

**SECURITRON MODEL SAM, SAM2 SHEAR ALIGNING MAGNALOCK  
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There are two Shear Aligning Magnalock families and several different installation variables exist for them. Accordingly, this manual provides a broad range of information- only some of which is applicable to any individual use. This manual guide provides a brief summary of many of the Sections which allows you to consult only the portions of the manual that apply to your application.

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This detailed reference section explains how to select wire gauge in complicated multi-lock installations.

# SECURITRON MODEL SAM, SAM2 SHEAR ALIGNING MAGNALOCK INSTALLATION AND OPERATING INSTRUCTIONS

## 1. DESCRIPTION

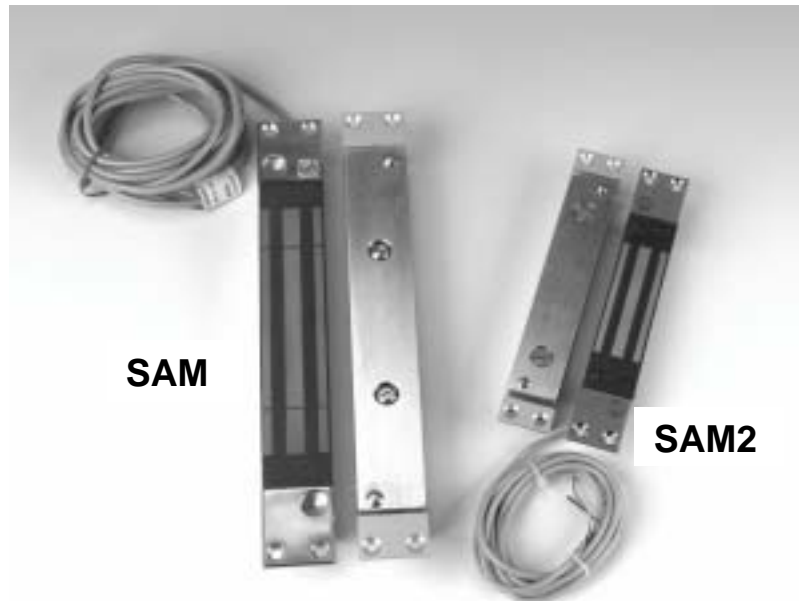
Securitron's SAM series shearlocks are intended for **concealed mounting** within the door frame and door. The SAM secures the door with **1,200 lbs (550 Kg)** of holding force while the smaller SAM2 provides **600 lbs (275 Kg)**. SAM's will function on **single or double acting** (swing through) doors and can also **secure bi-parting motorized sliding doors**. SAM's self align to secure the door when it closes and may be mounted horizontally on the top or bottom of the door/frame or vertically on the side. SAM's operate by pulling the strike plate against the magnet face when the door reaches a closed position. Their strength in the shear direction comes from a **combination of magnetic force coupled with mechanical interference** provided by conical buttons located on the strike plate fitting into machined holes located at each end of the magnet body. Adding the **suffix "M"** to the part number identifies an export version with **metric fasteners**.

**Product Specifications are:** **Input voltage:** 12 or 24 VDC. +30% overvoltage is acceptable; undervoltage proportionately reduces holding force. **Current: SAM:** 350 mA @ 12 VDC; 175 mA @ 24 VDC. **SAM2-12:** 125 mA , **SAM2-24:** 62 mA **Operating Temperature:** -40°C to 60°C, -40°F to 140°F. Note that the SAM is dual voltage but the SAM2 is supplied in two different versions respectively for 12 volt and 24 volt operation.

## 2. PHYSICAL INSTALLATION

### 2.1 SURVEY

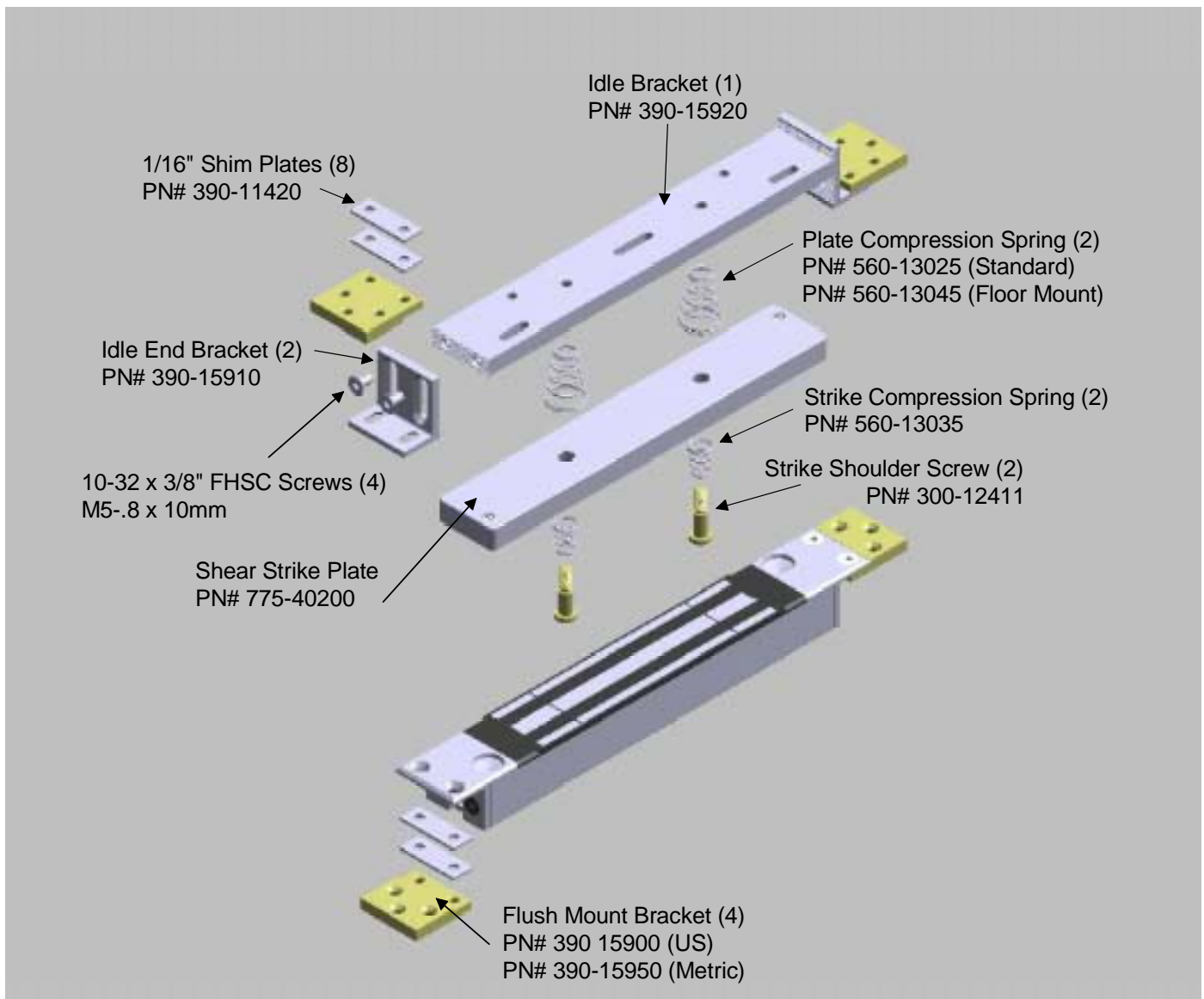
Before proceeding to installation, decisions must be made as to how the lock will mount. In some new construction situations, the door and frame will have been prepared to accept the SAM or SAM2. But otherwise, the installer must first make sure that the mortisable areas within the door frame and door **are sufficient in size** to accommodate the magnet body and strike plate. (In some cases, this will dictate selecting the SAM2 in place of the SAM.) The next decision is **whether to mount the lock on the top, side or bottom** of the door. Top mounting offers the best security against a possible impact attack. If you expect attempts to break the door open via an impact, placing the lock at the top of the door allows the door to flex, absorbing much of the impact



force. Note that if the door swings away from the protected area and is single acting (closes against a stop) an impact attack would not be anticipated as an intruder needs to pull on the door to defeat the lock.

If side mounting is chosen, security will be about the same as top mounting when the lock is positioned near to the top of the door. What is often preferred, however, in side mounting is to position the lock about half way up the frame, near to the door handle. This gives a feeling of solidity when the door is tried and by not allowing the door to flex, the risk of the door taking on a permanent bend is eliminated.

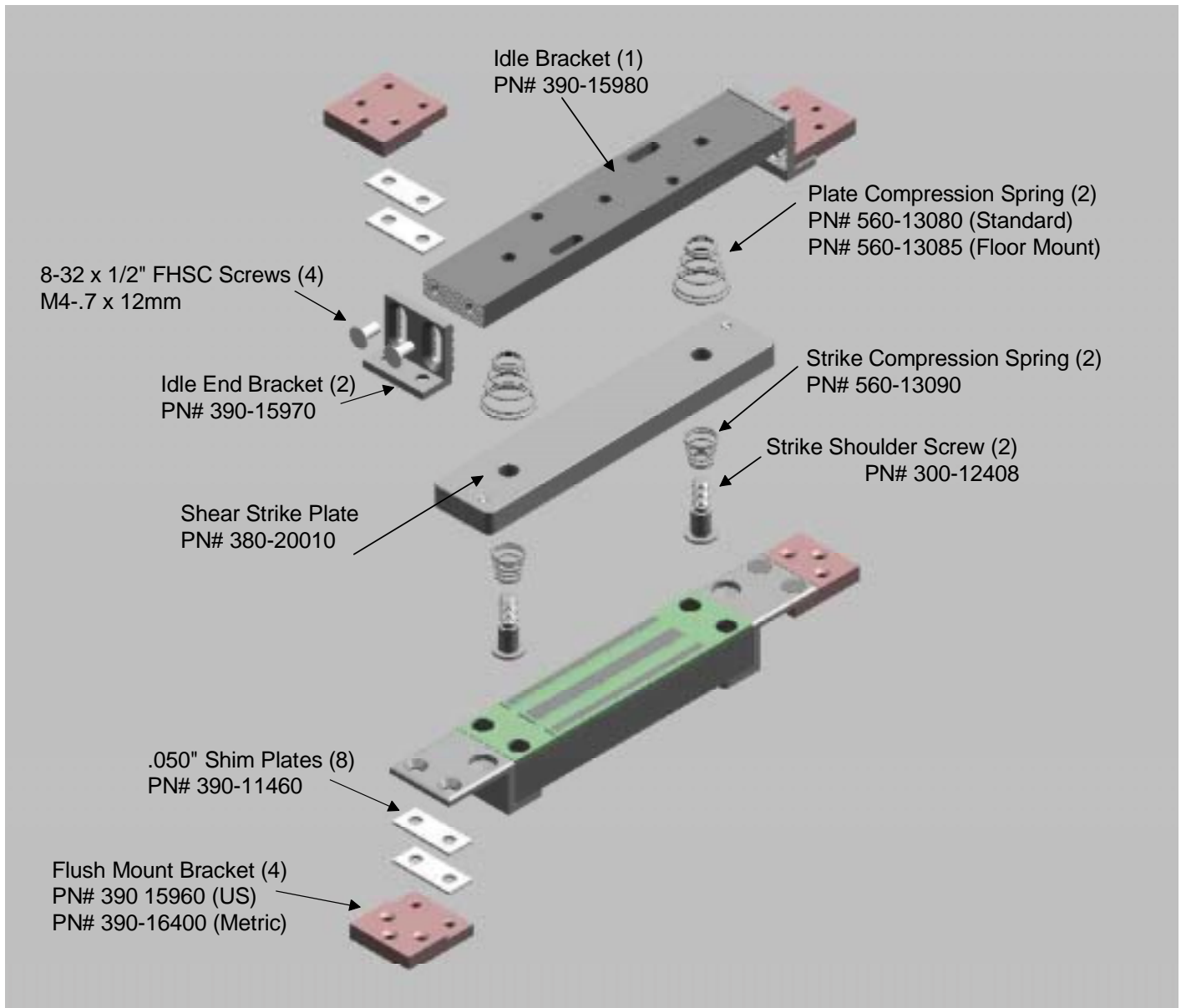
**FIG. 1: SHEAR ALIGNING MAGNALOCK ASSEMBLY (SAM)**



Bottom mounting is a last resort. It is problematical because a space must be cut into the floor and wires must be run from this point. Also dirt is able to accumulate on the magnet which can

cause a failure to lock properly if the dirt is not regularly cleaned away. Note that when you bottom mount the SAM, **you have to change two of the springs in the strike assembly** (see Figure 2).

**FIG. 2: SHEAR ALIGNING MAGNALOCK ASSEMBLY (SAM2)**



## 2.2 MOUNTING THE MAGNET BODY

The electromagnet body is mounted first in the door frame. The first step is to set the approximate position of the magnet body. **Lateral positioning** should be as close to the door edge as possible when the lock is mounted on the top or bottom of the door. **Centering the position of the magnet body** is more critical because there is not a lot of free width in the door frame and door to accommodate any centering error when the SAM is mounted. To set your

centerline in the door frame, **make sure the door is closed properly** (against the stop in the case of a single acting door or in centered rest position in the case of a double acting door). Note that the door closer may need adjustment particularly in the case of a double acting door. Then, using a pencil, trace the edges of the door on the frame indicating precisely how the door lines up under or adjacent to the frame. Measure the distance between the two “door lines” and set your magnet body mounting center line in the middle of these two lines. Next, you are ready to identify the correct template and prepare the frame to receive the magnet body.

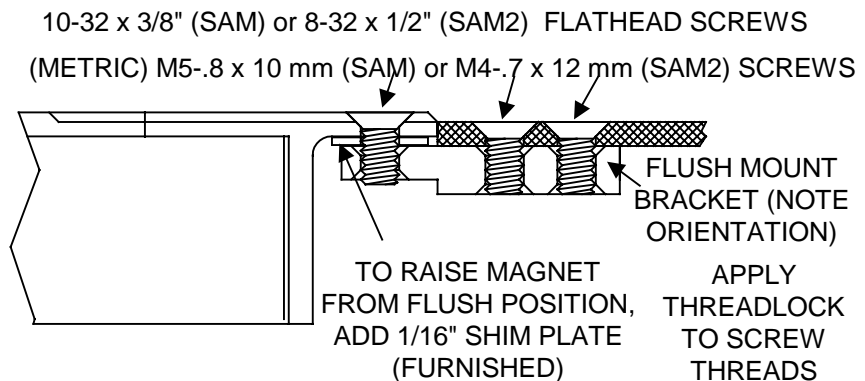
The techniques to employ depend on the type of door frame and the next three Sections cover respectively **hollow aluminum, steel and wood**. Each Section assumes that you will prepare the door frame to accept the magnet (when it has not been prepped in advance by the door manufacturer). Note that a **multi use template** has been supplied for frame preparation depending on the frame type (discussed in the following three sections).

### 2.2.1 HOLLOW ALUMINUM DOOR FRAME MOUNTING (STOREFRONT TYPE)

Following the template, a rectangular slot must be cut into the door frame. This can be done with a router or sabre saw. The slot should straddle the center line and be positioned close to the edge of the frame opposite from the hinges in the case of horizontal mounting to maintain security (the closer the lock is to the hinge side of the door, the more leverage is exerted on it when an attempt is made to open the door). However, when you determine where you will position the magnet body, **be sure that the strike will go into the adjacent area of the door** without encountering an obstacle (such as a door adjustment screw) that will interfere with mounting the strike. Then three holes must be drilled on each end of the cut-out following the template.

To actually mount the magnet once the frame has been prepared, note that it is not handed and it doesn't make any difference which end the wire exits from. You will be first attaching supplied “flush mount brackets” to the frame oriented as shown in the drawing to the right by using supplied flathead screws and the six holes you have drilled.

The flush mount brackets together with the supplied shim plates allow you to set the plane (level) of the magnet face to the frame surface. The **magnet face should protrude about 1/16” (1.5 MM) beyond the frame surface**. To achieve this, the flush mount brackets are oriented as shown in the drawing above and you will add one shim plate each. Then the magnet body is attached to the flush mount brackets via four supplied flathead screws. **Be sure to apply the supplied threadlock** to all mounting machine screw threads.

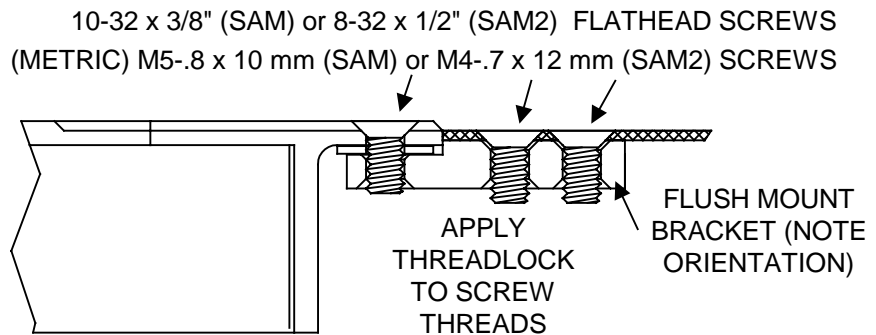


### 2.2.2 HOLLOW METAL DOOR FRAME MOUNTING (16 GAUGE)

Following the template, a rectangular slot must be cut into the door frame. This can be done with a router or sabre saw. The slot should straddle the center line and be positioned close to the edge of the frame opposite from the hinges in the case of horizontal mounting to maintain security. Also three holes must be drilled on each end of the cut-out following the template. Note that some hollow metal (steel) door frames are filled with concrete. This makes the installation more difficult (for this type of frame, it's optimum if the frame is prepared in advance

by the manufacturer with a box to accept the magnet body) but the concrete can be chipped away to eventually accept the flush mount brackets and magnet body.

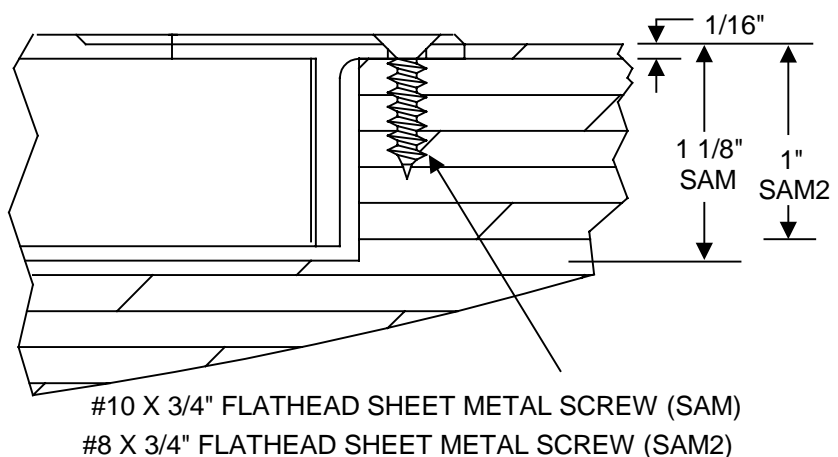
To actually mount the magnet once the frame has been prepared, note that it is not handed and it makes no difference which end the wire exits from. You will be first attaching supplied "flush mount brackets" to the frame oriented as shown in the drawing to the right by using supplied flathead screws and the six holes you have drilled. By positioning the flush mount brackets as shown in the drawing above, you can set the plane (level) of the magnet face to the frame surface so that the **magnet face will protrude about 1/16" (1.5 MM) beyond the frame surface**. This is with the expectation that the thickness of the steel is 1/16". To achieve this level, the flush mount brackets are oriented as shown in the drawing above. Then the magnet body is attached to the flush mount brackets via four supplied screws. **Be sure to apply the supplied threadlock** to all mounting machine screw threads.



### 2.2.3 SOLID WOOD FRAME MOUNTING

Following the template, a rectangular cut-out must be mortised into the door frame. The cut-out should **straddle the center line** and be positioned close to the edge of the frame opposite from the hinges in the case of horizontal mounting to maintain security. Also two holes must be drilled on each end of the cut-out following the template. Note that the drawing below shows details of the cut-out. The "step" to accommodate the end of the magnet body T bracket is **1/16" (1.5MM) deep** and the depth of the complete cut-out is **1 1/8" (28.5MM) for the SAM and 1" (25.4MM) for the SAM2**.

To actually mount the magnet once the frame has been prepared, note that it is not handed and it doesn't make any difference which end the cable exits from (the cable should be pulled upwards into the ceiling). You will be affixing the magnet body via four screws that go directly through the T brackets into the wood frame using the pilot holes you have drilled. By correctly preparing the cut-out, you will set the plane (level) of the magnet face to the frame surface



so that the **magnet face will protrude about 1/16" (1.5 MM) beyond the frame surface**. Then the magnet body is attached to the frame via four supplied flat head sheet metal screws. Note that the screws could be longer to yield a stronger result.

## 2.3 STRIKE PLATE MOUNTING

As with the magnet body, the strike plate mounting technique will vary with the type of door. There are in fact more variables with strike plate mounting because of there is greater variability of the physical situation found within doors. The various alternative techniques are shown on two templates which correspond to the following Sections. Naturally, the following Sections describe situations where the door has not been prepped in advance to receive the strike plate.

Before mounting the strike plate, however, inspect the strike assembly to understand how to configure and adjust it (see Figure 2). Note that the mount plate end brackets screw in to the idle bracket and are held at a specific level by ribbing. As factory delivered, the top of the strike plate is level with the top of the end brackets. This is appropriate for flush top aluminum doors (Section 2.3.1). and hollow metal (steel) doors (Section 2.3.4). Other door types (Sections 2.3.2, 2.3.3, 2.3.5 and 2.3.6) require altering the level of or removing the end brackets as will be explained. **The most crucial point however in strike installation is that the center line of the door cut-out for the strike must match the center line of the door cut-out for the magnet body** or the conical buttons on the strike will not seat in the machined holes in the magnet T brackets and the installation will fail.

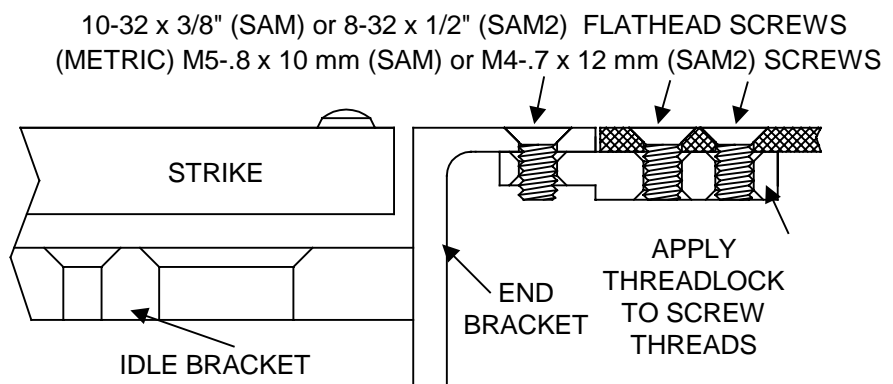
Also note that in the event you are **bottom mounting the SAM** (avoid this, where possible), the magnet body will go into the floor and the strike assembly will go into the door with the plate facing downwards. Because of gravity and to maintain optimum operation **two of the springs need to be changed** in the strike assembly when it is mounted with the strike plate facing downwards. The replacement springs are supplied in a separate bag and are clearly marked for bottom mounting only. Figures 1 and 2 will allow you to clearly identify the springs which need to be changed.

### 2.3.1 ALUMINUM DOOR MOUNTING (WITH FLUSH TOP)

“Flush top” simply means that the top (or side) of the door that you will be cutting into finishes flush. Many aluminum doors present a flat surface for routing which is recessed different distances. These situations are handled in subsequent Sections.

First, following the template, a rectangular slot must be cut into the door top. This can be done with a router or sabre saw. The slot should be positioned opposite the one that has been cut for the magnet body and centered within the door such that the strike plate will be centered on the magnet body. **Accurate centering is crucial.** Also three holes must be drilled on each end of the cut-out following the strike mounting template for this door type.

To actually mount the strike plate once you have prepared the cut-out, note that the factory set configuration of the end brackets and idle plate sets the initial level of the strike plate as shown in the drawing to the right (top of strike level with top of end brackets). From that rough position, you will make final adjustments to the level of the strike by turning the two shoulder (adjustment) screws that attach it to the sub-plate (Section 2.4 explains this adjustment in detail).

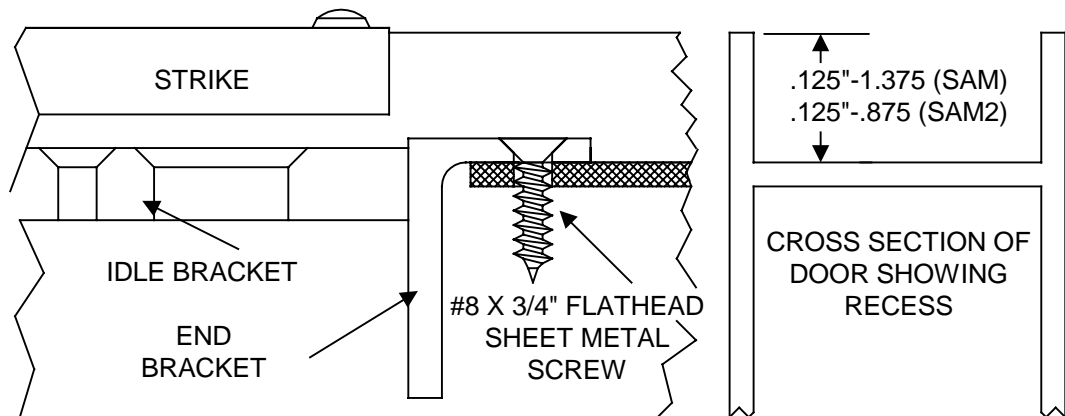


From that rough position, you will make final adjustments to the level of the strike by turning the two shoulder (adjustment) screws that attach it to the sub-plate (Section 2.4 explains this adjustment in detail).

The actual attachment between the strike assembly and the door is made via the flush mount brackets which are first attached to the door via six flathead screws using the holes in the door that you have previously drilled. To achieve this level, the flush mount brackets are oriented as shown in the drawing above. Then the strike assembly is attached to the flush mount brackets via four additional supplied flathead screws. The detail drawing above shows a side view of the proper mounting procedure. **Be sure to apply the supplied threadlock** to all mounting machine screw threads.

### 2.3.2 ALUMINUM DOOR MOUNTING (WITH SHALLOW RECESS)

“Recess” simply means that the top (or side) of the door that you will be utilizing finishes some distance below the edge of the door (as opposed to a flush top as is discussed in the previous Section). We use the term “shallow” recess in this



section because a **recess between .125” (3mm) and 1.375” (35mm) for the SAM calls for using the mounting technique shown in the drawing above. The dimensional limits for the SAM2 are .125” (3mm) to .875” (22mm).** Deeper recesses for either shearlock are addressed in the next Section.

First, following the template, a rectangular slot must be cut into the door recess flat. This can be done with a router or sabre saw. The slot should be centered and positioned opposite the one that has been cut for the magnet body so that the strike plate will be centered on the magnet body. **Accurate centering is crucial.** Also two holes must be drilled on each end of the cut-out following the template.

To actually mount the strike plate once you have prepared the cut-out, the drawing above shows you the proper way to orient and affix the strike’s idle bracket and end brackets. Note that the ends of the idle bracket are **ribbed** and match the inner ribbed surface of each end bracket. You will have to alter the position between these components from the factory set state. Set this position approximately as is shown in the drawing above. From that rough position, you will make final adjustments to the level of the strike by turning the two adjustment screws that attach it to the idle bracket (see Section 2.4 for the details of this adjustment).

The actual attachment between the strike assembly and the door is made via the end brackets as is shown in the drawing above. The end brackets are attached to the door via four supplied #8 x 3/4” flat head sheet metal screws into the holes in that you have previously drilled.

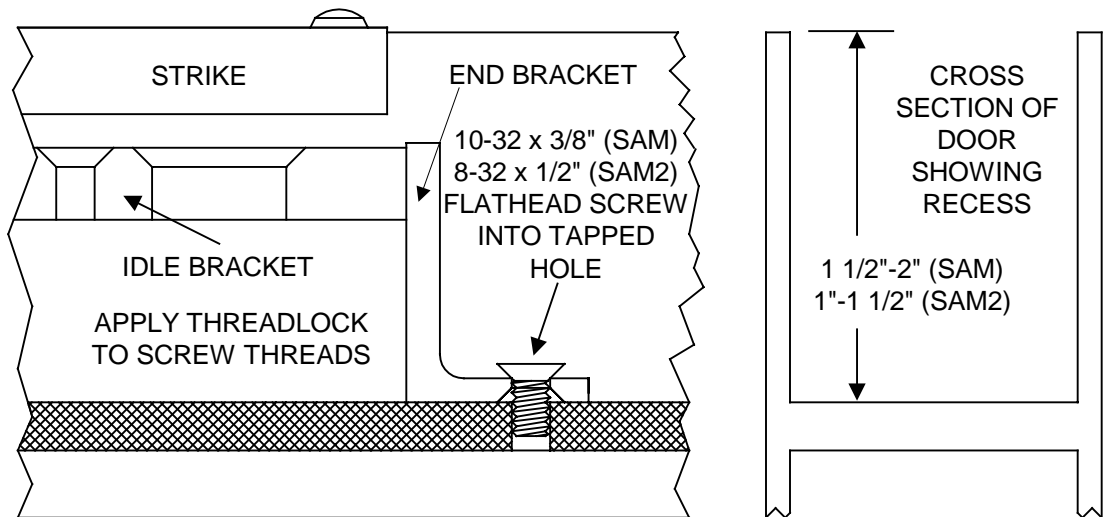
### 2.3.3 ALUMINUM DOOR MOUNTING (WITH DEEP RECESS)

“Recess” simply means that the top (or side) of the door that you will be utilizing finishes a distance below the edge of the door (as opposed to a flush top as is discussed in Section 2.3.1). **A deep recess (compared to the previous Section), is defined as between 1 ½” and 2” (38mm-51mm) for the SAM and between 1” and 1 ½” (25mm-38mm) for the SAM2.** Mounting becomes quite simple as no rectangular cut-out is required.

First, following the template, four holes must be drilled into the door recess flat. The center point of these holes should be centered within the recess and positioned opposite the center of the magnet body so that the strike plate will be centered on the magnet body. **Accurate centering is crucial.**

To actually mount the strike plate, the drawing below shows you the proper way to orient and affix the strike's idle bracket and end brackets. Note that the ends of the idle bracket are **ribbed** and match the inner ribbed surface of each end bracket. You will have to alter the position between these components from the factory set state (including flipping the end brackets). Set this position approximately as is shown in the drawing below. From that rough position, you can make final adjustments to the level of the strike by turning the two adjustment screws that attach it to the idle bracket (see Section 2.4 for the adjustment details).

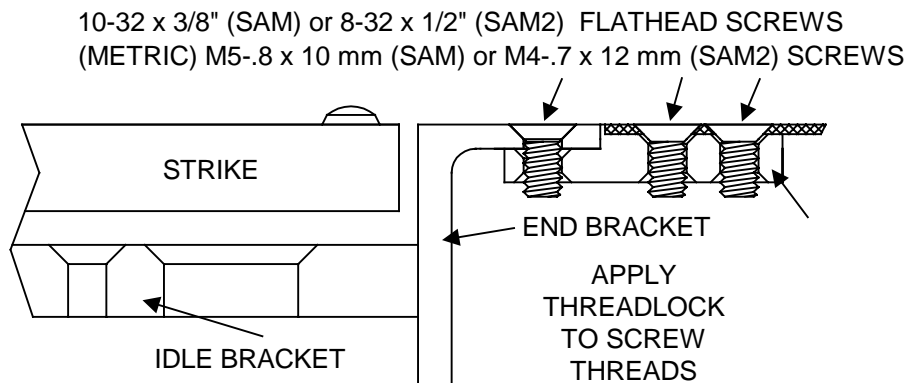
The actual attachment between the strike assembly and the door is made via the end brackets as is shown in the drawing to the right. The end brackets are attached to the door recess flat via four supplied flat head machine screws into the holes in



that you have previously drilled and tapped. **Be sure to apply the supplied threadlock to all mounting machine screw threads.**

**2.3.4 HOLLOW METAL (STEEL) DOOR MOUNTING**

First, following the template, a rectangular slot must be cut into the door top. This can be done with a router or sabre saw. The slot should be centered in the door and positioned opposite the one that has been cut for the magnet body so that the strike plate will be centered on the magnet body. **Accurate centering is crucial.** Also three holes must be drilled on each end of the cut-out following the template.



To actually mount the strike plate once you have prepared the cut-out, note that the factory set configuration of the end brackets and idle plate sets the initial level of the strike plate as shown in the drawing to the right (top of strike level with top of end brackets). From that rough position,

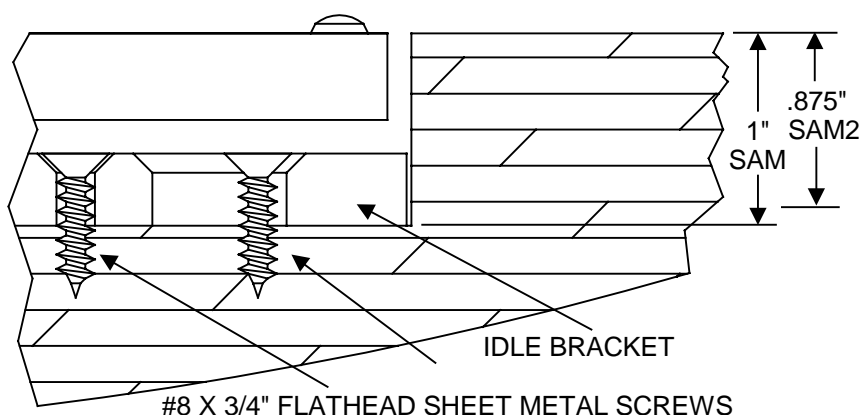
you will make final adjustments to the level of the strike by turning the two shoulder (adjustment) screws that attach it to the sub-plate. See Section 2.4 for the details of this adjustment.

The actual attachment between the strike assembly and the door is made via the flush mount brackets which are first attached to the door via six flathead screws using the holes in the door that you have previously drilled. To achieve this level, the flush mount brackets are oriented as shown in the drawing above. Then the strike assembly end brackets are attached to the flush mount brackets via four supplied flathead screws. The detail drawing above shows a side view of the proper mounting procedure. **Be sure to apply the supplied threadlock** to all mounting machine screw threads.

### 2.3.5 “HARD CORE” WOOD DOOR MOUNTING (WITHOUT USING END BRACKETS)

The strike can be mounted in a solid wood door by chiseling or routing out a rectangular recess one inch (25.4mm) deep in the case of the SAM and .875” (22mm) deep in the case of the SAM2 and running wood screws from the idle bracket directly into the door. This choice is appropriate for solid wood doors as opposed to “soft core” doors built around a rigid wood frame but with particle board or chalk on the inside..

This recess should be centered in the door and positioned opposite the one that has been cut for the magnet body so that the strike plate will be centered on the magnet body. The template also shows where to drill pilot holes for the supplied #8 x 3/4” sheet metal screws that will affix the idle bracket to the inside of the recess as well as clearance holes for the shoulder screws which adjust the level of the strike. You will, of course, have to disassemble the strike assembly prior to



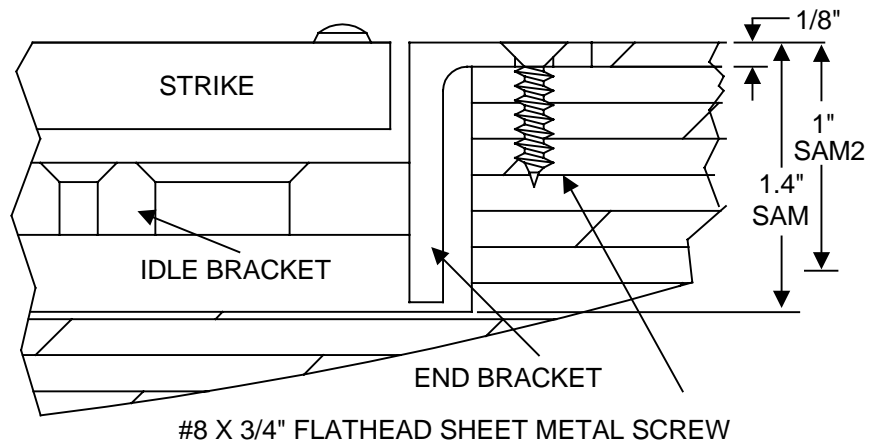
mounting the idle plate to the wood cut-out and the detail drawing to the right shows the concept. When mounting the idle plate, **first install screws through the three slots**. Doing this first allows you to move the idle plate laterally to make sure the center line of the strike is precisely aligned with the center line of the magnet body. Then you can anchor the idle plate by drilling and installing screws in the two round holes in the idle plate.

### 2.3.6 “SOFT CORE” WOOD DOOR MOUNTING (USING END BRACKETS)

This alternate method for wood doors (compared to the previous Section) employs the end brackets because “soft core” doors are built around a rigid wood frame but have particle board or chalk on the inside. **The only area where screws will hold is on the external framing**. Use of the end brackets allows the screws to function there.

This recess should be centered in the door and positioned opposite the one that has been cut for the magnet body so that the strike plate will be centered on the magnet body. The template also shows where to drill pilot holes for the wood screws that will affix the end brackets to the inside of the recess.

To actually mount the strike plate once you have prepared the cut-out, the drawing to the right shows you the proper way to orient and affix the strike's idle bracket and end brackets for this mounting requirement. Note that the ends of the idle bracket are **ribbed** and match the inner ribbed surface of each end bracket. You will have to alter the position between these components from the factory set state. Set this position approximately as is shown in the drawing above. From that rough position, you will make final adjustments to the level of the strike by turning the two adjustment screws that attach it to the idle bracket. Section 2.4 explains this adjustment in detail.

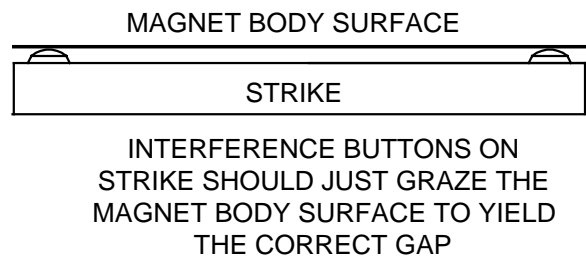


The actual attachment between the strike assembly and the door is made via the end brackets as is shown in the drawing above. The end brackets are attached to the door via four supplied #8 x 3/4" flat head sheet metal screws into the holes in that you have previously drilled.

## 2.4 FINAL ADJUSTMENT OF THE STRIKE LEVEL

At this point the magnet body and strike plate have been mounted and you will **adjust the level of the strike plate** with respect to the magnet body to assure reliable operation. The level of the strike plate surface is controlled by turning the two strike mounting shoulder screws. As factory delivered, the shoulder screws are bottomed out so you can only unscrew them and accordingly move the level of the strike towards the magnet body which is normally required given a typical door/frame gap. **Setting the gap properly is crucial for reliable operation.**

The optimum gap is 1/10" but this is difficult to measure. It is however exactly the height of the interference buttons on the strike plate so position yourself so you can visually look across the strike and magnet face and set the gap so that the buttons are just barely grazing the surface of the magnet body. Make sure that the strike surface is square to the magnet (the distance is maintained for the complete length of the assembly.) Note that at this separation distance, there can be a **slight bumping** between the conical buttons on the strike and the corresponding edges of the magnet body as the door closes. This is normal.



When you are setting the gap, note that the shoulder screws **can only be unscrewed two complete turns** which will move the strike level 1/10" (.050" per turn). If this is not enough to get the strike close enough to the magnet body (it depends on the door/frame gap), disassemble the strike assembly and reset the end bracket position with respect to the idle bracket to move the strike further outward towards the magnet body. **Each rib on the idle bracket and end bracket has a height of .050"** so each rib corresponds to one full turn of the shoulder screw.

When you have completed the installation, leave some slack in the shoulder screws for possible further adjustment by the end user who should be instructed as to how to make this simple level adjustment. It is possible that readjustment may become necessary over the life of the installation. With a horizontal mount, for example, the door may sag and thereby increase the

distance between the magnet and strike plate to the point where locking may become problematical.

## 2.5 MOUNTING ON MOTORIZED BI-PARTING DOORS

Such doors are commonly found on the perimeters of large retail stores such as supermarkets. Two doors **electrically slide open** to admit a customer. They are typically activated by a motion detector or mat. These same doors however **must allow emergency egress** in the event of a fire and the motor or wiring may be damaged in a fire, so some mechanical means must be present to permit this emergency egress. This is accomplished by the doors possessing a "**breakaway**" feature. When they are pushed from the inside with moderate force, they swing outward permitting egress.

Naturally the doors must be locked when the store is not in operation or it would be trivially easy for a thief to enter by pulling the breakaway feature open. This is conventionally done by using a key and mechanical lock but it may be electrically accomplished by using the SAM or SAM2. In this way, all doors can be automatically locked and unlocked as the store closes and opens without the need for a guard to carry a key to each door. The SAM is able to perform this function because it operates bi-directionally. The strike can slide into locking position or swing into locking position. The physical mounting techniques for this application are the same as on the equivalent hollow aluminum door (see preceding Sections).

## 3. ELECTRICAL INSTALLATION

### 3.1 GENERAL ELECTRICAL CHARACTERISTICS

SAM's constitute a low current electric load. Due to internal circuitry, they do not show the normal characteristics of an electromagnetic or other inductive load. Inductive kickback is suppressed, so arcing across switch contacts need not be a concern. This suppression also protects nearby access control or computer equipment from possible interference. Electrically speaking, the load is nearly purely resistive in nature.

### 3.2 STANDARD LOCK

For operation, DC voltage (12 or 24VDC), must be provided to the lock. The **SAM will accept either voltage** and will automatically adjust its current draw to maintain the correct power consumption (4 watts). This is **350 mA at 12 Volts or 175 mA at 24 Volts. The SAM2 is supplied in separate versions for 12 and 24 volt operation. The SAM2-12 draws 125 mA and the SAM2-24 draws 62 mA.** For either model, the red wire receives +12VDC or +24VDC, and the black wire, 0V (negative). **If the lock is connected with reverse polarity, it will not function at all.** The voltage source may be regulated, filtered or pulsating DC (transformer + bridge rectifier). **Half wave pulsating DC generated by a transformer and single diode will not properly operate the SAM's.** An exact voltage level is not necessary. Less than standard voltage will somewhat reduce holding force but will cause no harm. Overvoltage up to 30% is acceptable.

It is good practice to use power supplies with 1/3 extra capacity beyond the current requirements of the load. This greatly reduces the possibility of heat induced power supply failure and also allows for future expansion. Power supply cost is a small fraction of the job cost and should not be skimmed on.

Switches may be wired as necessary between the lock and power source. Internal circuitry eliminates inductive kickback, so neither electromechanical switches nor solid state devices will be damaged by arcing when the unit is shut off.

Note: We recommend switching the lock on the DC side of its power supply (NC contacts are used). If switched on the AC side, the power supply's output capacitor (in the case of a filtered supply) will discharge through the SAM, slowing its release.

### 3.3 AVOIDING POOR RELEASE CHARACTERISTICS

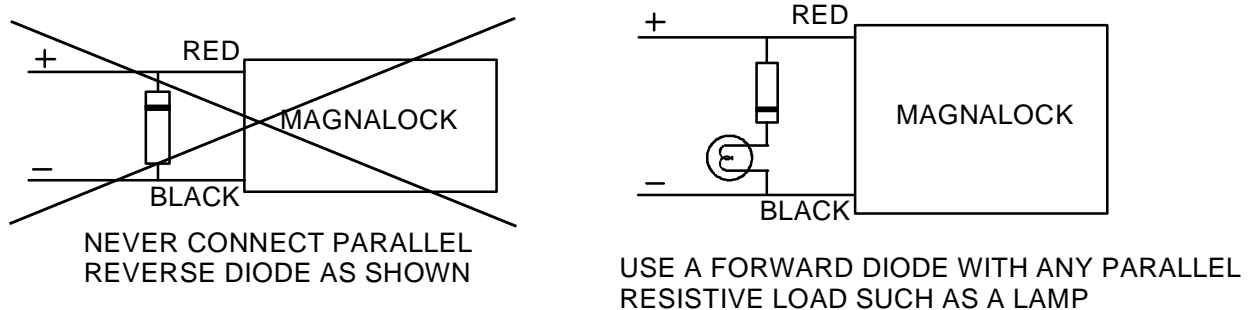
One of the exceptional features of the SAM's is quick release. This is particularly valuable when the lock is being switched off and the door is being opened at the same time as occurs when a switched exit device like Securitron's Touch Sense Bar is being used. Two separate wiring errors can however cause the SAM to release slowly (in one or two seconds) and this is annoying.

The first problem is **connection of a reverse diode in parallel with the lock's power input**. This is often done in a desire to suppress inductive kickback from a coil such as a relay coil or solenoid. SAM's already have internal inductive kickback protection, so addition of a reverse diode is pointless. The diode does act to "recirculate" current flow through the magnet coil and thereby considerably slows release. A diode should never be connected as shown in Figure 3.

The second problem is when any load is operated in parallel with the lock. A good example would be adding an incandescent lamp in parallel with the lock so that the lamp would be illuminated when the lock is powered. The lamp acts like a resistor and allows current recirculation which will greatly slow lock release time. When you want to add a resistive load in parallel with the lock, you **must put a forward diode in series with the resistive load**. This will block recirculation and restore quick release. Correct practice is shown in Figure 3 below.

A special case exists when you use an **LED connected in parallel with the SAM** (to show that the Magnalock is on for example). This does not slow release as the LED does not allow recirculation but the limited recirculation energy will eventually burn out the LED. LED's are susceptible to even a tiny amount of reverse voltage. Therefore add the forward diode as you would with an incandescent lamp (see Figure 3) to extend the life of the LED.

**FIG. 3: WIRING CONSIDERATIONS TO AVOID SLOW RELEASE**



### 3.4 WIRE GAUGE SIZING

If the power supply is distant from the lock, voltage will be lost (dropped) in the connecting wires so that the SAM will not receive full voltage. The following chart shows the **minimum** wire gauge that will hold voltage drop to an acceptable 5% for different **lock to power supply "one way" distances**. Proper use of the chart assumes a **dedicated pair of wires** to power each

Magnalock (no common negative). Note operating either lock at 24 volts is a better choice for long wire runs as four times the resistance is present compared to operation at 12 volts. Also note that the correct calculation of wire sizing is a very important issue as the installer is responsible to insure that adequate voltage is supplied to any load. In multiple device installations, the calculation can become quite complex so **refer to Appendix B for a more complete discussion.**

### CHART FOR SAM

Distance	Gauge 12V	Gauge 24V	Distance	Gauge 12V	Gauge 24V
80 FT	20 GA	24 GA	800 FT	10 GA	16 GA
200 FT	17 GA	22 GA	1500 FT.	8 GA	14 GA
400 FT	14 GA	20 GA	3000 FT	N/A	12 GA

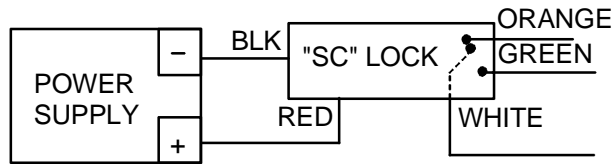
### CHART FOR SAM2

Distance	Gauge 12V	Gauge 24V	Distance	Gauge 12V	Gauge 24V
80 FT	24 GA	30 GA	800 FT	14 GA	20 GA
200 FT	20 GA	26 GA	1500 FT.	12 GA	18 GA
400 FT	18 GA	24 GA	3000 FT	10 GA	14 GA

### 3.5 "SC" SENSTAT OPTION

**Securitron's optional patented Senstat feature provides true lock status sensing and is available on the SAM but not on the SAM2.** In many electrically controlled door security systems, status sensing is provided by a magnetic switch on the door itself. This indicates the door is closed but not necessarily secured. Securitron's Senstat monitors the lock rather than the door and therefore provides higher security (but note that it can't be used as an auto-relock input to an access control system).

An "SC" SAM provides a dry SPDT output which changes state when the lock is reporting secure (**1 Amp @ 30 VDC maximum**). This is accomplished by conducting the input power of the lock through the strike and employing it to energize an internal SPDT relay. The white wire is the Senstat relay common. Green is closed to white when the lock is secure and Orange is closed to white when the lock is not secure.

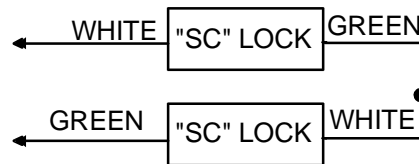
**FIG. 4: "SC" SENSTAT WIRING (SAM ONLY)**

WHITE AND GREEN WIRES PROVIDE ISOLATED CLOSURE WHEN LOCK IS SECURE.  
ORANGE AND WHITE ARE CLOSED WHEN LOCK IS NOT SECURE (AS SHOWN ABOVE).

### 3.6 DOUBLE DOOR PROCEDURE FOR STATUS REPORTING

Often two SAM's are mounted on a double door and are turned on and off together (no separate control). As to status reporting, it is of course possible to receive a separate Senstat status signal from each door or you can **combine the outputs** so that if both locks are secure, the double door is secure and if either lock is not secure, the double door is not secure.

Simply tie the white and green wires together from the two locks. A circuit will be closed between the other white and green wires only when both locks are reporting secure. If either is not secure, the circuit between other white and green wires will be open. The orange wires are not used. See Figure 5.

**FIG. 5: DOUBLE DOOR WIRING WITH SENSTAT LOCKS (SAM ONLY)**

"SC" LOCKS ARE INTERWIRED AS SHOWN TO PROVIDE STATUS MONITORING. AN ISOLATED CLOSURE WILL EXIST BETWEEN THE GREEN AND WHITE WIRES ONLY IF BOTH LOCKS ARE SECURE.

### 3.7 EMERGENCY RELEASE

Magnalocks are often wired into a system such that they can be released in an emergency -- either manually from one switch or automatically from the fire alarm system. It is the user's responsibility to accomplish this hookup correctly according to these instructions and good electrical practices. In general, we recommend that a switch or relay perform a series break of all DC power which is the simple and sure way to make sure the doors do release. Securitron power supplies have terminals for interconnection of such emergency release switches. Finally please note that **it is the responsibility of the end user and dealer/installer to insure that Magnalock installations comply with any applicable fire or building codes.**

## **MAGNACARE LIMITED LIFETIME WARRANTY**

SECURITRON MAGNALOCK CORPORATION warrants that it will replace at customer's request, at any time for any reason, products manufactured and branded by SECURITRON.

SECURITRON will use its best efforts to ship a replacement product by next day air freight at no cost to the customer within 24 hours of SECURITRON's receipt of the product from customer. If the customer has an account with SECURITRON or a valid credit card, the customer may order an advance replacement product, whereby SECURITRON will charge the customer's account for the price of the product plus next day air freight, and will credit back to the customer the full amount of the charge, including outbound freight, upon SECURITRON's receipt of the original product from the customer.

SECURITRON's sole and exclusive liability, and customer's sole remedy, is limited to the replacement of the SECURITRON product when delivered to SECURITRON's facility (freight and insurance charges prepaid by customer). The replacement, at SECURITRON's sole option, may be the identical item or a newer unit which serves as a functional replacement. In the event that the product type has become obsolete in SECURITRON's product line, this MAGNACARE warranty will not apply. This MAGNACARE warranty also does not apply to custom, built to order, or non-catalog items, items made by others (such as batteries), returns for payment, distributor stock reductions, returns seeking replacement with anything other than the identical product, or products installed outside of the United States or Canada. This MAGNACARE warranty also does not apply to removal or installation costs.

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EXCEPT AS STATED ABOVE, SECURITRON MAKES NO WARRANTIES, EITHER EXPRESS OR IMPLIED, AS TO ANY MATTER WHATSOEVER, INCLUDING WITHOUT LIMITATION THE CONDITION OF ITS PRODUCTS, THEIR MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

## APPENDIX A TROUBLESHOOTING

### **PROBLEM-- No magnetic attraction between magnet and strike plate.**

To verify no magnetic attraction, attempt to put a steel object like a paperclip or screwdriver against the magnet surface (covering at least two bars of the magnet body). It should adhere weakly. If it falls away with no adherence, you have no magnetic field. To analyze the problem, first be sure the lock is being correctly powered with DC voltage. This includes connecting the power wires with correct polarity. Positive must go to red and negative to black. If the SAM is wired in reverse polarity, it will not be damaged, but it will not operate. If the unit continues to appear dead, it must be electrically checked with an Ammeter. It must be powered with the correct input voltage and checked to see if it draws the specified current. If the unit meters correctly, it is putting out the correct magnetic field and the problem must lie with the mounting alignment in the door (see next paragraph).

### **PROBLEM-- The lock does not engage even though magnetic attraction is present.**

SAM's operate by pulling the strike plate against the magnet face when the door closes thereby seating conical buttons on the strike into corresponding machined holes at either end of the magnet body. If the buttons do not seat, the lock will not hold and should be considered **not engaged**. There are three potential causes that can produce a failure of the buttons to seat. First the mounting alignment between the strike and the magnet body can be off such that the buttons don't line up with the conical machined holes in the T brackets. To make this unlikely, the diameter of the machined holes exceeds that of the buttons by 1/8" and this provides a margin for error in mounting. A misalignment greater than this either along the long axis of the lock or in the door closing direction will cause engagement failure. You can normally visually detect such an alignment problem. Watch the strike closely as you very slowly close the door. You should see it "try" to move against the magnet body but note that the buttons are acting as stand-offs because they are not lining up with the holes. In some cases, this problem can be corrected by adjusting the door but re-mounting the unit properly is often required.

The second possible cause is that the gap between the magnet body and strike plate has widened to the point that the magnet can no longer pull the strike plate in. This can happen, for example, when the lock is mounted at the top of the door and the door sags downwards which increases the gap. Note that the gap is supposed to be 1/10" or the point at which the tops of the buttons just graze the magnet surface. If the actual gap is significantly greater than this, you have found the problem. It can be corrected by either readjusting the hanging position of the door or readjusting the level of the strike (by turning the two strike mounting screws) so as to reduce the gap to the correct dimension. The final possible cause is that the strike mounting hardware has somehow become frozen so that the strike has lost its movement ability towards and away from the magnet body. You can check this by trying to move the strike by hand with the door open. If it will not move, dismount it and clean and lubricate (or replace) the mounting hardware.

### **PROBLEM-- Reduced holding force.**

This problem usually expresses itself in terms of being able to kick the door open or to open it with a shoulder. The cause is usually a build-up of dirt or other material between the magnet body and strike. Check to see if anything is interfering with a flat fit. Even a small air gap can greatly reduce the holding force. Another possibility is if you are operating the lock on AC instead of DC or on half wave rectified DC (transformer + single diode). Half wave rectified DC is unacceptable; you must, at a minimum employ full wave rectified DC (transformer + bridge).

### **PROBLEM-- The Senstat output does not report secure.**

Because of the simplicity of Securitron's patented Senstat design, this is almost always a case of the lock status sensor doing its job. It is not reporting secure because a small obstruction or too stiffly mounted strike is causing the Magnalock to hold at reduced force. The problem is corrected by cleaning the surfaces of the magnet. If this doesn't work, you can verify function of the Senstat feature as follows. Note that there are 2 thin vertical lines on the magnet face that can be said to separate the core into 3 sections from left to right. The Senstat output is created by the strike establishing electrical contact between the leftmost and rightmost core segments. With the lock powered, use a pair of scissors and press the points respectively into the leftmost and rightmost core

segments. The Senstat output should then report secure. This shows that the problem lies in the strike not making correct flat contact with the magnet face. If the scissors technique doesn't cause the lock to report secure, check to see if there is a broken Senstat wire. If this is not the case, the lock must be returned to the factory for replacement.

#### **PROBLEM-- The lock does not release.**

When power is removed from it, the SAM releases as magnetic attraction is gone and the angles on the edges of the conical button "ramp" the strike off the magnet face. If the unit fails to release, the first possible cause to consider is that power may not have been successfully removed. This is generally a wiring integrity problem. What happens is that an upstream switch removes power from the wires going to the Magnalock, but through an installation error, the wires have their insulation abraded between the switch and lock so that partial or full power can leak in from another Magnalock or other DC device with similarly abraded wiring. This is most likely to occur at the point where the wire cable leaves the lock case and enters the door frame. Another area is via an improper splice on wiring in conduit. Either a metal door frame or the metal conduit is capable of leaking power between multiple devices with abraded wires, thereby bypassing switches. A good way to check this electrically (as opposed to visually removing and inspecting the wires) is to use a meter and check for leakage between the power supply positive or negative and the door frame and conduit. Magnalocks should be powered by isolated DC voltage without any earth ground reference to positive or negative. A second possible cause is mechanical bonding via vandalism. By mechanical bonding, we simply mean that glue has been applied between the strike and magnet as a prank. Finally, the SAM will not release if the strike plate is not able to pull away from the magnet body when power is cut. The strike may somehow have become wedged against the edge of the door. This is easily detectable by manually attempting to move the strike towards and away from the magnet body.

#### **PROBLEM-- Apparent electronic noise interference with the access control system.**

Electric locks, being inductive devices, return voltage spikes on their power wires and also emit microwave radiation when switched. This can interfere with access control electronics causing malfunctions. Access control contractors often employ installation techniques designed to isolate the access control electronics from the electric lock. These include separate circuits for the lock, shielded wiring and other techniques. These techniques will vary with the sensitivity of the access control system electronics and should, of course, be followed. Note that SAM's include internal electronics which suppress both inductive kickback and radiation. They have been extensively tested and accepted by numerous access control manufacturers and have been used in thousands of installations without incident. An apparent noise problem is therefore usually not caused by the Magnalock. The access control equipment may be itself faulty or have been installed improperly.

**IF YOUR PROBLEM PERSISTS  
CALL SECURITRON TOLL FREE  
1-800-MAG-LOCK**

### **APPENDIX B CALCULATING WIRE GAUGE SIZING**

The general practice of wire sizing in a DC circuit is to avoid causing voltage drops in connecting wires which reduce the voltage available to operate the device. As the SAM is a low power device, it can be operated a long distance from its power source. **For any job that includes long wire runs, the installer must be able to calculate the correct gauge of wire to avoid excessive voltage drops.**

This is done by adding the resistance of the Magnalock to the resistance in the power wires and then dividing the wire resistance by the total resistance. This yields the fraction of voltage drop in the wires. For example, a SAM operating on 24 volts has a resistance of 140 ohms. If the wires completing the circuit between the Magnalock and its power source have a resistance of 10 ohms, the total resistance is 150 Ohms. Dividing 10 Ohms (the wire resistance) by 150 (the total resistance) yields roughly 1/15 or 6.7%. With an input voltage of 24 volts, 6.7% of this

voltage will be dropped in the wires (1.6 volts) leaving 22.2 volts to operate the Magnalock. This will cause a minor reduction in holding force but in general, will be acceptable.

To calculate the wire resistance, you need to know the distance from the power supply to the Magnalock and the gauge (thickness) of the wire. The following chart shows wire resistance per 1000 ft (305 meters):

Wire Gauge	Resistance/1,000 ft	Wire Gauge	Resistance/1,000 ft
8 Gauge	.6 Ohms	16 Gauge	4.1 Ohms
10 Gauge	1.0 Ohms	18 Gauge	6.4 Ohms
12 Gauge	1.6 Ohms	20 Gauge	10.1 Ohms
14 Gauge	2.5 Ohms	22 Gauge	16.0 Ohms

Let's look at some other sample calculations. Suppose a SAM operating at 24 volts is 1200 ft from its power supply and we're using 20 gauge wire. First, the total length of the power wires is 2400 ft. **Remember that you combine the wire lengths from the power supply to the lock and back to the power supply to get the total circuit wire length.** The wire resistance then becomes  $2.4 \times 10.1$  Ohms which is 24.2 Ohms. Adding this to the (24V) SAM resistance of 140 Ohms yields a total resistance of 164.2 Ohms. 24.2 divided by 164.2 yields the percent drop in the wires which is nearly 15%. This is excessive. The problem can be dealt with in 2 ways. You can utilize 16 gauge wire which would reduce the drop to a more acceptable 6% range or you can provide extra voltage at the power supply (sometimes the wiring is pre-existing). For instance, Securitron 24 V power supplies are adjustable from 24 to 28 volts. If you set the power supply at 28 volts, for example, you would be supplying 14% overvoltage which would compensate for the 15% voltage drop in the wires. If the power supply is operating a number of locks, those closer the supply will receive more voltage, but the SAM will accept up to 30% overvoltage without ill effects.

Note when you operate the SAM at 12V, it exhibits **1/4th** the resistance (35 Ohms) that it does at 24 V. This means that wire voltage drops are 4 times more significant in a 12 volt system than in a 24 volt system. **In any job that has wire runs long enough to be of concern, always use 24 volts.** Note also that it's common to mount 2 Magnalocks on a double door and operate them as one lock (only 2 power wires). In this case, the resistance of the pair of locks is half the resistance of a single lock. The SAM2's are less of a concern because they draw a lot less current (roughly 1/3 of the SAM). The SAM-2-12 draws 125 mA which corresponds to a resistance of 96 Ohms. The SAM2-24 draws 62 mA for a resistance of 355 Ohms.

In multiple lock jobs with a single power supply, the calculation of wiring voltage drops is more difficult. So long as you run a separate pair of power wires to each lock, the calculation is as simple as has been described above, but if a common power wire is used in a loop structure, the locks powered by the single loop will have an increasingly low combined resistance so that the loop wire resistance will become more significant to the point where the locks don't receive enough voltage. To find the combined resistance of multiple locks powered by a common wire, divide the resistance of one lock by the number of locks. For example, eight SAM's operating at 24 volts would have a combined resistance of 140 divided by 8 which is only 17.5 Ohms. Another method is to calculate the current in Amps in the wire and divide that into the circuit voltage. Since each SAM operating at 24 volts draws .175 Amps, eight would draw 1.4 Amps. Dividing this into the same 24 volt input voltage yields the same 17.5 Ohm combined resistance.

In general, you have to be cautious about using common wires for loads in long distance situations unless you're very confident about your ability to calculate the correct configuration. Bear in mind, however, that anytime you're uncertain about the voltage drop in wiring, you can meter the voltage at the lock **while it's connected** and you will be able to see if it's receiving adequate voltage. If the lock is not connected when you make this measurement, the result will be false as the circuit will not see any lock resistance to compare to the wire resistance. You will read the full input voltage.

## PATENTS

Securitron's Shear Aligning Magnalock is covered under U.S. patent #4,516,114 and #6,007,119 with other US and international patents pending.