LVPS Brick modifications for version 6.5.3.

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Summary: **This document describes the component changes on LVPS brick (3.3V, 5V, or 15V versions) from produced version 6.5 into version 6.5.3. All mentioned component names and values are referring to the scheme components designed by Ivan Hruska of version 6.5 (or 6.4 as seen in this document on page 4).**
Previously published brick version 6.5.2 (28 Nov 2006) follows the same changes except that discussed points No.10 (Switching frequency back to 300kHz and high L4 inductors for weakly loaded bricks),
No.14 (Additional 200V independent divider),
No.15 (Feedback phase margin improvements for all bricks),
No.19 (Preloads for all 15V bricks) and No.20 (Preload for 5VHV) are different.
Complementary document to this paper, "BrickReconstForTech*_v6.5.3.pdf*", is recommended to read for more detailed information.

OverVoltageProtection (OVP) on brick board:

1. **Cut PCB wires:**

(a) between T15 and pin 1 of U13
(b) between GND pins R71 and C80
(c) "Butterfly" Isense pcb traced resistors on top side and bottom side.

2. Provide two wired short cuts:

(a) Connect the Divider R17, R18 to the output filter (30 mm piece of wire with isolation).
(b) Provide reference between pins 7, 6 and 2 of the U13 for the comparator.

3. Unsolder components R19, R24, C81 and C66.

4. Change the value of the resistor R18 by Table 1:

Brick type	R18(new value)
3.3V	1.1k
5.0V	1.8k
15.0V	5.1k

5. Change the value of the resistor R67 by Table 2:

Brick type	R67(new value)
3.3V	1.1k
5.0V	1.3k
15.0V	1.8k

6. Solder one 620 ohm resistor between U13 (pin 1) and R71 (to provide comparator function through the current feedback).

7. Unsolder C47 (to speedup the OVP reaction.)

Changes for reason of safety, stability and reliability:

8. Remove TRANSIL from output of the Brick.

9. Unsolder and remove C59.

10. **Switching frequency back to 300kHz and high L4 inductors for weakly loaded bricks.** The Switching frequency of DC/DC controller due to overheated 5VMB brick should stay in original value of 300kHz.

(a) Resistor R11 will be as in original version v6.5, **R11= 62kOhm**. Its value together with capacitor **C7=47pF** should be kept original too.

(b) L4 inductors of DC/DC converter have to be added for weakly loaded bricks in order to ensure continuous current mode of DC/DC controller. All 3x15V and 5VHV brick will change, see following Table3:

Brick	L4 [uH]
3VDIG	stay same
5VDIG	stay same
5VMB	stay same
-5VMB	stay same
5VHV	47
15VHV	150
15VMB	150
-15VHV	150

11. Changing the value of the resistors R56 from 100Ohm to 10kOhm **(11a)**, R59 from 100Ohm to 10kOhm **(11b)** (Protects feedback gain from influence of ELMB power cycle.)

12. Unsoldering R26 = 1kOhm (under voltage = 190V). Soldering R26 = 1.5kOhm (under voltage limit = 135V).

13. Cut trace from pin 11 of J2 connector. This disconnects the ELMB from LT chip's Thermal Shutdown if pin 3, and removes one brick Temperature measurement. The brick Thermal shutdown will still function.

14. Additional 200V independent divider: Unsolder R33 resistor on bottom pcb side **(14a)**. Then connect its one empty end after this resistor (that is going to pin 5 of J2 connector) with 680kohm wire resistor (0.25W, 1%) on +200VDC **(14b)** pins of J1 connector on bottom side. Unsolder C22 capacitor and on its place put resistor R = 3.6kOhm **(14c).** This gives an additional 200V divider for Vin measurement that is not influenced by LT current consumption.

15. Feedback phase margin improvements. It has been measured and justified to have the same feedback network components for all bricks. The original C78 capacitor of 100nF (as well as 10nF proposed in brick version v6.5.2) was found acceptable for highly loaded bricks and steady state Iout current conditions, unfortunately, it is very inadequate for Iout transient requirements and for weakly loaded bricks with high L4 inductors. In order to have phase margin at minimum of 45degrees ad more, the feedback components between pins 9 and 10 of LT controller has to be added: **Capacitor C78 = 33nF, add missing R15 = 3k3, add missing C10=200nF.**

16. Start-up Sequence. To start the bricks in sequence in one LVBOX it is necessary to change C9 by table 3. Here you find a comparison between C9 values of the original version v6.5 with identical capacitors (all bricks started at the same time), modified version v6.5.1 from 19th of Oct 2006 with already proposed start-up sequence, and proposed C9 values for final version of brick v6.5.2/ v6.5.3.

Table 4.

	V6.5.orig.		**v.6.5.1 19 Oct2006**			**v.6.5.2-3 08 Nov 2006**	
Brick's type	**C9**		**C9**	**Start seq.**		**C9**	**Starts seq.**
-5V MB	10uF		1.2uF	1.		**1.0uF**	**1. first**
+15V MB	10uF		25uF	3.		**4.7uF**	**2. second**
+5V MB	10uF		10uF	2.	*	**10uF**	**3. third**
+3.3V DIG	10uF		1.2uF	1.		**4.7uF**	**2. second**
+5V DIG	10uF		10uF	2.	*	**10uF**	**3. third**
-15V HV	10uF		1.2uF	1.		**1.0uF**	**1. first**
+15V HV	10uF		10uF	2.		**4.7uF**	**2. second**
+5V HV	10uF		25uF	3.	*	**10uF**	**3. third**

Note: * original value, no need to change

17. Maximum Iout current limit of bricks. First cut one end of both Isense-resistors R23 and R41 ("Butterfly" pcb Isense resistors) **(1c)** and solder new values by the following table 4, SMD size 2512. Over current protection limits (OCP) at Vout of each brick are listed.

Table 5.

Brick type	V6.5 OCP [A]	v.6.5.1 19 Oct 2006		v.6.5.2-3 08 Nov 2006	
		Isense resistor	OCP [A]	Isense resistor	OCP [A]
-5V MB	16-20	2x5mOhm	16	**3mOhm**	**13**
+15V MB	16-20	5mOhm	8	**22mOhm**	**2**
+5V MB	16-20	1.5mOhm	20	**2mOhm**	**18**
+3.3V DIG	16-20	2x5mOhm	16	**3mOhm**	**13**
+5V DIG	16-20	2x5mOhm	16	**3mOhm**	**13**
-15V HV	16-20	5mOhm	8	**10mOhm**	**4.5**
+15V HV	16-20	5mOhm	8	**22mOhm**	**2**
+5V HV	16-20	5mOhm	8	**22mOhm**	**2**

18. Adjust feedback gain: Table 6.

- Brick starts at minimum trimming: measure Vout
- By formulas in Excel calculate additive (parallel) resistor for R42 (SMD size 0603):
- Rn = 2*(Vtheor / Vout)-1;
- Radd = Rn / (1-Rn);
- Take nearest nominal in row E24(1%), size 0603, soldered in parallel with R42.

Type of Brick	Vmin [V]	Vmax [V]	OVP [V]
3V	3.25±50mV	3.9±50mV	4.2±100mV
5V	5.0±50mV	5.9±50mV	6.1±50mV
15V	14.4±100mV	15.65±100mV	16.0±100mV

19. Additional modifications for all 15V bricks:

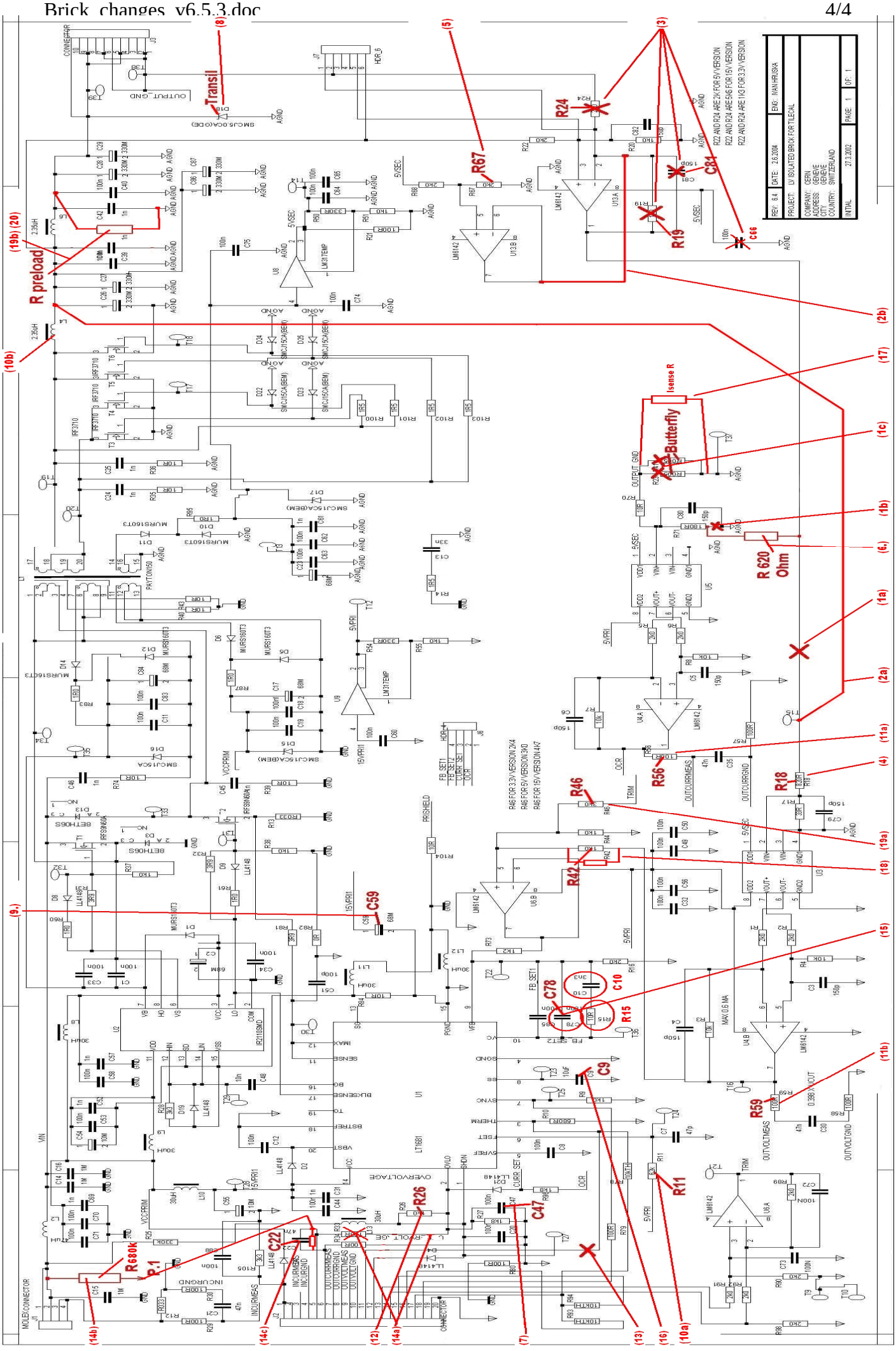
(a) Replace R46: from 4.7k to 7.5k (to reduce trimming range)

(b) Preload resistors are connected directly on Vout connector between positive and return pins. All resistors have the same value of 47Ohm, power resistor in TO220 package, rated for 20Watts, see following Table 7.

Brick	Iout_range [A]	Preload [Ohm]
3VDIG	1.7 - 5.6	No
5VDIG	3.3 - 6.7	No
5VMB	6.6 - 13.3	No
-5VMB	3.3 - 6.7	No
5VHV	0.1 - 0.3	47
15VHV	0.15 - 0.4	47
15VMB	0.2 - 0.6	47
-15VHV	0.15 - 1.9	47

20. Additional modifications for 5VHV brick:

Put preload resistor of 47Ohm. Preload resistors are connected directly on Vout connector between positive and return pins.


Transil
R preload
Isense R
Butterfly
R 620 Ohm
R680k
R24
R67
R19
C84
C66
R56
R18
R46
R42
C59
C78
C10
R15
C9
R26
C47
C22
R11
R59
(1a)
(1b)
(1c)
(2a)
(2b)
(3)
(4)
(5)
(6.)
(7)
(8)
(9.)
(10a)
(10b)
(11a)
(11b)
(12)
(13)
(14a)
(14b)
(14c)
(15)
(16)
(17)
(18)
(19a)
(19b) (20)
R22 AND R24 ARE 2K FOR 5V VERSION
R22 AND R24 ARE 5K6 FOR 15V VERSION
R22 AND R24 ARE 1K5 FOR 3.3V VERSION
R46 FOR 3.3V VERSION 2K4
R46 FOR 5V VERSION 3K0
R46 FOR 15V VERSION 4K7
REV: 6.4
DATE: 2.6.2004
EMS: MANHRUSKA
PROJECT: LV ISOLATED BRICK FOR TILECAL
COMPANY: CERN
ADDRESS: GENEVE
CITY: GENEVE
COUNTRY: SWITZERLAND
INITIAL: 27.3.2002
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