

INSTRUCTION MANUAL

High Voltage Electric Security Fence Voltage Monitor

Installation
Setup
Maintenance
Troubleshooting

TABLE OF CONTENTS:

- **Page 2: Table of Contents**
- **Page 3: An Electric Fence Overview**
- **Page 4: Fence Hawk**
- **Page 5: Description of Operation & Controls**
- **Page 6: Setup for Your Fence**
- **Page 7**
- **Page 8:**
- **Page 9: Adjustments and Setup**
- **Page 10: Installation Suggestions and Reasons Thereof**
- **Page 11: How to Install with a Fence.**

Eliminate False Alarms ... An Electric Fence that does NOT False Alarm

Secure your property without false alarms

A high voltage electric fence, when used for security applications, has to operate with flawless discrimination, and utilize all the security precautions that all security and commercial alarm systems employ.

The solution for using a high voltage electric fence for perimeter security turns out to be a combination of the reliability of older and proven technology coupled with the versatility and innovative use of newer technology and design.

Reliability of operation **without false alarms** is the only viable solution and defines the end goal. An intrusion barrier that cannot be compromised is also a critical part of the solution.

An Electric Fence Overview

A well designed high voltage electric fence is an extremely effective enclosure and/or barrier. However, when the fence is employed for or against human encroachment, an animal containment fence **will not** suffice by itself.

When used in a security environment the voltage on the fence has to be continuously monitored and analyzed for any encroachment that may occur.

False alarms are the weak link with any HV electric fences when used as a security barrier against humans and some animals. All electric fences are huge antennae that will generate spurious pulses from a myriad of sources including nearby lightning strikes and voltage surges which translates to false alarms with current fence voltage monitors. Local authorities do not like to spend time and money to respond repeatedly to these false alarms.

While the big market for HV electric fences are animal containment which number is the many millions. Electric fences that are used for security applications number only a few thousand because of the simple fact that they false alarm, hence, security is not considered a problem for most electric fence component manufacturers, and therefore not addressed for this minor market.

However, now available is the **FENCE HAWK Plus**. This high voltage fence monitor keeps continuous track of the health and status of your fence, and has been engineered and designed especially for the high voltage security fence and can filter out the false alarms that plague every other fence voltage monitors.

This unit **does NOT** false alarm and is stable in essentially any environment. It simply works as described and is compatible with all HV electric fence chargers with the added advantage of providing an alert when the undergrowth reduces the effective voltage of your fence.

Offering reliable security solutions

Fence Hawk +

Description:

Most (non-lethal) high voltage (HV) electric fences are barriers designed and installed for livestock containment.

Electric fences are generally not used for serious security barriers because of the tendency to produce random “false alarm”. When any security device false alarms (cries “wolf”) too frequently it is considered essentially worthless as a security device.

Since most electric fences (literally millions) are used in livestock containment, false alarms are not considered a problem as most are not monitored for operation, and as long as the fence voltage goes back to normal within a few minutes its not a big deal.

However, an electric fence monitor that does not “false alarm” (THAT DOES **NOT** FALSE ALARM) from random natural causes is a **critical requirement** for any HV electric fence that is used in any security environment.

A high voltage electric fences consists of one or more electrically charged wires or conductors that are connected to a voltage source that produces a direct current pulse usually between 3,000 and 15,000 volts.

A high voltage pulse, as developed for automotive spark plugs, while painful when applied to an animal, including humans, is not lethal. Every automotive mechanic has been shocked multiple times with this voltage, but none has ever been actually injured from the shock, and most would not voluntarily submit to being shocked as the result is painful and extremely unpleasant.

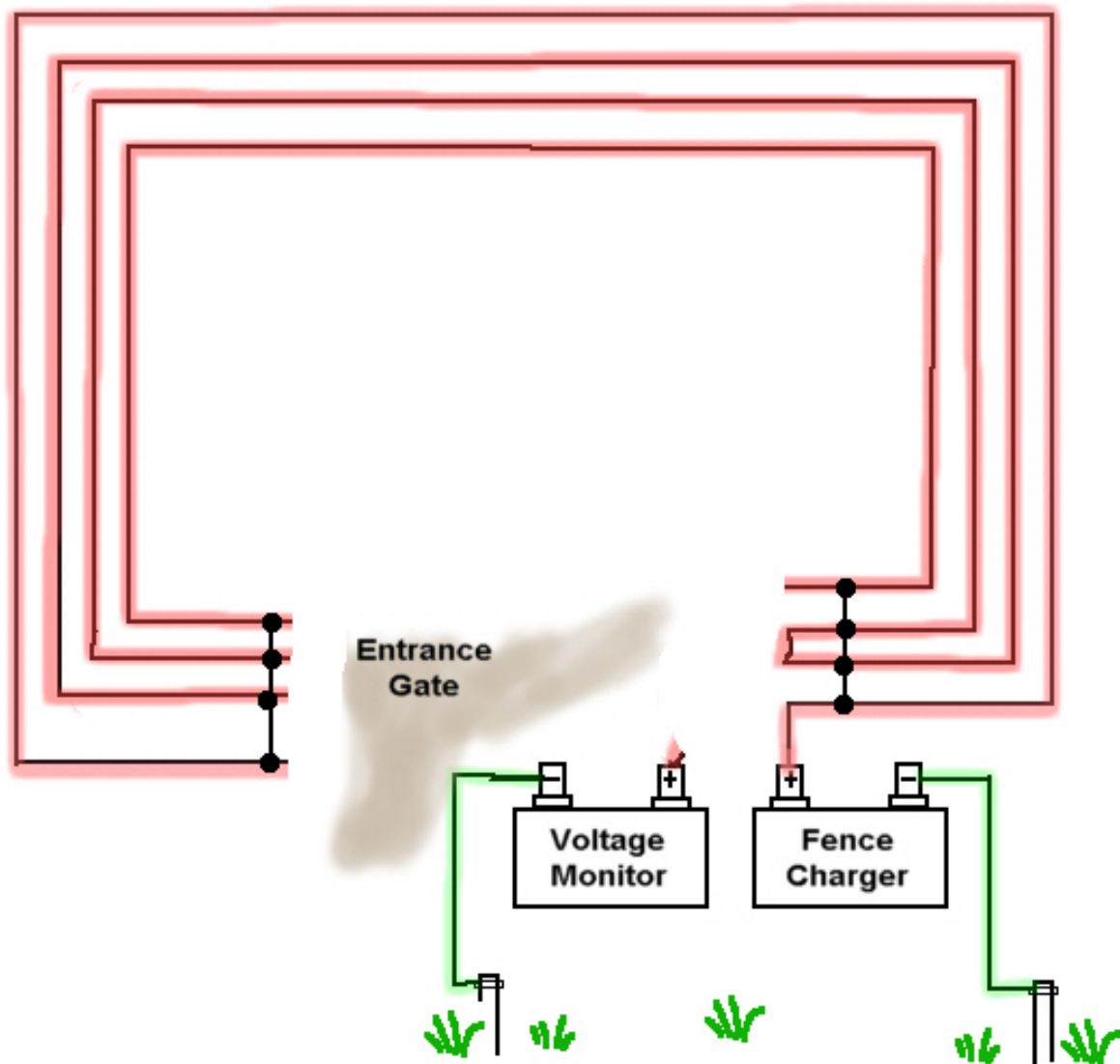
The **Voltage Source** (high voltage electric fence charger) for non-lethal fences are sold and furnished by many manufacturers throughout the world. Commonly known as a high voltage “fence charger” this item produces a single pulse of essentially direct current (DC) voltage, usually at a standard repetition rate of one pulse every second, while your car spark plug electrics will produce many pulses every second. The fence voltage pulses delivered will range between 3-4,000 volts to over 15,000 volts.

The standard electric fence charger generates one pulse per second which is the “non-lethal” standard around the world whether you are fencing elephants or baby chickens, and basically “non-lethal” to animals including humans.

The actual high voltage pulse that does the work is extremely short, and in the neighborhood of 0.000005 seconds (5 micro-seconds) to upwards of 0.000200 seconds (2-300 micro-seconds).

The actual design and construction of any electric fence will depend on the end use of the fence. By contrast, an automotive spark plug operates at 20,000 volts to over 30,000 volts at idle and the electric pulse of the spark plug is more than several times the power and voltage one would encounter with a non-lethal electric fence.

The standard way to interconnect the high voltage wires on any fence is shown below.

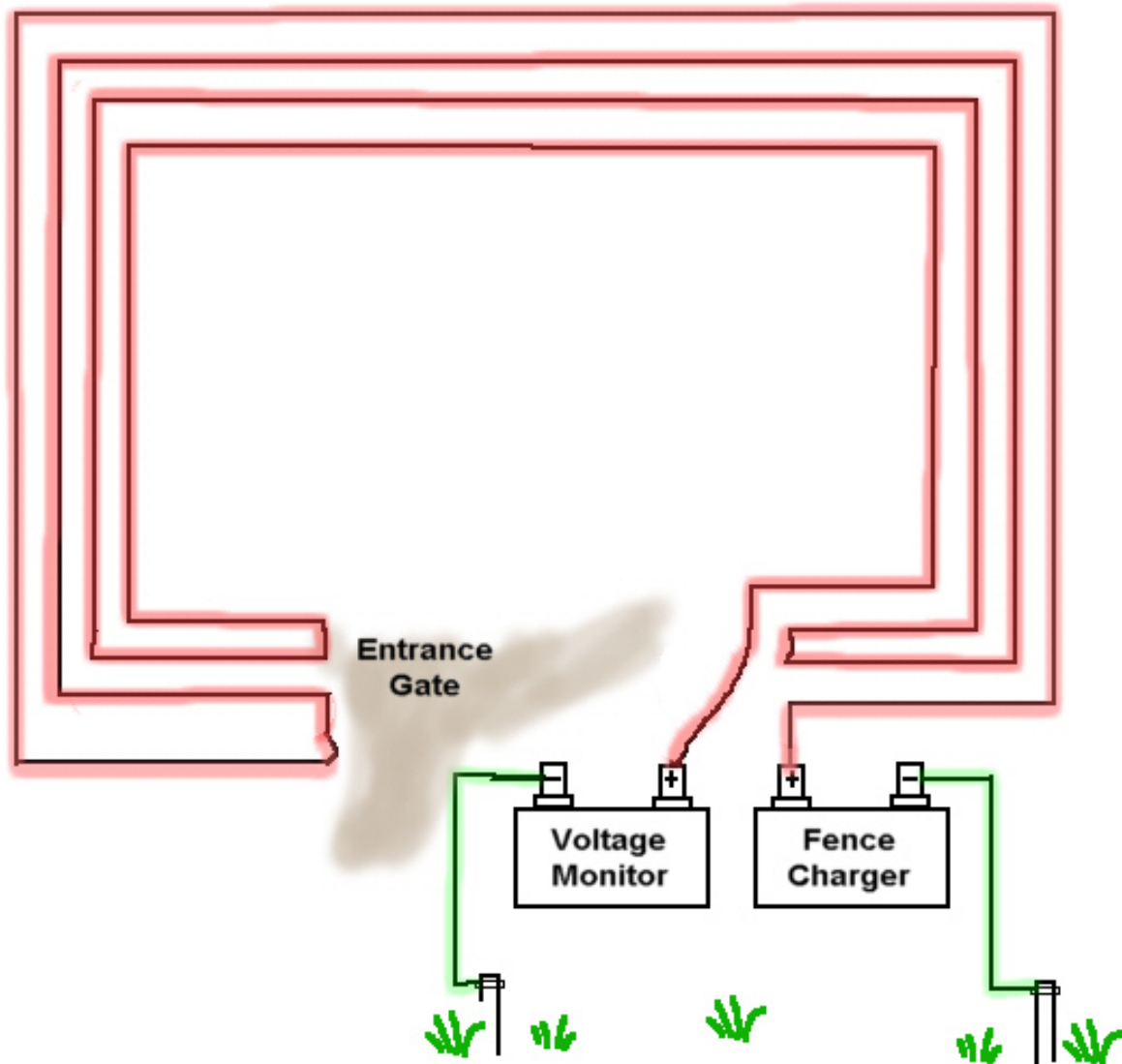


4 strand fence NO NO

This method is not used in a security application for a couple of reasons. While this minimizes the over-all wire resistance, it also allows the break of any single hot wire without losing the fence voltage. You could attach the voltage monitor anywhere on the fence with the same result.

This may be fine for some small pasture or other minimal application, but would not be acceptable in any security application.

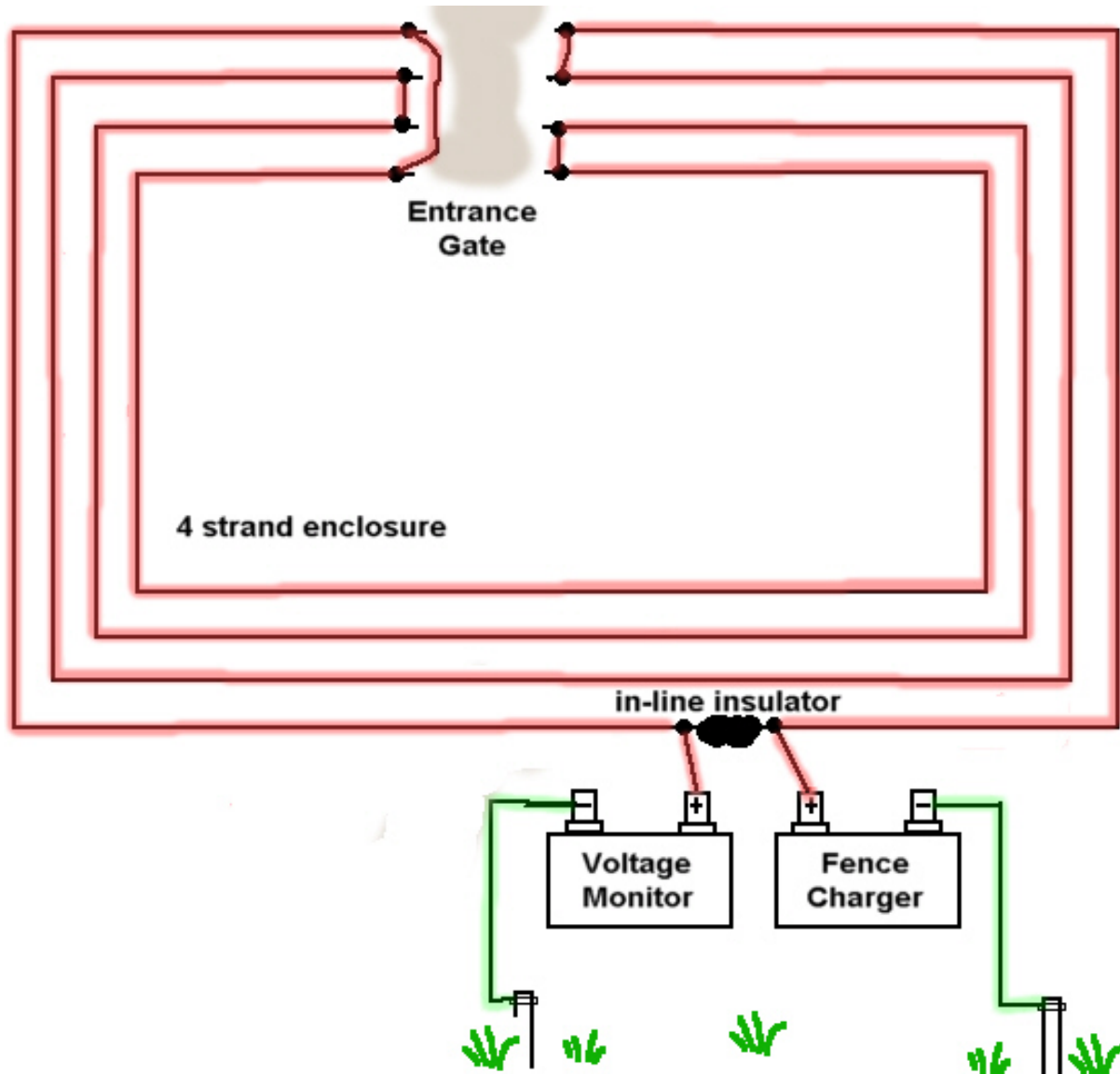
The standard way to interconnect the high voltage wires on any fence that is used for security is shown below.



4 stand fence inter-connected for security:

If the high voltage wire is

An alternative hookup utilizing a location away from the entrance gate



4 stand fence inter-connected for security:

At the other end of the fence is the voltage monitor and alarm connections so that the high voltage source and the fence voltage monitor is at the far end which effectively keeps track of the total fence and all the high voltage conductors.

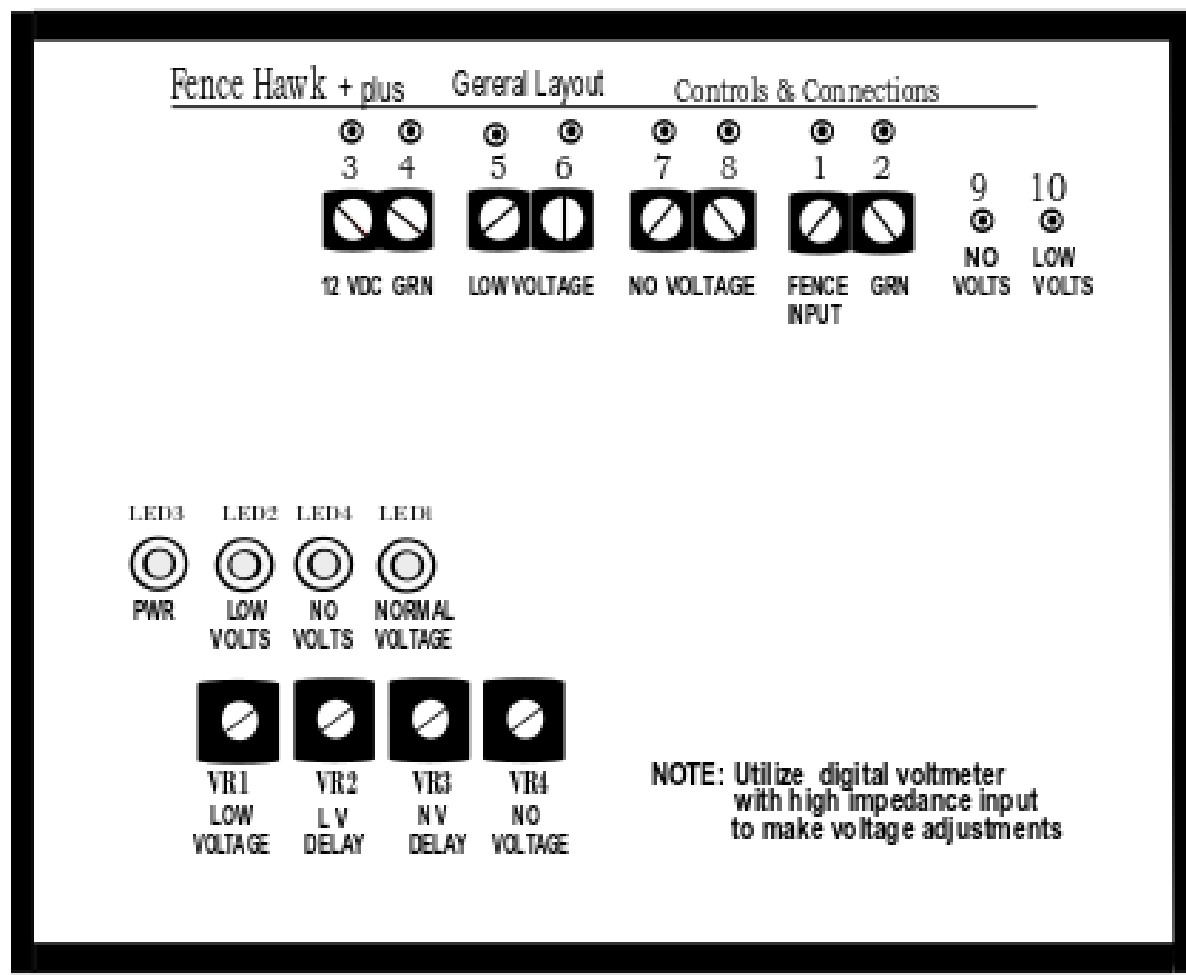
The **Fence Voltage Monitor** is usually connected to the far end of the high voltage fence conductor as shown under typical high voltage (HV) fence connections. This is done for the simple reason to monitor and keep track of the maximum amount of fence wiring. When this is configured correctly the total length of all the wires are under constant surveillance, which is desirable for most applications, especially for any application.

The less sophisticated fence monitors will only indicate that there is some “unknown” voltage on the fence and will have an approximate low voltage threshold so that an alarm is given if the fence voltage drops below this approximate voltage level which may or may not indicate a wire cut or break, and these “false alarms” are the main reason that electric fences are not usually used in security applications.

However, the “**Fence Hawk +**” fence monitor is designed for specifically for security applications, where a higher degree of control and reliability is required. The **FH+** (Fence Hawk Plus) is able to tell the difference between weed growth and an actual break and will also indicate when it is necessary to clean the brush and weeds from your fence. The **FH+** can also discriminate between intermittent loss of voltage due to wind blown trash and weeds.

When the **FH+** indicates a loss of fence voltage you are assured that it is not a false alarm or spurious voltage surge, and you should verify the status of your fence.

The holes in the circuit board next to the screw terminals are available as an easy place to insert your meter probes, which leaves your hands free to make the various adjustments that may be required.



Connections:

Power Connections:

12 volt power positive (+) is to be connected to terminal IO-3. While the unit is designed for standard 12 volt DC input, it will fully function at any voltage between 10vdc and 16vdc where 12vdc is the nominal input voltage.

Terminals IO-4 and IO-2 are connected and common and should be connected to earth ground, the same as the ground side of the fence sensor that is mounted directly to/on the fence. This common ground should be hard wired to the circuit ground. We suggest that all your grounds are connected together, as this is usually done through your ground wires on your fence, which are all connected together or not performing any useful function,

Terminal IO-1 is the pulsed input from the fence voltage divider that is usually directly mounted to, and connected to the high voltage wire. This is usually connected at the far end of the high voltage fence loop.

Isolated Outputs

The unit has two (2) on-board outputs. Terminals IO-5 and IO-6 which are the output terminals of the **low voltage** relay. The operation as described below is adjusted by VR2.

Terminals IO-7 and IO-8 are the outputs of the **no voltage** relay. The operation as described below is adjusted by VR3.

These are electrically isolated normally-open (NO) contacts which are rated at 0.5 amps at 30 volts, and are sized to connect directly to a security control panel. If your fence is not connected to, or part of a security system, then an auxiliary relay should be utilized to provide the current and voltage rating that your equipment requires.

IO-9 and IO-10

These are the actual voltage measurement points for the **low voltage (10)** set-point voltage which is usually adjusted to 500 to 600 volts below the actual fence voltage.

The **no voltage (9)** set-point voltage is usually set for 400 - 500 volts. When set a few volts above zero will eliminate most spurious and induced voltages which may false alarm.

Either will measure less than 3 volts and will vary depending upon what brand of fence charger you are using and the condition of your fence.

There are several areas in the circuitry where the voltage is reduced, and then reduced again to a usable level. The actual voltage value of the fence voltage pulse is divided several times to a final voltage reading that can be easily handled which is 1/4500 of the actual value of the voltage pulse that is on the fence. This voltage value can be read at the cusp at IO-10 for LED1 from blink to off and will provide the actual fence voltage when multiplied by 4,500 times.

Adjustable Components and Indicators:

Indicators:

LED 1 :: This indicator is illuminated in concert with fence pulse. When the controls and adjustments are set correctly this indicator should blink/flash with every voltage pulse that is applied to the fence.

The voltage setting is adjusted with VR1. The time delay that is adjusted with VR2 allows for the normal variation of the fence voltage of 200 to 300 volts that will occur from a variety of sources. That voltage level (VR1) in conjunction with 60 plus seconds of delay (VR2) will eliminate 99.9% of false alarms from blowing trash, grass and weeds.

Set the voltage read at IO -10 at 0.20 to 0.30 volts lower than the cusp reading. This will allow for normally occurring fence voltage fluctuations.

During normal operation this intermittent indicator will flash once for every fence pulse working at the correct set voltage. When/if it stops flashing, this indicates that fence voltage is less than the voltage setting as described in LED2 operation.

LED 2 :: This indicator is illuminated in concert with the normally open (NO) contacts of X2 to provide an alert when the fence voltage drops to a point where the fence generally needs cleaning. This is an adjustable value which is usually set about 500 volts below the operating fence voltage. The high voltage output from your fence charger is reasonably consistent, but will still vary up to 200-300 volts or more within any normal fence usage and environment.

This indicator has a time delay set at 60 seconds or more to allow for momentary and partial loss of voltage usually caused by wind and other temporary cases. This time delay is adjusted with VR2 and is usually set for the maximum delay.

Even with identical equipment, every fence has a different set of environmental conditions that will change the working voltage of your fence, so settings that work for one fence may not work well for another fence.

LED 3 :: This indicator indicates that the Fence Hawk II is producing the 5 volt circuit power required for stable operation

LED 4 :: This indicates a loss of fence voltage and closes the intruder alarm contacts. This occurs when the fence voltage becomes less than the voltage point set with VR4 and indicates a loss of fence voltage which is most often indicates an intrusion. The normal usage delay is 4 seconds which is preset at the factory.

This voltage level is adjustable with VR4 to allow for voltage noise on the fence which can be generated from several sources, which may not have anything to do with your fence. Your fence is essentially a massive antenna which will and does receive voltages signals from various

extraneous sources. This interference problem is solved by setting the alarm voltage threshold slightly above the noise threshold. This is usually in the range between 500 and 1,000 volts.

This adjusted with the voltmeter probe inserted into IO-9. Remember that 0.1 volts reading is 450 volts, an adjustment of 0.1 to 0.2 volts is pretty much what

This alarm can also be delayed for specific installations that require a delay before providing an alarm when fence voltage is lost usually because of a broken or cur fence wire. This alarm may also be delayed for up to 60 seconds and is set by adjusting VR3. The factory setting for this delay is set at 4 seconds for normal operation. A longer delay is only used to allow entry when the controls are inside the protected perimeter, although this is better served with a simple remote control device.

Adjustments:

VR1 :: This variable resistor adjusts to determine the actual fence voltage. To use and set, one varies the adjustment (VR1) until LED4 turns off or on. Vary this adjustment until a slight movement one way or the other will turn on or off LED4. Measure the DC voltage from IO10 to a ground point and using the correct multiplier will display the true and actual voltage on your fence.

For the most stable monitoring results, we recommend that you set this adjustment for about 500 volts less than the actual fence voltage. You need to use the correct multiplier for the fence voltage detector setting that you are using.

When your low fence voltage warning is constant, it almost always is an indicator that your fence needs cleaning, and/or your fence wire connections need tightening to raise the fence voltage back to normal.

This adjustment should be checked every 6 months or so on a clean fence. The voltage monitor should be adjusted and fine tuned as needed.

VR2 :: This adjustment will vary the time delay for the **“low”** voltage contact closure. This delay is usually set at 60 seconds or more. As the wind and/or rain can and will blow trash, wet weeds, and other debris which against a high voltage fence wire and will momentarily lower the fence voltage as much as 2,000 to 3,000 volts, hence the reasoning behind this delay.

This alarm will close the contacts of the X2 relay. These are isolated contacts rated at maximum of 30 volts DC and 0.5 amps. This rating is sufficient for direct closure to most alarm panels. If

some type of sounder is required, we recommend that you use the on-board relay to provide voltage to a power relay for switching voltage to a siren or other device.

VR3 :: This adjustment will vary the time delay for the no voltage contact closure. This delay is usually set for zero or minimum time delay, as this alarm alerts to a fence break which is usually a fence breach.

This delay is used when the controls are located inside the alarmed perimeter, and provides a time delay that allows one to enter the guarded area and disarm the system before the alarm is activated.

VR4 :: This setting adjusts and varies the no/low voltage threshold that provide an alarm should the fence voltage should be reduced to this level.

Because every electric fence is essentially a giant antenna, there will always be some voltage on the fence even with all the power turned completely off. Every area and every fence is different and this voltage will vary from almost (never completely) zero to a 1,000 volts or more depending upon the surroundings conditions. Therefore, whenever a hot fence wire is cut or shorted to ground and the fence voltage reflects, the Fence Hawk II will provide an alarm.

In the event of a cut or broken wire, the low voltage alarm will also activate after the previously set time delay. This is normal and not a malfunction.

Setup and Operational Adjustments

INITIAL SETUP:

Your fence high voltage is turned on, connected and working, and the voltage monitor is connected and powered. You will be measuring DC voltage ranging from 0.05 volts to 3 to 4 volts, so set your voltmeter settings and range accordingly. We will assume that your fence voltage sensing device is grounded and the fence high voltage is connected to middle terminal on the fence sensor. All measurements are referenced to ground.

At this point the power light LED3 is or will illuminate. There are pads with holes that allow you to insert your voltmeter or VOM probes into these holes so that your hands are free to adjust the equipment. The black or ground probe should be inserted into pad-IO2 or pad-IO4 which are common ground and should be connected to a hard earth ground. The red lead/probe should be inserted into pad-IO10. IO10 is the voltage reference point that measures the actual fence voltage.

Adjust the variable resistor R101 until LED4 stops or starts flashing. Adjust it back and forth until it is set as this cusp where LED4 turns on and off is your current fence voltage. Read the DC voltage on your VOM/voltmeter and make a note of this voltage. Using the correct multiplier, you can determine the actual voltage on your fence.

Maintaining the Fence Voltage:

There are multiple reasons why the high voltage on the fence can be lost, diverted or cancelled. Depending on the circumstances and the primary reason for the fence, the loss of high voltage

may or may not be critical for several days. However, when the fence is utilized for a security application, even a few minutes of total loss of voltage can result in major losses of stored materials and/or vehicles.

For the simple reason that it is extremely easy to purposely short or disable an electric fence, it becomes necessary that the fence voltage be continuously monitored when the fence is used in a security application.

There are several fence voltage detection devices available to determine if there is voltage on the fence which will determine the integrity of the fence for the section of fence that is monitored by the voltage detector. While maintaining, measuring and/or monitoring the voltage on the fence will depend on the actual use of the fence, however, in a security environment where one is dealing with human predators the total integrity of the fence is critical at all times.

Ideally, one would want all the high voltage fence strands to be monitored on a continued basis. If one is containing livestock, a momentary loss of fence voltage is not a critical thing. However, if you are monitoring a fence that is used in a human security function, then even a short period without fence voltage could be symptomatic of human intrusion.

Power Outages and Security:

May we restate that you are dealing with humans, which should be considered slightly more intelligent than most animals. Since most places experience power outages from time to time, one should look at the history of power outages in your area, and have backup power available for your security fence accordingly.

The most common way is to utilize a fence charger and fence monitor that operates on 12vdc which allows for a simple common battery to provide the voltage necessary to power your fence and communication equipment, and to also power this equipment during power outages.

A continuously charged battery such as those used in commercial fire alarm systems is your best choice for this feature. These are 12 volt batteries and available around the world and can be easily coupled to any AC source anywhere in the world.

Adjust your maintenance voltage alarm and time delay (Low Fence Voltage):

This is usually done when the Fence Hawk II is connected to a working fence. We suggest that any alarms, sirens, etc. are disconnected during this procedure.

These are the contacts on relay X2 which, when closed are indicated by LED2. These contacts have a time delay which provides an adjustable lag before activating. This alarm lag is to eliminate nuisance alarms from blowing trash, weeds and other miscellaneous events that will

drop your fence voltage, and if trash accumulates eventually you have no voltage on your fence. The recommended delay setting is over 60 seconds and the delay is adjusted with VR102.

The actual fence voltage will vary continuously throughout the day and will change with the seasons and time. By setting this adjustment (VR101) to roughly 500 volts below the normal running and operational fence voltage, you have allowed for slight voltage variations in the output from your fence charger. The fence voltage will also vary due to the fence itself caused by changes in temperature and humidity. Blowing grass, weeds and debris will also affect your fence voltage.

Depending on the multiplier you are using, you then want to set this point or adjustment to approximately 500 volts less than your fence voltage. Attach your multi-meter to earth ground with the negative lead (terminals IO2 or IO4). Attach the positive lead to IO10.

Therefore, by setting this alarm voltage at 500 volts less than your fence voltage will ignore of 99.5% of the usual fence variations, but will still alert you to a solid fault on your fence. When/if this alarm triggers you will still have working fence voltage until you have a chance to clean the fence. You should check and adjust this setting if needed at least once or twice a year as the fence voltage can and will change with corroded connections, normal weeds, etc.

Adjusting your intruder alarm (Essentially No Voltage = Intruder):

These are the contacts on relay X1 which, when closed are indicated by LED1. These contacts have a time delay available which provides an adjustable lag before activating. This alarm lag is seldom used and the purpose is when the owner has to break the circuit when entering the delay before alarm is to allow the owner to enter the premises and disarm the alarm. When used you would adjust VR103. The normal setting from the factory is set to minimum or zero delay

Depending on the multiplier you are using, you then want to set this point or adjustment (VR104) to approximately 500 volts plus or minus. Fence voltage less than 500 volts is generally considered a no-voltage situation or intrusion. Put your multi-meter on the lowest DC setting and adjust accordingly using the same multiplier that you used to set the maintenance voltage. Attach your multi-meter to earth ground with the negative lead (terminals IO2 or IO4). Attach the positive lead to IO9.

Therefore, by setting this alarm voltage threshold at 500 volts (plus or minus) will still alert you to a solid fault on your fence. When/if this alarm triggers there is definitely a break in your fence and most probably an intrusion.

