Standard Terminal Panel And UPS Design For Exterior Intrusion Detectors And Data Collection Applications

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ABSTRACT

Need for standardization has been discussed for years by many government agencies. In the past, every perimeter site upgrade resulted in the design, specification, procurement, and fabrication of a unique power and signal junction box. To save design and specification cost, a standard terminal panel and uninterruptible power supply (UPS) design for an exterior intrusion sensor detection system was developed for a security system within the Sandia National Laboratories complex at Albuquerque, New Mexico. In facilitating this requirement a design was sought that could easily be modified for other government or commercial applications and one that could easily be fabricated in the shop. Also of primary importance was the need for lightning protection for both the communications and voltage sources. A 12V DC UPS with a current capacity of up to 4 amperes complements the standard terminal panel design and allows uninterrupted sensor operation for a number of hours should the primary AC source be interrupted. This report encompasses the features of the designs. The designs are also being used and continuously evaluated in Sandia's Area III exterior test field.

INTRODUCTION

It would be economical from a labor cost consideration to design a terminal panel and signal junction box that could be

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easily fabricated in the shop. With this in mind, the use of modular type components including rail-mounted terminal blocks were explored in hopes of reducing construction costs. Also, modular components would facilitate a standard design wherein terminal parts for sensors could easily be added or deleted to comply with a particular sensor installation. Last but not least, a design that would reduce the installation time and wiring errors for external wiring to the terminal panel was considered.

Rail-mounted terminal blocks have been used for some time in Europe, but this technology is not highly employed in the U.S. Due to a greater number of European manufacturers of these products entering the U.S. market, it is expected rail mounted components will become more popular as the technology becomes more familiar. Along with snap-in rail mounted terminal blocks, snap-in fused blocks with LED indicators are available. Many cases of damage and destruction of sensitive sensor electronic components due to surge voltage effects have been recorded. Rail-mounted and pluggable gas-filled surge arrestors, varistors and suppressor diodes for lightning and voltage surges are also available. The design of this standard terminal panel includes all of these components.

A 12V DC UPS with a current capacity of up to 4 amperes complements the standard terminal panel design and allows uninterrupted sensor operation for a number of hours should the primary AC source be interrupted. Although not exactly an innovative design in itself, the unit is very reliable and adaptable to most any sensor installation.

STANDARD TERMINAL PANEL

The standard terminal panel design features technology that allows the panel to be fabricated in the shop with a minimum of labor. Initially, holes are drilled and tapped on the terminal panel. Two mounting rails, an AC power strip, and the transponder are mounted to the panel. The remaining modular components are snap-locked to the rails. See Figures 1 and 2. The modular components make for easy assembly and easy adaptation to most sensor specifications. The location of the blocks along the bottom of the panel allows for easy installation of external wiring. The drawing in Figure 3 illustrates the component locations. Following is a brief description of each component.

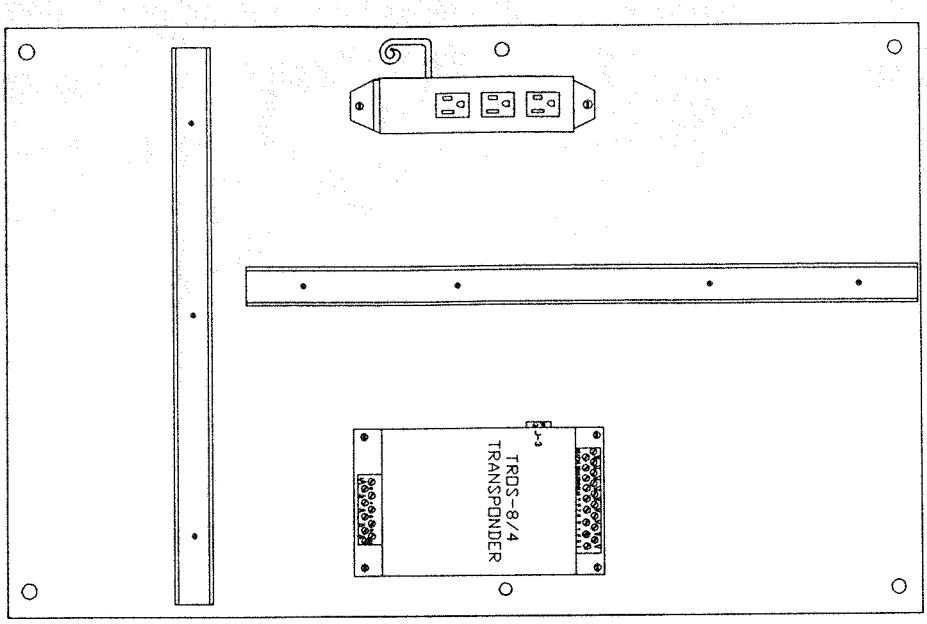

Figure 1. Two Rails, AC Power Strip And Transponder Mounted To Panel

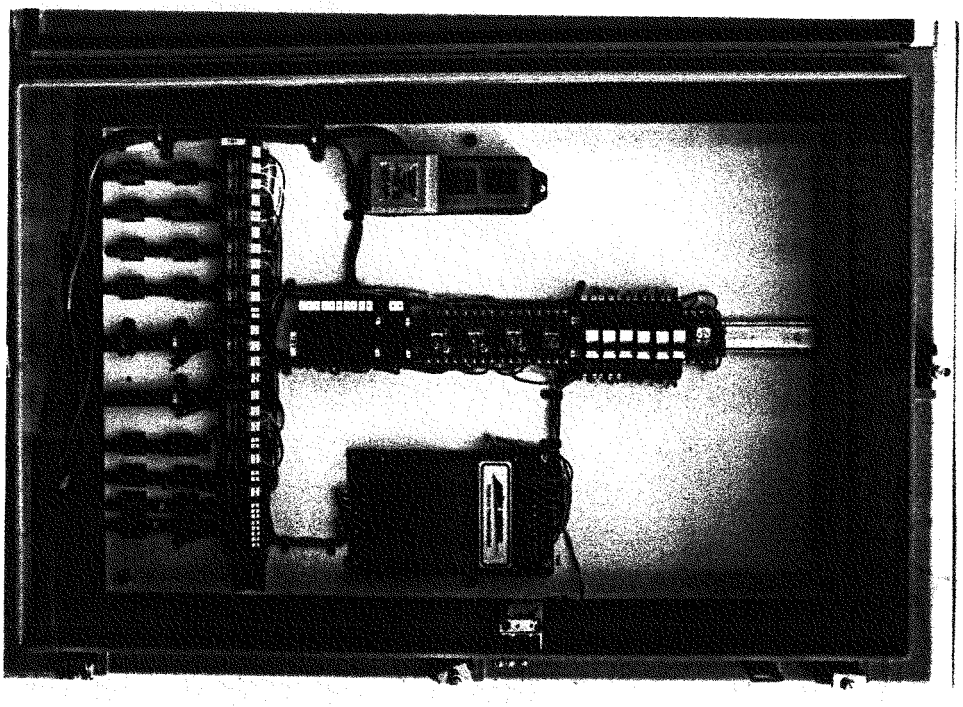

Figure 2. Modular Components Snap-locked To The Rails And Wiring Completed

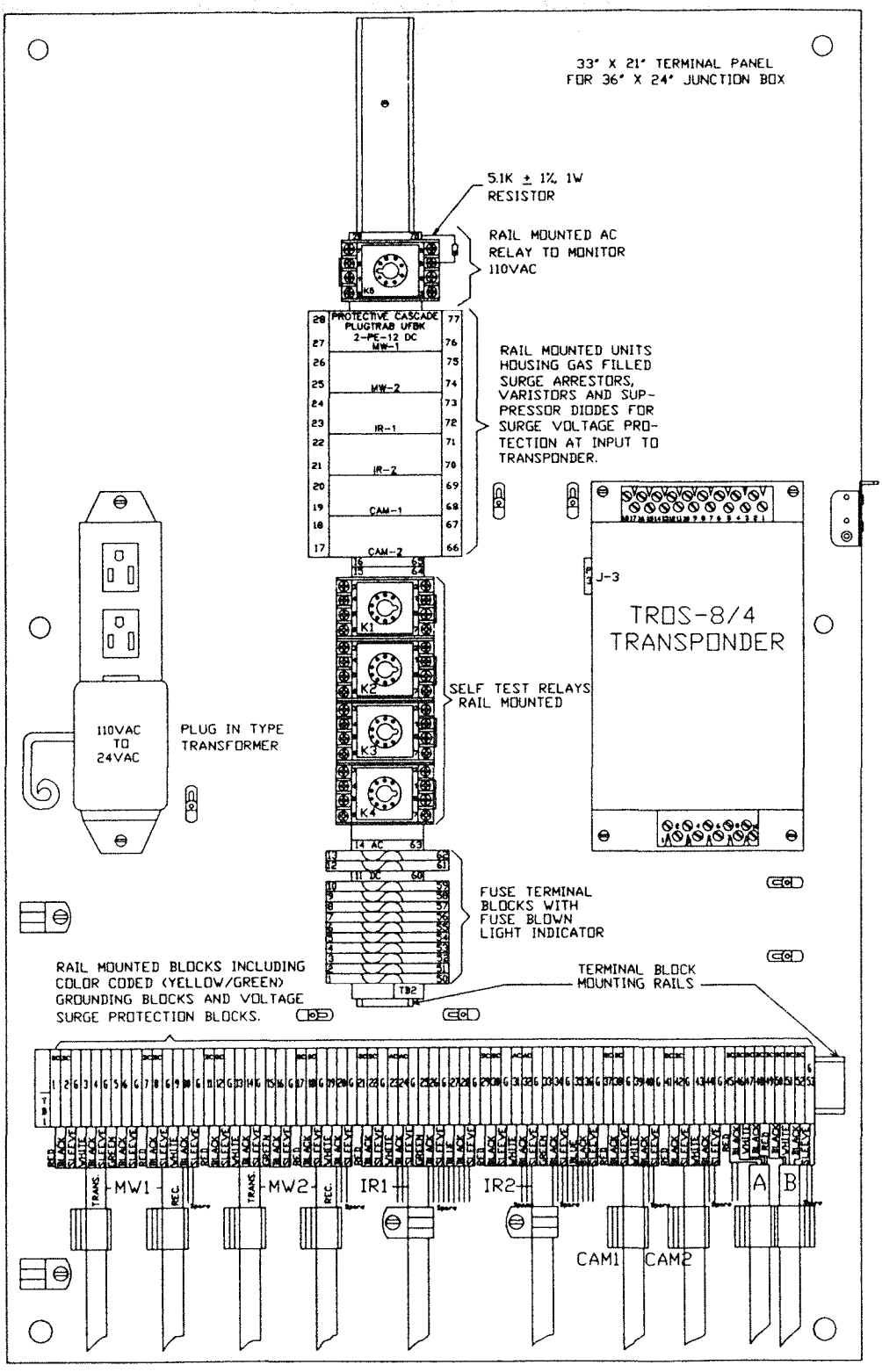

Figure 3. Parts Location For Standard Sensor Terminal And Communications Panel

Rail-Mounted Terminal Blocks

Rail-mounted terminal blocks have been used for some time in European countries and were chosen for the standard terminal panel design for many reasons. They provide additional space for more circuits since the slim terminal block design allows more circuitry per foot. Double level terminal blocks are available should space be a problem. Their modular construction allows for easy placement and removal. Snap-in universal markings are available to number the terminals. This provides the terminals with neat, tight, quick, sure and legible identification. The standard safety color-coded (yellow/green) grounding terminal blocks assure positive ground continuity to rails and eliminate the need for ground bus bars.

Rail Mounts

All terminal blocks and components with the exception of AC power and transponder are rail-mounted on a junction box terminal panel. This will save time during assembly and provide the flexibility required for installing different types of sensors. After the rails are secured in place, terminal blocks can be snap-lock mounted with no tools or tightening required and can be easily removed for modifications.

Shop Construction

The terminal panel can be fabricated in the shop with all wire cross connections, power, and ground connections completed prior to mounting it in the junction box. Terminal lugs are not required since a screw on the terminal block clamps a yoke saddle and a chamfered entry guides the wire to the contact area.

Easy Field Installation

The electrician or installer can simply terminate (without using terminal lugs) external sensor wiring to a block of terminals along the bottom of the terminal panel. A standard wire color code can be employed. A color coded ground terminal block exists for each ground lead of a wire pair. This should help prevent wiring errors.

Transponder

A TROS-8/4 Stellar transponder is used to communicate with a central processor to carry out alarm monitoring and remote control functions. The transponder has eight DC supervised status monitoring inputs with dual supervision on channels 1-4. Four external self test outputs are available to operate four relays. The Sandia application required only one of the transponders but two transponders can be stacked or mounted side-by-side to facilitate a total of sixteen supervised status monitoring inputs with dual supervision on eight channels and eight external self test outputs. Although Stellar transponders were used in the Sandia application for compatibility, other brand transponders could also be used.

Transient Surge Voltage Protection

Many cases of damage and destruction of sensitive sensor electronic components due to surge voltage effects have been recorded. The most frequent cause of surge voltage is atmospheric discharge, lightning. Lightning can generate discharge currents having a peak value of 100 KA and very short ascent times. To protect the load side or status monitoring inputs to the transponder, a Phoenix protective cascade unit consisting of three different types of protection elements has been installed for each channel input. Rail-mounted sockets for the pluggable units permits testing and replacement of the protection elements without affecting circuit operation. The pluggable unit contains two gas-filled surge arrestors, a metal oxide varistor and two suppressor diodes. The matched combination of these protective components provide maximum protection. Refer to Figure 4. The line side of the transducer is internally protected by transzorbs and varistors. Additional protection is provided by rail-mounted terminal blocks with built in suppressor diodes. These terminal blocks are also used to protect the individual 12V DC circuits.

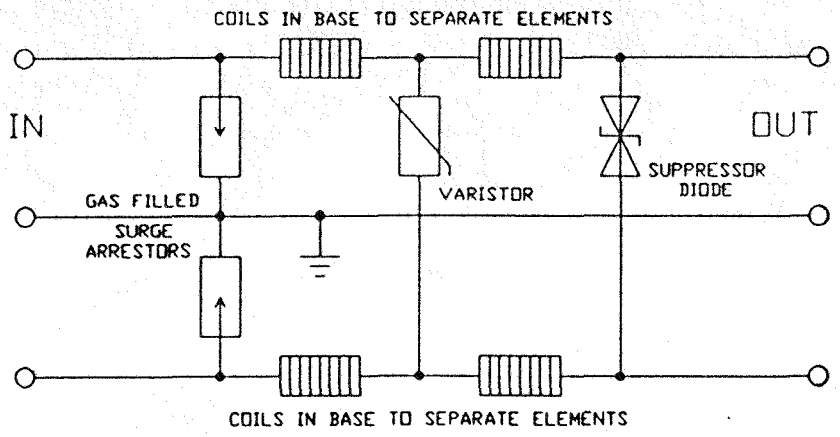

Figure 4. Transient Surge Voltage Protective Cascade Unit

Fuse Terminals

Rail-mounted fuse terminal blocks are used to protect the common power sources from individual sensor overloads. The terminals have low contact resistance and permit the use of all standard miniature fuses. They have an 8 mm wide disconnect lever with enclosed housing. The fuses are inserted in the captive disconnect lever and are shock resistant. A light indicator insert in the disconnect lever contains antiparallel LEDs including a series resistance. A lighted LED signals when a fuse is blown.

Relay Sockets

Standard rail mounted Potter & Brumfield sockets and plug-in relays are used for the line self tests. The sockets snap on to the rail by pressing down on one side and a small screwdriver can be used to release a latch and remove the socket. This snap-on feature permits quick track mounting and removal of the sockets without the need for special tools or extra hardware.

AC Power

An AC power strip is provided to power test equipment or any auxiliary equipment necessary for a particular installation. This power strip is monitored for an interruption in the AC voltage. Loss of voltage to the terminal junction box will result in an alarm to the central processor. At the Sandia installation, a plug-in transformer supplies the 24VAC power to the infrared sensor heaters.

Junction Box

The size of the junction box is 36" X 24" X 8". This is large enough to provide the space for additional sensor accessories such as monitoring units, power supplies, control units or other devices. This size should suffice for most any installation.

UNINTERRUPTIBLE POWER SUPPLY

A 12 volt DC UPS was designed to back up each terminal junction box at the Sandia installation. Its purpose is to prevent a break or interruption in the 110VAC source for known or unknown reasons anywhere in the power loop from immediately effecting the performance of the security system. Failure of the 110VAC within any one terminal box will be reported to the central processor. Primarily the UPS consists of two 12 volt 20 ampere hour rechargeable sealed lead acid batteries connected in parallel with a trickle battery charger. The charger produces a maximum charging current of 4 amperes and will supply the less than 2 amperes required for our load. Refer to Figures 5 and 6. Following is a brief description of each component.

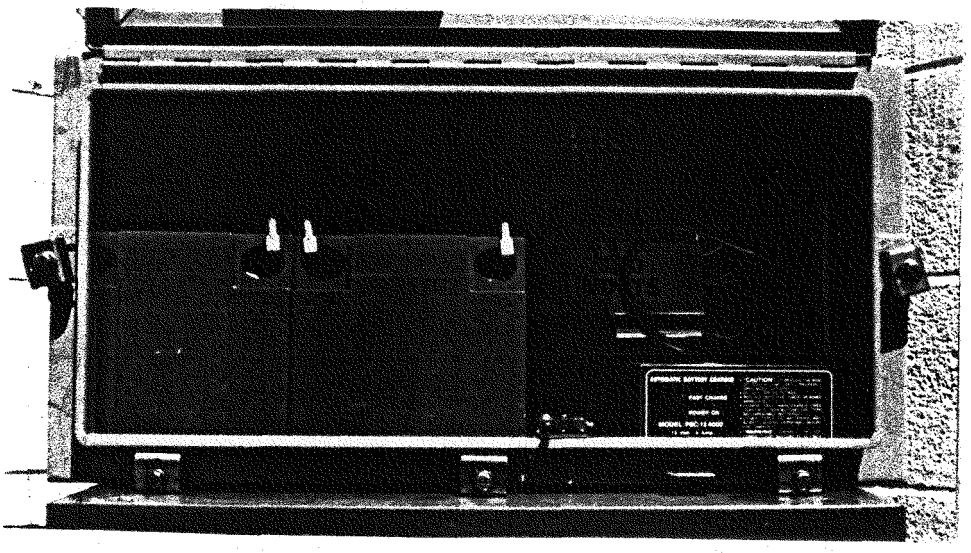

Figure 5. View Of Uninterruptible Power Supply

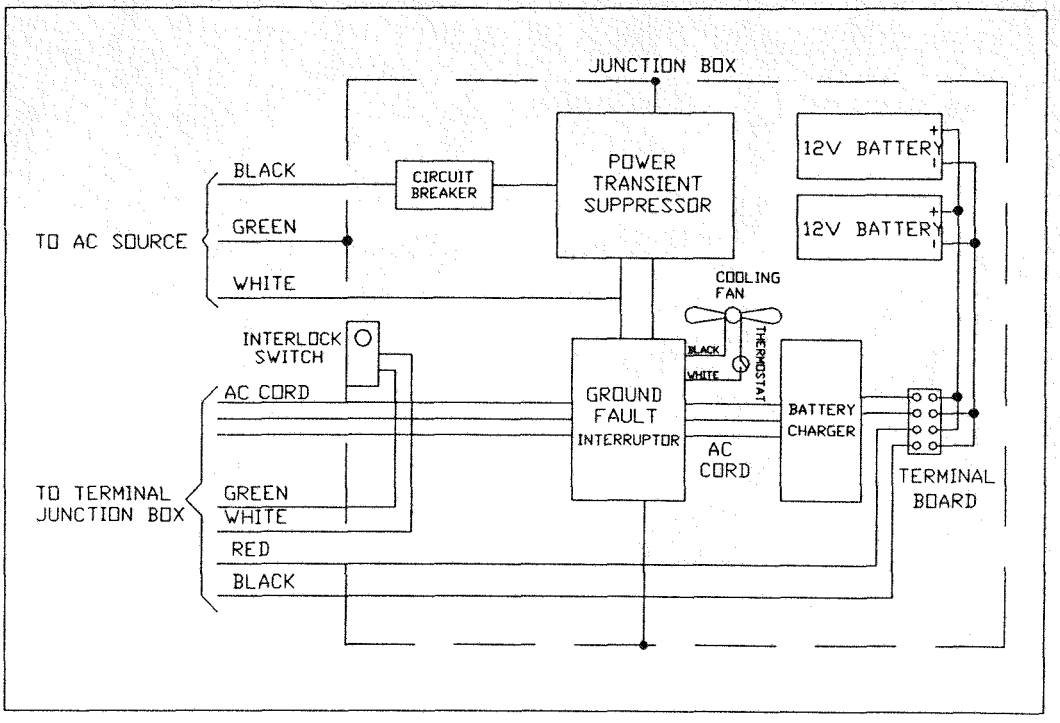

Figure 6. Block Schematic Of UPS

Batteries

Two 12 volt 20 ampere-hour Power Sonic rechargeable sealed lead-acid batteries are connected in parallel. The sealed leak-proof construction allows for safe maintenance-free operation as there is no need to add electrolyte. This also reduces the number and types of batteries that would have to be maintained if each sensor had its own battery.

Battery Charger

An Xenotronix battery charger that will trickle charge the batteries and also supply up to two amperes of current to the load is used for the Sandia installation. The Xenotronix Company of Valencia, California will custom build these units for a variety of current requirements. Model 8765-1 used in the Sandia installation has a maximum capacity of four amperes.

Circuit Breaker

A 10 ampere circuit breaker is installed on the line side of the 115 volt AC input. It is installed on the UPS junction box and can be reset without opening the box. A visual indication on the outside of the box indicates a tripped circuit breaker.

Power Transient Suppressor

A power transient suppressor that meets the IEEE 587 industry standard is installed after the circuit breaker, primarily to reduce lightning effects. IEEE 587 is an industry standard describing the transient environment in low voltage AC power lines (less than 600 volts). It addresses transient voltages which exceed twice the peak operating voltage with durations ranging from a fraction of a microsecond to a millisecond, and originating primarily from system switching and lightning effects. It also proposes test conditions for evaluating the transient voltage withstanding capability of AC powered electronic equipment. For personnel protection and to prevent electromagnetic coupling to the load, a metal shield has been installed over the suppressor.

Ground Fault Interrupter Receptacle

Following the suppressor, an interrupter designed to protect people from line-to-ground hazards, has been installed. The interrupter is designed to protect people from the line-to-ground shock hazards which could occur from tools or appliances operated from this device. It does not prevent electric shock, but does limit the time of exposure to a period considered safe for normally healthy persons. The interrupter includes two AC receptacles to provide power to the battery charger and terminal panel junction box.

Cooling System

A study of the high temperature impact on the performance of the UPS design for the Sandia installation indicated that some means of cooling should be provided. A small (3.125") 110VAC tubeaxial fan with a fairly high (36 CFM) exhaust rate was chosen to satisfy this demand. A small fan requires smaller holes for the intake and exhaust in the junction box that houses the UPS. A Bud diecast aluminum minibox was mounted in a unique fashion to the back of the junction box to allow air input from the bottom to be exhausted out the back. The minibox provides security and protects the junction box from adverse weather conditions. With the holes located in these locations and filters installed, the UPS junction box has maximum protection from foreign elements and rain. To save wear and tear on the fan, an ambient air temperature sensor is installed on one side of the AC line to

switch power on at a temperature greater than 80 degrees Fahrenheit. This added cooling feature will prolong the life of the batteries and battery charger.

Interlock Switch

The interlock switches of the UPS and terminal junction boxes share a common transponder channel. The transponder termination consisting of a 5.1K ohm resistor appears at the UPS junction box. Should the UPS box be opened, a short to the transponder channel will activate an alarm to the central processor. If the alarm cable to the terminal junction box is opened an open to the transponder channel will activate the alarm. Conversely, if the terminal junction box door is opened the channel will be alarmed. Refer to figure 7.

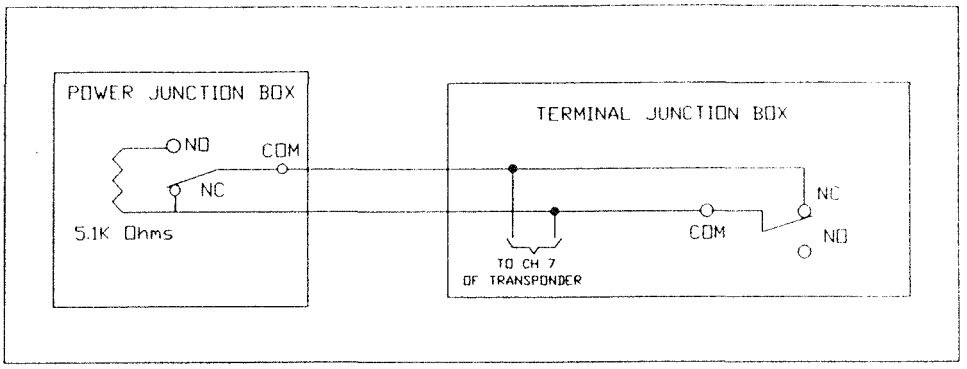

Figure 7. Terminal And Power Junction Box Interlock Wiring

SUMMARY

A terminal box may be the last consideration in the design of a security system. Perhaps this standard design will end some frustrations and turmoil involved in selecting the box size and components necessary for maximum circuit protection. This design represents the ideas of people responsible for designing maximum security installations. The simplicity of the modular design will aid in the economically feasible construction of terminal panels in the shop that will accommodate most types of exterior intrusion sensors on the market. The simplified installation procedure should result in fewer wiring errors on the part of the electrician or the installer of the exterior sensor wiring. The UPS design complements the terminal board design by insuring continuous system operation in the event AC power is interrupted. A complete drawing package for both the Standard Terminal Panel and the UPS are available.