FAQ

Fundamentals of Solar Gate Operators and Application Ideas

As the cost of labor increases and with the increased public awareness of alternative energy sources and eco-friendly products, questions about and installations of solar powered gate operators are becoming more common. This guide is intended to help you determine if a solar operator is right for your application and how to properly specify and install the system.

FAQ #1: When is Solar appropriate?

As in everything, there are pros and cons to any system; the key is if the pros outweigh the cons. As an installer, one of the key advantages for solar is that you do not need to run high voltage all the way out to the operator. On long runs this makes solar a viable solution. The main disadvantage with solar applications is its relatively low power capacity and the need to conserve power. If you have an operator 800 yards away from the nearest power line and are thinking of going solar, but absolutely need 100% operation 24 hours a day 7 days a week in a high cycle application, you would need to take in to account the size of the battery pack required to have full capability during the night. Maybe running high voltage to the location would make more sense. Another option may be to remote locate the Linear operator power transformer near the 110V source and run 24V low voltage to the operator. It's about weighing the options. Here are some key things to weigh:

Solar Pros

Does not need line voltage
Tax breaks for solar portion of install leads to lower effective cost to customer
Works very well in sunny locations or limited duty applications
Can add solar panels in increments as application requires
Can still use many accessories

Solar Cons

Limited power availability results in limited duty cycles
High duty cycles or power requirements require auxiliary battery pack provisions
Power hampered even further by clouds or extensive night operation

Tip #1: Know your power requirements

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The main thing you're going to want to keep in mind when specifying a solar installation is what your power requirements are. When installing an AC operator, you have line power and therefore essentially an infinite supply of electrical power. Your limitations are typically the electrical service size and the wire gauge of the run. A typical residential AC supply may be 15 Amps. This times volts times 24 hours a day can get you nearly 30,000 watt hours of energy per day. This is like completely expending 12 deep cycle marine batteries every day!

When specifying and installing a solar operator, you only get the power you can harvest from the sun and store in the batteries. Just because you have a solar panel on your operator doesn't mean you have an infinite supply of energy. The amount of energy you get from the sun is largely determined by the size of your solar panel (usually measured in watts) and the amount of sunlight you get (usually measured in sun-hours). A fairly large 60 watt solar panel in Phoenix in the summer will get you about 430 watt hours of power a day. This is significantly less than the 30,000 watt hours from the AC line. You can see why a power budget is needed.

Just like your household money budget, there are two parts to the gate operators power budget – how much you take in and can save/store, and how much you can spend.

FAQ #2: What affects the amount of energy I will spend?

Many things in the gate operator system affect how much energy is required for proper operation. The single largest factor is the gate itself. Obviously, the larger the gate is, the more energy it will take to move. Equally as obvious, the more often you move the gate, the more energy is will consume. Not quite as obvious is the fact that swing gates take less energy to move than comparably sized slide gates. Swing gates don't need to move as far or operate as long and typically have less resistance in movement than slide gates; therefore they typically take less energy.

Tip #2: Generally speaking, smaller, lower duty cycle, swing gate applications are much better suited towards solar applications. Sounds like the LRA is an ideal solar operator, doesn't it?

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Of course, there are always exceptions. In windy areas, slide gates often are preferred since the wind sail area of the gate doesn't need to be pushed or pulled into the wind. Likewise, slide gates are typically preferred in areas with a lot of snow, as swing gates tend to push or snowplow standing snow (or even drifts of sand), creating high loads on the operator and the gate.

The operator system itself is the next main factor of how much energy will be used. The system includes the operator itself plus accessories like loops and detectors, photo eyes, access control, keypads, maglocks, and many others. Accessories like free exit devices, radio receivers, and keypads need to be powered all the time since they need to monitor and respond to inputs at any given time. For these types of accessories, it is suggested to use low current draw versions.

Tip #3: Use low current draw accessories for items that need to be continuously powered.

Some examples for useful items in solar applications (actual use up to the installer's discretion):

Free exit loop detectors:
Diablo DSP-6LP DSP-7LP (<1mA)
EDI LMA-1500-LP (plug in style) (<8mA)
EDI LMA-1250-LP (box style) (<3mA)

Free exit probes:
EMX CarSense 202 SLIM (<1.5mA)

Keypads:
Linear AK-11 (10mA typ)

Receivers (standby):
Delta GRD (14mA)
MultiCode 109950, 302850 (16mA)
MegaCode MGR (25mA)

Examples of current draw for other accessories:

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Free exit/reversing loop detectors:
EDI LMA-1500 (<50 mA)
EDI LMA-1250 (box style) (<50mA)
EMX Ultra D-Tek (plug in style) (<18 mA)

PhotoEyes:
EMX IRB-325 (150 mA)
EMX IRB-4X (60mA)
EMX NIR (40mA)
EMX NIR+ (28 mA)
OMRON E3JM (125mA)

Omron E3k (<420 mA @ 24V)
Albano IR55 (??)

Access Control:
Linear RE-1 (150mA standby)
Linear AE-100 (<200 mA)
Linear AE-500 (<500 mA)

Other:
Maglock (235mA @ 24V) – not recommended
Heater – not recommended

As you can see, the amount of current draw varies greatly among different types and models of gate operator accessories. What you choose to install on the machine will greatly affect the power consumption of the machine. Most solar installations should only use the bare minimum in installed accessories.

TIP #4: Use the APEX controller Low Power (LP) mode, to further reduce the current draw of the operator.

In most operators, you can either have a full set of gate controller features (mid travel stop, soft start/stop, etc) or you can have a simple low power draw controller. The Linear APeX operator enables you to have both the full feature set and low power draw. It does this by enabling the low power (LP) mode that is available on all DC operators (SLD/SWD/LRA). When the LP mode is turned on, the APeX controller will go to sleep after

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about one minute of idle. This reduces the standby current draw from about 75mA to 45mA; even less if the radio is turned off. While in LP mode, the controller shuts off all auxiliary power and ignores most of the input connection and is woken up by a few select inputs. See the following table for a complete list of functions and sleep mode status.

INPUT/TERMINAL/ INTERFACE	GROUP	FUNCTION	FUNCTION WHILE IN "LP"/SLEEP MODE
2 CHARACTER 9 SEGMENT LED DISPLAY	PROGRAMMING DISPLAY	PROGRAMMING STEP INDICATION	OFF
UP	PROGRAMMING BUTTONS	FOR ENTERING AND EDITING STEPS IN PROGRAMMING MODE	NON-FUNCTIONAL
ENTER			
DOWN			
OPEN	BUILT-IN 3 FUNCTION STATION	OPEN - CLOSE - STOP/RESET FUNCTIONS ON CONTROLLER BOARD	NON-FUNCTIONAL
CLOSE			
STOP			
16 FUNCTION/DIAGNOSTIC ROUND LED AREA	FUNCTION DISPLAY	FOR PROGRAMMING AND DISGNOSTIC INDICATIONS	OFF
INTEGRATED MEGACODE RADIO RECEIVER	RADIO RECEIVER	MEGACODE RECEIVER, 40 TRANSMITTER PLUS 2 MGT TRANSMITTERS	**FUNCTIONAL**, UNLESS TURNED OFF USING THE "RA" RADIO ENABLE/DISABLE PROGRAMMING STEP
AC N	24 VOLT INPUT	FACTORY CONNECTED TO 24 VAC FROM TRANSFORMER OR 24 VDC FROM CONTINUOUS DUTY DC SUPPLY.	**FUNCTIONAL**
AC			

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DC - DC +	ACCESSORY POWER	PROVIDES 24 VOLT DC POWER FOR ACCESSORIES. (.5A MAX)	OFF. NO DC ACCESSORY POWER IS PROVIDED FROM THE OPERATOR WHILE IN LP MODE
RESET COMMON	RESET BUTTON	FACTORY CONNECTED TO THE CONTROLLER'S RESET BUTTON.	NON-FUNCTIONAL
C B A	COMM LINK	FOR 3-WIRE NETWORK CONNECTION TO SECOND OPERATOR IN DUAL GATE INSTALLATIONS.	NON-FUNCTIONAL
COMMON SINGLE	SINGLE BUTTON INPUT	CONNECT TO NORMALLY OPEN SWITCH FOR SINGLE BUTTON OPERATION. ALTERNATES BETWEEN OPEN-CLOSE OR OPEN-STOP-CLOSE DEPENDING ON PROGRAMMING.	NON-FUNCTIONAL
COMMON FIRE DEPT	FIRE BOX INPUT	CONNECT TO NORMALLY OPEN SWITCH IN FIRE BOX FOR FIRE DEPARTMENT ACCESS.	NON-FUNCTIONAL
COMMON OPEN	OPEN INPUT	CONNECT TO NORMALLY OPEN DEVICES (KEYPAD, CARD READER, KEYSWITCH, TELEPHONE ENTRY SYSTEM) TO OPEN THE GATE. A CONSTANT OPEN INPUT WILL OVERRIDE THE MID-TRAVEL STOP AND HALT THE AUTO CLOSE TIMER UNTIL RELEASED.	NON-FUNCTIONAL

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OPEN CLOSE COMMON STOP	3-BUTTON STATION INPUT	CONNECT TO 3-BUTTON STATION FOR OPEN-CLOSE-STOP CONTROL. A CONSTANT OPEN INPUT WILL OVERRIDE THE MID-TRAVEL STOP AND HALT THE AUTO CLOSE TIMER UNTIL RELEASED.	NON-FUNCTIONAL
COM	OBSTRUCTION INPUTS	CONNECT TO NORMALLY OPEN DEVICES (GATE EDGE, PHOTO BEAM) TO DETECT AN OBSTRUCTION DURING OPENING. WHILE GATE IS IN MOTION, ANY OPEN OBSTRUCTION SIGNAL WILL CAUSE THE GATE TO STOP, REVERSE A SHORT DISTANCE, AND THEN STOP AGAIN. AT THIS TIME THE AUTO CLOSE TIMER IS DISABLED AND A RENEWED INPUT WILL BE REQUIRED TO START THE GATE AGAIN. SHOULD THE GATE BE RESTARTED AND THE OBSTACLE SIGNAL OCCUR AGAIN PRIOR TO REACHING A LIMIT, THE GATE WILL STOP AGAIN, LOCKOUT, AND SOUND THE EMERGENCY ALARM.	NON-FUNCTIONAL
O-OBS			
C-OBS COM		FUNCTIONS THE SAME AS THE OPEN OBSTRUCTION, EXCEPT IN THE CLOSING DIRECTION.	

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COM REV	REVERSE	CONNECT TO NORMALLY OPEN DEVICES TO CAUSE A REVERSAL WHEN THE GATE IS TRAVELING CLOSED. THE GATE WILL REVERSE TO THE FULL OPEN POSITION.	**FUNCTIONAL**
OPEN LOOP	PLUG-IN LOOP DETECTORS	10 PIN CONNECTORS FOR PLUG-IN STYLE LOOP DETECTORS	NON-FUNCTIONAL
REVERSE LOOP			**FUNCTIONAL**
SHADOW/RESET LOOP			NON-FUNCTIONAL
OPEN LOOP OPEN LOOP	OPEN LOOP	CONNECT TO OPEN LOOP/FREE EXIT LOOP. THE GATE WILL OPEN WHEN THE LOOP IS TRIGGERED, AND REMAIN OPEN AS LONG AS THE LOOP IS TRIGGERED. REQUIRES LOOP DETECTOR	NON-FUNCTIONAL
REVERSE LOOP REVERSE LOOP	REVERSE LOOP	CONNECT TO REVERSE LOOP. TRIGGERING THE LOOP WILL CAUSE A REVERSAL WHEN THE GATE IS TRAVELING CLOSED. THE GATE WILL REVERSE TO THE FULL OPEN POSITION. REQUIRES LOOP DETECTOR	**FUNCTIONAL. THE LOOP CONNECTION PASSES THROUGH TO THE PLUG-IN DETECTOR**
SHADOW/RESET LOOP SHADOW/RESET LOOP	SHADOW/RESET LOOP	CONNECT TO SHADOW/RESET LOOP TO KEEP THE GATE IN ITS FULLY OPEN POSITION AS LONG AS THE SIGNAL IS PRESENT. USED TO KEEP GATE OPEN WHILE VEHICLE IS PASSING THROUGH.	NON-FUNCTIONAL

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		REQUIRES LOOP DETECTOR	
- +	ALARM	FACTORY CONNECTED TO THE ALARM BEEPER.	NON-FUNCTIONAL
N.O. COM N.C.	AUX RELAY	FOR CONNECTION TO AUXILIARY DEVICES (MAGNETIC LOCK, SOLENOID LOCK, STROBE LIGHT) FOR ACTIVATION (OR DEACTIVATION) DURING GATE OPERATION.	NON-FUNCTIONAL
+ -	24 VOLT SOLAR PANEL	FOR CONNECTION TO 24 VOLT SOLAR PANEL FOR BATTERY CHARGING.	**FUNCTIONAL**
+ -	24 VOLT BATTERY	FACTORY CONNECTED TO BATTERIES IN DC MODEL OPERATORS.	**FUNCTIONAL**

Tip #4: The APeX controller is woken up from LP mode by one of three events: a Megacode radio signal, a reversing input signal, or reversing loop detector signal.

Specifically, a learned in MegaCode radio code will wake the operator and cause it to start opening. A non learned in MegaCode code transmission, the reversing input, or the reversing loop will all only wake the operator and be ready for subsequent commands. These three features can be used in a multitude of creative ways depending on the application. When awake, the APeX controller functions in normal fashion.

Idea #1: When a fire department knox box is required for the low power mode installation, you can connect the fire department terminal input and the reversing input with a diode on one leg of the connection. On a fire key usage, this will wake the operator (via the reversing input) and give it a fire department open command. This same method can be used for open inputs, and single button inputs.

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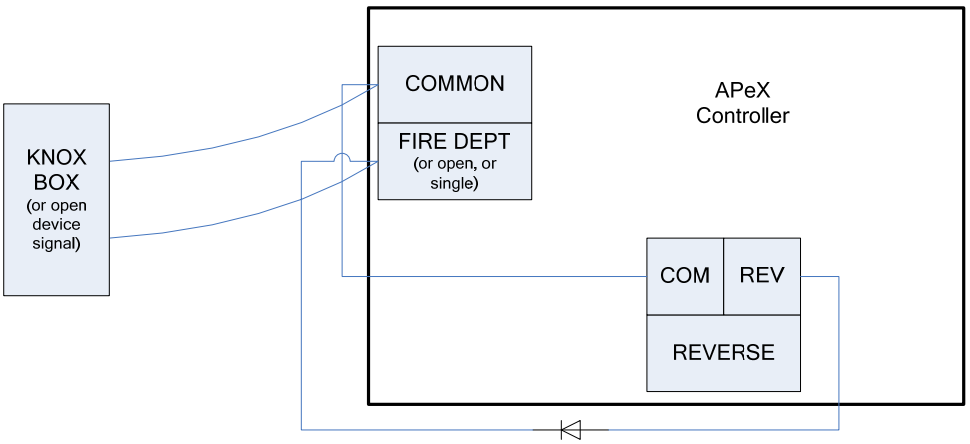

Idea #2: On a dual gate application, you can learn in the MegaCode transmitter into one of the two controllers. The MegaCode radio transmission will cause the controller with the learned transmitter to wake up and start opening, the other controller will only wake up, but will receive the open command communication from the first controller and start opening.

Idea #3: There are several ways you can issue an open command from a loop while the operator is asleep for use as a free exit loop.

Idea #3a: The first is to use a low power loop detector – it doesn't have to be a plug-in style – that is directly powered off the battery and connected to the open loop. Connect the relay output on the detector to the open input on the APeX controller and then diode connect that to the reversing input per Idea #1 above.

Idea #3b: For a free exit using a loop and a plug in loop detector: Use a plug in loop detector with two channel outputs (Linear plug in loop detector, EDI LMA-1500, or 1500-LP) and activate the second channel to an output on vehicle entry (DIP 4 and 5 to ON). Plug the detector into the reversing loop input (this is the only one powered during sleep mode). Connect a wire between the lug next to the detector to the open input. Upon loop detection, this will wake up the controller as well as issue an open command.

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Idea #3c: Another option is to attach a MegaCode transmitter with wires jumpered from one of the transmitter buttons (i.e. Linear P/N ACP00933) to the relay output of the detector. In these cases, the open loop is always on (powered by the battery) and will wake the operator up upon detection via the MegaCode radio receiver. The same can be done with a probe detector.

Idea #4: For controlled entry using wired entry devices, you can put a reversing loop near the entry device (keypad, etc) and have the entry device powered by the operator. When the operator goes into low power mode, the entry device will not be powered. When a vehicle approaches the entry device, it will be sensed by the reversing loop, thus waking up the operator and powering the entry device (and any other accessories like photo eyes attached) for normal (battery powered) use. Remember to account for the current draw of the entry device when awake during any energy and power calculations.

Idea #5: Photo eyes can be used on a solar operator in LP mode. The photo eyes are not powered while the operator is sleeping. However when the operator is awake and operating, the photo eyes are powered and operating as normal. Remember to account for the current draw of the photoeyes when awake during any energy and power calculations.

FAQ #3: What affects the amount of energy I can take in and store?

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The amount of energy you can take in to the solar operator system is determined mainly by two things. The size of the panel, and the amount of sun you get. The size of the panel, usually measured in watts, is an indication of how much energy can be converted in full sun. If you have a 40 watt panel, but it's usually cloudy, you can't figure on usually getting 40 watts. In this case you need to specify larger panels to make up for this.

Obviously, the amount of sun you get will depend on the panel location. Phoenix locations will get more sun than Minneapolis. The solar calculator includes sun-hour values for many US locations. Alternately you can use other publicly available solar insolation numbers. Of course, don't locate the panels in a place that might get shade either. It is also recommended to mount the panel facing south so that you get maximum exposure during the shorter winter days.

Another often overlooked factor in how much energy you can take in a store is the charge control circuit. Energy coming from the panel needs to be controlled so it can be stored in the batteries. Most operators have either a built in charger or offer a separate charger board for this purpose. The Linear APeX gate controller includes a battery charger that properly controls the charge process in order to make the batteries last as long as possible. This charger circuit has a maximum output of 1A at 24VDC. So if you calculations show that you need to be able to charge the batteries from the solar panels at some rate larger than 1 Amp in order to recover from the anticipated operator usage, the built in APeX charger will not be able to charge fast enough. A separate charging system will be needed in order to charge the batteries.

The amount of energy that you can store is determined primarily by the size of your batteries. The Linear solar compatible operators, SLD/SWD/LRA, all come with 2 – 12V 7 amp-hour batteries. These can store a total of 168 watt hours of energy. If you calculate that you need to store more than 168 watt hours of energy, it is suggested to place these batteries in a separate enclosure.

Last but not least -

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Tip #5: You can use solar as a green upsell.

There is a government stimulus program that allows the homeowner to deduct 30% of the cost of the solar (or other alternative energy source) part of the installation as a tax credit. This includes the material and labor of the solar portion of the installation.