# Humphrey 401/402 Micro Solenoid Valves

Humphrey introduces the first 10 millimeter-wide micro solenoid air valves designed and manufactured in the United States.

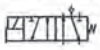
The new 400 Series direct acting micro solenoid valves feature small size, light weight, and a poppet design field proven by years of reliable service in thousands of tough applications worldwide.

Other attributes of these single or double solenoid valves are low AC or DC power consumption, electrical plug connectors, surge suppression circuit, indicator light, and manual override. They can be mounted directly in the media supply line or on two different subbases or two styles of manifolds.

Humphrey's 400 Series valves meet the challenges of new technology's demanding pneumatic control applications.

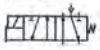
**401**

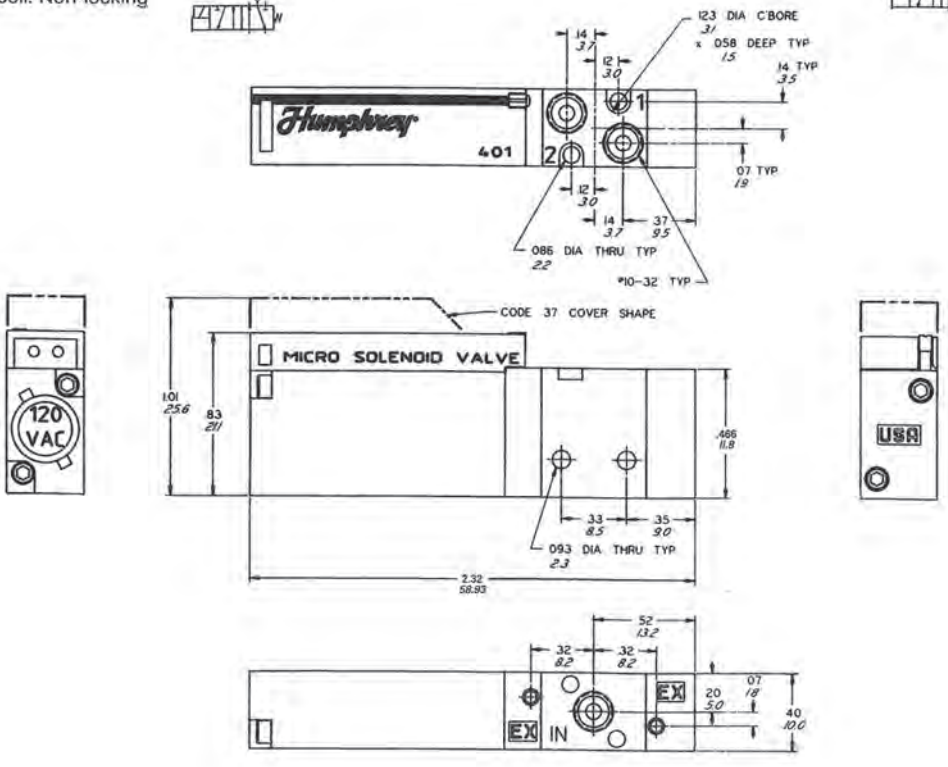
Model 401 is a 4 way, 5 port, 2 position, spring return valve. Direct acting, with a single solenoid and 12 inch lead wires exiting the solenoid cover via rubber grommet. Continuous duty coil. Non-locking manual override. 10-32 threaded IN and Delivery ports. Exhaust ports not threaded. Use in-line or with manifold (MO/MO-70) mounting.



**401-37**

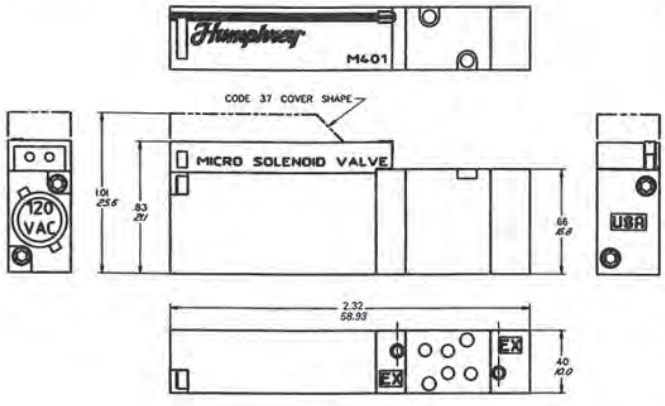
Model 401-37 is identical to 401. Electrical connector features 12 inch leads pre-wired to custom electrical plug connector which attaches to circuit board within solenoid cover. Integral red LED indicator light illuminates when power is applied to the valve.



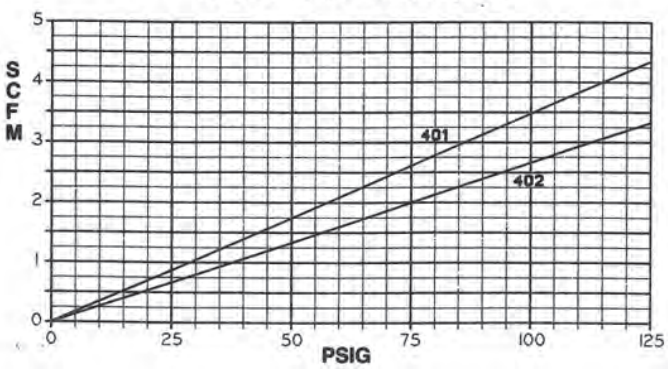


## M401

Model M401 is similar to 401. Use with subbase (SO1/SO1-70) or with manifold (MO/MO-70) mounting.




### 401/402 Air Flow To Atmosphere



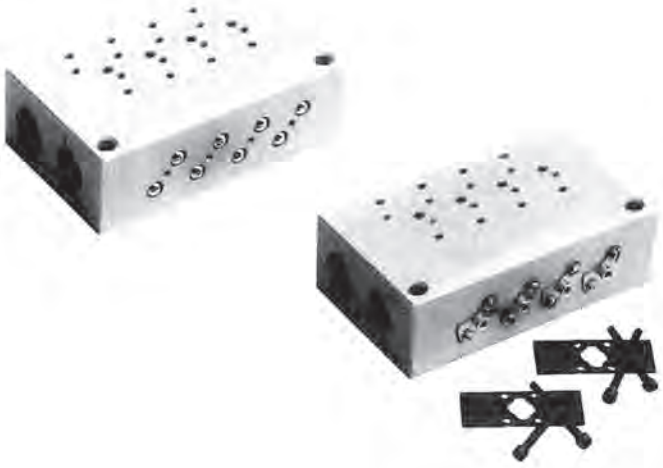

## M401-37

Model M401-37 is similar to 401-37. Use with subbase (SO1/SO1-70) or with manifold (MO/MO-70) mounting.

### Specifications

| | 401 Models |
|---|---|
| Media | Air or Inert Gases |
| Pressure Range | 0–125 PSIG (8.5 bar)/Vacuum: Consult factory |
| Ambient Temperature Range | 32 to 125°F (0 to 52°C) |
| Temperature Rise (Any voltage) | 90°F (35°C) |
| SCFM @ 100 PSIG (7.0 bar) | 3.5 |
| Cv | .05 |
| Fill.Exhaust @ 100 PSIG (7.0 bar) | |
| 1 cu. in. | .06/.10 sec. |
| 10 cu. in. | .60/1.0 sec. |
| 100 cu. in. | 6.0/10.0 sec. |
| Leak Rate (Max. allowed) | 4 cubic centimeters/minute @ 100 PSIG (7.0 bar) |
| Type of Operation | Direct Solenoid |
| Effective Area | .003 square inches (1.98mm²) |
| Stroke | .018 inches (.46mm) |
| Power Consumption (AC/DC) | 2 Watts |
| Response Time (On/Off) | .010/.005 sec. |
| Maximum Cycle Rate (Cycles/Min.) | 2400 DC (Grommet)<br>1200 AC (Code 37)<br>1200 AC |
| Voltage Tolerance | ± 10% of Rated Voltage |
| Lubrication | Not Required |
| Filtration | 40 Micron Recommended |
| Weight | 1.12 oz. (32g.) |
| Materials | Aluminum, Stainless Steel, Buna, Plastic, Steel, Brass, Urethane |
| Lead Wire | PVC Insulated hook up wire<br>UL 1007, CSA TR-64<br>300 Volts, 80°C<br>24 AWG - 7/32 Stranding |

# Humphrey MO Manifolds — MOC Manifolds



## MO MANIFOLDS

MO manifolds accept any combination of 401 or 402 valves using valve's delivery ports as cylinder ports. This simplifies plumbing and increases inventory flexibility. Made of one piece anodized aluminum and available in 2-16 stations, these manifolds have a common inlet and common captured exhaust. Manifold has no cylinder outlet ports. Valve delivery ports (1 & 2) are cylinder outlet ports. Mounting screws and gasket furnished for each manifold station. Available with optional Code 70 flow controls at each station.

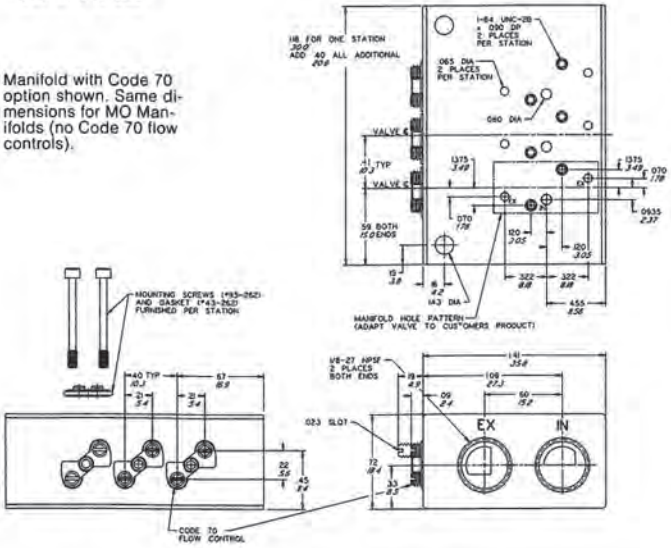
## MOC MANIFOLDS

MOC manifolds accept any combination of M401 or M402 manifold valves. Integral cylinder outlet ports (2 per station) permit valve installation or removal without disconnecting any plumbing. Made of one piece anodized aluminum and available in 2-16 stations, these manifolds have a common inlet and common captured exhaust. Manifolds have integral cylinder outlet ports (2 per station). Mounting screws and gasket furnished for each mainfold station. Available with optional Code 70 flow controls at each station.

*MO Manifold Gasket Configuration*

Gasket #43-262

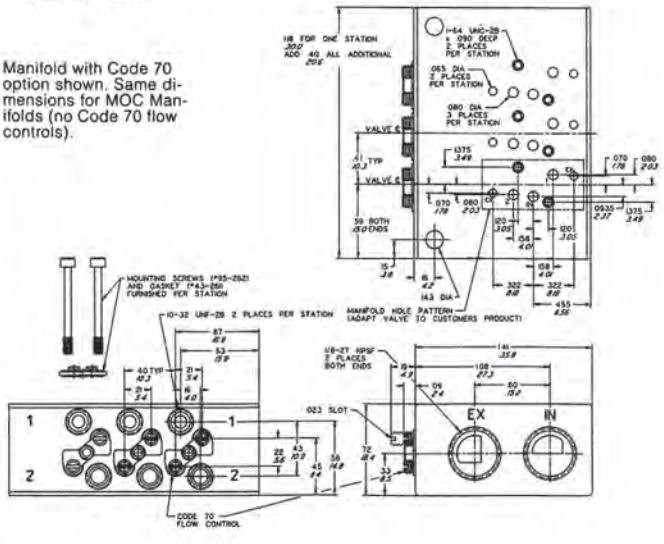
Manifold with Code 70 option shown. Same dimensions for MO Manifolds (no Code 70 flow controls).



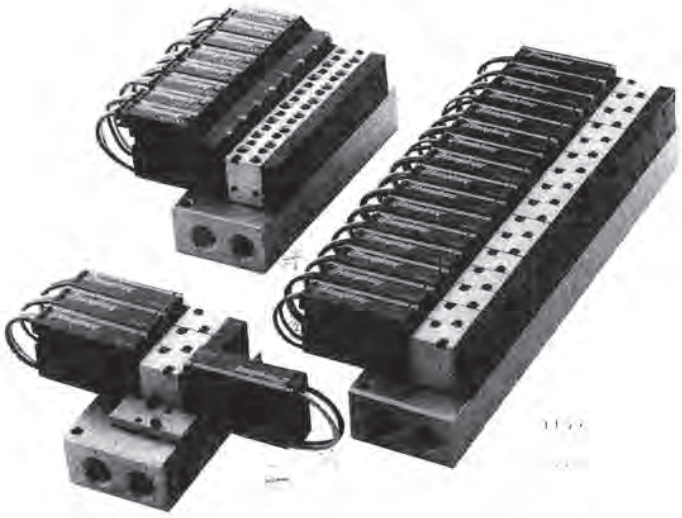

*MOC Manifold Gasket Configuration*

Gasket #43-261

Manifold with Code 70 option shown. Same dimensions for MOC Manifolds (no Code 70 flow controls).



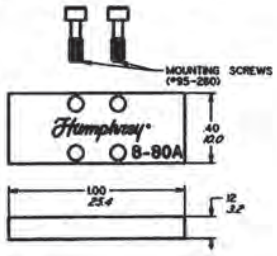
# Humphrey Block-off Plate — Valve Manifold Assemblies



401, 402, 8-80A
on MO3-70 Manifold

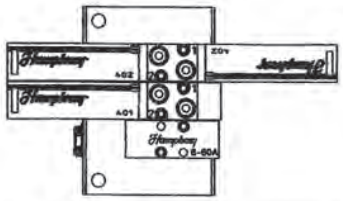
### BLOCK-OFF PLATE

Model 8-80A anodized aluminum block-off plate is used to suspend use of any station on any MO or MOC manifold. It is frequently used to permit future valve additions as related to machine option. Mounting screws furnished; use gasket furnished with manifold station. Weight: 0.07 oz. (2 gms.)

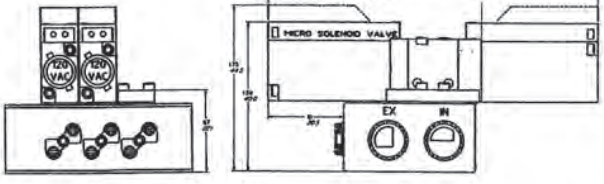


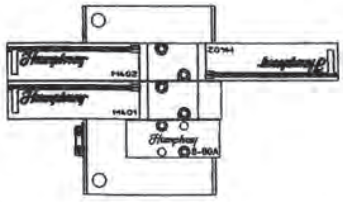

### VALVE MANIFOLD ASSEMBLIES

NOTE: Some fittings may protrude beyond valve body side requiring use of washers or shim stock to space valve away from non-manifold mounting surfaces.

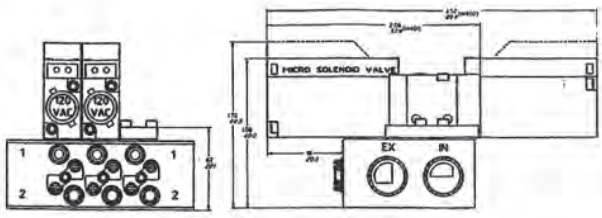


401, 402, 8-80A
on MO3-70 Manifold



M401, M402, 8-80A
on MOC3-70 Manifold




## Valve Manifold Assemblies

Manifold mounting permits convenient sub-assembly of control valves and other components for installation as a complete pneumatic control unit for the user's product. This procedure saves labor and expense by eliminating individual valve and flow control installation or service of single or multiple valves without disrupting plumbing. Manifold mounting frequently saves space and simplifies plumbing.

Humphrey's manifolds offer the added advantage of accepting combinations of both single and double solenoid valves.

The 8-80A block-off plate can be installed on any station of either manifold.

# Humphrey SO1-SO1-70 Subbase — Valve Subbase Assemblies

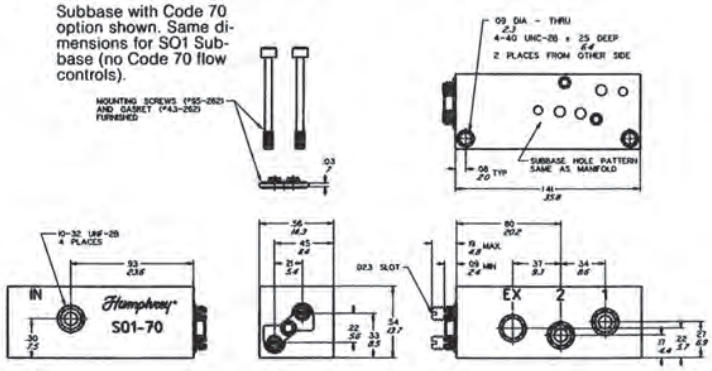
## SO1 SUBBASE

SO1 subbase permits independent mounting of any M401, M401-37, M402, or M402-37 valve. Provides any alternative to mounting valve individually with body mounting holes. Provides a permanent plumbing device and facilitates changing valves. Permits captured exhaust of single valve units. Mounting screws and gasket furnished. Weight: 0.6 oz. (17 gms.)

## SO1-70 SUBBASE

SO1-70 subbase provides the same features as SO1 subbase with the addition of Code 70 flow controls. Saves space, streamlines plumbing and reduces cost.

Subbase with Code 70 option shown. Same dimensions for SO1 Subbase (no Code 70 flow controls).

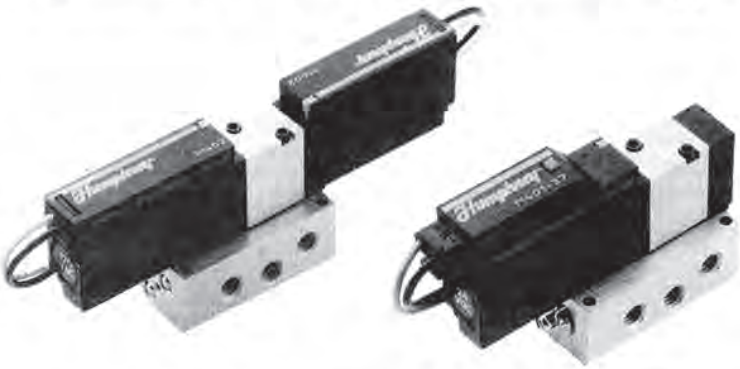



## VALVE SUBBASE ASSEMBLIES

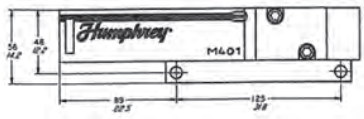
Subbase mounting provides the convenience of manifold mounting for single valve units and offers an alternative to mounting valves individually with body mounting holes. Subbases provide a permanent plumbing device which enables valves to be changed quickly without disturbing plumbing. They are also capable of capturing exhaust and can be ordered with Code 70 flow contols.

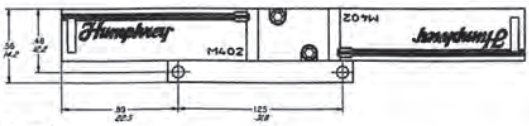
Subbases accept either single or double solenoid valves as well as the 8-80A block-off plate.

NOTE: Some fitting may protrude beyond valve body side requiring use of washers or shim stock to space valve away from non-manifold mounting surfaces.

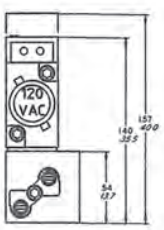


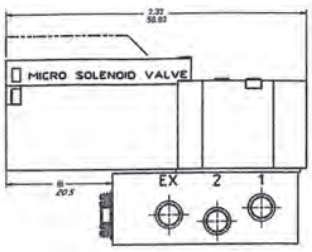
M401 on SO1-70 Subbase

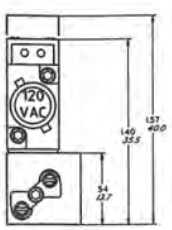


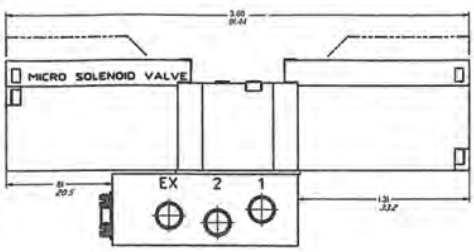




M402 on SO1-70 Subbase



## FLOW RATES/$C_v$

Humphrey recommends "fill/exhaust times," which are related to various chamber sizes, as the best method for calculating total valve and device (specifically, cylinder) response time. Humphrey recognizes the industry's use of flow coefficient $C_v$ as a comparison standard.

Consequently, Humphrey offers three types of flow data. The National Fluid Power Association's standards for $C_v$, the SCFM flow rate determined by flowing to atmosphere, and Humphrey's preferred "fill/exhaust times."

| Model | $C_v$ | SCFM @ 100 PSIG | Fill Time (Sec) (0 to 90 PSIG) Chamber (cu. in.) | | | Exhaust Time (Sec) (100 to 10 PSIG) Chamber (cu. in.) | | |
|---|---|---|---|---|---|---|---|---|
| | | | 1 | 10 | 100 | 1 | 10 | 100 |
| 401 | 0.05 | 3.5 | .06 | .60 | 6.0 | .10 | 1.0 | 10.0 |
| 402 | 0.04 | 2.7 | .07 | .70 | 7.0 | .11 | 1.1 | 11.0 |

Note: Manifolds cause some reduction of flow rates.

**Example of how to calculate fill/exhaust times:**

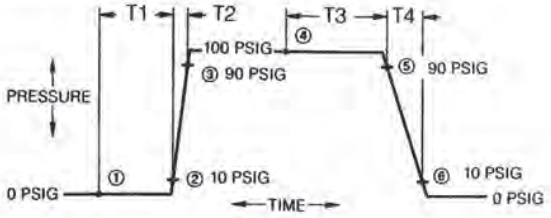
Model 401, 24VDC — Two Air Lines (0.125 I.D. x 36-inch long)
100 PSIG supply — Air Cylinder (1.062-inch bore x 4-inch stroke)
Volume = 0.785 x Diameter squared x stroke or length

| | |
|---|---|
| Cylinder Volume | = 3.54 cubic inches |
| Air Line Volume | = 0.44 cubic inches |
| Total Circuit Volume | = 3.98 or 4 cubic inches |

| | |
|---|---|
| T1 Time to Energize Valve | = 0.010 sec. |
| Time to Fill 4 cubic inches = 40% of 0.6 sec. for 10 cubic inches | = 0.240 sec. |
| T3 Time to De-energize Valve | = 0.005 sec. |
| Time to Exhaust 4 cubic inches = 40% of 1 sec. for 10 cubic inches | = 0.400 sec. |
| Total Cycle Time | = 0.655 sec.* |

*Although this result is not exact, it is sufficient for most application needs and provides a simple, straightforward system.

## RESPONSE TIMES




**Identification of response time areas:**

T1 times are measured from point [1] (valve energization) to point [2] (10% of supply pressure detected at valve outlet port).

T2 times are measured from point [2] (valve energized) to point [3] (90% of supply pressure).

T3 times are measured from point [4] (valve de-energization) to point [5] (10% of supply pressure exhausted from outlet port).

T4 times are measured from point [5] (valve energized) to point [6] (90% of supply pressure exhausted).

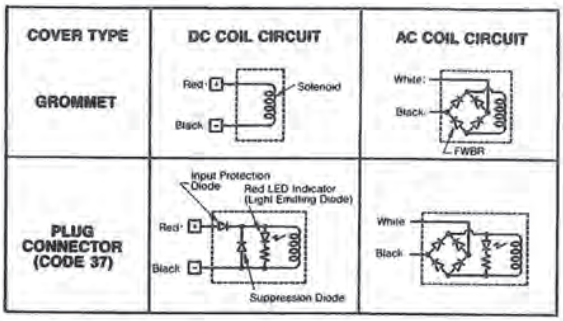
AC/DC Voltages

| Model | T1 | T2 | T3 | T3* | T4 |
|---|---|---|---|---|---|
| 401 | .010 sec. | .002 sec. | .005 sec. | .014 sec. | .005 sec. |
| 402† | .010 sec. | .002 sec. | .010 sec. | — | .002 sec. |

*DC coils with suppression diode and AC coils. Measured at 70°F (21°C) with 100% voltage and 100 PSIG supply. Times shown are median performance of valves tested.

†When de-energized, double solenoid models rely upon pressure to maintain position. Therefore, they may require longer electrical signal duration when used with larger bore cylinders, to permit pressure/flow conditions to stabilize. Transient pressure surges may cause valve shift or leak. Exercise care in selecting valve for specific application.

## SOLENOID CIRCUIT SCHEMATICS




**Cautions:**

1. Valves with plug connector (Code 37) and DC coils incorporate polarity protection. Improper voltage polarity prohibits valve operation; although no damage will result.
2. Both solenoids of couble solenoid type valves (402/M402) should not be energized simultaneously. Energizing both coils results in valve assuming an unpredictable postion.
3. External drive circuitry resulting in solenoid current leakages of greater than three milliamps (AC or DC) may cause improper valve operation.
4. Ensure proper voltage supply per voltage label, ± 10% for AC or DC voltages.

## ELECTRICAL SPECIFICATION CHART

All coils are continuous duty and conform to Class B insulation system (266°F/130°C). AC coils rated for 50/60 Hz.

| Voltage | Cover Type* Grommet | Cover Type* Code 37 | Resistance (Ohms) | Current (Milliamperes) |
|---|---|---|---|---|
| 5VDC | • | | 12.5 | 400 |
| 5VDC | | • | 8.7 | 485 |
| 12VDC | • | | 72.0 | 170 |
| 12VDC | | • | 63.0 | 180 |
| 24VDC | • | | 288.0 | 85 |
| 24VDC | | • | 270.0 | 90 |
| 24VAC | • | • | 241.0 | 95 |
| 100VAC | • | • | 4,660.0 | 22 |
| 120VAC | • | • | 6,750.0 | 20 |
| 200VAC | • | • | 18,970.0 | 11 |
| 240VAC | • | • | 27,370.0 | 10 |

*Grommet - DC has coil only. AC has coil and full wave bridge rectification.
Code 37 - DC has coil, LED, input protection and suppression diodes. AC has coil, LED and full wave bridge rectification.

Resistance and Current are nominal values.

Valve assemblies (coils, circuits, connectors, etc.) are "Hi-Pot" tested to 1,750 VAC for 1 second.

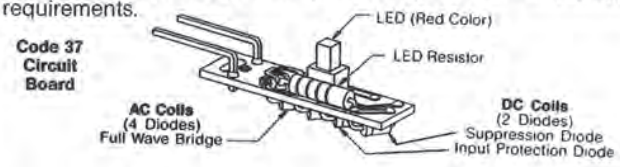
## CIRCUIT BOARD COMPONENTS

Drawing shows components incorporated into miniature circuit board used with plug connector type cover (Code 37). Circuit board is not used with grommet type cover except for AC voltages which incorporate full wave bridge diodes. Therefore, suppression and input protection diodes are furnished with Code 37 only.

Suppression diode protects other electronic components from valve's solenoid generated voltage transients ("noise").

Input protection diode prevents circuit (suppression diode/LED) damage in event of improper voltage polarity connection.

Modifications to electrical components and circuitry may be accomplished (space permitting) to satisfy a customer's unique requirements.



**401/402 Micro Solenoid Series**
**#10-32 ports, 4-way, Direct operating**

## VALVES

| | Electrical Plug Connector | Specify Voltage |
|---|---|---|
| Option Code | 37 | See Below |
| **Model 401** | SP | SP |
| **M401** | SP | SP |
| **402** | SP | SP |
| **M402** | SP | SP |

**Available Voltages**
5VDC
12VDC
24VDC
100VAC
120VAC
200VAC
240VAC

## MANIFOLDS

| | Flow Controls | Description |
|---|---|---|
| Option Code | 70 | |
| **MO** | SP | 2-16 station, annodized aluminum manifold without cylinder ports. Includes mounting screws and gasket. |
| **MOC** | SP | 2-16 station, annodized aluminum manifold with cylinder ports. Includes mounting screws and gasket. |

## SUBBASES & ACCESSORIES

| Model | Description |
|---|---|
| **SO1** | **Subbase Assemply** |
| | 1-258 Subbase |
| | 43-261 Gasket |
| | 95-262 Screws (2 req'd) |
| | 33-260 Ball (2 req'd) |
| **8-80A** | Block Off Plate Assembly |
| | 8-80 Block Off Plate |
| | 43-262 Gasket |
| | 95-260 Screws (2 req'd) |
| **SO1-70** | Subbase Assembly With Flow Controls |
| | 30-260 Retainer |
| | 90-33 O-Ring (2 req'd) |
| | 97-260 Adjusting Screws (2 req'd) |
| **PL1A** | DC Plug Connector Assembly |
| **PL1B** | AC Plug Connector Assembly |
| **28-260A** | Contacts (Box of 10)* |
| **25-260** | Connector |
| **151-11** | 1/16" Hex Drive Tool |
| **151-20** | Humphrey Handy Wrench |

*Order by quantity of boxes only.

## HOW TO ORDER

Starting with Model Number specify options in order from left to right.

Example: To Order Model 401-37 12VDC

| | |
|---|---|
| 4-Way Operation, Single solenoid | (401) |
| Electrical Plug Connector | (401-37) |
| Voltage 12VDC | (401-37 12VDC) |

Remember: Option Codes marked STD and NA are not used as part of the Model Number when ordering. N/C indicates no charge but Option Code must be included in the Model Number. OS indicates that Option must be ordered separately and is not used as part of the Model Number.

N/C = No charge
NA = Not available
OS = Order separately, additional charge for this option
STD = Standard
SP = Specify, additional charge for this option