INSTRUCTION MANUAL

KEPCO An ISO 9001 Company.

KES 48 VOLTS

48 VOLT ENGINE START BATTERY CHARGER

I — INTRODUCTION

SCOPE OF MANUAL.

This instruction manual covers the installation and operation of the Kepco Series KES 48 Volt Engine Start Battery Chargers (see Table 1).

WARNINGS and CAUTIONS

- **Do not operate the unit without proper grounding. Improper grounding risks an electric shock that could result in injury or death.**
- **Do not touch the unit's input or output terminals to avoid the risk of electric shock that could result in injury or death. Energy stored in the unit's output capacitor is present on the DC OUTPUT terminals for a few seconds even after the a-c input voltage is removed.**
- **The Float Voltage and Current Limit must be preset prior to starting the initial charge to avoid damage to the battery being charged.**
- **To avoid damage to the unit or the battery being charged, never obstruct the ventilation holes at the sides of the unit. The unit must be installed in a properly ventilated area, free of smoke and corrosive or explosive vapors.**

DESCRIPTION.

The Kepco Series KES 48 Volt Engine Start Battery Chargers are wall-mounted units designed to charge 48-Volt lead-acid or nickel cadmium batteries used in engine start applications. Model KES 48-5 is rated at 5 Amps, Model KES 48-10 is rated at 10 Amps, and Model 48-25 is rated at 25 Amps.The output voltage and output current limit are factory set, and are adjustable from the front panel recessed trimpots (see Table 1 for values). An optional temperature compensation probe (not supplied) provides automatic adjustment of the float voltage to accommodate temperatures from 0° to 35°C. Units may be operated with a nominal 100V a-c to 240V a-c (input voltage range 85 to 265 Va-c), 50-60 Hz nominal, range 47-66Hz (see Table 1, Note 1). Both AC lines are protected by fuses. A front panel ammeter shows charging current.

The heart of the KES 48 Volt Series is a solid-state switching power supply, Kepco's RKW, which has an integral cooling fan. A front panel CHARGER ON indicator lights while the unit is on. The front panel TEMP PROBE NOT CONNECTED indicator lights to show that the temperature compensation probe is not attached to the unit. An internal diode network across the output provides protection in the event that the battery connections are reversed, causing the front panel circuit breaker to open.

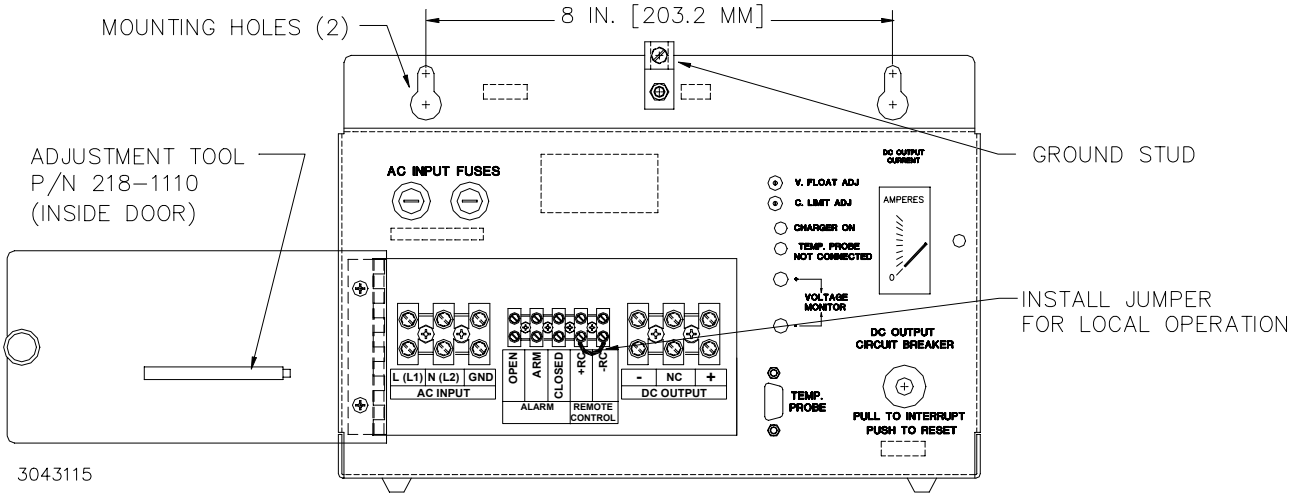

FIGURE 1. KES 48 VOLT ENGINE START BATTERY CHARGER, FRONT VIEW

FEATURES

- **Wide Range Input** - Operates from input voltage range of 85 to 265V a-c, input frequency range 47-66Hz (see Table 1, Note 1) with no adjustment or modification required.
- **Adjustable Float Voltage** - The float voltage is adjustable over a wide range (see Table 1 for adjustment range and factory setting). Adjust the output voltage from the front panel using the tool on the back of the front panel door (see Figure 1) to adjust the V. FLOAT ADJ potentiometer while monitoring the + and – VOLTAGE MONITOR test points with a precision digital voltmeter.
- **Adjustable Current Limit** - The current limit is adjustable over a wide range (see Table 1 for adjustment range and factory setting). Adjust from the front panel using the C. LIMIT ADJ potentiometer using the tool on the back of the front panel door (see Figure 1).
- **Temperature Compensation** - Optional temperature compensation probes (Models TEMPCO-10 (10 ft. long), TEMPCO-50 (50 ft.), TEMPCO-100 (100 ft.) and TEMPCO-200 (200 ft.), not supplied) provide automatic adjustment of the float voltage to accommodate temperatures from 0° to 35°C for lead-acid batteries. For other lengths, consult factory.
- **CHARGER ON indicator** - on while a-c input power applied to unit and unit is operational.
- **Charging Current ammeter** - indicates charging current
- **Input protection** - Two line fuses are provided.
- **Battery connection protection** - If battery connections are reversed, an internal diode network across the output is forward biased; the resulting current flow causes the front panel circuit breaker to pop open. The connections must be switched and the circuit breaker pushed in to reset.
- **Form C Relay Contact** - Used for Battery Charger fault alarm.
- **ON-OFF Control** - Local On-Off circuit breaker and isolated Remote On-Off control of Battery Charger output.

II — INSTALLATION

If desired, the battery charger output voltage and current limit can be preset prior to mounting at a separate location.

PRESETTING THE OUTPUT VOLTAGE (FLOAT VOLTAGE)

1. Open the access door to gain access to input/output connections by pulling the latching retainer.
2. ***With a-c voltage not present and the battery disconnected*** route the a-c source line, neutral and ground wires through the appropriate openings in the bottom of the chassis and secure to L (L1), N (L2), and GND terminals of the AC INPUT terminal block, respectively.
3. Connect the local ground connection to the ground stud (see Figure 1) using the 10-32 x 3/8 ACF Brass Hex nut provided (Kepco P/N 102-0007)
4. Turn a-c power on and connect a precision digital voltmeter (DVM) to the + and – VOLTAGE MONITOR test points at the front panel.
5. Monitor the DVM and set the float voltage as desired using the tool mounted on the back of the access door to adjust the V. FLOAT ADJ potentiometer at the front panel. It is recommended that the unit be tagged with the float voltage.
6. Turn a-c power off and disconnect DVM. If unit is to be mounted at a different location, disconnect ground and a-c input connections, then close the access door and snap in the retainer.

PRESETTING THE CURRENT LIMIT (CHARGING LIMIT CURRENT)

1. Open the access door to gain access to input/output connections by pulling the latching retainer.
2. ***With a-c voltage not present*** disconnect battery from the output terminals.
3. Place a short-circuit (jumper link, No. 8 AWG wire, minimum) between (+) and (–) DC OUTPUT terminals.
4. If not already connected, route the a-c source line, neutral and ground wires through the appropriate openings in the bottom of the chassis and secure to L (L1), N (L2), and GND terminals of the AC INPUT terminal block, respectively.
5. Turn a-c input power on. Monitor the front panel ammeter and set the current limit as desired (see NOTE) using tool mounted on the back of the access door to adjust the C. LIMIT ADJ potentiometer at the front panel.

   NOTE: The unit incorporates a foldback characteristic for current limit to reduce power dissipation when there is a short across the output terminals. From a shorted output (e.g., for a brand new battery), the current limit increases linearly from 10% less than the full current limit to the full current limit as the battery charges. Consequently, if the desired current limit is I_{LIM}, adjust for $0.9I_{LIM}$ with shorted output.
6. Turn a-c power off and remove the short-circuit between (+) and (–) DC OUTPUT terminals.

MOUNTING THE BATTERY CHARGER

Two slotted holes, 8 inches apart, are provided on the upper rear chassis (See Figure 1) to wall mount the unit. The unit also has four feet for bench top operation. The unit has forced air cooling from a single fan located within the integral RKW power supply as well as ventilation holes in the chassis which must be kept clear from obstructions to ensure proper air circulation. Enough space must be provided around the chassis to allow the hot air to exhaust from the components inside the chassis.

1. Open the access door to gain access to input/output connections by pulling the latching retainer.
2. Route the a-c source line, neutral and ground wires through the appropriate openings in the bottom of the chassis and secure to L (L1), N (L2), and GND terminals of the AC INPUT terminal block, respectively.
3. Connect the local ground wire to the ground stud (see Figure 1) using the 10-32 x 3/8 ACF Brass Hex nut provided (Kepco P/N 102-0007)
4. Proceed to CONNECTING THE BATTERY or, if the battery will be connected later, close the access door and snap in the retainer.

CONNECTING THE BATTERY

1. ***With DC output circuit breaker pulled out to interrupt the output circuit*** open the access door and route the + and – battery connections through the appropriate openings at the bottom of the chassis and secure to the DC OUTPUT, + and – terminals, respectively. NOTE: Verify the polarity! If the polarity is reversed, when the front panel circuit breaker is pushed in, it will pop. If this occurs, reconnect the battery correctly and push the circuit breaker in to reset.
2. Close the access door and snap in the retainer.

III — OPERATION

USING TEMPERATURE COMPENSATION FOR LEAD-ACID BATTERY (OPTIONAL)

Temperature compensation can prolong battery life by adjusting the float voltage automatically. Temperature compensation allows the output voltage of the KES battery charger to be automatically decreased or increased for temperatures above or below 77°F (25°C), respectively, in the 0°C to 35°C range. Beyond this range, the compensation is clamped to 0°C and 35°C for temperatures below 0°C and above 35°C, respectively. Compensation is 3mV/(°F)(cell) or 5.4mV/(°C)(cell), and can be calculated as follows: $\Delta V = -(K_T)(T_a - 77)(V_B/2.23)$ where V_B = Battery voltage, K_T = 0.003V/(°F)(cell), T_a = ambient temperature in °F and 2.23 = cell voltage at 77°F. Thus, for example, to calculate the float voltage V_F of a 52.5V battery charging at 80°F: $V_F = V_B + \Delta V = 52.5 - (0.003)(80-77)(52.5/2.23) = 52.5 - 0.212 = 52.288V$.

1. Connect the temperature probe cable to the TEMP PROBE connector at the front panel. Verify that the TEMP PROBE NOT CONNECTED indicator is not lit.
2. Attach the temperature probe to the negative (–) terminal of the battery being charged. If the threaded stud is long enough, mount the probe on the threaded stud and attach it with another nut. Otherwise, remove the existing nut and use it to attach the temperature probe. In either case observe torque requirements when tightening the nut.

CHARGING THE BATTERY

1. If the float voltage has been preset, proceed to step 2. Otherwise, refer to PRESETTING THE OUTPUT under INSTALLATION and set the float voltage for the battery to be charged.
2. Connect the battery (see INSTALLATION). If the circuit breaker pops, the battery connections are reversed; reverse the battery connections, and push the circuit breaker in to reset.
3. Install temperature compensation if desired (see previous paragraph). Verify all battery and a-c line connections are tight.
4. Apply a-c source power to the unit. The front panel ammeter indicates the charging current. NOTE: If the CHARGER ON indicator fails to light, verify that a-c source power is present and that the AC INPUT fuses have not blown. As charging begins, the battery forces the unit into current limit. At this time the desired charging limit current can be readjusted with the front panel C. LIMIT ADJ potentiometer (using the tool provided on the inside of the access door) while monitoring the front panel ammeter.
5. When the charging current as indicated on the front panel ammeter falls to near zero, the battery is fully charged.

USING THE ALARM OUTPUT

The isolated internal relay contacts are connected to the Battery Charger terminals as follows: NC (normally closed contact to ALARM OPEN terminal, NO (normally open) to ALARM CLOSED terminal and relay common to ALARM ARMATURE terminal. If the Battery Charger fails, the circuit between ALARM ARMATURE and ALARM OPEN opens, and the circuit between ALARM ARMATURE and ALARM CLOSED closes. The outputs from the form “C” relay can be used to alert other equipment, a computer, or an operator about a Battery Charger failure (overvoltage, internal overcurrent, overtemperature or fan failure).

USING REMOTE ON-OFF CONTROL

To use remote ON-OFF control first remove the jumper between ±RC terminals. Then connect an external NC relay contact or d-c voltage (see Table 1 for specifications) across ±RC terminals to turn the output on or off. A short or low voltage turns the output on; An open circuit or high voltage turns the output off.

IV — SPECIFICATIONS

Specifications listed in Table 1 are at nominal input voltage and at 25°C unless otherwise specified.

TABLE 1. KES 48 VOLT SPECIFICATIONS

SPECIFICATION	RATING			DESCRIPTION/CONDITION
	KES 48-5	KES 48-10	KES 48-25	
Input Voltage	100V a-c to 240V a-c			Nominal
	85V a-c to 265V a-c			Range
	50Hz/60Hz(1)			Nominal Frequency
	47Hz to 66Hz(1)			Frequency Range

(1) KES units can operate with source power frequency up to 400Hz nominal (range to 440Hz). Power factor, efficiency and leakage current will derate as frequency increases. Consult factory for additional information.

TABLE 1. KES 48 VOLT SPECIFICATIONS (CONTINUED)

SPECIFICATION		RATING			DESCRIPTION/CONDITION
		KES 48-5	KES 48-10	KES 48-25	
Input Current	100V a-c to 120V a-c	4.4A a-c max.	8.4A a-c max.	22A a-c max.	
	200V a-c to 240V a-c	2.2A a-c max.	4.2A a-c max.	11A a-c max.	
	100V a-c to 120V a-c	20A p-p max.	30A p-p max.	20A p-p max.	Surge, cold start, interval > 30 sec
	200V a-c to 240V a-c	40A p-p max.	60A p-p max.	40A p-p max.	Surge, cold start, interval > 30 sec
Output Voltage (Floating)	Factory Setting	52.0Vd-c			0.2% tolerance
	Adjustable Range	37.6 - 52.5V d-c			Minimum
Output Current Limit	Factory Setting	5A d-c	10A d-c	25A d-c	4% tolerance
	Adjustable Range	1 - 5A d-c	2 - 10A d-c	5 - 25A d-c	
	Short Circuit (2)	4.5A d-c	9A d-c	22.5A d-c	For factory-set current limit, 4% accuracy
Output Voltage Ripple and Noise (4)	Ripple	$200mV_{rms}$	$300mV_{rms}$		
	Noise	$300mV_{p-p}$	$400mV_{p-p}$		
Power Factor		0.99 typical			100V a-c input, rated output
Efficiency	AC input 100V	81%	84%	84%	Rated output
	AC input 200V	85%	87%	88%	
Leakage Current:		0.34mA a-c typ.	0.55mA a-c typ.	0.65mA a-c typ.	Per IEC 950 and UL 1950 @ 120V a-c, 60Hz
		0.46mA a-c typ.	0.75mA a-c typ.	1.25mA a-c typ.	Per IEC 950 and UL 1950 @ 240V a-c, 60Hz
Stabilization	Source Effect	0.2% max.			85 to 132V a-c and 170 to 265V a-c
	Load effect	0.4% max.	0.6% max.	0.6% max.	Measured at front panel test points (5), 0-100% load
	Temperature effect	1% max.			–10° to 65°C
	Time effect	0.5% max.			8 hours at 25°C
Output Voltage Temperature Compensation		3mV/(°F)(cell), 5.4mV/(°C)(cell) 0.5% accuracy @ 2.23V cell voltage (6)			Use optional temperature compensation probe, 0°C to +35°C for Lead-Acid battery.
Output Protection	Overvoltage (3)	60V d-c			Shutdown upon fault condition.
	Overcurrent (internal > 30 sec) (3)	11A d-c	19A d-c	45A d-c	
	Internal Overtemperature (3)	Detected			
	Fan Failure (3)	Detected			
	Battery Reversed	7.25A d-c (7)	14.5A d-c (7)	36.3A d-c (7)	Output limited to a negative Schottky diode drop.
Input Protection			Fuses (2) 10A, 250V	Fuses (2) 25A, 250V	10A: Kepco P/N 141-0057 (Bussman P/N MDA-10) 25A: Kepco P/N 141-0127 (Bussman P/N MDA-25)
Front Panel Display		Analog meter for output (charging) current			0 to maximum current limit, 5% accuracy
		"Charger ON" LED			Green indicates charger is on
		"Temp Probe Not Connected" LED			Yellow indicates that the probe is not connected
Alarm Output		One form "C" Relay contact Terminals: ARMATURE, OPEN, CLOSED. (8)			Contact Ratings: 120V a-c/0.5A a-c, 24V d-c/1A d-c, 0.1 Ohm (max. ON resistance)
Remote On-Off Input		Isolated ON-OFF control terminals ±RC ON: Requires short or low voltage OFF: Requires open or high voltage			ON: 0.4V max., 1.6mA source current OFF: 2.4V to 24V d-c, 1 mA sink current
Operation Temperature		-10°C to +65°C			Output performance derated above 50°C and below 0°C
Storage Temperature		-30°C to 75°C			
Cooling		Forced air flow - one fan (exhaust to the left side)			
Weight		9.0 lbs (4.1 Kg)	12.0 lbs (5.4 Kg)	approx. 22.0 lbs (10 Kg)	
Dimensions (H x W x D)	inches	7.25. x 11.14 x 9		9.25 x 15.16 x 9	
	millimeters	(184.2 x 283 x 228.6		(235 x 384.6 x 228.6)	

(2) 10% of current limit setting value foldback.
(3) After disconnecting a-c input, remove the fault, wait about 40 seconds, then reconnect a-c input.
(4) Ripple & noise = 1.5 x indicated values for Ta = -10°C to 0°C. Values shown are satisfied for 0 to 100% load, 0 to 65°C, measuring bandwidth ≤ 100MHz.
(5) Minimum input impedance of 1 Megohm required for voltage measurement instrument.
(6) To calculate temperature compensation for cell voltage other than 2.23V, see Section III - Using Temperature Compensation for Lead-acid Battery.
(7) Output disconnected for output current > 1.45 x rated current limit
(8) Alarm activates upon detection of missing a-c input, charger not operational, or output current falls below 1% of charger maximum current limit.