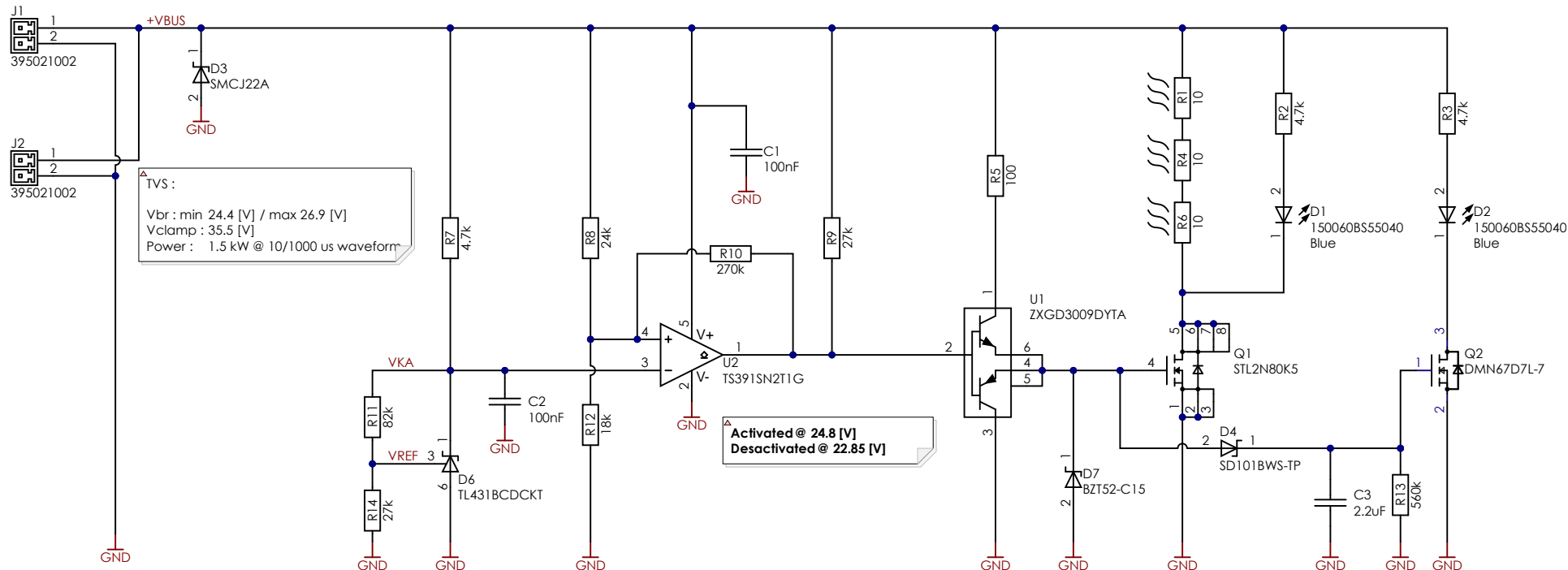


VBUS Voltage :
 Battery = Vmax = 17.6 [V] / Vtyp = 15.4 [V] / Vmin = 14.85 [V]
 PowerSupply = Vmax = 25 [V] / Vtyp = 22 [V]



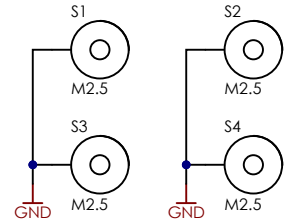
TVS :
 Vbr : min 24.4 [V] / max 26.9 [V]
 Vclamp : 35.5 [V]
 Power : 1.5 kW @ 10/1000 us waveform

Activated @ 24.8 [V]
 Desactivated @ 22.85 [V]

VKA :
 $V_{REF} = 2495 \text{ [mV]}$
 $I_{ref} = 2 \text{ [uA]}$
 $V_{KA} = V_{ref} * (1 + R1/R2) + I_{ref} * R1$
 $V_{KA_typ} = 2.495 * (1 + 82k/27k) + 2u * 82k = 10.23 \text{ [V]}$
 $I_{KA_max} = (V_{BUSmax} - V_{KA_typ})/R9 = (35.5 - 10.23)/4.7k = 5.38 \text{ [mA]} < 100 \text{ [mA]}$
 $I_{KA_min} = (V_{BUSmin} - V_{KA_typ})/R9 = (15 - 10.23)/4.7k = 1.01 \text{ [mA]} > 1 \text{ [mA]}$

Non inverting hysteresis :
 $V_{ref} = V_{KA} = 10.23 \text{ [V]}$
 $V_{th} = (V_{BUS} / (R8 + (R12//R10))) * (R12//R10)$
 $V_{KA} = (V_{BUS} / (24k + (18k//270k))) * (18k//270k) \Rightarrow 10.23 = 0.4128 * V_{BUS} \Rightarrow 10.23/0.4128 = V_{BUS} = 24.8 \text{ [V]}$
 $V_{H1} = (V_{BUS} / (27k + 270k + (24k // 18k))) * (24k // 18k) + (V_{BUS} / (((18k//((270k+27k))) + 24k) * (18k//((270k+27k))))$
 $V_{KA} = 0.3347 V_{BUS} + 0.4142 V_{BUS} = 0.4477 V_{BUS}$
 $10.23 = 0.4477 V_{BUS} \Rightarrow V_{BUS} = 10.23 / 0.4477 = 22.85 \text{ [V]}$

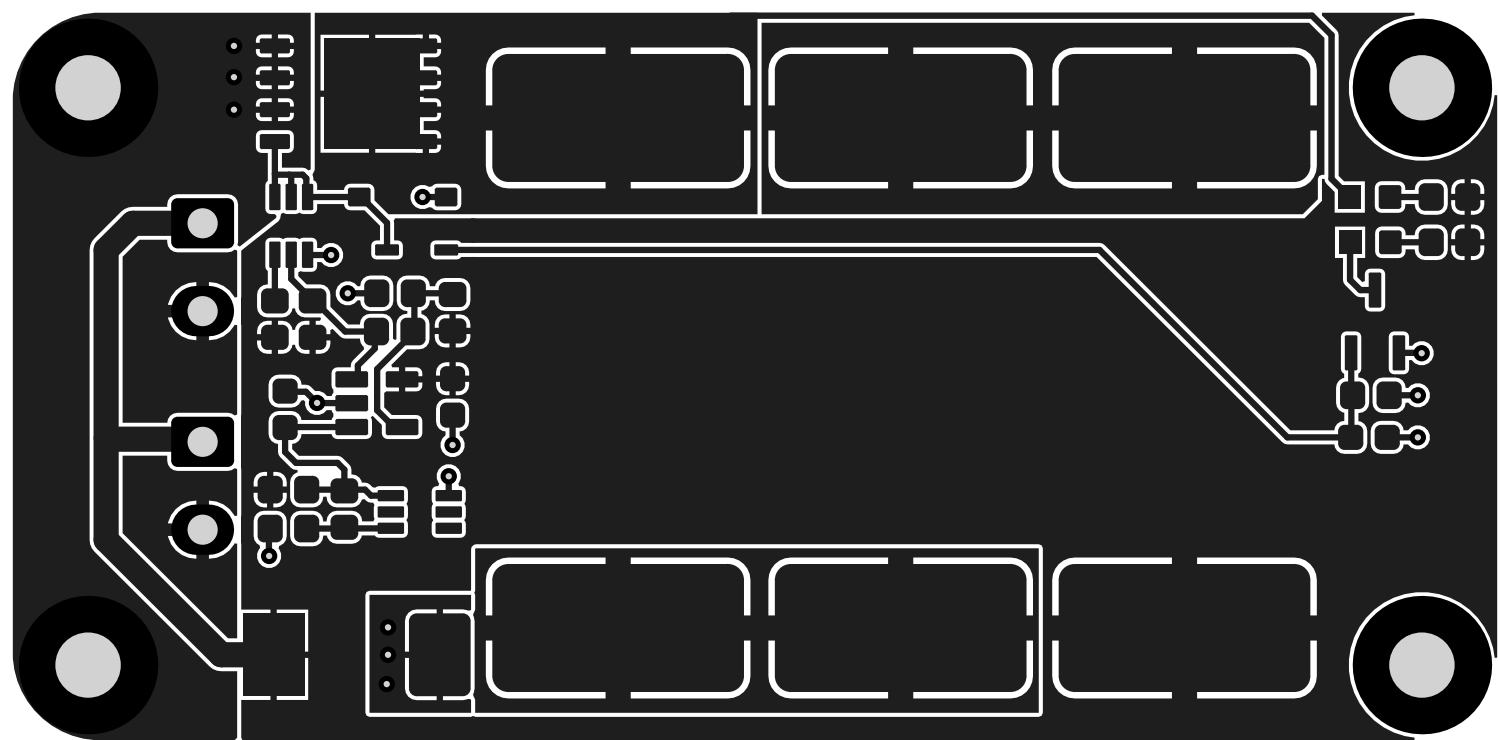
U2 :
 $V_{GS(TH)} = 4[V]$
 $R_{ds(on)} = 3 - 4 \text{ [Ohm]} @ V_{GS} = 10 \text{ [V]}$

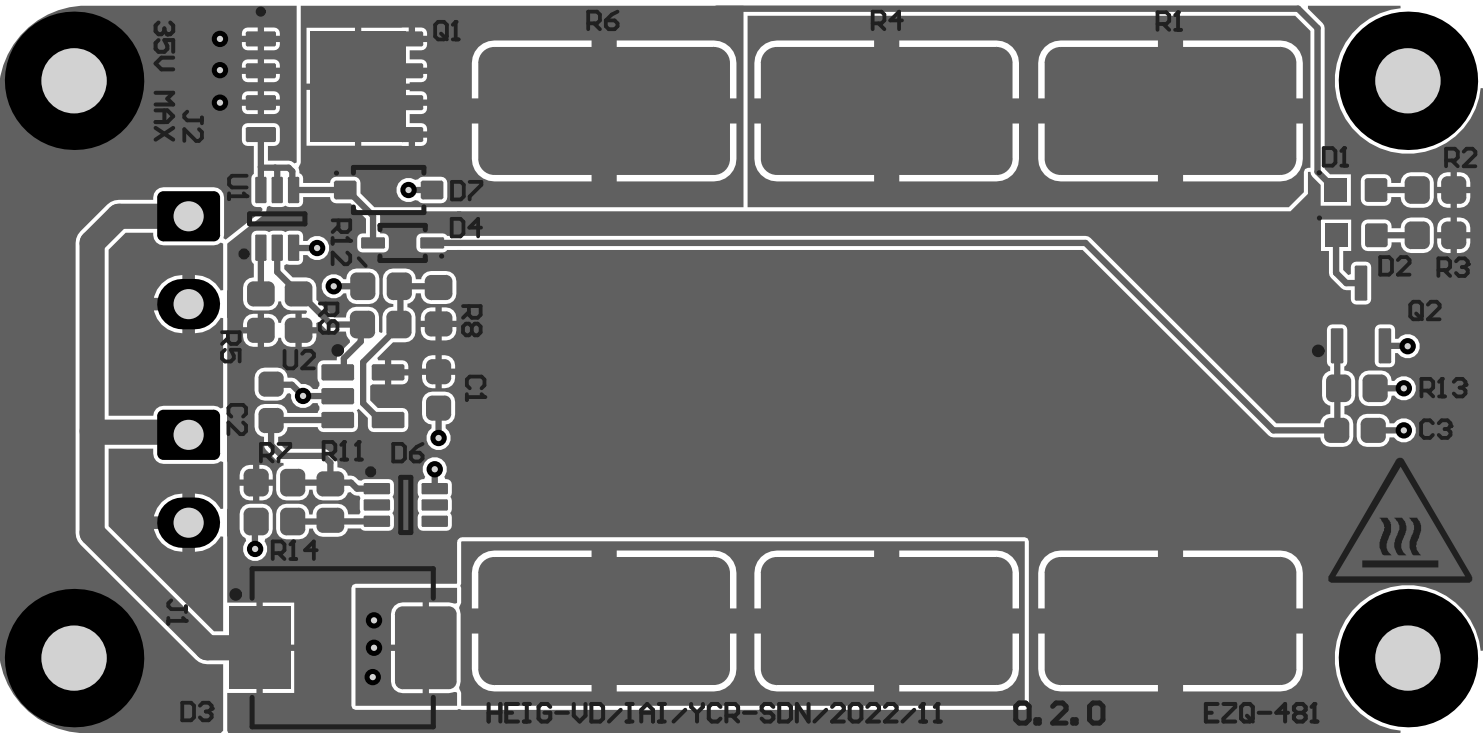


HES-SO / HEIG-VD / TIN / IAI
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 CH-1401 Yverdon-les-Bains
 +41 24 557 73 77
<http://iai.heig-vd.ch>
 iai@heig-vd.ch

Dynamic Breaking Resistor

Format	ProjectName	Project ID	VCS	Revision
A4	Toaster	EZQ-481	GitHub	0.2.0
Date	2022-11-27	Author	YCR / SDN	Page 1 / 1
File	toaster.SchDoc			





35V MAX
J2

D3

HEIG-VD/IAI/YCR-SDN/2022/11

0.2.0

EZQ-481

HE^{VD}
IG



open source
hardware



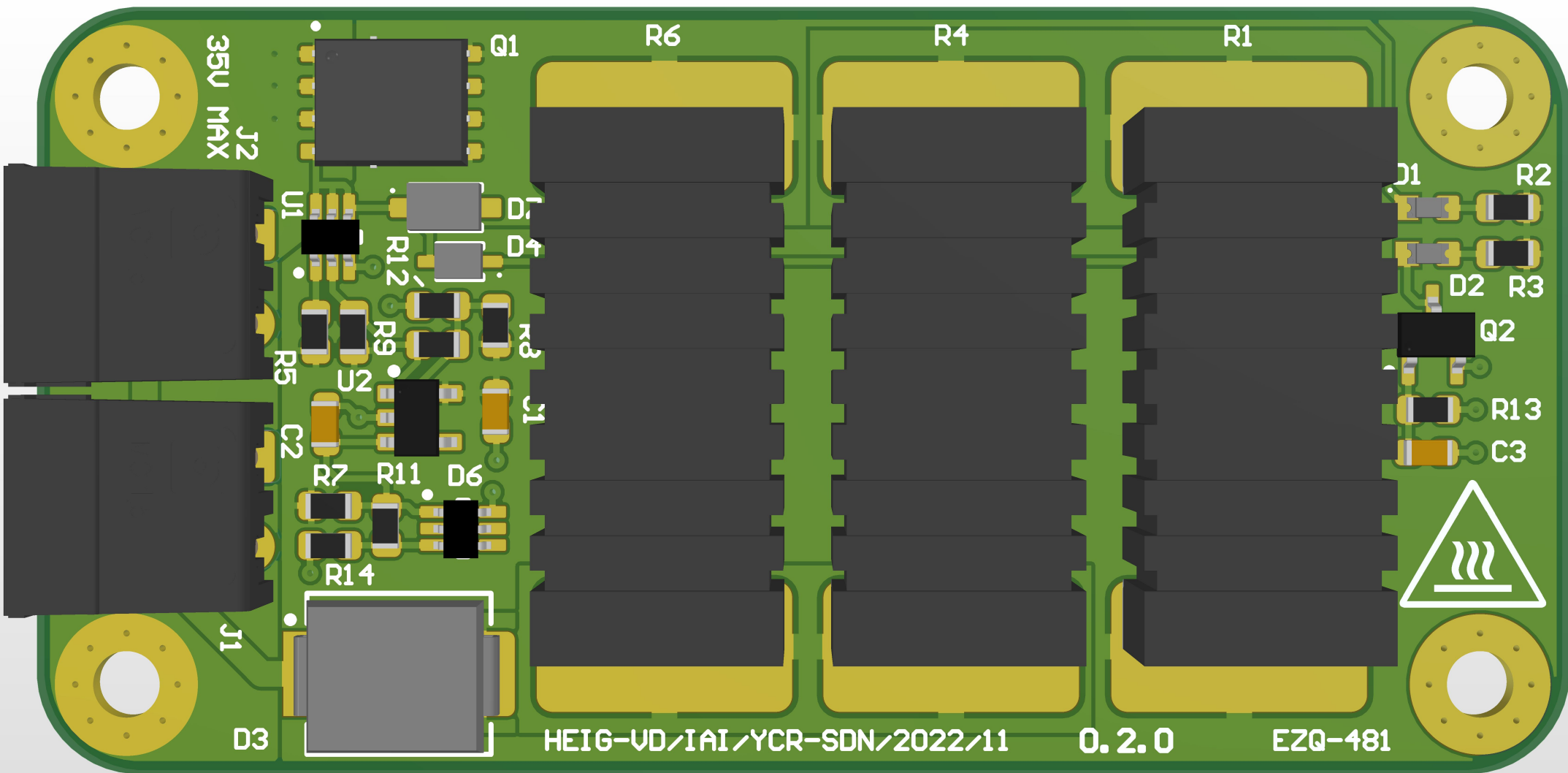
CRH

Toaster
Dynamic breaking resistor



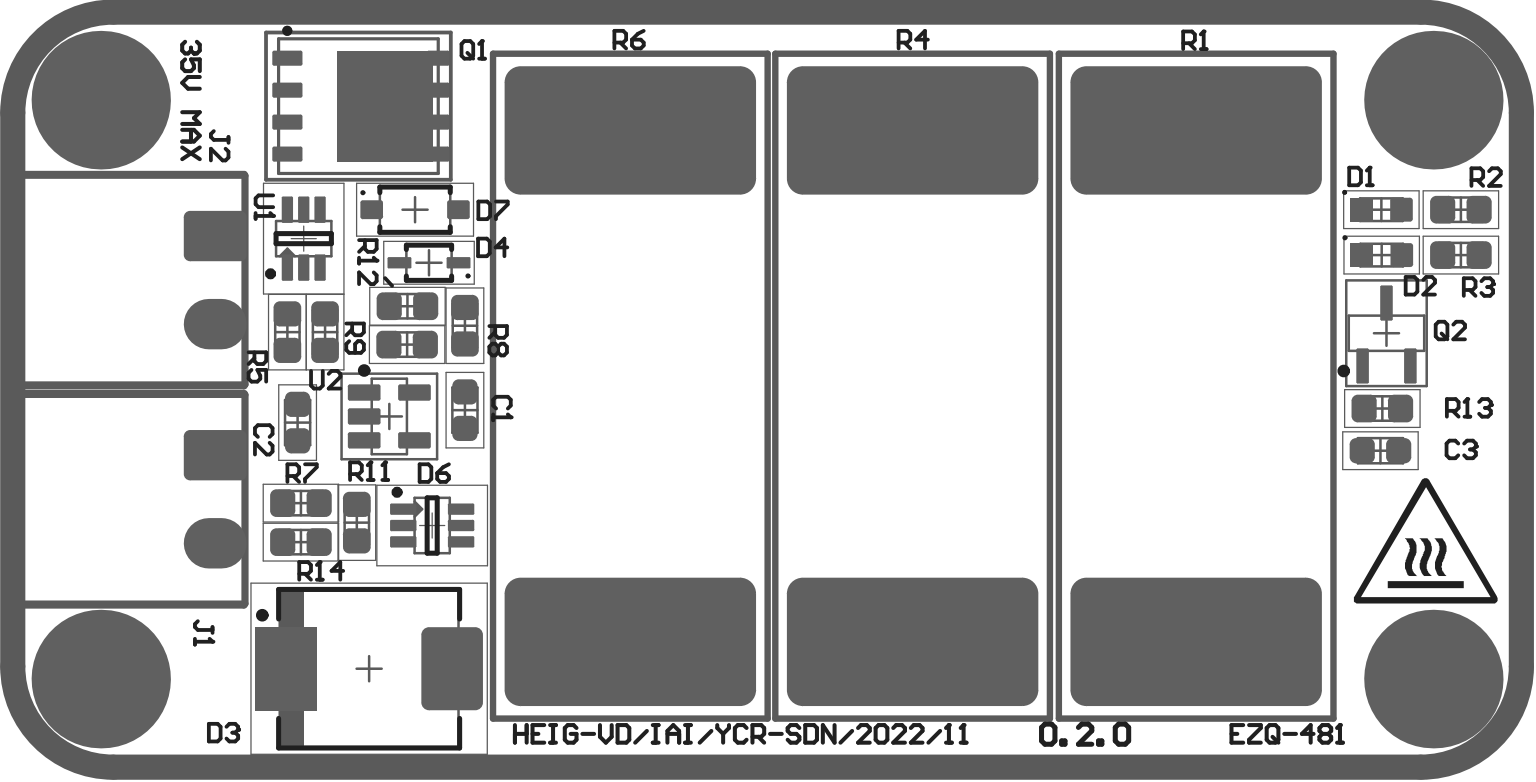
Battery
15..35V







Battery
15..35V



12V Battery

+

+

+

+

+

CRH
Toaster
Dynamic breaking resistor

hardware
open source
IG
HE
av

+

12V Battery

+

CRH

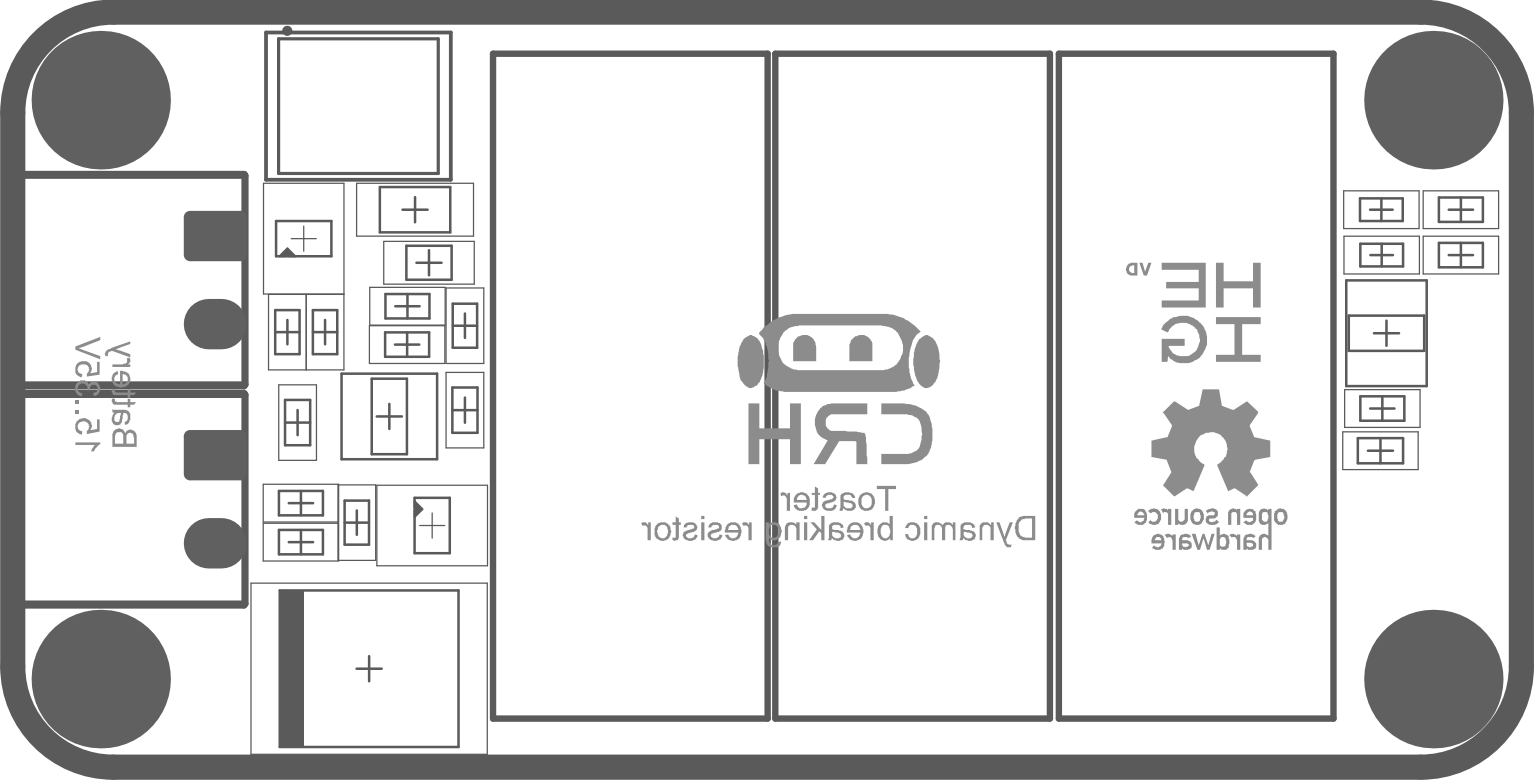
Dynamic breaking resistor
Toaster



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HEIG^{av}



12...32V
Battery

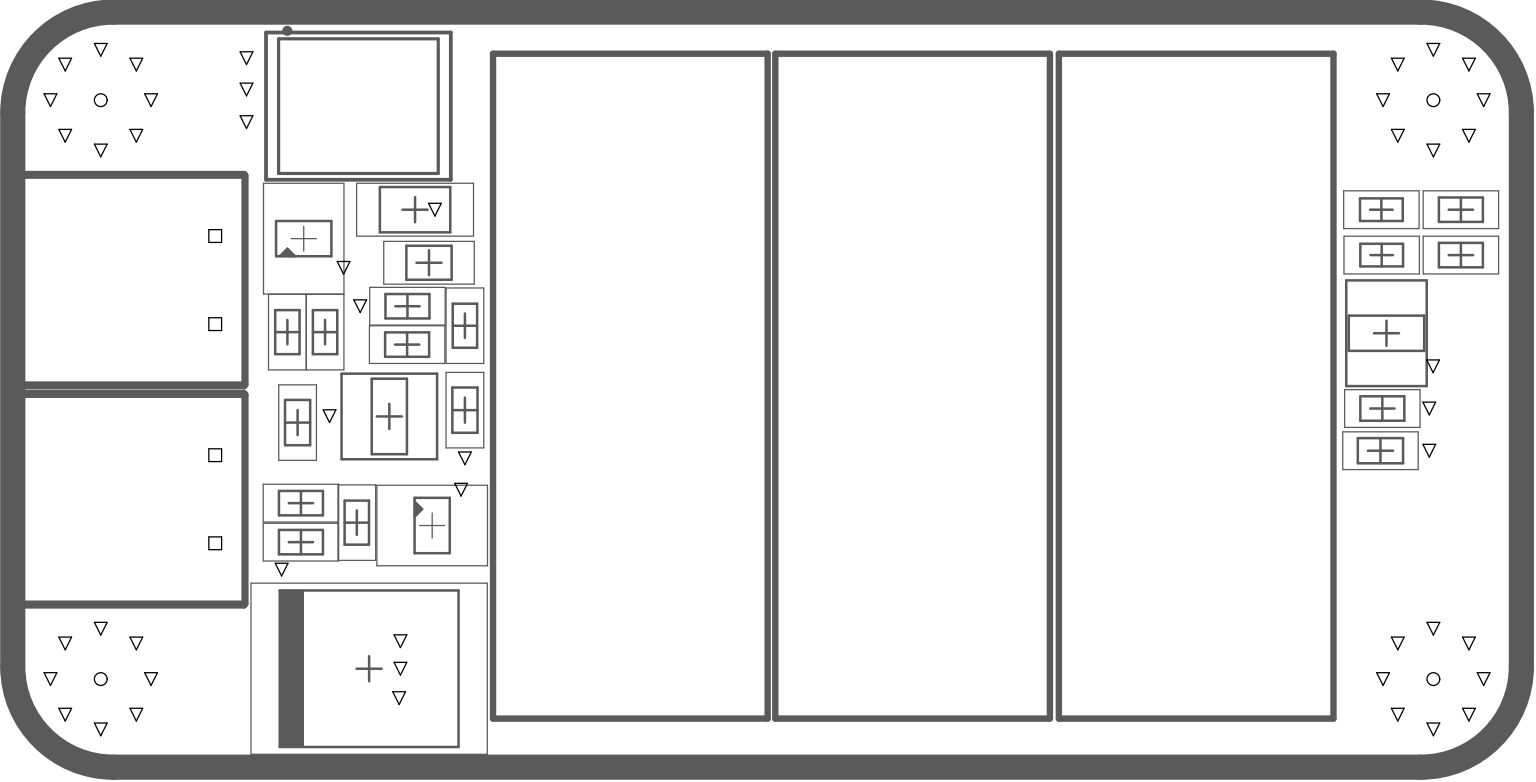
Dynamic breaking resistor
Toaster

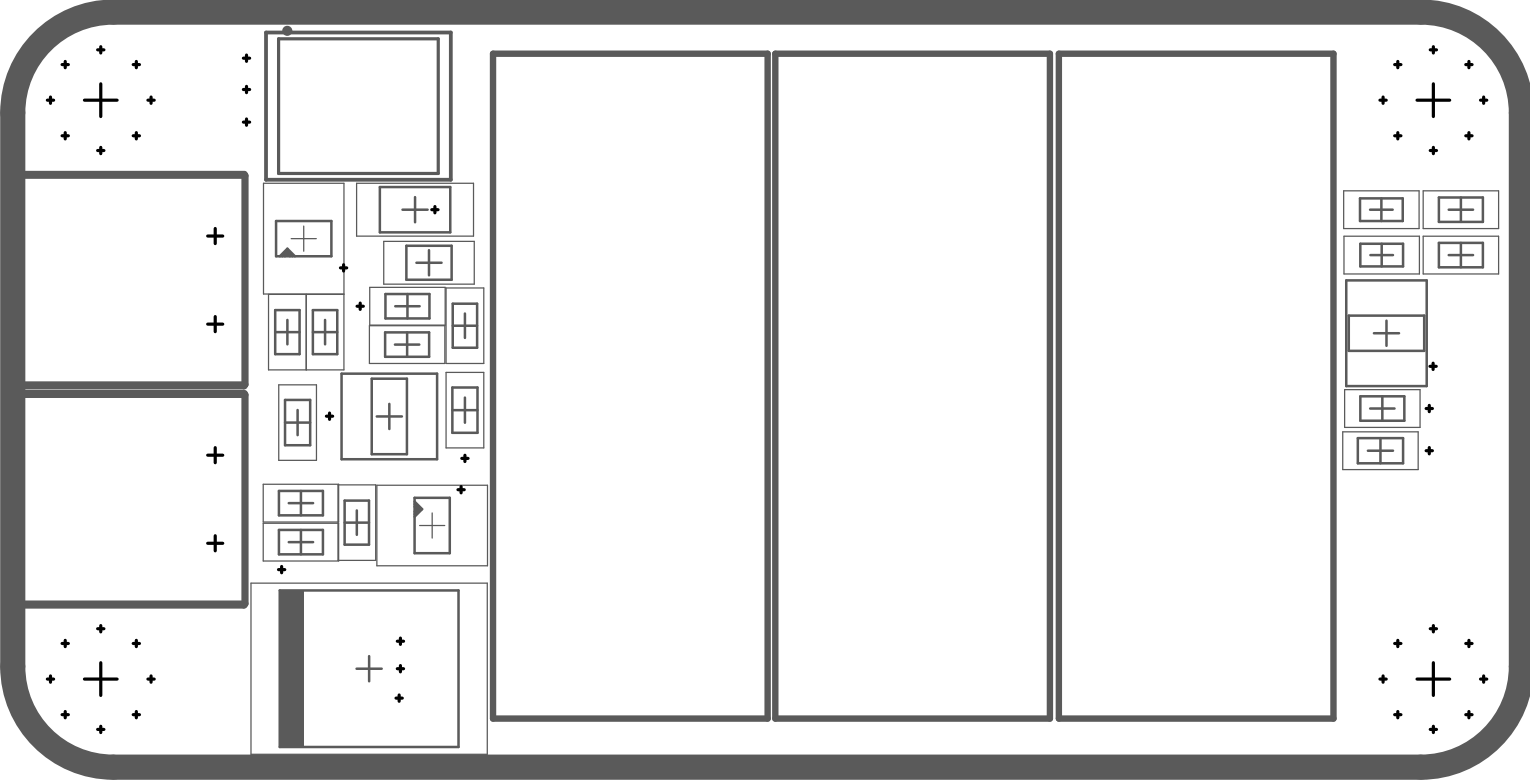


open source
hardware



HEIG
av





Line #	Designator	Value	Quantity	Manufacturer 1	Manufacturer Part Number 1	Supplier 1	Supplier Part Number 1	Supplier Unit Price 1
	C1	100nF	1	Würth Electronics	885382206004	Digi-Key	732-13187-1-ND	0.0946
	C2	100nF	1	Würth Electronics	885382206004	Digi-Key	732-13187-1-ND	0.0946
	C3	2.2uF	1	Murata	GRT188R61H225KE13D	Digi-Key	490-12332-1-ND	0.2838
	D1	150060BS55040	1	Würth Electronics	150060BS55040	Digi-Key	732-12013-1-ND	0.17974
	D2	150060BS55040	1	Würth Electronics	150060BS55040	Digi-Key	732-12013-1-ND	0.17974
	D3	SMCJ22A	1	Littelfuse	SMCJ22A	Digi-Key	SMCJ22ALFCT-ND	0.53922
	D4	SD101BWS-TP	1	MCC	SD101BWS-TP	Digi-Key	SD101BWSTPMSCT-ND	0.3311
	D6	TL431BCDCKT	1	Texas Instruments	TL431BCDCKT	Digi-Key	296-TL431BCDCKTCT-ND	1.08
	D7	BZT52-C15	1	Pan Jit	BZT52C15_R1_00001	Digi-Key	3757-BZT52-C15_R1_00001CT-ND	0.15136
	J1		1	Molex	0395021002	Digi-Key	WM7770-ND	0.64328
	J2		1	Molex	0395021002	Digi-Key	WM7770-ND	0.64328
	Q1	STL2N80K5	1	STMicroelectronics	STL2N80K5	Digi-Key	497-14539-1-ND	1.61
	Q2	DMN67D7L-7	1	Diodes	DMN67D7L-7	Digi-Key	DMN67D7L-7DICT-ND	0.26488
	R1	10	1	Ohmite	RW5S0FA10R0JE	Digi-Key	RW5S0FA10R0JE-ND	1.53
	R2	4.7k	1	Yageo	AC0603FR-074K7L	Digi-Key	YAG3613CT-ND	0.0946
	R3	4.7k	1	Yageo	AC0603FR-074K7L	Digi-Key	YAG3613CT-ND	0.0946
	R4	10	1	Ohmite	RW5S0FA10R0JE	Digi-Key	RW5S0FA10R0JE-ND	1.53
	R5	100	1	Yageo	AC0603FR-07100RL	Digi-Key	YAG3561CT-ND	0.0946
	R6	10	1	Ohmite	RW5S0FA10R0JE	Digi-Key	RW5S0FA10R0JE-ND	1.53
	R7	4.7k	1	Yageo	AC0603FR-074K7L	Digi-Key	YAG3613CT-ND	0.0946
	R8	24k	1	Yageo	AC0603FR-0724KL	Digi-Key	YAG3583CT-ND	0.0946
	R9	27k	1	Yageo	AC0603FR-0727KL	Digi-Key	YAG3585CT-ND	0.0946
	R10	270k	1	Yageo	AC0603FR-07270KL	Digi-Key	YAG3584CT-ND	0.0946
	R11	82k	1	Yageo	AC0603FR-0782KL	Digi-Key	YAG3633CT-ND	0.0946
	R12	18k	1	Yageo	AC0603FR-0718KL	Digi-Key	YAG3570CT-ND	0.0946
	R13	560k	1	Yageo	AC0603FR-07560KL	Digi-Key	311-560KLDCT-ND	0.0946
	R14	27k	1	Yageo	AC0603FR-0727KL	Digi-Key	YAG3585CT-ND	0.0946
	U1	ZXGD3009DYTA	1	Diodes	ZXGD3009DYTA	Digi-Key	ZXGD3009DYTADICT-ND	0.40678
	U2	TS391SN2T1G	1	ON Semiconductor	TS391SN2T1G	Digi-Key	TS391SN2T1GOSCT-ND	0.58652

Design Rules Verification Report

Filename : D:\Dropbox\work\heig-vd\teaching\rbt\eda\toaster\toaster.PcbDoc

Warnings 0
Rule Violations 0

Warnings	
Total	0

Rule Violations	
Clearance Constraint (Gap=0.15mm) (All),(All)	0
Short-Circuit Constraint (Allowed=No) (All),(All)	0
Un-Routed Net Constraint (All)	0
Modified Polygon (Allow modified: No), (Allow shelved: No)	0
Width Constraint (Min=0.15mm) (Max =1mm) (Preferred=0.25mm) (All)	0
Power Plane Connect Rule(Relief Connect)(Expansion=0.508mm) (Conductor Width=0.254mm) (Air Gap=0.254mm)	0
Hole Size Constraint (Min=0.25mm) (Max =5.08mm) (All)	0
Hole To Hole Clearance (Gap=0.15mm) (All),(All)	0
Minimum Solder Mask Sliver (Gap=0.1mm) (All),(All)	0
Silk To Solder Mask (Clearance=0.15mm) (IsPad),(All)	0
Silk to Silk (Clearance=0.1mm) (All),(All)	0
Net Antennae (Tolerance=0mm) (All)	0
Board Clearance Constraint (Gap=0mm) ((InComponent("J1") OR InComponent("J2")))	0
Board Clearance Constraint (Gap=0mm) (All)	0
Height Constraint (Min=0mm) (Max =25.4mm) (Preferred=12.7mm) (All)	0
Total	0

Electrical Rules Check Report

Class	Document	Message
		Successful Compile for toaster.PrjPcb