Technical Practice

Issue 2, May 2005

Model 732A DC Power Supply with Battery Back-Up

1. General Description

1.1 Product Overview

The Model 732A DC Power Supply with Battery Back-Up provides a filtered and regulated source of 54 volts DC with a maximum output current of 2 amperes. The nominal input voltage is 120 volts, 60 hertz. Rechargeable batteries contained within the Model 732A provide output back-up capability in the event of an AC input voltage interruption. Under battery operation, the Model 732A will continue to supply a 2 ampere DC output for up to nominally three hours. For output loads of less than 2 amperes the battery operating time will substantially increase. The unit is completely self-contained in a compact wall-mounted cabinet. The Model 732A is Underwriters Laboratories, Inc. LISTED under their CUL-1950 ITE category.

1.2 Features

Model 732A features include LED status indicators, filtered and regulated DC output, wide AC input-voltage operating range, uninterruptible output provided by internal back-up batteries, output short-circuit protection, status contact, dual output connectors, and simple installation. Two LED indicators are provided to serve as installation, operation, and maintenance aids. The DC output is expressly designed to support a wide range of telecommunications and data applications. The AC input-voltage range, 95-135, allows operation even when the AC power source deviates significantly from nominal 120 volts.

The Model 732A's circuitry provides a full on-line uninterruptible power source for important applications. Events ranging from a momentary AC power loss to a sustained AC power outage will have minimal impact on the DC output. A 2 ampere output load can be typically supported for up to three hours with a direct increase in support time as the load current decreases. The internal batteries are precisely charged to ensure maximum output performance and long usable life.

The Model 732A's circuitry is designed for robust performance. The DC output is short-circuit and over-current protected, returning to normal operation when a fault condition is removed. An electrically isolated status contact is provided for installer selected applications. This contact indicates when the incoming AC power has effectively failed and the Model 732A is operating under battery power.

The Model 732A is primarily intended for wall-mounted applications. Locating the unit on a shelf or other flat surface is also acceptable. For installation flexibility two output connectors are provided. A 3-position removable screw terminal strip provides access to the ground and DC output connections. Ground, DC output, and status contact interconnections are accessible using a 6-position detachable connector. 120 volt AC input power is connected using a nondetachable 3-conductor cord and standard NEMA 5-15P plug.

1.3 Physical Description

The Model 732A consists of a painted steel enclosure that houses a precision-fabricated circuit board, four 12 volt, 7.2 ampere-hour sealed lead-acid batteries, and related interconnection wiring. The overall dimensions are 6.3 inches (24.8 cm) high, 12.4 inches (31.5 cm) wide, 7.1 inches (18.0 cm) deep. The unit weighs a hefty 30.5 pounds (13.8 kg) and wall mounts using four screws.

2. Applications

2.1 Primary Application

The Model 732A DC Power Supply with Battery Back-Up is intended to provide telecommunications and data applications with an uninterruptible source of 54 volts DC. The true on-line implementation ensures a reliable DC output even in the face of an uncertain AC power input. The DC output is directly applicable for equipment that requires a "–48 volt" power source.

2.2 Floating Output

The Model 732A's DC output is isolated (floating) from ground, making it suitable to provide positive or negative ground-referenced DC voltage. The DC output can float up to ±150 volts away from ground, allowing it to be connected in series with other telecommunications power supplies, e.g., ring voltage generators.

2.3 Device-Specific Interconnecting Cables

In some situations the Model 732A shipping carton may include a cable assembly that will allow direct interconnection with a specific telecommunications or data device. One end of the cable will have a 6-position plug to directly mate with the Model 732A's 6-position output connector. The other end will have a connector appropriate for the device to be powered by the Model 732A. This arrangement will allow for rapid, simple, and reliable installation. Contact Gordon Kapes, Inc. if your installations warrant having a custom interconnecting cable fabricated. While not appropriate when installing a limited number of Model 732A units, a custom interconnecting cable can be very cost effective when multi-site installations are contemplated.

2.4 Safety Compliance

The Model 732A has been tested by Underwriters Laboratories, Inc. as a CUL (Canada-United States) LISTED device under their CUL-1950 ITE category. A LISTED product is one that has passed the requirements of a complete, independent unit. This helps to ensure that the Model 732A will perform in a safe manner, as well as complying with most local electrical codes.

3. Installation

3.1 Words of Caution

As with any product, installing the Model 732A requires a safety-first approach. Read the entire installation section of this practice before starting the installation process.

Warning: Handle the Model 732A with caution! It is very heavy relative to its physical dimensions. If dropped the unit can be extremely hazardous to people or property.

3.2 Checking for Damage

The Model 732A should be inspected for damage immediately upon receipt. A claim should be filed with the shipper if damage is found. A replacement should be ordered if necessary.

3.3 Installation Accessories

Included in each Model 732A shipping carton are several components that provide assistance during installation. A paper template is included to display the location of the Model 732A's mounting holes. Four pan-head screws (#10-¾, Type A) are provided to secure the unit to the mounting surface. A 3-position removable terminal strip is also included. It is shipped already plugged into its mate and is located on the left side of the enclosure.

3.4 Selecting a Mounting Location

Three factors come into play as you select the "perfect" Model 732A mounting location: ability to hold the unit's weight, unrestricted air flow, and proximity to an AC outlet. The weight of the Model 732A requires careful selection of the mounting surface. Ventilation holes, located in the top and bottom of the unit, must remain clear to allow adequate airflow through the unit. Selecting a mounting location that allows convenient access to a 120 volt AC outlet is also important. The Model 732A contains a 6-foot (2-meter) 3-conductor power cord with a NEMA 5-15P plug attached.

3.5 Wall Mounting the Unit

Mount the Model 732A using the four screws supplied in the shipping carton. These screws are intended for use with a wood backboard surface (minimum thickness ¾-inch). The Model 732A's cabinet is outfitted with four keyhole-type screw slots. Use one screw per slot and securely fasten the unit to the backboard. As previously mentioned, a paper mounting template is included with each Model 732A. This allows the screw-hole-locations to be easily marked so that "pilot" holes can accurately drilled. Use the mounting template to locate the four screw locations, rather than trying to use your hand, your knee, or your noggin' to hold the Model 732A up to the wall!

3.6 Alternate Location

There may be specialized applications where the Model 732A can't be wall mounted. In these situations the unit can be placed on top of a shelf, rack cabinet, or other flat surface. The only caveat is that air must be allowed to flow from the bottom of the unit to the top. As maximum battery life depends on controlling the temperature of the Model 732A, do not locate the unit on top of any significant heat sources.

3.7 Safety Ground Connection

One conductor of the 3-conductor AC power cord brings safety ground to the Model 732A's enclosure. In addition, a separate safety ground connection must be made directly to the Model 732A's enclosure. This will ensure that a safety ground connection will be maintained, even if the power plug is disconnected from its associated AC outlet. A ground connection screw has been specifically provided on the right side of the Model 732A's enclosure. Using a #12 or #14 AWG wire, connect safety ground to this green-colored screw. The other end of the wire must be connected to a known-good safety ground location. Should questions arise, a competent electrician is best able to identify an adequate safety ground connection point.

3.8 Safety First

Before making any output connections to the Model 732A, ensure that a separate safety ground connection has been made and that the power plug is not plugged into an AC outlet. In addition, be certain that the DC output is not active. This can be easily confirmed by observing the state of the DC output LED indicator, visible on the front of the unit. If the DC output LED is lit, refer to Section 7.3 for details on how to manually "shut down" the unit.

3.9 Ground and DC Output Connections—3-Position Terminal Strip

A 3-position removable screw terminal strip, located on the left side of the Model 732A, allows access to the ground and DC output signals. No tools are required to remove the terminal strip from the side of the enclosure. Pin 1 is connected, via the Model 732A's internal circuitry, to ground. Pin 2 provides the + connection of the 54 volt DC output. Pin 3 provides the – connection of the 54 volt DC output. Refer to Figure 1 for details. Note that the ground provided on pin 1 is the same as that supplied by the AC power cord and the separate safety ground connection. This allows a safety ground connection to be provided to connected equipment. This

ground connection should not be used as the primary safety ground connection for the connected equipment! This ground is provided strictly as a secondary path.

3.10 Ground and DC Output Connections—6-Position Connector

A 6-position connector, located on the left side of the Model 732A, also allows access to the ground and DC output signals. Pin 1 is connected, via the Model 732A's internal circuitry, to ground. Pin 2 provides the + connection of the 54 volt DC output. Pin 3 provides the – connection of the 54 volt DC output. Refer to Figure 2 for details. Note that the ground provided on pin 1 is the same as that supplied by the AC power cord and the separate safety ground connection. This ground allows a safety ground connection to be provided to connected equipment. This ground connection should not be used as the primary safety ground connection for the connected equipment! This ground is provided strictly as a secondary path.

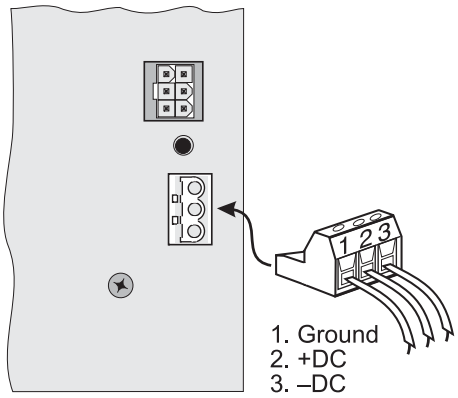

Figure 1. Model 732A cabinet showing 3-position plug-in terminal strip

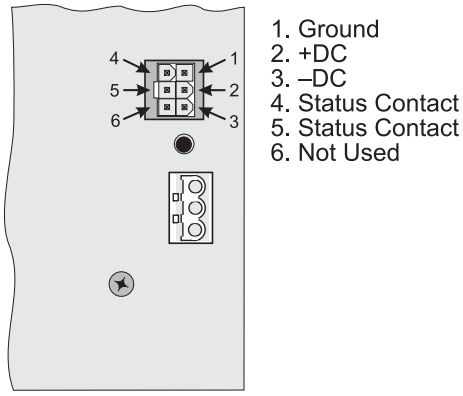

Figure 2. Model 732A cabinet showing 6-position connector

3.11 Selecting the Desired DC Output Scheme

As mentioned previously, the DC output is isolated (floating) with respect to ground. The DC output can be connected directly to the equipment to be powered in this manner, or it can be referenced to ground. In telecommunications applications it is typical to utilize a positive ground scheme, with the output configured to be –54 volts DC with respect to safety (earth) ground. This is easily accomplished with either output connector by wiring pin 1 (ground) to pin 2 (+ DC) and using this combination as the ground connection for the load. Pin 3 (– DC) provides the –54 volt DC connection for the load.

3.12 Status Contact

The status contact provides an indication of the Model 732A's AC power input. It is accessible on pins 4 and 5 of the 6-position connector. The status contact is intended for use in a variety of site-specific applications. It is isolated from ground, making it compatible with most monitoring and alarm equipment. When the Model 732A is producing 54 volts DC from the incoming AC power, nominally 120 volts, the status contact is open (not shorted). When the incoming AC power has failed (below approximately 15 volts) the status contact changes into, and maintains, a closed (shorted) state. Note that the status contact is intended only for use in low-voltage (less than 60 volts AC or DC), and low-current (less than 0.5 amperes) applications.

3.13 Status Contact Connections—6-Position Connector

The 6-position connector, located on the left side of the Model 732A, allows access to the status contact connections. Specifically, the normally open (not shorted) contact is accessible on pins 4 and 5. Refer to Figure 2 for details.

3.14 Connecting AC Power

Before the Model 732A's power plug is plugged into a nominal 120 volt AC source, confirm that a separate safety ground connection has been made. The desired DC output connections should have been made by way of the 3-position terminal strip or 6-position connector. If desired, a status contact connection should have been made. Now the power plug can be plugged into the designated AC outlet. Upon connection to AC power, the AC

input and DC output LED indicators, visible on the front panel, should light. The unit will now be producing nominal 54 volts DC. Do not secure the AC power cord to any surface or other equipment. It must hang free to allow rapid disconnection if circumstances require. Attaching the AC power cord to any other surface or other equipment creates a safety hazard and may be an electrical-code violation.

4. Testing and Operation

4.1 Installation Review

By this point, the desired connections should have been made between the Model 732A and the associated equipment. A safety ground connection should have been made to the ground screw located on the right side of the Model 732A. The power plug should have been plugged into the selected AC outlet. Confirm that the power cord is hanging free. The AC input and DC output LED indicators should be lit steadily. If the DC output LED does not light a wiring error may exist; most likely a short or over-current condition is present. Check the installation and refer to Section 6 of this practice for troubleshooting assistance.

4.2 Status LEDs

The Model 732A contains two status LED indicators, which are visible on the front panel of the unit. The AC input LED lights steadily whenever the AC input voltage is in excess of approximately 85 volts. The DC output LED lights steadily whenever a DC output voltage is being produced, regardless of whether the unit is operating from incoming AC power or the internal batteries.

4.3 Testing the Associated Equipment

Now that 54 volts DC is being produced, check each piece of equipment that is being powered by the Model 732A. If possible, use a digital voltmeter to check the DC output for nominal 54 volts DC; a reading of 53 to 55 volts would be considered normal when AC power is present and the batteries are fully, or nearly fully, charged. A reading of 42 to 50 volts would be considered normal when the AC power input has failed and the unit is operating under battery power. If the status contact has been utilized, check the associated equipment to ensure that it recognizes the Model 732A's normal and AC failure operating states.

4.4 Testing Battery Operation

Warning: The testing method described in this section makes the assumption that a safety ground connection has been made to the ground screw located on the right side of the Model 732A's enclosure. This dedicated ground ensures that a safety ground connection is maintained even if the power plug is disconnected from the AC outlet. If you are uncertain whether this safety ground connection has been made, review Section 3.7 of this practice.

The Model 732A does not include a direct means of placing the unit under battery operation. This design decision was made to enhance the reliability of the system and prevent "button pushers" from accidentally placing and leaving the unit in a test mode. To test the Model 732A's back-up capability simply unplug the unit's power plug from its associated AC outlet. The AC input LED should no longer be lit, while the DC output LED should remain lit. If the status contact has been connected to other equipment, ensure that this AC power fail state is recognized. After observing correct battery operation, reconnect the Model 732A's power plug into the AC outlet. The AC input LED should again light; the DC output LED should remain lit.

4.5 Placing the Model 732A in Service

The unit should now be ready for a long, uneventful life. Normal operation should find the two status LEDs lit steadily.

5. Technical Notes

5.1 Battery Charging Time

The rate at which the Model 732A will charge its internal batteries is directly related to the output load. The greater the output load the longer the battery recharge time will be. This is because both the battery charging and output functions share the DC energy that is generated by the circuitry. With the DC output loaded to its 2 amperes maximum rated value, the recharge time for fully discharged batteries is on the order of 24 hours.

As the output load decreases, more energy is available to charge the batteries. An output load of 1 ampere will reduce the recharge time to something less than six hours. With no load on the DC output, the recharge time will be in the range of just three hours. Note that in most "real world" cases the batteries will supply energy for only limited periods of time before being recharged. This is because most AC failures are of a relatively short duration. A recharge process will generally start with batteries that are not in their fully discharged state. In this more typical scenario the recharge time would be considerably less than the 24-hour worst-case figure.

5.2 Ambient Temperature

As previously mentioned, four 12 volt, 7.2 ampere-hour sealed lead-acid batteries are contained in the Model 732A. A large book could be written on how various factors impact the long-term performance of such batteries. But instead of boring you with a book, we'll simply review a few of the issues. The battery charging voltage, charging rate, discharge rate, and discharge depth all greatly impact the length of time a battery is able to provide adequate performance. (This "adequate" performance would be measured in months or years.) The Model 732A's circuitry was carefully optimized to correctly handle these parameters. This approach is conservative, sacrificing a faster charging time but providing a more "gentle" treatment of the battery's internal chemistry. When the Model 732A's output is supplying power from the batteries the maximum discharge rate is limited. The output also automatically "shuts down" when reaching a specified voltage value. By limiting the maximum output current and preventing deep discharge the batteries are protected from damage.

The one factor that is entirely installation dependent is ambient temperature. A simple rule of thumb would be to strive to locate the Model 732A in an environment that is maintained at a 68-degree Fahrenheit (20-degree Celsius) ambient temperature. This is an excellent temperature as it promotes both optimum battery life and good performance. Locating the unit where there's an elevated ambient temperature will serve as an effective battery killer. For example, changing the ambient temperature to 104 degrees Fahrenheit (40 degrees Celsius), compared to 68 degrees, will reduce the battery life by well over 50%! But whatever the ambient temperature, the Model 732A's air vents must remain clear. This ensures that airflow can be maintained.

6. Incorrect Operation

6.1 Review Practice

Should problems arise in the operation of the Model 732A, please review Section 3–Installation and Section 4–Testing and Operation in this practice.

6.2 AC Outlet

If the AC input LED does not light, reconfirm that the AC outlet is functioning by plugging another piece of equipment into it. If the AC outlet is okay, but the AC input LED doesn't light, the Model 732A needs to be returned to the factory for repair.

6.3 Output Overload or Short-Circuit Condition

Finding the AC input LED lit, while the DC output LED is not, would typically indicate that an overload condition is being placed on the Model 732A's DC output. This will occur whether the output is being fully shorted, or has a load that is attempting to draw more than approximately 3.5 amperes. Carefully recheck the wiring and equipment being powered. "Shed" some or all of the load to ensure that an overload is not present. Once an acceptable load is connected, the Model 732A may restart and the DC output LED will light steadily. In some cases the output protection circuitry may require that the load be completely removed before the DC output again becomes active. Simply remove all loads from the output, observe the DC output LED until it lights, then reconnect the loads. Note that it may take several minutes for the protection components to cool sufficiently to again allow normal operation.

6.4 Internal Fuses

The Model 732A contains two internal fuses. One is connected in series with the incoming AC power. This fuse will open ("blow") if the unit experiences serious trauma. The other fuse is connected in series with the batteries. It will open if the batteries are incorrectly connected or if excessive current is drawn from, or sent to, the

batteries. An open fuse always indicates that the unit must be returned to the factory; neither fuse is intended for user replacement. Removing the unit's cover will expose you to hazardous voltages.

6.5 Application Limitations

The Model 732A was designed to operate correctly in many applications. However, Gordon Kapes, Inc. does not guarantee that the Model 732A will be compatible with every specific application. All functions of the installed Model 732A should be thoroughly tested before the unit is placed into service.

6.6 Save Time

You are encouraged to email or call Gordon Kapes, Inc. for technical support. Please refer to the web site, www.gkinc.com, for the applicable email address and telephone number. We do not mind "walking" you through an installation, or performing a verbal review prior to you actually getting started. Please have these items with you: a copy of this technical practice, system configuration documentation, and adequate tools, including a digital volt-ohm meter (VOM).

7. Maintenance

7.1 Maintenance

The Model 732A requires no normal maintenance. It is recommended that the unit be examined not less than every three months to ensure that the vents on the top and bottom surfaces are unobstructed and free of dirt.

7.2 Battery Replacement

The Model 732A's internal batteries should provide reliable service for a minimum of 3 years. Refer to Section 5.2 of this technical practice for details. Variables that can affect battery life include the number of charge/discharge cycles and ambient temperature. A label, attached to the right side of the cabinet, indicates when the batteries were installed at the factory. This can be used to "guess" when the batteries will require replacement. However, the only true test of battery quality is to place a known load across the Model 732A's DC output, disconnect the AC input power to place the unit under battery operation, and then measure the time until the unit automatically "shuts down." If the measured time deviates significantly from the published specification, the batteries need replacement.

Warning: The batteries are not user replaceable, requiring that the Model 732A be returned to the factory or an authorized service center. Removing the Model 732A's cover will expose you to potentially lethal voltages—don't do it!

7.3 Manual Battery Shutdown

By design, the Model 732A doesn't contain an on/off switch. The nominal 54 volt DC output is intended to be provided whether incoming AC power is present or not. During battery operation, only when the batteries have discharged to their minimum acceptable voltage level will they automatically disconnect. This protects the batteries from damage due to deep discharge. There may be cases, e.g., testing or storage, where a Model 732A will need to be manually "shut down." The Model 732A provides a "secret" button to allow this to happen. Personnel at the factory use this button to manually shut down new units, allowing them to be shipped with near-fully charged batteries. The button is located on the left side of the unit, directly between the two output connectors. The button is accessible through a small hole in the panel, preventing accidental activation.

With the Model 732A operating under battery power (incoming AC power disconnected), press the button with a small non-conducting tool. To indicate that the unit has shut down, the DC output LED will not be lit. At this point, the batteries are disconnected from any load. The Model 732A can now be stored for up to six months without significant adverse effect on the batteries. Note that the storage temperature should not exceed the recommended 68 degrees F (20 degrees C) value. To return the Model 732A to normal operation, simply reconnect incoming AC power; both LEDs should light.

8. Repair and Replacement

8.1 Not So Fast

Statistically, most equipment returned to Gordon Kapes, Inc. for repair actually has nothing wrong with it. An email or telephone call to Gordon Kapes, Inc. technical support can often help get the equipment operating correctly. We don't mind spending time with our customers getting a site up and running.

8.2 Repairs

In the event repairs are ever needed on your Model 732A, they should only be performed by Gordon Kapes, Inc. Do not remove the cover as it will expose you to hazardous voltages. If you determine that the Model 732A is defective, we request that you obtain a return authorization number prior to returning any equipment.

9. Specifications

Input Voltage: 95-135 volts, 47-63 hertz

Input Current: 2.0 amperes, maximum

Input Power Cord:
Type: 3-conductor with NEMA 5-15P plug
Length: 6 feet (2 meters), nominal, not detachable

Output Voltage:
54 volts DC, nominal, with AC input voltage present
48 volts DC, nominal, battery operation; no AC input voltage present

Output Current: 2.0 amperes continuous, maximum

Recommended Minimum Output Load Current: 50 milliamperes (helps maintain correct charge voltage)

Output Ripple Voltage: less than 100 millivolts p-p; "talk-battery" quality

Output Protection:
Type: solid-state, automatic reset

Batteries: 4
Type: 12 volts, 7.2 ampere-hour (Ah), sealed lead-acid (Panasonic LC-R127R2P or equivalent), classed for transportation as "Non-Spillable"

Battery Operating Time (Nominal):
20 hours, 0.3 ampere output load
10 hours, 0.6 ampere output load
5 hours, 1.2 ampere output load
3 hours, 2 ampere output load

Battery Charge Time (Nominal):
3 hours, no output load
6 hours, 1 ampere output load
24 hours, 2 ampere output load
Figures reflect charging process beginning with batteries in fully discharged state

Automatic Battery Disconnect:
Type: solid-state
Operating Threshold: 41 volts, nominal

Input to Output Efficiency: 80%, nominal, measured with 120 volt 60 hertz input, 2 ampere output load

Output Connector—3-Position:

Functions Supported: ground, DC output
Type: Phoenix Contact (or equivalent) pluggable terminal strip, 0.2-inch (5.08 mm) contact centers
Mating Plug (included with Model 732A): Phoenix part number IC2,5/3-ST-5,08 (Phoenix order number 1786187) or equivalent

Output Connector—6-Position:

Functions Supported: ground, DC output, status contact
Type: Molex® Mini-Fit, Jr.™ 6-position dual row header
Mating Connector: Molex Mini-Fit, Jr. 6-position dual row receptacle, suggested part number 39-01-2060; suggested crimp-on female terminals part number 39-00-0039

LED Status Indicators: 2

Functions: AC input present, DC output present

Status Contact:

Action: normally open (not shorted)
Type: sealed bifurcated relay contact, isolated
Rating: 0.5 amperes maximum at 60 volts AC or 60 volts DC (resistive)
Function: closes (shorts) upon loss of AC input power, defined as nominally less than 15 volts

Safety Compliance: Underwriters Laboratories, Inc. CUL-1950 ITE LISTED

Radiated Noise Compliance: complies with FCC Part 15, subpart J, class A for radiated and conducted emission

Operating Environment:

68 degrees F (20 degrees C), nominal. Intended for operation in commercial environment where air conditioning is present. Operation at temperatures greater than recommended will significantly reduce battery life.

Dimensions (Overall):

6.3 inches high (24.8 cm)
12.4 inches wide (31.5 cm)
7.1 inches deep (18.0 cm)

Mounting: intended primarily for wall mounting

Weight:

30.5 pounds (13.8 kg)
32.4 pounds (14.7 kg), shipping weight

Specifications and information contained in this technical practice subject to change without notice.

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