Nadler & Associates

Antares Hydraulic DCDC Control Circuit ECO

Dave Nadler (DRN)

Overview

The hydraulics DCDC generates high-current 12v supply for the hydraulics pump, 288v in to 12v out. The control circuit takes key-switch input and keeps DCDC turned off unless the key-switch is on (switching-cable leads connected via the key-switch).

The control circuit interfacing the key-switch has failed in two Antares, and does not work when cold in DRN's Antares. Analysis shows six design errors that can lead to component failures or operational failures (highlighted in yellow below). **The most serious mistake is a voltage source driving a diode without a current limit resistor, which of course results in excessive current and overheating**.

The simple ECO below creates a more reliable control circuit and operates over the specified Antares electronics temp range –25...+54°C.

Problems with this board not addressed in this ECO include:

1. Extreme heating of power-OR output diodes due to inappropriate diode selection and inadequate heat-sink (discussed below). No change is recommended as the heating will probably not fail the output diodes iff the pilot respects limits on frequency of hydraulic system operation (in Lange's factory worst-case test, diodes touch the temperature limit of 175C).
2. Missing voltage-regulator protection diode to prevent damage during power-off-sequence.
3. Inadequate clearance between high voltage traces or connectors and other traces.
4. Inadequate clearance between traces and mounting screws.
5. Inadequate clearance between mounting screw and key-switch-lead connector, leading to connector damage.

Document Change Log

Revision	Notes
Version 0.9, 6-June-2013	Initial draft by Dave Nadler, forwarded to Andor for comments.
Version 0.91, 7-June-2013	No major changes: Minor corrections to some calculations, fix R7/R8 labeling mistakes in reference schematics, minor text clarifications.
Version 0.95, 13-June-2013	Updated values to ensure operation with 5% variations in LR8 output and LED voltage. CPC1018 are required (replace any CPC1008). Added section on additional problems, notes on lacquer on components and traces near 288v...
Version 0.98, 1-October-2013	After review with Andor at Lange. Measured D3-D4 operational temperatures. Clarify ECOs (separate some v4.2 and v4.4 steps). Clarify current errors during LR8 thermal-limit.
Version 1.00, 18-March-2014	Update after last USA glider ECO applied, better intro, picture of LR8 overheating damage.

History of Hydraulic DCDC Power Problems and EASA ADs

The original hydraulic power board had design errors that caused failures which burned a DCDC converter and filled the engine compartment with soot. This happened in two 20E in USA and to other customers.

The first EASA AD for this problem added a fuse, so that when the DCDC converter failed the fuse would blow and there would be no fire.

The second EASA AD replaced the problem power board with a new board designed to be dual-redundant. Unfortunately:

- The board was **prepared by two individuals who are not trained electrical engineers**.
- Contrary to good practice, the board was **not reviewed by an independent and qualified engineer**.
- The board was put into production without complete testing. There are at least two revisions installed in customer aircraft, and Lange could find neither documentation for which aircraft received which versions nor complete schematics and parts lists.
- A patched-on fuse is installed in some boards with leads carrying 288v dangerously close to other components.
- The new board has failed in service, prompting this ECO.

Different Revisions Installed in Aircraft

Two different versions have been installed since the EASA AD (according to Andor):

Board Label	**Notes**
V4.2 – Initial revision for EASA AD installed in all USA aircraft.	5.14V LR8 setpoint, optos in parallel, CPC1008 (not 1018) optos. According to Andor, all installed units include patchwork to connect an additional LR8 input fuse to 288v input before main fuse.
V4.3 – not produced	Schematic labeled 4.3 includes above patchwork correction for fuse. No 4.3 board was built.
V4.4 – production since 2011	Andor revision, reduced drive voltage to 2.43v, optos in series, place for but no installed series resistor. Fuses on minus and plus. Schematic shows CPC1008 opto but Andor says only CPC1018 used (these optos have different electrical characteristics). Likely will not work if optos are cold.

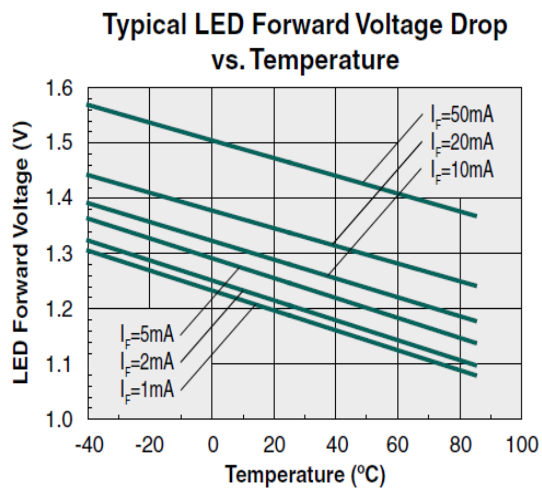
Table of Contents

Engineering Background for Control Circuit

The schematics (before and after ECO) are shown in the ECO section. Here we review the characteristics of the voltage regulator and opto-isolaters.

Opto-Isolator LED Characteristics

Opto-isolators such as IXSYS (Clare) CPC1018 or LCB110 use an GaAIAs infrared LED. This is a current-mode device, with typical **recommended minimum operating current of 1ma** (for CPC1018 at 25C). The forward voltage drop of the diode is highly temperature-dependent and current-dependent; from the CPC1018 Datasheet: for If=10ma Vf=1.4 at -40C to around 1.2 at 80C.



From the above chart and CPC1018 data-sheet:

- maximum required current to turn on is 1ma at 25C; below 1ma the opto-isolator may not switch.
- 1ma turn-on is valid at 25c, but required current increases with temperature (3ma at 60C).
- with a 1.2v supply, current drops below 1ma as temperature drops below 19C (typical value).
- with a 1.25v supply, current drops below 1ma as temperature drops below -10C (typical value).

The hydraulic DCDC supply control uses an LR8 voltage source to drive two CPC1018 opto-isolators. Current production schematic v4.4 shows the two optos in series for a nominal 1.225v (LR8 2.43v divided by 2). The graph above shows 1.22v is below the 1ma curve required to turn on the opto at temperatures below 0C. While the LR8 set-point resistors are 1%, the regulator is +/- 5% or +/- .06v. **Thus in v4.4, opto switch-on is marginal and becomes increasingly unreliable at low temperatures, as the LR8 supply voltage is well below the required switch-on value.** This can be easily tested (in an Antares or on the bench) using a can of Freeze-It.

Minor Note: Above also applies to CPC1008 opto-isolator used in earlier hydraulic DCDC supplies; LED characteristics are similar but CPC1008 requires much more current to switch.

Minor Note: minimum switching current for LCB110 (and possibly Vishay replacement for CPC1018) is 5ma.

For reference only: The opto LED does not conduct much current below 1 volt: 1ma or less, with conduction dropping very rapidly as voltage decreases. Representative voltage-current curves for this type of diode can be seen here: http://www.optekinc.com/datasheets/op223-224_tx-txv-s.pdf

Supertex LR8K4 Linear Regulator Notes

The control circuit on Lange hydraulic DCDC converters produced through May 2013 use a Supertex LR8K4 linear regulator to supply the switch-on opto-isolators. Critical points from data-sheet:

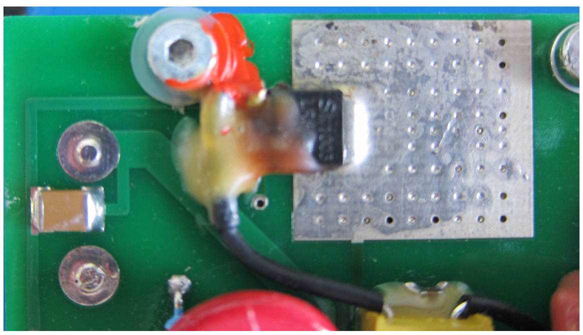
- Maximum allowable power dissipation is 2.5W, or 8.8ma at 285v.
- Operation in 20ma current-limiting mode will exceed above limit, overheat, and enter thermal limiting. Thermal limiting is at ~ $T_{junction}$ 125°C which is the absolute maximum allowable for the LR8.
  In thermal-limit mode, output current can drop to .5ma.
- Continuous operation in the thermal-limiting modes can damage the device, or as the data-sheet nicely puts it: **"*Exposure to absolute maximum rating conditions for extended periods may affect device reliability*"**

Additional Likely Causes for Device Failures or Operation Failures

LR8 Excessive Power Consumption and Heating

When driven by a voltage source, the opto-isolator LED current increases very rapidly with temperature. For v4.4 at 40C, the opto current increases to 10ma (typical), which means the power dissipated in the LR8 is 285v*10ma=2.85W, exceeding the LR8 2.5W maximum allowable power dissipation. In v4.2 the LR8 output is set to 5v, so the LR8 will immediately go into current-limiting at 20ma, and quickly overheat. **The LR8 has current limiting (typically 20mA) and temperature limiting (minimum temperature limit 125°C), so the LR8 will heat to 125°C then limit current. Prolonged operation in thermal-limit mode will likely damage the LR8: "*Exposure to absolute maximum rating conditions for extended periods may affect device reliability*". When the LR8 goes into thermal-limit mode, output current can drop to .5ma:**
- v4.4: 1 ma is minimum required to reliably switch CPC1018N optoisolators (at 25C).
- V4.2: 2ma is required to reliably switch CPC1008N used in v4.2, and
V4.2 opto-isolators are in parallel, so each optoisolator can receive less than .25ma.

In a 20E at Lange, the measured LR8 temperature after hours powered on with ambient ~20C is 65C (in v4.2 aircraft prior ECO). That's external temperature with a large heat-sink area; T_j will be much hotter (from datasheet, typically 125C). However, in Buchanan's 20E the epoxy slobbered over the regulator was badly discolored, indicating severe overheating:



V4.2 only: Excessive inrush current exceeds opto-isolator limits

Version 4.2 sets the LR8 regulator voltage to 5.14 volts. In static operation the LR8 goes into current limiting mode with an output around 1.3v depending on temperature, then the LR8 will heat up and fall into thermal-limit mode.

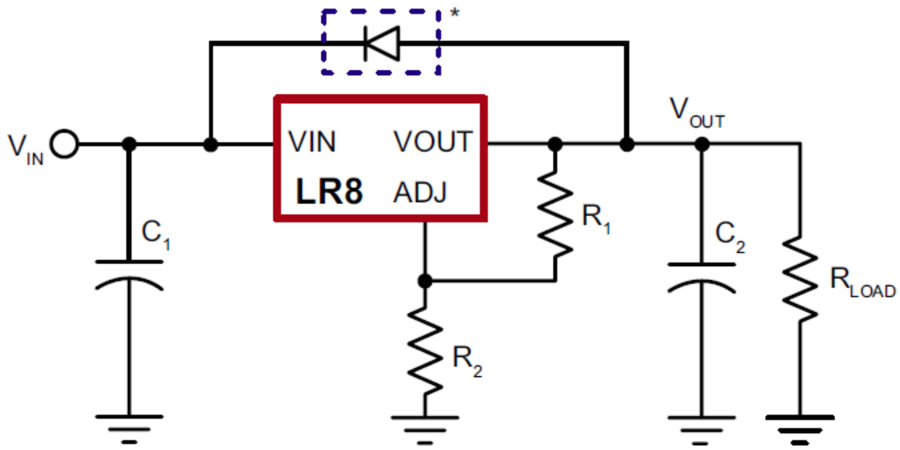
However, at the instant of turn-on, the LR8's 1uF output capacitor is still charged to 5.14v, so the initial inrush current (from the capacitor into the opto-isolators) will exceed their 50ma maximum, and may exceed the 1A-50msec limit (can damage the opto-isolators).

LR8 Stability Requirements Violation

LR8 requires a minimum load of .5 ma for stability. When key-switch is off, the only load on LR8 is the set-point resistors, which only draw .2ma in v4.2 or v4.4 – **Operation below minimum-required load can theoretically cause oscillation and device destruction.**

LR8 Back-bias during Shutdown

Here's the typical LR8 application circuit from the Supertex data sheet:



* *Required for conditions where V_{IN} is less than V_{OUT}.*

The absolute maximum reverse-bias allowed across the LR8 is .5v.
The protection diode on the top is nominally required to prevent back-biasing the LR8 regulator.

In Antares, V_{IN} can drop rapidly to 0 when the wings are unplugged, while the LR8 output takes some time to decay as it has no load except the set-point resistors: Time to decay to .5v is 20 msec on V4.4 boards (56 msec on v4.2). An instantaneous input rail will back-bias LR8 several volts, which can damage the LR8.

If the Vin (288 supply rail) drops to 0 faster than 20msec (56 msec on v4.2) when wings are unplugged, back-bias exceeds LR8 limits, and can destroy the LR8.

When using high V_{IN} such as with Antares 288v, a protection diode as suggested above is not feasible, as diodes rated for 300v have a conduction voltage drop greater than 0.6v. This forward drop is higher than the .5v drop required to protect the LR8. Instead, a series diode should have been used (between V_{IN} and C_1).

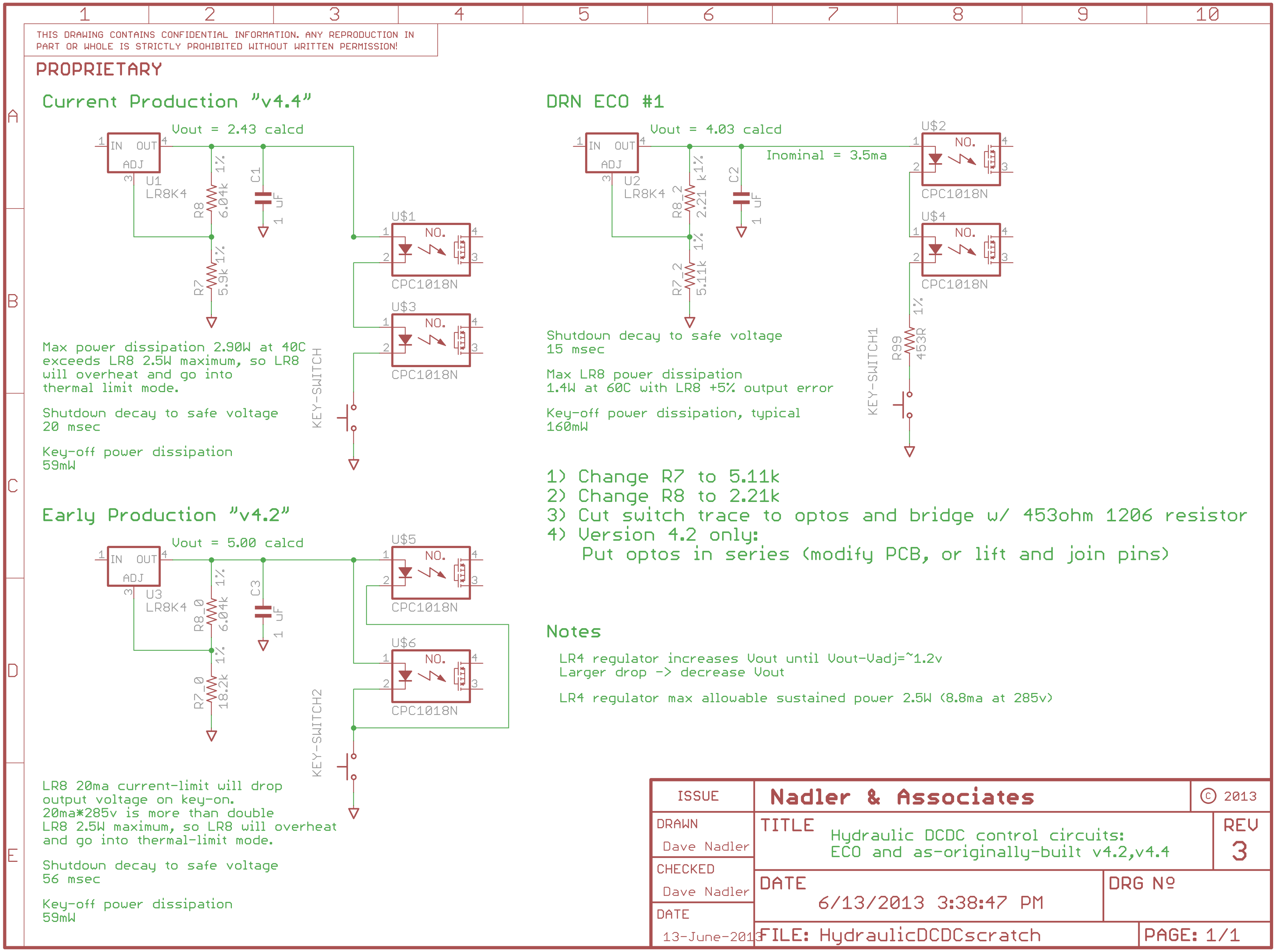
ECO Details and Reference Schematics

This ECO turns the opto-isolator LED drive into something more resembling a current-source by adding a series resistor. The LR8 voltage is increased to account for the voltage drop across the series resistor. This change:

- Reduces LR8 power consumption to worst case 1.4W, well below the LR8 2.5W limit,
- Reduces temperature sensitivity to provide proper opto-isolator operating voltage over temperature,
- Increases LR8 quiescent load to meet required minimum load for stable operation,
- Decreases the decay-to-safe-voltage time to 15 msec,
- Increases key-switch-off power dissipation from 60mW to 160mW.

ECO Parts Required

Reference	Part	Quantity
RE1-RE2	**Required for v4.2 boards (also v4.4 boards if CPC1008 are installed):** Clare Ixsys CPC1018N optical-isolators	2
DC3	LR8K4-G Supertek voltage regulator (must be replaced)	1
R7	5.11 kOhm axial through-hole ¼ watt 1% resistor	1
R8	2.21 kOhm axial through-hole ¼ watt 1% resistor	1
R99	SMD 1206 453 ohm 1% resistor	1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PROPRIETARY
Current Production "v4.4"
Vout = 2.43 calcd
U1
LR8K4
R8 6.04k 1%
R7 5.9k 1%
C1 1 uF
U$1
U$3
CPC1018N
KEY-SWITCH
Max power dissipation 2.90W at 40C exceeds LR8 2.5W maximum, so LR8 will overheat and go into thermal limit mode.
Shutdown decay to safe voltage
20 msec
Key-off power dissipation
59mW
Early Production "v4.2"
Vout = 5.00 calcd
U3
LR8K4
R8_0 6.04k 1%
R7_0 18.2k 1%
C3 1 uF
U$5
U$6
CPC1018N
KEY-SWITCH2
LR8 20ma current-limit will drop output voltage on key-on.
20ma*285v is more than double LR8 2.5W maximum, so LR8 will overheat and go into thermal-limit mode.
Shutdown decay to safe voltage
56 msec
Key-off power dissipation
59mW
DRN ECO #1
Vout = 4.03 calcd
Inominal = 3.5ma
U2
LR8K4
R8_2 2.21 k1%
R7_2 5.11k 1%
C2 1 uF
U$2
U$4
CPC1018N
R99 453R 1%
KEY-SWITCH1
Shutdown decay to safe voltage
15 msec
Max LR8 power dissipation
1.4W at 60C with LR8 +5% output error
Key-off power dissipation, typical
160mW
1) Change R7 to 5.11k
2) Change R8 to 2.21k
3) Cut switch trace to optos and bridge w/ 453ohm 1206 resistor
4) Version 4.2 only:
Put optos in series (modify PCB, or lift and join pins)
Notes
LR4 regulator increases Vout until Vout-Vadj=~1.2v
Larger drop -> decrease Vout
LR4 regulator max allowable sustained power 2.5W (8.8ma at 285v)
ISSUE
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DRAWN
Dave Nadler
TITLE
Hydraulic DCDC control circuits:
ECO and as-originally-built v4.2,v4.4
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ECO Calculations

Opto LED Notes:

5ma typical: 1.33v @-20C... 1.20v @50C
3ma typical: 1.29v @-20C... 1.18v @50C
1ma typical: 1.17v @-20C... 1.13v @60C
So, Design voltage drop range for opto 1.16-1.28 (plus some margin to ensure required current)
Note: Antares electronics temp range is – 25...+54°C
WARNING: CPC1018 says 3ma recommended at 60C, "max 1ma turn-on" spec is at 25C.
WARNING: CPC1008 (not 1018) take minimum 2ma, 4 recommended at 60C
Good news: as temp increases and required turn-on current increases, LED voltage drops and helps.

Four LED design corners:

Margin to add to LED voltages over typical	Margin_LED	5%
Typical min voltage, 60C at 3ma	V_LED_typ_hot	1.16
Worst-case voltage, 60C, requires 3ma (4ma for 1008)	V_LED_margin_hot	1.22
Typical max voltage, -30C at 1ma	V_LED_typ_cold	1.28
Worst-case voltage, -30C, requires 1ma (2ma for 1008)	V_LED_margin_cold	1.34

Current given source voltage set-point resistors and series resistor, calculate currents

	First Try	**First Try -5%**	**ECO**	**ECO -5%**	**ECO +5%**
R8 (to Vout)	**2.70**		**2.21**		
R7 (to gnd)	**4.75**		**5.11**		
Vsource	3.36	3.19	4.03	3.82	4.23
Iquiescent, ma (.5ma reqd)	0.45	0.43	0.55	0.52	0.58
Rseries, kOhm	**0.33**	0.33	**0.453**	0.453	0.453
Current at V_LED_typ_hot, ma	3.15	2.64	3.77	3.32	4.21
Current at V_LED_margin_hot, ma	2.8	2.29	3.51	3.07	3.95
Current at V_LED_typ_cold, ma	2.42	1.91	3.24	2.79	3.68
Current at V_LED_margin_cold, ma	2.03	1.52	2.95	2.51	3.4
Rseries power, mw, 1206...	8.73	6.67	13.55	11.17	16.11
LR8 power, Quiescent, mw	129.22	122.83	157.28	149.52	165.02
LR8 power, Maximum, mw	1031.37	879.56	1234.11	1099.94	1368.08
LR8 power, Typical, mw	927.14		1158.35		
Rseries Vtypical	0.92	0.75	1.59	1.38	1.79
Check: Measured Vsource	3.36				
Check: Measured Rseries V	0.96				
Check: Measured V_LED	1.2				
Check: Measured LED current	2.91				

LR8 DCDC setpoint and Decay-to-safe time

	Version 4.4	**V4.2 – DRN**	**First Try**	**ECO**	**3-Scratch**
R8 (to Vout)	6.04	6.04	2.70	2.21	2.2
R7 (to gnd)	5.90	18.20	4.75	5.11	3.9
VoutCalc	2.43	5	3.36	4.03	3.37
Iquiescent, ma (.5ma reqd)	0.2	0.21	0.45	0.55	0.55
I_LED, typical@25C, ma	5	10	3	3	3
I_LED max, typical@40C, ma	10	10	3.2	4.2	3.15
V(t) = V0*e^(-t/RC), vcrit/v0=e^(-t/RC), t = -ln(Vcrit/v0)*Tau					
R=R7+R8, kOhm	11.94	24.24	7.45	7.32	6.1
C, uF	1	1	1	1	1
Tau, seconds	0.012	0.024	0.007	0.007	0.006
Vinitial	2.43	5	3.36	4.03	3.37
Vcritical	0.5	0.5	0.5	0.5	0.5
Decay Time, seconds	0.019	0.056	0.014	0.015	0.012
Power, quiescent, mW	59	59	130	158	159
Power, LEDs on, mW	1,499	2,939	994	1,022	1,023
Power on, 40C mW 2.5W max	2,909	2,909	1,042	1,355	1,057

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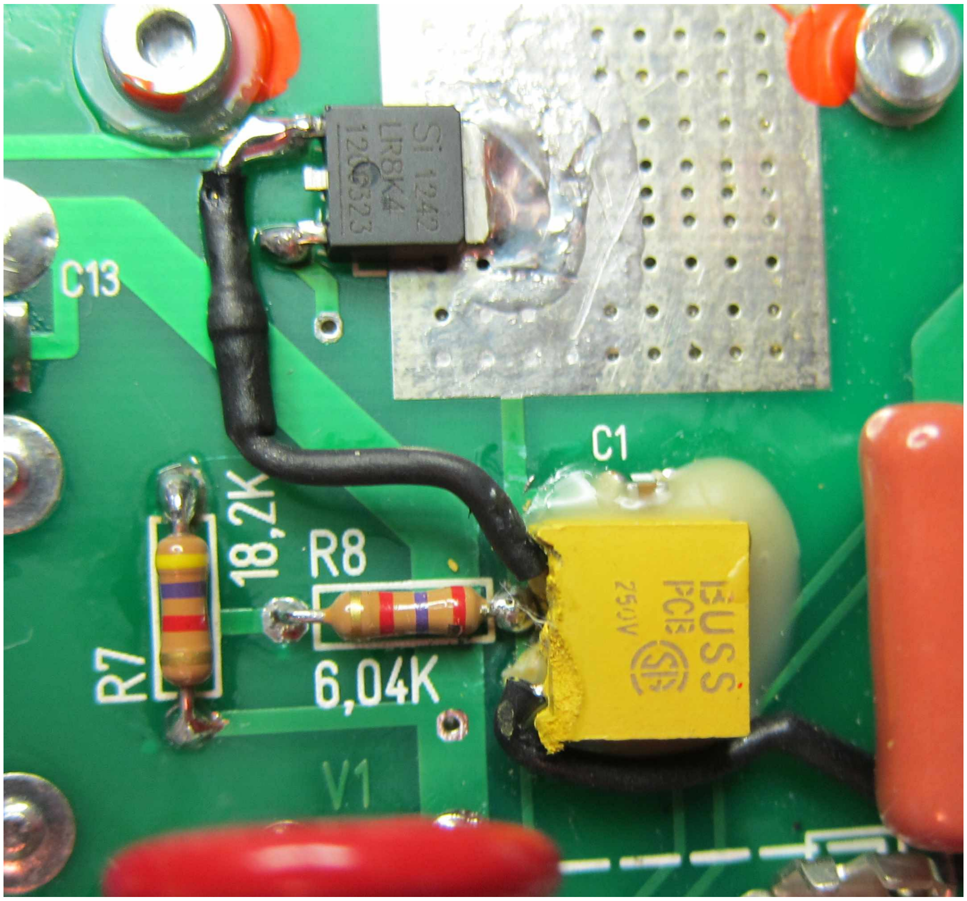
ECO Procedure – V4.2

Change LR8 Set-Point Resistors and LR8

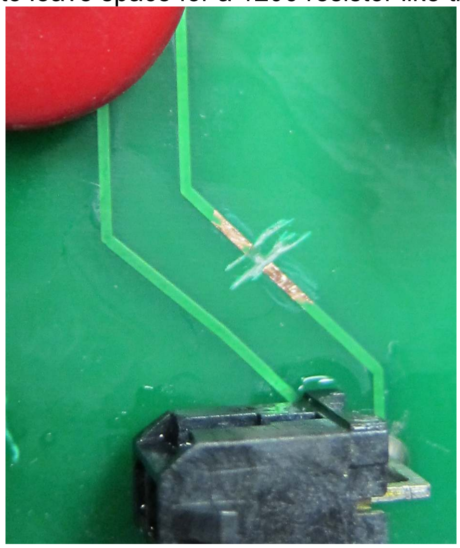
Change R7 to 5.11k 1%, change R8 to 2.21 1%. Bend the resistor leads and trim them very short, so there is no possibility the leads can touch the Vicor part underneath the through-holes where the resistors are installed. Replace the LR8 with a new part.



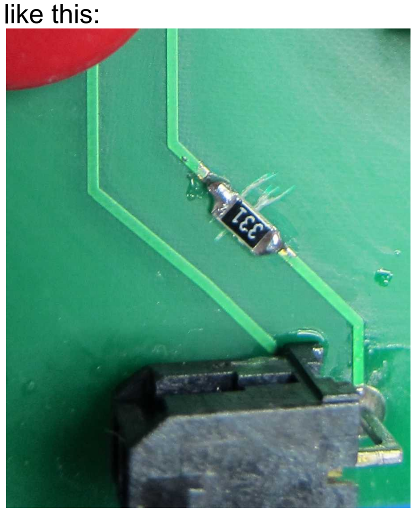
WARNING: If the fuse (yellow square above) has been badly placed with its leads very close to resistor R8 lead as above, make sure to add insulating lacquer between R8 terminal and fuse leads – fuse leads are 288 volts !!!

Add Opto-isolator Series Resistor

Cut the trace grounding the opto-isolators just above the switching-line Molex connector, and clean top of trace, removing just enough trace material to leave space for a 1206 resistor like this:

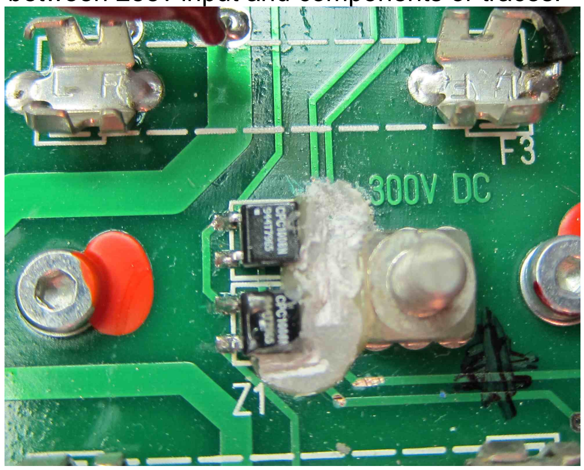


Install the ~~330~~ 453 ohm series resistor like this:

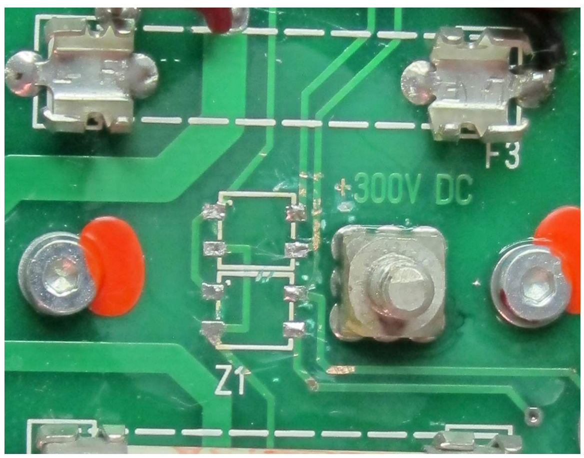


Put Opto-isolators In Series

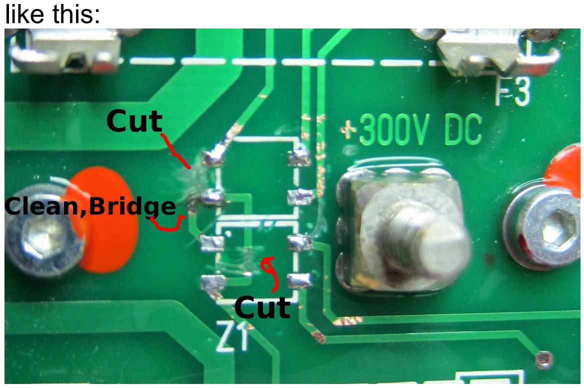
The board may have a gigantic goober of epoxy on the opto-isolators (to the left of the "300v" label), installed to try and rectify unsafe clearance between 288v input and components or traces:



Carefully remove the epoxy goober while cursing violently at whatever idiot made this mess (work slowly with hot-air soldering station to melt). Remove the opto-isolators, and clean the board, after which it should look like this:



Cut the two bridges pin1-pin1 and pin2-pin2, then clean part of the left bridge and make a solder-bridge from top pin2 to bottom pin 1, so it looks like this:



Install two new CPC 1018 opto-isolators (take care to preserve the solder bridge), and clean.

__WARNING:__ Make sure to add insulating lacquer over opto leads and traces near 300v stud !!!

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ECO Procedure – V4.4

If fitted with CPC1008, Replace with CPC1018

This ECO is designed for the current requirements of the CPC1018N opto. If the v4.4 board is fitted with the earlier CPC1008 optos, replace them with CPC1018. Installed CPC1018N do not need to be replaced.

Change LR8 Set-Point Resistors and LR8

Change R7 to 5.11k 1%, change R8 to 2.21 1%. Replace the LR8 with a new part (the installed part has been over-stressed).

Add Opto-isolator Series Resistor R15

Cut the bridging trace under not-installed R15. Install R15: 453 ohm series resistor.

ECO Final Steps – V4.2 and V4.4

Mark ECO Number on Board

Where ??

Check Operation in Glider

Warning: Dangerous ! Careful ! Risk of electrocution !

Reinstall except for blue box cover.

Connect wings.

Ensure LR8 Vout is 4.03v (<u>before</u> switching on key-switch).

Switch on key-switch, and then:
- ensure both power segments come on (indicated by LEDs).
- ensure LR8 Vout is still 4.03v

Verify operation of landing gear extension and retraction.

Power off, then disconnect wings.

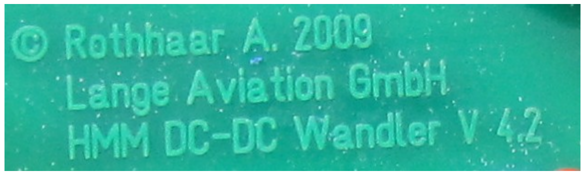
Reinstall blue box cover.

Add sticker to outside of blue box indicating version number of board and “ECO#1 applied”.

Update glider logbook with version of Hydraulic DCDC board and “ECO#1 applied”.

DRN Antares 35E33 Notes

Board revision is labeled “4.2”.



Andor said V4.2 LR8 Vout would be around 1.3 volts. Wrong. It is actually 5.14 volts.

No hydraulic pump voltage output with key-switch on (opto-isolators damaged ?) – something has failed.

Removed module from glider...

Calcd LR8 Vout (R8=6.04k, R7=18.2k, as labeled on PCB) = 5.00v.
Measured LR8 output = 5.14 is due to R7/R8 not matching schematic (actual values 6.00k, 18.6k).
Thus the LR8 was actually producing its commanded output voltage when removed from glider.
Amazingly, parts list shows R8 18.7k; apparently mis-transcribed from schematic 18.2k, aarrgggg.....

Small patched-on Bussman fuse (yellow cube above +288v input stud) is not blown.

Installed opto-isolators were CPC1008 and **not CPC1018 as shown on v4.3 schematic.** Note: CPC1008 has higher switch-on current requirements then ECO calculations above; must replace with CPC1018.

With key-switch on, LR8 would be expected to immediately current-limit to 20ma, then quickly overheat and go into thermal-regulation.

Static current-limit of 20ma is OK for opto-isolators, however initial turn-on discharges 1uF cap at 5v into opto-isolators and exceeds their max 50ma current rating.

Because LR8 and opto-isolators were all operated beyond maximum values, replace everything...

Other Serious problems

Power-OR Diode Overheating

Plastic caps on terminal screws of power-OR diodes melted, implying a temperature > 110C. Melted plastic caps were also found in Nico's Antares. These diodes are capable of 175C T_j but this is well in excess of what should be allowed here. Each diode pair (D3 and D4) dissipates around (30A x .7V) = 21 Watts during constant motor run (start-up current for motor is up to 80A), for a total 40W in this area.

Measured temperature 100°C after four pylon cycles with only brief pauses between operations, after installing heat-sink on top diode D3 only. Maximum thermal resistance, junction to case per package (DC operation) 0.25°C/W. At 20W, 5°C delta, junction temperature is ~105°C, well below critical. Using Lange's worst-case 10 cycle protocol starting at 20C ambient, D3 (top diode pair) reaches 148C.

After...	**Upper Diode D3 Temperature, with heat-sink installed**	**Lower Diode D4 Temperature (no heat sink)**
Ambient at start	25C	25C
1 cycle	58C	
2 cycles	75+C	45C
3 cycles	82+C	60C
4 cycles	100C	75C
Pausing 25 sec between cycles...	**Without heat sink...**	
5 cycles	128C	115C
10 cycles	148C	129C

For some reason, D4 is lower temperature, though they should be identical (same load, D3 had heatsink for first part of above test). Without heatsink, D3 reaches 100C after 2-3 cycles.

Note: D3 and D4 are each diode pairs. D3 ORs the two supplies, and D4 protects the sense lead (from after D3) from any excess voltage from the load (motor back-EMF).

How about a heat-sink under the diodes? Diode body is output voltage (ie 11.3v). Should not connect to back panel as that is chassis ground.

For worst case, max ambient temperature is 38C (18C more than above test), so D3 would reach 166C. With 5°C delta (junction-to-case), junction temperature is ~172°C, just under 175°C limit...

Missing Documentation

Initially, Lange could not find v4.2 schematics, v4.2 ECO documentation, or v4.2 parts list (different from v4.4). This is a support problem and risk for Lange Aviation.

Mistakes/Inconsistencies in Parts List and v4.4 schematics

The parts list image emailed by Axel (and/or the v4.4 schematics sent by Andor) have problems:

- Matches neither v4.2 as built into 35E33 (CPC1008 in 35E33 vs. CPC1018 on parts list), nor v4.4 schematic (wrong R7?R8, etc).
- Parts list R7/R8 LR8 set-point values (5.14v) contradict Andor (says v4.4 LR8 set-point is 2.49 volts)
- C1 on schematic (also labeled C1 on board) appears to be C14 in parts-list.
- C13 on parts list is missing all component details. From the schematic, it should be a 400v 100nF.

Related Technical Notes

Antares Hydraulic power supply Control Logic

The key-switch controls the hydraulic converter via a two-wire input (referred to as the “switching cable” in “Technical Note Nr. 904-2 Level 2 and 3”). This cable provides a simple switch-closure: Switch-closed continuity when key-switch is turned on (and emergency shutoff not pressed).

The switch closure grounds two opto-isolators which turn on Vicor filter modules (not main DCDC modules). On initial “V4.1-V4.3” DCDC production boards opto-isolators were paralleled and driven directly from a DC source 5.14v. Current “v4.4” production runs optos in series from 2.49V source.

The always-on LR8 power supply seems to be intended to avoid routing 288v forward to key-switch.

Vicor DCDC Module “Primary-Control” PC Input

Vicor power DCDC modules have a primary control input PC, used as follows:

- to turn OFF DCDC: pull below 2.3v (ideally just pull to ground)
- to turn ON DCDC: pull above 2.9v (ideally float)

Vicor FIAM Module On/Off Input

In this application power control is via a Vicor FIAM (Filter Input Attenuator Module) in front of the actual DCDC module, which has the reverse control sense:

- to turn OFF DCDC: float On/Off input
- to turn ON DCDC: pull On/Off input to ground

Vicor recommends an opto-isolator or debounced relay to control the PC input.
This application uses a normally-open opto-relay.