

Technical Practice

Issue 2, March 2001

MODEL 732 DC POWER SUPPLY WITH BATTERY BACK-UP

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1. General Description

1.1 PRACTICE Issue 2 of the Model 732 Technical Practice is released primarily to document several changes in the way the unit's performance is specified. No changes have been made to the unit's actual performance. In addition, text has been added to several sections to improve understanding.

1.2 PRODUCT OVERVIEW The Model 732 DC Power Supply with Battery Back-Up provides a filtered and regulated source of 54Vdc with a maximum output current of 2A. The nominal input voltage is 120V, 60Hz. Rechargeable batteries contained within the Model 732 provide output back-up capability in the event of an AC input voltage interruption. Under battery operation, the Model 732 will continue to supply a 2A DC output for up to nominally 3 hours. For output loads of less than 2A the battery operating time will substantially increase. The unit is completely self-contained in a compact wall-mounted cabinet. The Model 732 is Underwriters Laboratories, Inc. Listed under their CUL-1950 ITE category.

1.3 FEATURES Model 732 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, 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, 95-135V, allows operation even when the AC power source deviates significantly from nominal 120V.

The Model 732'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 2A output load can be supported for up to 3 hours, nominal, 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 732'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 732 is operating under battery power.

The Model 732 is primarily intended for wall-mounted applications. Locating the unit on a shelf or other flat surface is also acceptable. Ground, DC output, and status contact interconnections are made using a 6-position detachable connector. Nominal 120V input power is connected using a nondetachable 3-conductor cord and standard NEMA 5-15P plug.

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

2. Applications

2.1 PRIMARY APPLICATION The Model 732 DC Power Supply with Battery Back-Up is intended to provide telecommunications and data applications with an uninterruptible source of 54Vdc. 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 “-48Vdc” power source.

2.2 FLOATING OUTPUT The Model 732’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 $\pm 150V$ away from ground, allowing it to be connected in series with other telecommunications power supplies, e.g., ring voltage generators.

2.3 SAFETY COMPLIANCE The Model 732 has been tested and approved 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 732 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 732 requires a safety-first approach. Read the entire installation section of this practice before starting the installation process.

WARNING: Handle the Model 732 with great caution! It is very heavy relative to its physical dimensions. If dropped, it can be hazardous to people or property.

3.2 CHECKING FOR DAMAGE The Model 732 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 KIT Included in each Model 732 shipping carton are several components that comprise the installation kit. A paper template is included to display the location of the Model 732’s mounting holes. Four pan-head screws (#10- $\frac{3}{4}$, Type A) are provided to secure the unit to the mounting surface.

3.4 OUTPUT CABLE A DC output interconnecting cable is provided in each Model 732 shipping carton. The type of cable supplied will depend on how the unit was ordered from the factory. In all cases one end will have a 6-position plug that mates with the connector on the left side of the Model 732. The other end will have either unterminated wire leads or be provided with a connector specifically selected to interface with the equipment to be powered. If unterminated leads are provided, refer to Figure 1 for the wire color code.

Pin Number	Function	Wire Color
1	Ground	Green
2	+DC	Red
3	-DC	Black
4	Status Contact	White
5	Status Contact	Brown
6	Not Used	

Figure 1 Output interconnecting cable wire color chart

3.5 SELECTING A MOUNTING LOCATION Three factors come into play as you select the “perfect” Model 732 mounting location: ability to hold the unit’s weight, unrestricted air flow, and proximity to an AC outlet. The weight of the Model 732 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 120V AC outlet is also important. The Model 732 contains a 6-foot (2-meter) 3-conductor power cord with a NEMA 5-15P plug attached.

3.6 WALL MOUNTING THE UNIT Mount the Model 732 using the four screws supplied in the installation kit. These screws are intended for use with a wood backboard surface (minimum thickness $\frac{3}{4}$ -inch). The Model 732’s cabinet is outfitted with four keyhole-type screw slots. Use one screw per slot and securely fasten the unit to the backboard. A paper mounting template is included with each Model 732. 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 732 up to the wall!

3.7 ALTERNATE LOCATION There may be specialized applications where the Model 732 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 airflow must be allowed to flow from the bottom of the unit to the top. To ensure that an airflow gap is maintained, four self-stick “feet” are factory attached to the bottom of each unit. Besides ensuring airflow, these “feet” will protect the finish of the surface supporting the Model 732. As maximum battery life depends on controlling the temperature of the Model 732, do not locate the unit on top of other heat sources.

3.8 SAFETY GROUND CONNECTION One conductor of the 3-conductor AC power cord brings safety ground to the Model 732’s enclosure. In addition, a separate safety ground connection must be made directly to the Model 732’s enclosure. This will ensure that a safety ground connection will be maintained, even if the AC power plug is unplugged from its associated outlet. A ground connection screw has been specifically provided on the right side of the Model 732’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 there be any questions, a competent electrician is best able to identify an adequate safety ground connection point.

3.9 SAFETY FIRST Before making any output connections to the Model 732, ensure that a separate safety ground connection has been made and that the AC power plug is not plugged into an 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 8.3 for details on how to manually “shut down” the unit.

3.10 GROUND, DC OUTPUT, AND STATUS CONTACT

A 6-position connector, located on the left side of the Model 732, allows access to the ground, DC output, and status contact connections. Refer to Figure 2 for details.

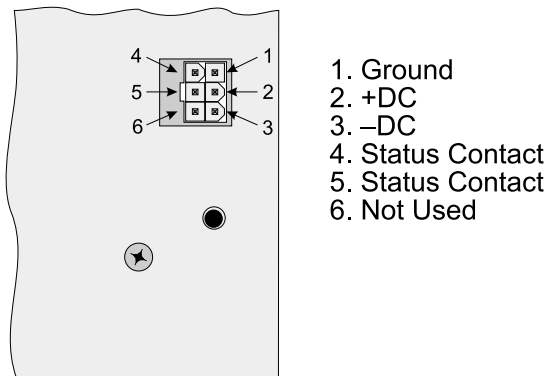


Figure 2 Output connector pinout (left-side view)

Pin 1 of the output connector is connected, via the Model 732’s internal circuitry, to ground. This ground is the same as that supplied by the AC line cord and the separate safety ground connection. This ground on pin 1 allows a safety ground connection to be provided to connected equipment. Note that 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.

Pin 2 of the output connector provides the + connection of the 54Vdc output. Pin 3 provides the – connection of the 54Vdc output. Pins 4 and 5 provide access to the AC failure status contact.

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 –54Vdc with respect to safety (earth) ground. This is easily accomplished by connecting pin 1 (ground) to pin 2 (+DC) and using this combination as the ground connection for the load. Pin 3 (–DC) provides the –54Vdc connection for the load.

3.12 STATUS CONTACT The status contact provides an indication of the Model 732’s AC input voltage. It is accessible on pins 4 and 5 of the 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 732 is producing 54V from the incoming AC power, nominally 120V, the status contact is

open (not shorted). When the incoming AC power has failed, or is below approximately 85V, 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 60V AC or DC), and low current (less than 0.5A) applications.

3.13 CONNECTING AC POWER Before the Model 732’s AC power plug is plugged into a 120V source, ensure that a separate safety ground connection has been made. The desired DC output connections should have been made by way of the 6-position connector. If desired, a status contact connection should have been made. The 6-position plug should be firmly mated with the output connector located on the left side of the Model 732. Now the AC 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 54Vdc. 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 732 and the associated equipment. A safety ground connection should have been made to the ground screw located on the right side of the Model 732. The power plug should have been plugged into the selected AC outlet. Confirm that the power cord is hanging free. At this time 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 7 of this practice for troubleshooting assistance.

4.2 STATUS LEDS The Model 732 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 85V. The DC output LED lights steadily whenever 54V 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 54V is being produced, check each piece of equipment that is being powered by the Model 732. If possible, use a digital voltmeter to check the DC output for nominal 54Vdc; a reading of 53 to 55V would be considered normal when AC power is present and the batteries are fully, or nearly fully, charged. A reading of 42 to 50V would be considered normal when the AC 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 732’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 732’s enclosure. This dedicated ground ensures that a safety ground connection is maintained even if the AC power plug is disconnected from the outlet. If you are uncertain whether this safety ground connection has been made, review Section 3.8 of this practice.

The Model 732 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 732’s back-up capability simply unplug the unit’s AC plug from its associated 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, again plug the Model 732’s plug into the AC outlet. The AC input LED should again light; the DC output LED should remain lit.

4.5 PLACING THE MODEL 732 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 732 will charge the 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 shares the DC energy generated by the circuitry. With the DC output loaded to its 2A 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 1A will reduce the recharge time to something less than 6 hours. With no load on the DC output, the recharge time will be in the range of just 3 hours. Note that in most cases the batteries will supply energy for only a limited period of time before being recharged. This is because most AC failures are of a relatively short duration. A recharge process would generally start with batteries that are not in their full 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 12V, 7.2Ah sealed lead-acid batteries are contained in the Model 732. 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 will provide adequate performance. (This “adequate” performance would be measured in months or years.) The Model 732’s circuitry was carefully optimized to correctly handle these parameters.

But what is entirely installation dependent is ambient temperature. A simple rule of thumb would be to strive to locate the Model 732 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. Note that an elevated ambient temperature serves 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 732’s air vents must remain clear. This ensures that airflow can be maintained. For more detailed information about sealed lead-acid batteries, please refer to the Panasonic web site. As of the date

of this practice, a valid link is: http://www.panasonic.com/industrial_oem/battery/battery_oem/chem/seal/seal.htm.

5.3 BATTERY TYPE At the factory the Model 732 is assembled into several configurations to meet different performance and price goals. The serial number tag, located on the right side of the unit, will provide the exact configuration number. The Model 732-01 contains batteries optimized for intermittent use applications. The battery manufacturer, Panasonic, describes these batteries, part number LC-P127R2P, as being applicable for long life in trickle-charge setting. This scenario matches most Model 732 applications where the batteries are normally on “standby,” awaiting infrequent failures of incoming AC power. By using these specific batteries, and maintaining the unit’s temperature at the recommended value, it is expected that battery replacement will not be required for 6 or more years. As with most things in life, this excellent performance doesn’t come without a catch. These batteries are premium priced and have to be manufactured specifically for Gordon Kapes, Inc. But it’s worth it in what they do for the performance of the Model 732!

The Model 732-02 contains batteries that are of very good quality, but are optimized for general-purpose, rather than extended-life use. The specific batteries, Panasonic LC-R127R2P, are recommended for repeated charge/discharge applications. In the Model 732 they should have a minimum 3-year operating life. This battery was selected for use in the Model 732-02 due to its lower cost and ready availability.

6. Specifications

INPUT VOLTAGE
95-135V, 47-63Hz

INPUT CURRENT
2.0A, maximum

INPUT POWER CORD
Type: 3-conductor with NEMA 5-15P plug
Length: 6 feet (2 meters), nominal, not detachable

OUTPUT VOLTAGE
54Vdc, nominal, with AC input voltage present
48Vdc, nominal, battery operation; no AC input voltage present

OUTPUT CURRENT
2.0A continuous, maximum
RECOMMENDED MINIMUM OUTPUT LOAD CURRENT
50mA (maintains correct charge voltage)

OUTPUT RIPPLE VOLTAGE
Less than 100mV p-p, “talk-battery” quality

OUTPUT PROTECTION
Type: solid-state, automatic reset
Current required for automatic output shutoff: 5A, nominal

BATTERIES
Qty: 4
Type: 12V, 7.2Ah, sealed lead-acid (732-01 Panasonic LC-P127R2P; 732-02 LC-R127R2P), classed for transportation as “Non-Spillable”

BATTERY OPERATING TIME (NOMINAL)

20 hours, 0.3A output load
10 hours, 0.6A output load
5 hours, 1.2A output load
3 hours, 2A output load

BATTERY CHARGE TIME (NOMINAL)

3 hours, no output load
6 hours, 0.1A output load
24 hours, 2A output load

Figures reflect charging process beginning with batteries in fully discharged state

AUTOMATIC BATTERY DISCONNECT

Type: solid-state
Operating Threshold: 41V, nominal

INPUT TO OUTPUT EFFICIENCY

86%, nominal, measured with 2A output load

OUTPUT CONNECTOR

Qty: 1
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

Qty: 2
Functions: AC input present, DC output present

STATUS CONTACT

Action: normally open (not shorted)
Type: sealed bifurcated relay contact, isolated
Rating: 0.5A maximum at 60Vac or 60Vdc (resistive)
Function: closes (shorts) upon loss of AC input power, defined as nominally less than 85Vac

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

WEIGHT

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

MOUNTING

Intended primarily for wall mounting

7. Incorrect Operation

7.1 REVIEW PRACTICE Should problems arise in the operation of the Model 732, please review Section 3—Installation and Section 4—Testing and Operation in this practice.

7.2 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 732 needs to be returned to the factory for repair.

7.3 OUTPUT OVERLOAD OR SHORT 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 732'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 3A. 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 732 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.

7.4 INTERNAL FUSES The Model 732 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 connected incorrectly, 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.

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

7.6 SAVE TIME You are encouraged to e-mail or call Gordon Kapes, Inc. for technical support. Please e-mail support@gkinc.com or refer to the web site, www.gkinc.com, for the applicable telephone number. We do not mind "walking" you through an installation, or performing a verbal review prior to your 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).

8. Maintenance

8.1 MAINTENANCE The Model 732 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.

8.2 BATTERY REPLACEMENT The Model 732's internal batteries should provide reliable service for a minimum of 3 years, with 6 or more years possible. Refer to Section 5.3 of this technical practice for better details. Variables that can

effect 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 732’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 the Model 732 to be returned to the factory or an authorized service center. Removing the Model 732’s cover will expose you to potentially lethal voltages—don’t do it!

8.3 MANUAL BATTERY SHUTDOWN By design, the Model 732 doesn’t contain an on/off switch. The nominal 54V output is intended to be there 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 732’s batteries will need to be manually “shut down.” The Model 732 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 below the output connector. The button is accessible through a small hole in the panel, preventing accidental activation.

With the Model 732 operating under battery power (incoming AC power disconnected), press the button with a small nonconducting 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 732 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 732 to normal operation, simply reconnect incoming AC power; both LEDs should light.

9. Repair and Replacement

9.1 NOT SO FAST Statistically, most equipment returned to Gordon Kapes, Inc. for repair actually has nothing wrong with it. An e-mail 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.

9.2 SEND IT BACK If you determine that the Model 732 is defective, return it for repair or replacement according to the Gordon Kapes, Inc. Warranty/Repair and Return policy. We request that you obtain a return authorization number prior to returning any equipment.

9.3 ONLY WE FIX IT In the event repairs are ever needed on your Model 732, they should only be performed by Gordon Kapes, Inc. Do not remove the cover as it will expose you to hazardous voltages.

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

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