Technical Manual

for

Model No. LR3C-14 and LR3C-28
Linear Regulator

With Over-Voltage Protection, Low-Voltage Sensing,
And Field-Adjustable Charging Voltage

Including:

Installation Instructions;
Troubleshooting Guide; and
Instructions for Continued Airworthiness

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LR3C_Install, Rev. B (3/15/16)

NOTE

The LR3C-14 and LR3C-28 Linear Regulators are not STC'd or PMA'd and are intended for installation on amateur-built aircraft only.

INTRODUCTION

This kit is applicable to any aircraft requiring external control and regulation of a B-type, wound-field Alternator.

DESCRIPTION OF INSTALLATION

(1) Remove engine cowl and disconnect aircraft battery.
(2) Remove existing regulator (if applicable).
(3) Install new Controller (Regulator).
(4) Install 2A and 5A circuit breakers, alternator master switch, and incandescent warning light on instrument panel.
(5) Wire the LR3C Controller (Regulator), circuit breakers, alternator master switch, and incandescent warning light.
(6) Reconnect battery and replace engine cowl.
(7) Update ship's weight and balance, pilot operating handbook and maintenance records.

PARTS LIST

The following parts are supplied with the LR3C-14 and LR3C-28:

Qty.	Part No.	Description
1	LR3C-14 or LR3C-28	Alternator Controller (Regulator)
8	S814R6	Terminal, Ring, 18-22AWG
1	S888-1-4 (14v) or S888-2-4 (28v)	Warning Lamp, Incandescent, Yellow

The following parts are needed but **not** supplied with this kit:

Qty.	Part No.	Description
1	L-40, BC460-H, BC410-H, BC462-H (or equal)	Alternator
1	CB2 (or equal)	Circuit Breaker, 2A
1	CB5 (or equal)	Circuit Breaker, 5A
1	S700-2-3 (or equal)	Switch, Toggle
AR	M22759/16-18-9	Wire, 18 AWG, White, Tefzel
AR	M22759/16-22-9	Wire, 22 AWG, White, Tefzel
4	AN3-3A	Bolt
4	AN960-10L	Flat washer
4	MS21042-3	Locking nut

The above items are available, individually or as part of an installation kit (P/N: LR_INSTALL), from B&C Specialty Products, www.BandC.aero, phone: 316-283-8000.

CHANGE IN WEIGHT AND BALANCE

Installation of this kit will impact aircraft weight by a nominal 0.6 lbs. Variations in airframe station references for all aircraft affected by this kit preclude including pre-calculated weight and balance data in these instructions.

INSTALLATION INSTRUCTIONS

Preparation

Step 1. Refer to applicable service manual instructions; remove and retain engine cowl. Disconnect ship's battery, Negative (-) terminal first.

Step 2. Refer to applicable service manual instruction; remove existing regulator.

Step 3. Select a suitable location to mount the LR3C. Mounting on the pilot's side of the firewall, or inside the cabin near the panel, is preferred (linear controllers are electrically "quiet," and create no noise when properly installed).

> **NOTE**
> Take care to choose a mounting location that will protect the LR3C from heat, vibration, and water.

Step 4. Select a suitable location to mount the incandescent low voltage warning light (supplied) in your instrument panel. The light should be positioned within the pilots' peripheral vision — generally, a 45-degree angle in front of the pilot. A panel location away from direct sunlight is preferred.

Step 5. Select a suitable panel location to mount the 2A and 5A circuit breakers. A panel location within the pilot's field of vision and reach is recommended.

Step 6. Select a suitable panel location to mount the alternator field switch. A panel location immediately adjacent to the ship's battery master is recommended, if practicable.

Regulator Installation

Step 7. Mount the LR3C to the firewall or selected location. On a metal firewall, AN3-3A bolts, AN960-10L flat washers, and MS21042-3 locking nuts, will be adequate to secure the regulator.

Step 8. Wire the LR3C power and control circuits using M22759/16 Tefzel wire and the supplied S814R6 ring terminals, according to the wiring diagram on page 8.

> **NOTE**
> The LR3C senses bus voltage through terminal #3. If the low voltage warning light is not desired, terminal #5 may be left unconnected; however terminal #3 ***must still be connected*** to the bus through a fuse or circuit breaker. If terminal #3 is not connected to power, the LR3 ***will not work***. Do not connect or "jumper" terminal #3 to terminal #6.

Step 9. Wire the LR3C to ground using M22759/16 Tefzel wire and the supplied S814R6 ring terminals, according to the wiring diagram on page 8. Be certain to establish ground connections to both terminal #7 and the threaded ground stud below the terminal strip.

NOTE

This step is important for all airframes, and ***crucial*** for composite aircraft. The LR3C obtains a redundant connection to ground through the threaded stud. A jumper between terminal #7 and the ground stud will not provide this. Ground connections must be totally independent and not rely on common fasteners. Select 18AWG wire (or larger) and ring terminals for these connections.

Step 10. Wire the 2A and 5A circuit breakers and alternator field switch using M22759/16 Tefzel wire, according to the wiring diagram on page 8.

NOTE

If panel space is limited, a 2A in-line fuse may be substituted for the 2A circuit breaker associated with terminal #5. The 5A circuit breaker associated with terminal #6 MUST be used. Connecting terminal #6 directly to the bus or using "solid-state breakers" (PTC thermistors) will damage the regulator if there is an over-voltage condition.

Step 11. Wire the incandescent warning light using M22759/16 Tefzel wire, according to the wiring diagram on page 8. Place heatshrink (supplied) over each wire for the warning light base, solder the wires onto the base terminals, and shrink the heatshrink over the connection.

Step 12. Connect ship's battery, Negative (-) terminal last, and replace engine cowl.

Step 13. Test the installation as follows —

A. Low-voltage indication: turn the battery master switch ON, and observe the incandescent warning light. Depending on the condition of the battery, this light may or may not flash. If it does not begin flashing, turn on the landing light or the nav lights to lower the battery voltage sufficiently to make the warning light start to flash (typically between 12.5 and 13 volts; or 25 and 26 volts on 28v models).

B. Over-voltage protection: with the battery master switch ON, turn the alternator field switch ON. Touch a jumper wire momentarily between terminal #2 and terminal #6; this should cause the 5A field breaker to open (thus confirming the function of the over-voltage protection circuit). Failure of the field breaker to open is cause for investigation.

C. System charging: start the engine according to normal procedure. With the engine running and the battery master switch ON, turn the alternator field switch ON. An increase in bus voltage to 14 to 14.4 volts (or 28 to 28.8 volts) should be observed, depending on the electrical load, engine RPM, and type of alternator (refer to the supporting documents for the alternator to determine the RPM at which measurable output may be expected). The low-voltage warning light should no longer flash.

Step 14. Update ship's weight and balance, pilot operating handbook and maintenance records.

OPERATION OF THE LR3C

The LR3C is pre-set at 14.4v (28.8v on the LR3C-28). If adjustment of alternator output voltage is needed, remove the 3/4" round plug from the side of the LR3C and use a small screwdriver to turn the small adjustment screw (clockwise to increase voltage, counterclockwise to decrease voltage; approximately 1/2 turn per .1 volt). Use a digital voltmeter at the battery for this measurement.

NOTE

The pre-set charging voltage of the LR3C should be suitable for most 12v and 24v Sealed Lead Acid (SLA) and Valve-Regulated Sealed Lead Acid (VRSLA) batteries. Electrical systems using legacy "Flooded" batteries, or "Lithium" (LiFePo or other similar) batteries, may require field adjustment. Consult the documentation provided by your battery manufacturer to insure adequate performance and maximum battery life.

In normal operation the 5A field circuit breaker will be closed (ON) and the incandescent warning light will not be flashing. Depending upon battery type, condition and temperature, the warning light may flash a few times and then quit when the master switch is ON and the engine is not running.

LOW-VOLTAGE WARNING - continuous rapid flashing of the warning light.

OVER-VOLTAGE WARNING - the 5A alternator field circuit breaker will open causing alternator to be shut down. If sufficient loads are operational, the incandescent warning light will begin to flash in a few seconds. If electrical loads are very light, the warning light may take longer before flashing.

The integrated Over-Voltage protection function is set at a non-adjustable 16.0v (+/- 0.2v) on the LR3C-14, and 32.0v (+/- 0.2v) on the LR3C-28.

INSTALLATION TIPS

1. Avoid deviating from the installation instructions and wiring diagram. The LR3C has been designed to integrate into your aircraft electrical system in a very specific way, with separate bus connections for "sense" and "control". Similarly, the LR3C also requires other associated components, such as circuit breakers and an alternator field switch, which meet certain specifications. These connections and associated components are vital to proper system function.

2. Use time-proven components in your installation. Our technical staff has found that a reliable installation is often made or broken by the associated parts used to install the LR3C. Here are several specific choices that can help you avoid trouble:

    - Select a "toggle-type" rather than a "rocker-type" switch for the alternator field switch. Our tear-down analysis of the internals of each type has shown that the mechanical properties and basic materials used in a simple toggle switch will provide superior service over time. Avoid "split-rocker" switches in particular (a common source of reliability woes as they accumulate time in service).

- Use KLIXON or Mechanical Products circuit breakers, frequently used in general aviation. These well-constructed, single-purpose devices are reasonably economical, and will serve you well over time. Avoid combination "switch-circuit breakers" (another common source of reliability issues).

- Use nylon pre-insulated ring terminals (supplied), and crimp these with the correct tool. Route wiring along existing harnesses, where they exist, and secure with nylon wire ties. Insure that all wiring is tied away from chafe points and clear of all flight control mechanisms throughout the entire range of control movements. Use a 5-lb pull test to check crimped connections; verify the terminal is crimped on the wire, not the insulation.

- Avoid substituting an LED indicator light for the supplied incandescent warning light. The LR3C is designed to drive an incandescent light only; an LED will not provide satisfactory results (viz. it will remain constantly illuminated, regardless of whether there is an actual over-voltage or low-voltage condition).

- Insure the integrity of your alternator field connector and associated wiring. The LR3C connects to the alternator by means of a single wire; an intermittent connection at the alternator will result in erratic (and unstable) operation.

TROUBLESHOOTING GUIDE

Refer to the wiring diagram found on page 10 and use a high impedance (preferably digital) volt/ohmmeter (DVM) to make the following checks. Please note that the engine should not be running, the mags should be off, and there should be no auxiliary power applied to the aircraft electrical system:

1. Turn all switches OFF. Use the lowest resistance scale on the DVM. Check resistance between the battery negative (-) terminal and both pin 7 of the regulator and the engine case. Measurements over 0.5 Ohm to either would be cause for investigation. In this case, check the engine ground strap, battery ground strap, and regulator ground wire for loose or contaminated connections, broken conductors or bad crimp joints. If these measurements are less than 0.5 Ohm, any of these three points may be used as reference (-) for the following measurements.

   Resistance from battery to pin 7:_____Ohms; from battery to engine case:_____ Ohms

2. Turn ON the battery master and alternator field switches. Measure the voltage on the battery bus and on pin 3 of the regulator. The voltages should be equal within 0.2 volts. A difference of greater than 0.2 volts may be caused by using a breaker as the source for pin 3 that supplies another device of considerable load. Change to a lightly loaded breaker or a breaker dedicated to pin 3 and the low voltage lamp. It is recommended that pin 3 NOT be jumpered to pin 6. If pin 3 has no voltage, the regulator will operate but low voltage warning and over-voltage protection will be lost.

   Bus voltage:_____ volts Pin 3 voltage:_____volts

3. Measure the voltage on pin 6 of the regulator. It should be within 0.5 volts of the bus voltage. A

difference of greater than 0.5 volts may be caused by poor contacts in the field breaker or field switch, or poor crimp joints/loose screw terminals in the wiring between the bus and pin 6. Absence of voltage on pin 6 will prevent the regulator from operating.

Pin 6 voltage:_____volts

4. Check the voltage on pin 4 of the regulator. The voltage should be approximately 1.2 volts less than the voltage on pin 6. A difference significantly less than 1.2 volts between pins 4 and 6 may indicate an open field circuit from pin 4 through the alternator to ground (-). Voltage differences of several volts could indicate a bad regulator. An ideal pin 4 voltage would be approximately 10.9 to 11.4 volts on a 12.6 volt bus and 23.5 to 24.0 volts on a 25.2 volt bus.

   Pin 4 voltage:_____volts

5. Move to the engine compartment. Measure the field voltage at the alternator as follows –

   L-40, L-60, BC410-H, and BC425-H Alternators: Use a thin probe or small gage wire wrapped around the probe to reach through the connector body and measure the voltage on either male blade coming out of the alternator. Do not disconnect the field connector for this measurement.

   BC460-H and BC462-H Alternators: Turn OFF the battery and alternator master switches. Disconnect the field connector from the alternator. Use an 18 AWG jumper with an alligator-clip (or fashion an 18 AWG jumper wire) approximately 6” in length to temporarily link either active field connector terminal with the corresponding male blade coming out of the alternator. Turn ON the battery and alternator switches. Use DVM probe to measure voltage at the alligator clip. Turn OFF battery and alternator master switches, remove jumper, and reinstall field connector.

   Observed voltage in the above should measure within 0.5 volts of the measurement on pin 4 of the regulator. A lack of voltage may indicate an open circuit between pin 4 of the regulator and the field terminal, or a damaged/failed regulator.

   If an open field circuit is suspected, the battery and alternator master switches may be turned OFF, the alternator field connector removed, and a resistance measurement made between the connector and pin 4 of the regulator. Look for near 0 Ohms. Field resistance of the alternator may also be checked at this time by measuring from either male field terminal blade to alternator case; typically, this should measure between 3 and 10 Ohms. Values other than these may indicate a broken field wire, or heavily worn alternator brushes and slip rings (respectively).

   Field terminal voltage:_____volts Alternator field resistance:_____Ohms

6. With the switches ON, check the voltage between the alternator output post (or “B”-lead) and ground. It should be battery voltage. If not, check the wiring between the alternator “B”-lead and the battery positive (+) terminal. Look for loose or contaminated connections, broken wires, or an open breaker or fuse.

Alternator “B”-lead voltage:_____volts

7. If all of the voltages in the first 6 steps are close to the value specified, the charging system should be operative. If not, check for a broken or loose alternator belt or broken alternator drive coupling (if so equipped). It is also possible on some installations that the engine speed will have to be near run-up RPM or more for the system to provide useable output.

Intermittent problems are the hardest to find. In composite aircraft a common root cause is poor system grounds; metal aircraft can exhibit this defect, also, if proper system grounding is not a priority.

Noise problems can also be challenging. To manage system noise problems, consider the following:

- Correct (or prevent) noise problems by using a unitized grounding system, such as a “ground block.” This averts small voltage differences between different ground points — a common source of electrical noise (and erratic behavior in associated devices).

- The battery acts as a noise filter in the system. Poor connections to the battery, or a battery in the initial stages of failing, can add to or even cause noise problems.

- Shielding of low level audio leads (especially microphone leads or headset leads) is a necessity. Sometimes the shields in the cables can separate from repeated flexing; so a check of shield continuity with an ohmmeter may prove illuminating.

- Wire routing is important. Separate noise-carrying conductors (like “P”-leads) from other wiring. Avoid running noisy wiring parallel to other wiring in the same bundle.

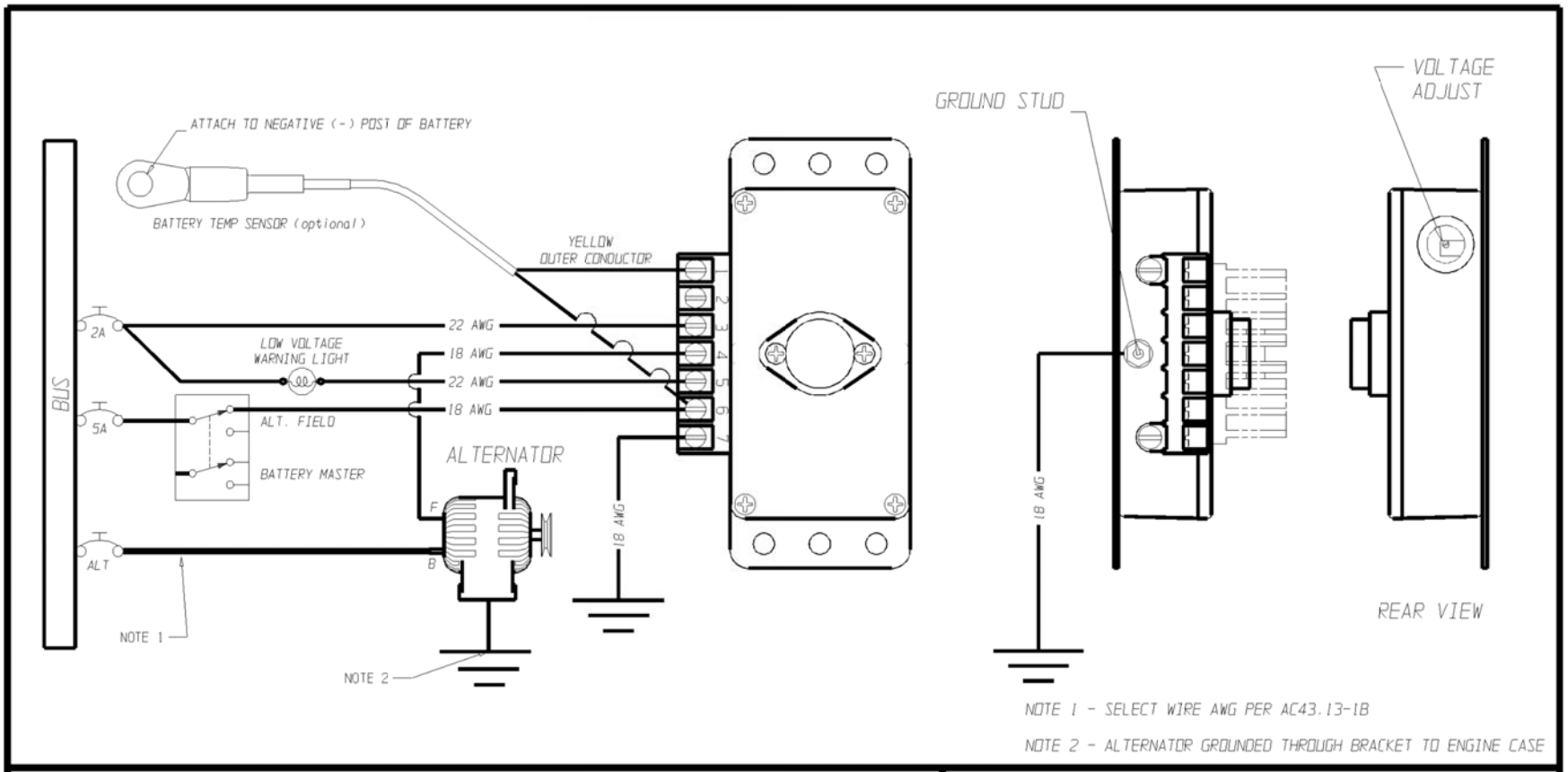
- Stop the noise at its source. Once the noise is “loose,” it can be difficult to filter it out of all affected systems. Try to locate the offending item and correct the problem at that point. Switching off the alternator, the mags (first one then the other), or any other electrical equipment that generates noise should help to find the offender.

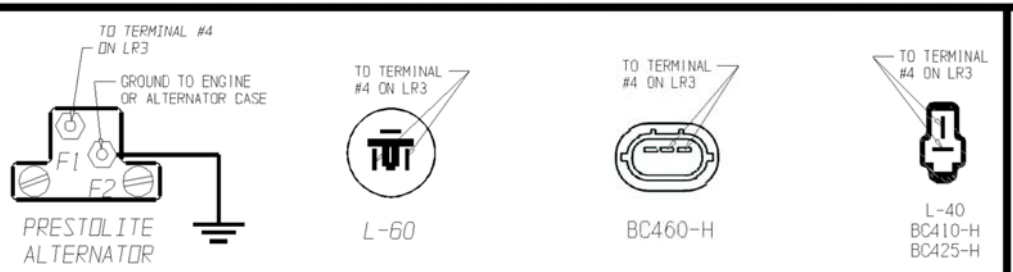
B&C is always ready to assist our customers with technical problems during construction and thereafter. The safety of our friends and reliability of our products are top priority. If this guide has not solved your problem, please feel free to contact us –

Phone: 316-283-8000 (Monday – Friday, 8:00am to 4:30pm Central time)

E-mail: tech@bandc.aero

Wiring Diagram for LR3C-14 and LR3C-28 Voltage Regulator





THIS PART IS NOT STC'd/PMA'd AND IS SOLD
FOR EXPERIMENTAL AIRCRAFT ONLY.

EXPLANATION OF TERMINALS 1 THRU 7

1. Temp Probe - yellow wire (optional)
2. Over-Voltage Test
3. Bus Voltage Sense
4. Field
5. Low Voltage Warning Light (Incandescent)
6. Bus - Field Supply (white wire of temp probe connects here when used)
7. Ground

B&C SPECIALTY PRODUCTS 02-2016

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Instructions for Continued Airworthiness
for
B&C Specialty Products LR3C-14/28 Regulators

The B&C LR3C-14 or 28 regulators require no recurrent maintenance and have an indefinite service life. At each Annual or 100 hour inspection required by the FAA, check the regulator externally for security of mounting, tightness of terminal screws, and chafing or breakage of wiring. Perform an operational check to determine that the regulator maintains the aircraft electrical bus at its approximate set point as loads are added and removed (at high loads, cruise RPM may be required).

Failure due to broken wires or damaged connectors may be corrected in the field using repair procedures complying with the latest revision of AC43.13-xx. Field adjustment of the regulated voltage may be accomplished by use of the external adjustment screw if required. The adjustment screw is located under a 3/4" diameter black plastic cover along the edge of the regulator. The plastic cover may be pried form the access hole and a small screwdriver used for the adjustment. Turning the screw clockwise increases the set voltage. All other repairs are by replacement only.

IF THIS UNIT IS TO BE INSTALLED ON A TYPE-CERTIFICATED AIRCRAFT
IT MUST BE ACCOMPANIED BY AN STC OR BY A ONE-TIME FIELD APPROVAL