments. Units utilize a hermetically sealed construction and meet humidity requirements of MIL-STD-810 Method 507 procedure 1 and seal requirements of MIL-STD-202 Method 112, Cond A and C

Model STX

This model 462 Joystick/serial interface circuit combination transmits data in most common "mouse" formats. The compact below panel configuration provides an installation that meets tough environmental standards and requires very little space.





Model STXK Control Pad

This "ready to install" STXK Control Pad incorporates the features of the STX joystick with its RS232 or RS422 serial interface circuit and a sealed keypad with tactile switches. Designed for panel mounting, the STXK is an economical input device providing excellent pointing or motion control, compact size, high reliability and excellent sealing capabilities.

Model 473
Three Axis Control

This control provides ± X and ± Y control operated by the vertical handle. ± e control is achieved by turning the knurled ring. This separation of the control functions is useful in applications that require no cross-talk between axes.



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Wallingford, CT 06492 USA
+1 203.949.3500

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Force Type, Miniature, Finger Operated

Models 475,485 Designator, Two Axis Control with Switch

Model 475, 485 for use in control grips such as Model 1505. It includes a joystick with spring loaded axial motion to operate a SPDT switch. The Model 475 is for less severe environments. Model 485 is sealed for severe military environments. Overall length is 1.54 inches.





Servo Bushing Grip

Mounting

Various mounting configurations including front mount, servo mount, grip mount and bushing mount are available. Ask for specification control drawing 344072 or our Miniature Joystick Catalog.



P/N 361870 Handle | P/N 361745 Knob | P/N 361545 Handle | P/N 361510 Handle | P/N 583149 Boot

Fingertip Handles, Thumb Knobs, Boot Seals

A variety of handles, knobs and boot seals are available. Ask for drawing 364068 or our Miniature Joystick Catalog for more complete information.

Joystick with Quadrature, Pulse or Serial Output

Model 865, 867 or 869 two axis joysticks incorporate our Model 465,467 or 469 joystick as the fingertip control. The module contains circuitry which converts the joystick analog output to quadrature, pulse, or serial output. The circuit is designed to permit the operator to slew rapidly yet also produce very small motions.



Maximum output rates can be specified as 500, 1000 or 2000 counts per second.

Model 865 ..... Military Environments
Model 867 ..... Industrial Environments
Model 869 ..... Commercial Environments



Model 469 10/20 Pound Force

Option: 10/20 Pounds Force

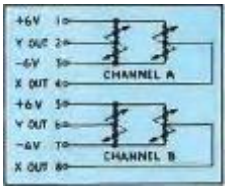
Maximum operating forces are 10 and 20 pounds with elastic limits of 64 and 128 pounds and sensitivities of ± 0.14 V/lb. and ± 0.07 respectively. Configuration of these joysticks is different from. the standard 3 pound and 5 pound units. Overall length including the rod is 1. 75 inches with a body diameter of 0.655 inches.

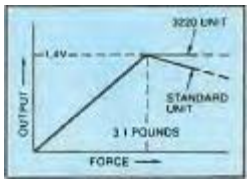
Option: High Output Voltage

Unit designed for applications where a high sensitivity is required and a ± 28 VDC supply is available. Output voltage range is o to 9 volts, sensitivity is ± 3.0 V/lb. and output impedance is 4K ohms. This feature Is available on most configurations.

Option: Dual Redundant

This is a dual redundant joystick. Each output is provided in two channels, A and B. Mechanical configuration per standard Model 465 units. Schematic as shown.





Option: No Foldback

Option 3220 allows the maximum output to remain relatively constant as increased force beyond 3.1 pounds is applied. Sensitivity after stop is less than ± 10m V/lb. (see characteristics curve).

Model JTX

The JTX joystick provides a precise reliable and rugged control that withstands harsh environmental conditions. The joystick is available in quadrature square wave and serial outputs. All common “mouse” formats can be emulated.



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Force Type, Hand Operated

- **Infinite Resolution**
- **High Tracking and Positioning Accuracy**
- **AC or DC Input/Output**
- **High Dynamic Range**

Isometric (force or stiff stick) controls have been shown by human factors studies to provide the operator with a device that permits higher tracking accuracy, more rapid and accurate positioning capability, with less training time and fatigue than other styles. This series of controls is designed for fixed panel mounting and is operated by the hand. They are normally used to control rate and provide a linear, infinite resolution voltage signal output proportional to the applied force. When the force is released, the control signal returns to zero. Force is specified as 10 lbs. maximum with options up to 50 lbs.

Model 446

This hand control offers the versatility of using a grip as the human interface. The added trigger and other switches allow the operator to perform multiple tasks while operating the primary transducer. The unit provides a ± 10 VDC output from a± 15 VDC supply.





Model 435 MS

A two axis hand control incorporates a push button switch on the handle Unit operates on AC supply, 12-28 VRMS, 50-1000 Hz.

Model456

Physically similar to Model 435 MS but operates on plus or minus 15 VDC supply voltage at 100 mA The output has adjustable sensitivity and offset.



Model 435

A two axis hand control using a small diameter, straight, fingertip handle which provides comfort and sensitivity for high accuracy applications. Unit operates on AC supply, 12-28 VRMS, 50-1000 Hz.

Model 436

Physically similar to Model 435 but operates on ± 15 VDC supply voltage at 100 mA. The output has adjustable sensitivity and offset.



Model 438 Two Axis Hand Control

This is similar to Model 435, with a two channel operational amplifier The output can be specified as high as ± 40 VDC Balance and gain controls are provided .



Model 415

This force operated hand control was designed to specifically simulate an F16 flight stick; including the dual slope output and grip quick disconnect feature. A variety of grips is available to simulate a particular F16 stick model. The unit operates from a± 15 VDC supply. A single slope output model is available for industrial applications.

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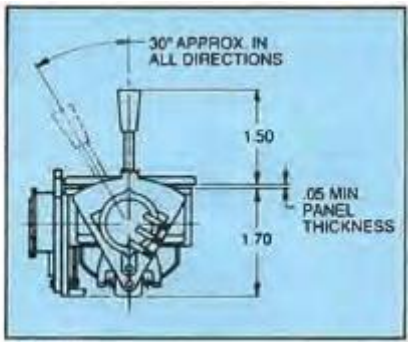
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Displacement Type, Finger Operated

- **Compact Size**
- **One, Two or Three Axis Capability**
- **High Resolution Potentiometers**
- **Optional Features and Accessories**

These displacement joysticks feature a compact, plastic construction utilizing potentiometers that translate stick movement into precise control for positioning and 1rack-ing tasks. Standard potentiometers are conductive plastic with optional high reliability. carbon and wire wound types available. A table of optional features is shown on Page 9.





Model 521 Two Axis Joystick

This basic two axis control utilizes a ball and socket Joy-stick pivot with precision metal balls to provide smooth, low friction motion of the X and Y axis Removable return-to-center detent springs, trim controls for fine adjustment, a round bright chrome bezel with mounting screws are standard



Model521 BP
Two Axis Potentiometer Joystick with Push Button Switch

This model has a boot for mounting surface sealing and a smaller boot at the switch to prevent moisture entry through the handle. The switch leads are brought through the handle and then out of the body, below the mounting surface.

Model 521 Z
Three Axis Joystick

This control features a spring return-to-center twist knob on the joystick handle. A 5K ohm, ½ Watt potentiometer housed within the knob can be rotated ± 45° for the third axis.





Model 510
Spring Return Pot

Provides smooth continuous control of rate in rotating dis• plays and machines. The potentiometer wiper moves ± 45° at maximum deflection and is centered on a SK ohm in-finite resolution element. It is conveniently mounted using a single hole to clear the 5/8-24 threaded bushing. Other resistance values and/ or MIL-Spec potentiometers are available.



Model 521 P with Push Button Control

This control is a Model 521 with a single pole, single throw, momentary push button function switch mounted in the Joystick handle. The switch is rated at 1 AMP, 115 VAC

Model520
Single Axis Control

This model has spring return-to-center, a SK ohm. 1 Watt high resolution potentiometer Fine trim adjustment is accessible from the panel with a thumb knob. The body and handle are molded plastic



Model 521
A Joystick with Long Life Potentiometers

This is a model 521 with long life (2,000,000 cycles) potentiometers. It does not include fine trim adjust levers



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Displacement Type, Finger Operated



Model 521-2513
Joystick with Positive Lock

This product is our· Model 521 joystick with an addition of a lock on each axis. Lock may be specified as positive lock or adjustable friction hold.

Model 522
Digital Joystick

This model provides continuously variable pulse output rates in two axes. Rates are 1O to 700 PPS (pulses per second) nominal. It has spring return features and requires a single + 5 VOC supply.





Two Axis
Subminiature Joystick

Has a smooth action and infinite resolution 1 Watt potentiometers Our smallest dis-placement type joystick, it will fit in a space only 1½ inches. Wide. The handle remains in position where set within a 90° wide cone.

Model525/3
Three Axis Joystick

This unit has a solid dome (no slot) with bezel ring. The unit is much like Model 525 SP in the X and Y axis structure. The third axis (0) is 0.5 Watt rating. All three axes remain in position.





Model 526 PAZ
Three Axis Control with Push Button Switch

This three axis control features a spring return-to-center and twist knob with a finger-tip actuated switch at the end of the joystick handle.

Model 523
Single Axis Control

This model is a single axis proportional joystick with spring return-to-center using a 5K ohm center tapped potentiometer whose electrical angle matches the mechanical angle of the joystick. Stay in place versions, direction switches and boot seals are among the available standard options. Several units may be mounted side by side for multi-axis positioning tasks





Model 525-G1066
Joystick

Features a solid dome (no slot) and individual adjustable friction locks on both axes to prevent movement during vibration or in a turbulent environment. MIL-Spec infinite resolution potentiometers are standard

Model 525
Potentiometer Joystick

This control has potentiometer pick-offs in each axis and provides ± 45° conical motion. When the control handle is released the joystick remains in place Military grade, infinite resolution potentiometers are used.





Model 526
Two Axis Joystick

Has spring return-to-center in both axes and is supplied with a metal bezel, mounting plate and dust cover.

Model526Z

(not shown)
A three axis version of the 526 unit, a SK ohm,½ Watt potentiometer housed within the knob can be rotated ± 45° for the third axis.

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Displacement Type, Finger Operated



Model 529-20-10
Joystick with Coded Digital Output

The 529 series uses a finger operated potentiometer type re of displacement joystick with shaped transfer characteristics including a dead band and non linear curve shaping that allows the operator to obtain high slew rates without sacrificing precise positioning capability. Units are available with TTL level pulse output, Model 529-1-10, parallel binary, Model 529-30-10, or RS-232C serial, Model 529-20-10. Optional lighted push buttons are available with any version.



Model531
Heavy Duty Construction

A two axis control with rugged all metal construction, environmental boot seal and high reliability conductive plastic, center tapped potentiometers. Options include direction or limit switches together with a finger operated switch in the joystick handle.

Available Options

This table provides a few of the numerous extra charge options available on our displacement type, finger operated joysticks. Most, but not all, can be provided on each model. Please contact the factory for recommendations and availability.

Feature	Option	Description
Boot Seal (large)	**B**	A 2.7-inch diameter boot with mounting plate and 0.62 diameter handle
Center Detent	**C**	For non return-to-center models.
Direction Switches	**D**	SA, 250 VAC, SPOT switches that actuate 2.5° from center position
Boot Seal (small)	**E**	Neoprene boot with mounting plate. Used for all models using standard .150 inch diameter handle
Friction Hold	**F**	Remain in position, adjustable force range to 12.5 oz. maximum
Gloss Black Bezel	**G**	Round, supplied separately, mounting screws included.
Matte Black Bezel	**J**	Round, supplied separately, mounting screws included.
Limit Switches	**L**	SA, 250 VAC, SPOT switches. Actuate near end of handle travel.
MIL-Spec Potentiometers	**M**	Per MIL-R-94, 2.25 Watts, carbon element. 5K ohms.
Push Button Switch Handle	**P**	1A, 115 VAC, low force, snap action.
Quad Potentiometers	**Q**	Two per axis, SK ohms, 1 Watt.
High Reliability Potentiometers	**R**	5K ohms, 1 Watt, life 1,000,000 cycles.
Segmented Potentiometer	**S**	5K ohms, 0.5 Watt with center tap, ± 28° angle.
No Trim Control	**T**	Deleted trim tabs.
Low Force	**U**	Low force springs providing breakout force of 1.5 oz. full scale force 3.5 oz.
Spring Removed Third Axis	**V**	Provides 300° rotation of twist knob.
Wirewound Potentiometer	**W**	With center tap, 5K ohms, 0.5 Watt, ± 28° angle.
Third **Axis**	**Z**	Spring return-to-center twist knob, ± 45°.

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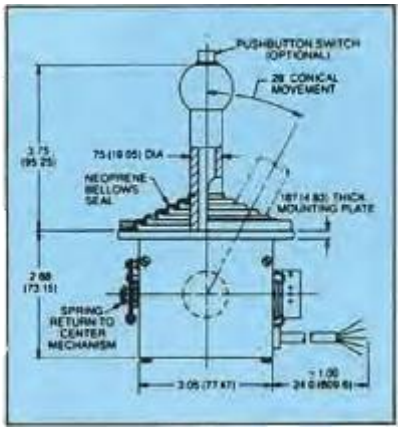
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Heavy Duty, Displacement, Hand Operated

- **Two and Three Axis Capability**
- **Rugged, Gimbal Movement**
- **Selection of Joystick Handles and Hand Grip Styles**
- **Environmentally Sealed Construction**

These controls provide two and three axis q:)eration with a rugged. full gimbal construction providing smooth operation. The full-scale output voltage is 100% of the applied voltage. Units incorporate a neoprene boot seal for resistance to severe environmental conditions and utilize precision, center tapped ± 28° angle potentiometers. The direct coupling of the handle and the sha1t of the potentiometer without the use of gears or linkages means the backlash is reduced to a minimum.





Model 541 Gimbal Joystick

A two-axis displacement control for severe environments. Full gimbal construction operates very smoothly with as low as 1 pound force applied to the joystick. This model is available as Model 541 P which includes a push button switch at top of the handle,

Model 546 Two Axis Gimbal Type Joystick

These gimbal type displacement joysticks are inherently rugged and work smoothly without loss of precision throughout operational life. The direct coupling of the handle and the shaft of the potentiometer without the use of gears or linkages means the backlash is reduced to a minimum. Also, the spring levers allow the user a choice of various operating forces by simply changing two standard extension springs. The materials used in the const ruction, anodized aluminum alloy, stainless steel and sleeve bearings, allow the product to e2sily withstand severe environments including salt spray, humidity and dust.





Model 541 Z
Three Axis Control

The same as Model 541 except that the handle knob is replaced by a 5K ohm potentiometer (not center tapped) which is spring return-to-center.

Model 542-G903
Two Axis
Hand Grip Control

This rugged, gimbal movement model features high forces, a special cast aluminum enclosure and construction to provide spray resistance under high pressure conditions. Auxiliary functions are performed by an array of switches including finger operated push buttons. a trigger switch with a guard and a bar switch in the grip handle. This model includes long life potentiometers and full-scale output force of 7.0 pounds.





Model 544
Three Axis Control

Provides X and Y control by conventional motion of the control grip. Rotational control is easily obtained by rotation of the control grip. All three axes are spring return-to-center. Potentiometers are 5K center tapped ½ Watt conductive plastic. The control grip includes trigger and three push button switches for thumb operation.

Model 544-G308
Three Axis Control

A special version of Model 544. It includes a thumb operated miniature joystick, a four-way trim switch in the center position, a side mounted switch on the grip body and bar switch.



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Heavy Duty, Displacement, Hand Operated

Model 544-G414
Three Axis Control with T Bar Grip



This provides X and Y control by conventional motion of the control handle. Rotational control is obtained by twisting of the grip handle. The grip handle has a push button switch in one end for thumb operation. The potentiometers are 1 OK center tapped conductive plastic ½ Watt.

Model 544-G510

This three axis joystick has a T Bar grip and provides X and Y control by conventional motion of the handle as on the above model. The third axis, however, is an orthogonal motion of ± 0.5 inches perpendicular to the other two axes.

Model 547
Three Axis Gimbal



Type Joystick This rugged, precision hand control provides a rotational axis in addition to the conventional displacement X and Y control simply by twisting the hand grip. The 3 push buttons and trigger switch on the grip allows the operator to perform multiple tasks. Other custom grip configurations are also available. Output potentiometers are 5K ohm, ½watt conductive plastic.

Switching Type

- **Quick Motion, Positive Actuation**
- **Available with Pulse Rate Output and TTL Discrete Level Switching**
- **Eight Separate Directions**
- **Fast/Slow Selection Feature**

These controls provide a multi-position joystick switch ideal for medium accuracy manual positioning tasks in a two axis system. A small motion and quick, positive actuation make many of these switch models suitable for keyboard mounting.



Model571
Joystick Switch with TTL Pulse Output

The primary action of the joy-stick produces a "slow" pulse rate of 20 PPS (pulses per second). When the bar switch is pressed simultaneous to a joystick direction pressure a "fast" output rate of 200 PPS is produced.

Model 572 Joystick Switch

No bounce, TTL level similar in appearance to Model 571 It provides switching signals directly from a 7400 logic device



Model 570 Miniature Multi-Position Joystick

A positive action, center off switch. Moving the handle in any X or Y direction will actuate a single switch. Moving the handle 45° will actuate two switches giving eight sepa-rate directions. Depressing the bar switch provides a means of a fast/slow selection.

Model 574 Joystick Switch with Lock



This rugged controller can be actuated in eight separate directions. The handle normally returns to center off position, but when desired, a¼ turn of the knurled tip will lock the handle in any position. Switches are SPST-NO, snap action, Rating: 5 amps at 28 VDC Ind.

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Switching Type



Model 575 Multi-Position Toggle Switch

This model is a positive action, center off switch that can be actuated in any of eight different positions. In addition there is a thumb operated three position toggle switch mounted at the end of the handle. Switches conform to MIL-S-8834 and MIL-S-8805. Handle is 4.25 inches long. Base is 3.0 inches in diameter.



Four Way Trim Switch P/N 706871

This switch is extremely rugged and is rated at 15 amps, 28 VDC inductive. Meets MILS- 9419. A high actuating force (4 lbs.) or low force (1.5 lbs.) is available. Engraving is optional.

Hand Operated, with Optional Controls

- **Designs for Two, Three and Four Axis Controls**
- **Right and Left Hand Configurations**
- **Various Grip Shapes and Styles**
- **Variety of Switching and Control Options**

Grip configurations with the miniature joystick used as a thumb control improve tracking tasks in turbulent environments because only the mass of the thumb is involved, not that of the hand or arm. There is a variety of miniature joysticks and button styles available to meet most operator preferences. Measurement Systems pioneered the development of this type of control and can offer this vast experience to solve your control problems



Model 1505-G412 Control Grip

This control grip has a two axis thumb operated joystick. Designed tor Navy Shipboard use, and for severe specifications of shock, vibration. humidity, and drip proofing. Power input is 115 VRMS, 400 Hz at 100 mA Output is ± 10 VDC.





Model 1600-2 Control Grip

This ambidextrous grip is constructed of high strength molded thermoset plastic. A thumb operated, Model 465 joystick and 2 push button switches are included on the grip face. A two detent trigger switch is provided for index finger operation. Other switch and joystick options are available.

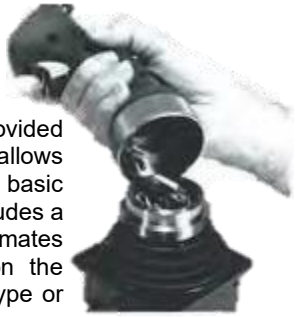


Model 1505-2 Control Grip

This model utilizes a rugged cast aluminum construction and includes a Model 465 two axis miniature joystick control, a trigger switch and two push button switches Other finger operated controls are available.

Detachable Grip Mount P/N 688649

Many grip styles can be provided with a disconnect mount that allows easy removal from the basic joystick control. The grip includes a knurled retaining ring that mates with a threaded adapter on the control and includes a "D" type or circular connector.



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Hand Operated, with Optional Controls

Model 1500-G738 Control Grip

This control grip incorporates a thumb operated miniature joystick. Model 467L. a trigger, slide and push button switch. The 2.5 inch square housing incorporates electronics to convert the analog output of the joystick to a pulse rate range of 2-1000 PPS (pulses per second). Rates to 500 and 2000 PPS are also available. A cable and connector are included.



Model 1505 Control Grip with Side Switch ("D") Position

This aluminum control grip features a side switch posit ion designed to be operated by the right hand thumb. A variety of switches can be incorporated into this 'D" position; including a push button, slide switch, toggle switch, 4 way trim or miniature joystick. Custom configurations and a left hand version is available as shown.





Model 1505-G239 Control Grip

This control grip was designed for military applications and incorporates a thumb operated miniature joystick, Model 465L, two slide switches and a single detent trigger switch. It is constructed of high str3ngth aluminum alloy and features a special mounting plate and connector.



Model 1515 Control Grip

A large face plate and thumb rest allow this aluminum grip to accommodate a large number of switches which can be reached comfortably by the operator. A variety of switches and thumb operated joysticks are available to meet custom application requirements.

Model 1505-G879 Control Grip

This cast aluminum grip incorporates an internal amplifier, a military grade two axis joystick (Model 465) and a thumb operated three position, maintained action, toggle switch. Maximum output voltage is ± 10VDC.



Model 1522

A cast aluminum grip for left hand operation. It is designed to attach to a periscope sight used on a military helicopter. Control functions are a thumb operated toggle switch, a push button switch, a two detent trigger with spring loaded guard and bar switch. A right hand configuration is also available.





Model 1510 Control Grip

This aluminum alloy grip provides a large flat face to accommodate a larger number of switches and controls. Additional switches may be incorporated in other locations on the grip.



Palm Grip P/N 366664

This unique left hand grip is designed to operate as a generic simulated fighter aircraft throttle control grip. The shape of the grip provides a comfortable hand hold and facilitates the positioning of a variety of input devices used on aircraft throttle controls; such as finger operated joysticks, thumb wheels, toggle and slide switches. Custom configurations are available in addition to existing designs.

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50 Barnes Park Road, Suite 101
Wallingford, CT 06492 USA
+1 203.949.3500

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Optional Controls for Grips

The following are some of the optional controls that may be incorporated in various control grips. They provide a vast variety of switch and thumb operated controls for maximum design flexibility.



Miniature Thumb Operated Force Type Joystick

Models 465, 467, 469 and 470 offer a variety of available features. See Page 4 for details or ask for our Miniature Joystick Catalog.



Push Button Switch P/N 701683 and 7010137

Available in momentary (P/N 701683) or alternate action (P/ N 7010137} with ratings of 5 amps, 28 VDC resistive. Meets MIL-S-8805.



Slide Switch P/N 685807

Is rated at 4 amps, 28 VDC resistive and is available in single or double pole, two or three position, momentary or maintained action.

Rocker Trim Switch Model 580

Is single pole, double throw, double break, snap action. Rated at 5 amps, 28 VDC inductive. Meets MIL-S-8805.



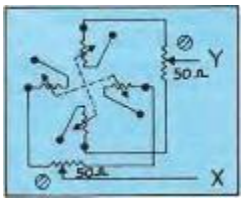


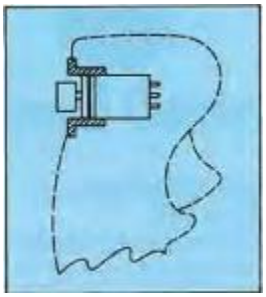
Model 465P

This miniature joystick has a special case and knob design to provide maximum protection to the cantilever beam from accidental mechanical damage. This unit can withstand more than 100 lbs. of force applied to the side of the knob. In addition, it provides relatively constant output for forces exceeding 3 lbs.

Joystick Balance Pots P/N 682545

These may be required to adjust the null voltage level on Model 465 miniature joystick. Two multi-turn pots can be mounted in a cavity on the grip for external screw driver adjustment.



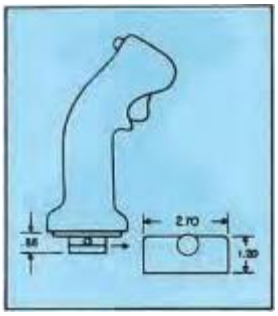


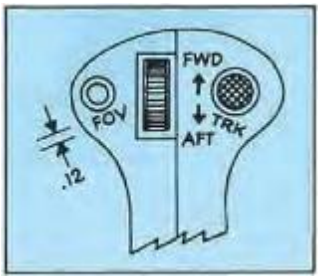
Recessed Mounting Adapter P/N 022026

For use with Model 465 thumb operated joystick. The adapter lowers the thumb knob about .25 inches into the grip shell. This provides for more comfortable operation and protects the joystick from inadvertent actuation.

Quick Disconnect Adapter P/N 021119 and Mounting Block P/N 021235

These attachments provide a quick means of using a grip control alternately mounted to a console or operated remotely on a retractable cable. A knurled thumb screw on the mounting b lock secures the grip to console when desired.





Thumbwheel Control P/N 682412

This control incorporates a knurled thumb wheel used to rotate a SK ohm, 2 Watt, infinite resolution potentiometer. This is normally mounted in the center position on grip Model 1505.



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Manually Operated, Multi-Functional

- **Custom Designs**
- **Ergonomically Designed**
- **Variety of Control and Switch Options**
- **Multi-Axis Capability**

These products are custom designed to meet specific application requirements and demonstrate our capability in providing solutions to your control needs. We can provide a variety of controls, each carefully selected and designed to interface effectively with your equipment or system.



Model 404
Four Axis Control

A ± 10 VDC output signal proportional to force applied to the grip is provided in four axes. Three mutually perpendicular axes are X, Y and Z. The twist axis, e, is rotation about the vertical Z axis. The grip is stiff, it has no perceptible motion. Operating force range for X and Y axes is 5 pounds or 20 pounds.

Model 424
Four Axis Control

A ± 10 VDC output signal proportional to force applied to the grip is provided in four axes. Three mutually perpendicular axes are X, Y and Z. The twist, e, is rotation about the vertical Z axis. This g rip moves slightly with applied force to provide the operator with a directional feel (see chart).



Model 411
Limited Motion

Force Operated Control This control Incorporates a "flexible" handle, a compact configuration with a 2.5 inch square by 1.5 inch deep base containing sensors and amplifiers. Power required Is ± 15 VDC at 60 mA. Output sensitivity is 1.9 volts per pound up to the 6 pounds maximum operating force. Total motion at the knob is .190 inches nom.





Model 426-G811
Four Axis Control

A ± 10 VDC output signal proportional to force applied to the grip is provided in four axes. Three mutually perpendicular axes are X, Y and Z. The twist axis, e is rotation about the vertical Z axis. This grip moves easily in all four axes. See chart to compare deflection with other types of controls.

Model Number	Type of Control	Force			Deflection		
		X, Y Axes	Z Axis	Θ Axis	X, Y Axes	Z Axis	Θ Axis
404	Stiff Stick	20 lbs.	40 lbs.	60 in.-lbs.	0.10 in.	0.03 in.	1° (degree)
424	Small Motion	16 lbs.	40 lbs.	60 in-lbs.	0.40 in.	0.10 in.	4° (degrees)
426-G811	Increased Deflection	10 lbs.	20 lbs.	32 in.-lbs.	0.65 in.	0.25 in.	9° (degrees)

This chart compares the force and deflection characteristics of three types of multi-axis force controls shown in this section.

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Manually Operated, Multi-Functional

Model 446-G912
Two Axis Control

This isometric (force or stiff stick) control uses a multi-position grip that includes a four-way trim switch in the center position, three momentary push buttons, a bar switch and a two detent trigger switch. The grip is stiff with no perceptible motion and will accommodate other auxiliary controls such as a thumb operated miniature joystick, push button, slide, toggle switches or a thumb wheel control. Output sensitivity is 1.0 volts per lb. Maximum force is 10 lbs.





Model 1505-G1422

This control grip features a special configuration for wall or panel mounting and incorporates immersion proof construction. Included is a thumb operated miniature joystick (Model 470LR), two push button switches and a circular type connector.



Model 544-G1159
Rotational Hand Control

This three-axis displacement joystick features a pivot point in the control grip for the Y axis and a separate pivot point for the X and 8 (twist) axis. There are different breakout and force gradients for all three axes. Deflection is ± 14° in the X and Y axes, and ± 10° in the Θ (twist) axis.

Model 541-G3403
F16 Hi-Fidelity Throttle

Included in this high-fidelity simulated throttle control is the friction adjust hand wheel, throttle grip pivot mechanism, 5K ohm potentiometer output, and grip control. This grip includes finger activated input devices to simulate one of a variety of F16 models.



Model '544-G1810
Translational Hand Control

This control is normally bulkhead mounted and incorporates a 'rail" that provides a guard and stabilizes the operator's hand thus achieving more precise control. In addition to the X and Y axis outputs, inline motion to the handle provides output signals for the Z axis. Features include precision potentiometers, rugged gimbal movement and a bellows type boot seal.





Model 541-G3580-1
F15 Hi-Fidelity Throttle

This twin lever high-fidelity simulated throttle quadrant control includes finger lifts, a throttle detent mechanism, friction adjust lever and split grip control. The grip configuration represents the F15 MSIP throttle control. A 5K ohm potentiometer provides the output for each lever.



Model 551

Deflection of the grip on this control operates a miniature, force operated joystick (Model 465) and X/Y axis direction switches. The joystick provides a maximum deflection angle of ± 15°. output is proportional to the applied force o to ± 1.40 VDC with ± 6 VDC applied.

Model 541-G665
Throttle Control

This single lever generic throttle control is suited for applications that don't require high fidelity simulated controls, but require a rugged, precision control that can be tailored to fit particular requirements. A lever guide plate is used to annunciate critical throttle positions.



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Hand Operated, with Optional Controls

- **Four Ball Sizes Available**
- **Two or Three Axis Capability**
- **Output Interface Options**
- **Uniform Tracking Force, No Preferred Directions**
- **Variable Pulse Rate Option**

A trackball is a fast and accurate, two axis manual positioning device requiring a minimum amount of operator training and skill. It is particularly well suited to tasks that require precise positioning, yet, at the same time, it is capable of being slewed quickly to a new position. The trackball assembly contains a plastic ball that is free to rotate in any direction without limiting stops. When the operator moves the ball, pick off devices resolve the ball motion into orthogonal (X and Y) components. When the ball is at rest, no outputs are produced. Factors to consider in choosing a specific trackball are: size, count per ball revolution, and the output interface.



Model 622-G607

A high reliability grade unit designed for United States FAA. Air Traffic Control applications. It is similar to a standard two inch trackball with 300 count and 40 microsecond pulse output. It has an outboard bracket mounted connector to facilitate the specific sub-panel mounting and disconnect requirements. It does not have a protective cover.

Model 615
1.5 Inch Trackball



This trackball is offered in both a military and industrial version to provide a quality input device for applications where panel space is at a minimum. A unique ball suspension design results in smooth motion with no preferred direction: as well as a much higher ball surface exposure than many larger trackballs. TTL quadrature and serial outputs are available.

Model 622-G319



Designed for medical use in CAT (Computerized Axial Tomography) X-Ray system. It is similar to a two inch trackball with 300 count and 40 microsecond pulse output, but, it is equipped with an open collector type of TTL interface. A 25 pin box mounted rectangular connector carries the input power and output signal lines.



Model 621
Low Profile Trackball

This model features a 1.5 inch diameter ball in a 3 inch square housing and a very shallow behind-the-panel depth of .750 inches. It provides a solution to those applications that have space restrictions. A cable with connector is provided.



Trackball Model 622-G452
Two Inch Trackball

This control was developed and qualified for the demanding requirements of the B-52 Program. It features extended reliability components with a special housing shielded for EMI & EMP requirements.

Model 622
Two Inch Trackball

A 15 pin pendant connector with 10 inch cable is standard. Power required· is + 5 VDC at 170 mA maximum. Standard colors are: black ball, pilot ring and case with a white Teflon seal around the ball. Measures 3.5 inches square by 2 inches deep.



Model 622-20
Digital Output



Model 622-20 is an input device for use in interactive display systems. It provides asynchronous RS- 232C compatible signals in response to operator direction commands through motion of the trackball. Optional push button switches in momentary or alternate action are available.

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TRACKBALL CONTROLS

Manually Operated, Incremental Controls



Model 623
Console Trackball

This small portable console has all the features of the 622 plus the option of one, two or three push button switches. Switches are available in either momentary or alternate action and in four colors. The standard case color is black, but other color combinations are available.



Model 626 with Switches
Three Inch Trackball

This trackball includes the same heavy duty metal chassis and 3" ball with teflon sealing ring as the standard Model 626 with the added feature of incorporating up to 3 momentary or alternate action switches. Both military and commercial versions are available.

Model 625
2.5 Inch Trackball



This rugged, all metal chassis trackball offers the advantages of a large ball in a package that _ requires only 2" of below panel space. Our ball suspension design provides a smooth motion in all directions and an increase in ball surface exposure for superior control. Output options are TTL quadrature and serial (RS232 or RS422) in a variety of formats.

Model 626-G2519-2
Three Inch Trackball



This heavy duty trackball is a good example of our custom work to customer requirements. The device incorporates 6 switches inside a special switch guard for use in an air traffic control application.



Model 625 with Switches
2.5 Inch Trackball

This popular version of the Model 625 trackball offers up to 3 switches in 3 colors. Both commercial and military grade lighted switches can be provided in either momentary or alternate action types.



Model XRT Trackball
2.5 Inch Trackball

The model XRT desktop trackball features a 2.5" high exposure ball, enclosed encoders, heavy duty metal cast housing and 20 million cycle switches. The high quality modular enclosed encoders protect the trackball from failure due to liquid spills, dust and humidity. Our unique ball/encoder 'pick off' system provide the operator with a smooth and uniform tracking force in all directions.

Model 626
Three Inch Trackball

A 15 pin pendant connector with 10 inch cable is standard. Power required is ± 15 VDC at 170 mA maximum. Standard colors are black ball, white teflon seal and grey pilot ring. Measures 4.5 inches square by 2.3 inches deep. An analog output version is available in addition to square wave and pulse output types.



Model 636
Three Axis Trackball



This control provides a third output proportional to the theta or rotational motion in addition to the normal X and Y components of ball motion. This model uses a three-inch ball and is available with a choice of output options (see chart on page 19).

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Trackball Option Features

Characteristic		615	621	622	625	626
Ball Size (Inches)		1.5	1.5	2.0	2.5	3.0
Output (See Legend Below)		Q, S	Q, S	Q, P, S	Q, P, S	Q, P, S
Max. Counts/Rev. (Fixed Rate)		500	500	564	660	444
Counts/Rev. Range (Variable Rate Serial Only)		180 – 720	180 – 720	170 – 680	130 – 520	178 - 712
Unit Dimensions No Switches (Inches)	L	2.75	3.00	3.50	3.50	4.50
	W	2.75	3.00	3.50	3.50	4.50
	H	1.09	0.77/1.42	2.07	2.07	2.30
Unit Dimensions With Switches (Inches)	L	4.50	5.00	5.00	5.00	6.00
	W	2.75	3.50	3.50	3.50	4.50
	H	1.75	1.42	2.07	2.07	3.00

Output Types: Q = Quadrature Square Wave
P = TTL Level Pulses
S = Serial RS232 or RS422

Note: The trackball features listed above are for panel mounted devices. Tabletop trackball versions are also available.

Explanation of Counts Per Revolution

The number of pulses or square waves produced per ball revolution (called count per ball revolution) is significant because it defines the resolution, slew rate and precise positioning characteristics of the trackball. We offer all trackballs with various fixed counts per revolution. For serial output models variable rate is an available option where the basic count is multiplied by 1, 2 or 4 depending on ball speed. This option combines high resolution for fine positioning with high slew rates for rapid cursor movement.

Optical Encoder Controls

Model 921 Encoder

This is a compact, bi-directional, optical, incremental encoder. Two channel, quadrature outputs are direct from phototransistors. Resolution is up to 120 cycles per revolution. This rugged encoder with perforated metal encoding disc and LED light source is used in most of our standard trackball products.



Model 925 Encoder

The small size and length of this product makes it ideal for application with space limitations. It is used in Models 615, 621 and 625 low profile trackballs. This unit is very rugged for its size. It has a .125 diameter shaft and the .625 case is machined from stainless steel. Outputs of both channels are direct from phototransistors. Resolution is 36 counts per revolution. Other counts available.



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Manually Operated, Desktop Control



Model XLT

The new XLT Trackball control from MSI culminates three decades of experience in commercial, industrial, and military applications. Until now, low cost trackball controls lacked the performance required for fast, accurate positioning and precision trackballs may have presented a cost problem. With the XLT series, MSI provides both high performance and cost effectiveness.

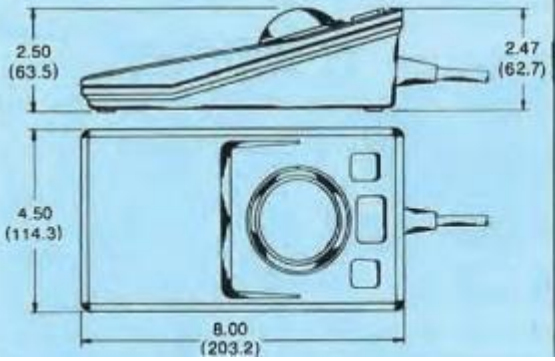
FEATURES:

- Uniform tracking force in all directions.
- Ergonomic design for optimum performance and minimum operator fatigue.
- Enclosed encoder construction provides protection from liquid spills, dust and humidity.
- High impact case material.
- High MTBF.
- Complies with UL Standard 1950 and FCC Part 15, Subpart B. Class B.

SPECIFICATIONS:

MECHANICAL

Ball diameter:	2.25"
Body color:	Light grey.
Tracking force:	30 grams nominal tangential force on ball periphery.
Weight:	1.4 lbs. max.
Outline:	See figure



ELECTRICAL

Input power:	+5 VDC ±5% at 150mA (except in self-powered applications)
Output: (Quadrature) (Serial)	200 TTL pulses ± 10% per revolution. Fixed rate: 400 pulses ± 10% per rev. Variable rate: 200-800 pulses ± 10% per rev.
Switches: (Quadrature) (Serial)	TTL level. Logic "0" when depressed. Transmitted in data format.

ENVIRONMENTAL

Switch Life:	20,000,000 Cycles
Trackball Life:	75,000 hours MTBF.
Operating temp. range:	+0 °C to +50 °C
Storage temp. range:	-40 °C to +70 °C
Humidity:	5 – 90% Operating; Non-condensing
Altitude:	0 – 7,000 ft Operating. 0 – 50,000 ft storage.

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Control/System Integration

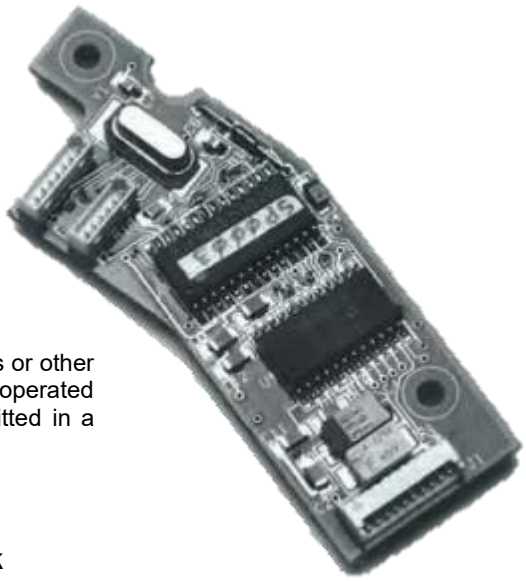


Model 4302 Serial Interface Module

This compact interface device is designed to receive input signals from a variety of MSI input controls, such as hand controllers or grip controls, and transmit output signals in an RS232 or RS422 serial data stream. The device can accommodate up to 3 analog (axis) input signals plus 4 switches and transmits position data as incremental or relative information. A variety of popular data formats can be supplied; including Microsoft or Mouse Systems.

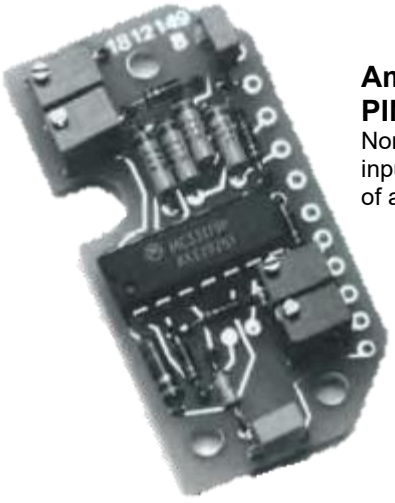
Model 4303 Serial Interface Module

The Model 4303 is the same package size as the 4302 Interface Module; however, this device can accommodate up to 7 analog (axis) input signals plus 24 switches and transmits position data as absolute position information in an 8 bit number (-127 to + 127). A version transmitting incremental information is also available



Serial Interface Circuit P/N 6816424

This miniature interface circuit is designed to fit inside our grip controls or other small spaces and provide a serial transmission for a thumb operated proportional joystick and multiple switches. The data can be transmitted in a variety of popular formats.



Amplifier Circuit for Joystick PIN 6812150

Normal operating voltage range can be amplified up to ± 10 VDC with a± 12 to 15 VDC input. The small size of one circuit card allows installation in spaces as small as the inside of a hand grip. Other amplifier circuit cards are available.

Pulse Generator Circuit (Not Shown)

This circuit converts a two axis analog input into a TTL level pulse output. Consult the factory about your specific application.

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Order /Service/Warranty

ORDERING INFORMATION

All orders are to be issued to Measurement Systems, Inc. as indicated on the quotation.

Terms
Terms and Conditions of Sale are available on our website (www.ESCOMaritime.com). Standard payment terms are Net 30 on approved credit. All customers are subject to MSI's credit worthiness determinations at the time of order placement.

Shipping Methods
Standard freight terms are FCA Wallingford, CT USA. MSI will use customer's preferred carrier and customer's carrier account. UPS and Federal Express both have daily scheduled collection at the Wallingford facility.

Drawings and Specifications
Material presented in this catalog is current at the time the catalog is printed. Mechanical and electrical requirements are subject to change. However, if either of the above is critical in the customer's intended usage, please contact the factory to verify the information or obtain the latest information.

Engineering Assistance
MSI maintains a team of technical experts who can assist you with your potential requirements. MSI will provide appropriate engineering assistance to properly define the optimum solution for your application.

SERVICE AND REPAIR

General
MSI's standard warranty is applicable to all items manufactured by MSI. Customers are expected to test/inspect our products promptly upon receipt. For items requiring either warranty or non-warranty repair, the MSI Customer Service department must be contacted for a Returned Material Authorization (RMA) number prior to return of any item. To expedite matters, provide the model number, the serial number and a full description of the problem.

Return of Units
All items returned to MSI for repair must be shipped to MSI prepaid and include a RMA number. An evaluation fee will be charged for testing and processing units that have been returned. Obtain specific shipping instructions and RMA from MSI before returning units for repair. A purchase order covering the cost of evaluation must be supplied and accepted before returning any item to MSI. An item returned without a purchase order will be returned to customer at customer cost.

Repair Costs
Warranty repairs will be made at no charge to the customer. MSI will provide our customers with an estimated cost for the repair of non-warranty units. A purchase order revision covering the costs and allowing for the quoted repair lead time will be required before repairs are made. For those items which are deemed beyond economical repair, MSI will recommend the purchase of a new unit. In the event the customer decides against repairing the unit, evaluation charges will apply.

Warranty Period
MSI warrants new units against defects in materials and workmanship for a period of one (1) year from date of shipment. Repaired units are warranted against defects on only those parts replaced or repaired and the workmanship completed for a specific problem for a period of one (1) year from date of shipment. The full terms of our warranty are defined in the Terms and Conditions of Sale available on our website. The warranty shall be void if, in MSI's judgement, the unit has been subject to misuse, negligence or accident.

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