Technical Explanation Board 2s SKYPER® 32PRO R

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Keyword: IGBT Driver, Adapter Board SKYPER

Please note:

All values in this technical explanation are typical values. Typical values are the average values expected in large quantities and are provided for information purposes only. These values can and do vary in different applications. All operating parameters should be validated by user's technical experts for each application.

1. Application and Handling Instructions

- Please provide for static discharge protection during handling. As long as the hybrid driver is not completely assembled, the input terminals have to be short-circuited. Persons working with devices have to wear a grounded bracelet. Any synthetic floor coverings must not be statically chargeable. Even during transportation the input terminals have to be short-circuited using, for example, conductive rubber. Worktables have to be grounded. The same safety requirements apply to MOSFET- and IGBT-modules.
- Any parasitic inductances within the DC-link have to be minimised. Over-voltages may be absorbed by C- or RCD-snubber networks between main terminals for PLUS and MINUS of the power module.
- When first operating a newly developed circuit, SEMIKRON recommends to apply low collector voltage and load current in the beginning and to increase these values gradually, observing the turn-off behaviour of the free-wheeling diode and the turn-off voltage spikes generated across the IGBT. An oscillographic control will be necessary. Additionally, the case temperature of the module has to be monitored. When the circuit works correctly under rated operation conditions, short-circuit testing may be done, starting again with low collector voltage.
- It is important to feed any errors back to the control circuit and to switch off the device immediately in failure events. Repeated turn-on of the IGBT into a short circuit with a high frequency may destroy the device.
- The inputs of the hybrid driver are sensitive to over-voltage. Voltages higher than VS +0,3V or below -0,3V may destroy these inputs. Therefore, control signal over-voltages exceeding the above values have to be avoided.
- The connecting leads between hybrid driver and the power module should be as short as possible (max. 20cm), the driver leads should be twisted.

2. Further application support

Latest information is available at http://www.semikron.com. For design support please read the SEMIKRON Application Manual Power Modules available at http://www.semikron.com.

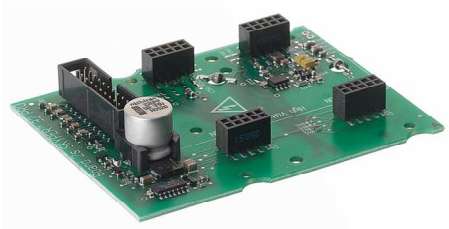
3. General Description

The Board 2s SKYPER® 32PRO R is an adaptor board for the IGBT module SEMiX® 2s (spring contact version). The board can be customized allowing adaptation and optimization to the used SEMiX® Module.
The switching characteristic of the IGBT can be influenced through user settings, e.g. changing turn-on and turn-off speed by variation of R_{Gon} and R_{Goff}. Furthermore, it is possible to adjust the monitoring level and blanking time for the DSCP (see Technical Explanations SKYPER® 32PRO R).

Please note:

This technical explanation is based on the Technical Explanations for SKYPER® 32PRO R. Please read the Technical Explanations SKYPER® 32 PRO R before using the Adaptor Board.

Figure 1: Board 2s SKYPER® 32PRO R

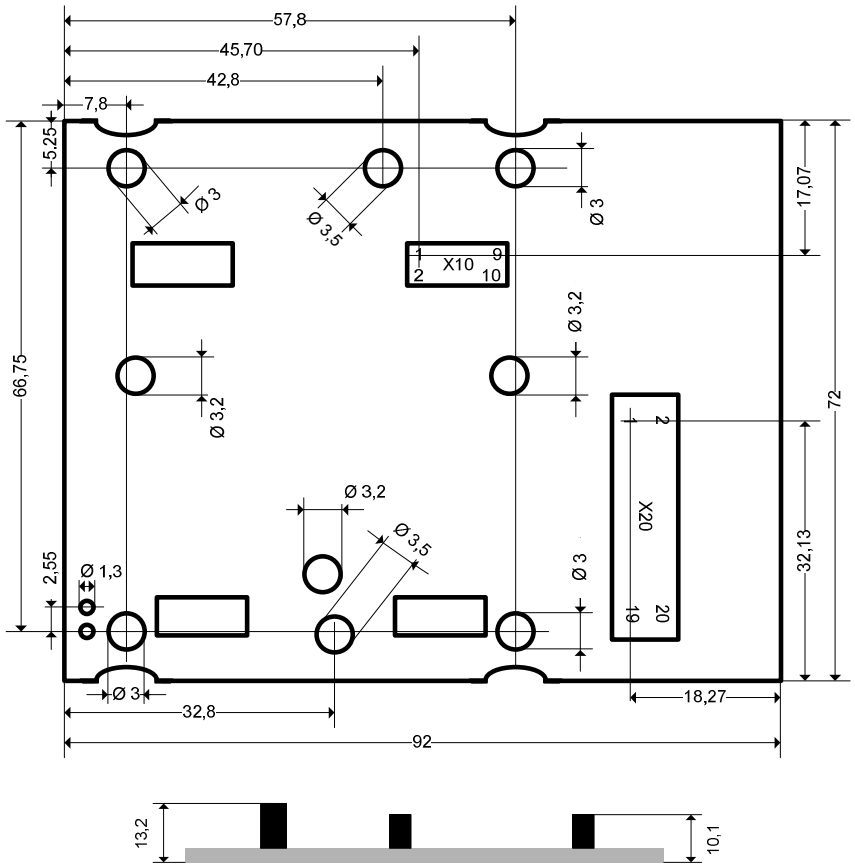


4. Quality

Table 1: Quality			
End test	**test category**	**test describtion**	**standard**
AOI	Automated Optical Inspection	Control of accurate placement of components/ of solder joints	SEMIKRON
ICT	In-Circuit Test	Test of the populated PCB, checking the correctly fabrication	SEMIKRON
Type test	**test category**	**test conditions**	**standard**
EP	Electrical Parameters	Jamb = -40°C / +85°C	SEMIKRON
SP	STEP Test, Interrupted PS	20x 10µs to 2s	EN61000-4-29
Iso	Isolation Test	High voltage test 4kV, 60s	EN 61800-5-1
TC	Thermal Cycling	200 cycles, Tstgmax – Tstgmin	IEC60068-2-14
PD	Partial discharge test	>1,2 kV; suitable for 1000V DC Link	VDE 0110-20
TH	Temperature Humidity	85°C, 85% RH, 96h	IEC 60068-2-67
VB	Vibration	Sinus 20/2000Hz Random 10/2000Hz, 5g, 26 per x,y,z	IEC 60068-2-6
SH	Shock	Half-sinus pulse, 30g, 6000 shocks, 6ms, ±x, ± y, ± z	IEC 60068-2-29

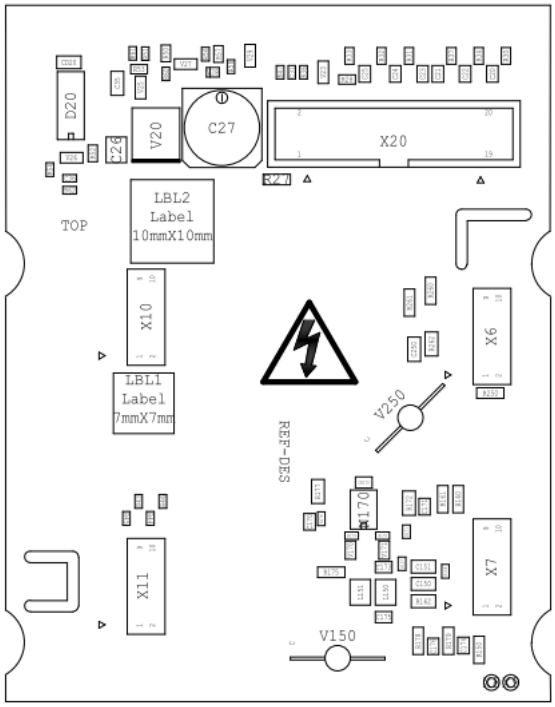
5. Dimensions

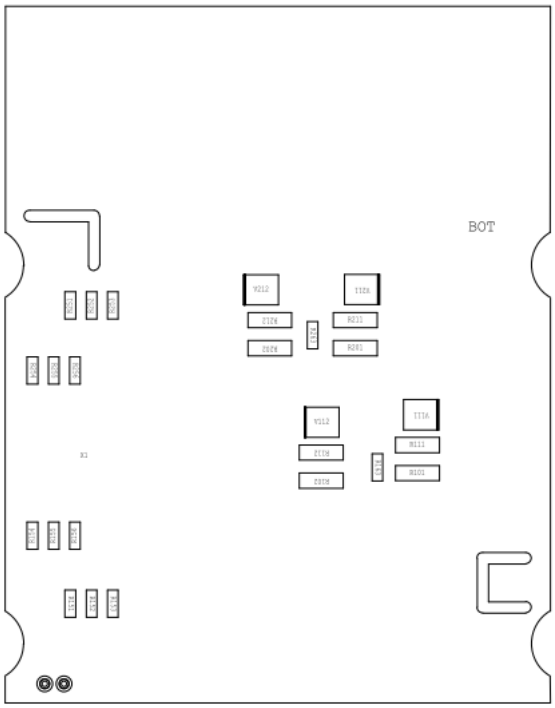
Figure 2: Dimensions in mm



6. Component Placement Layout

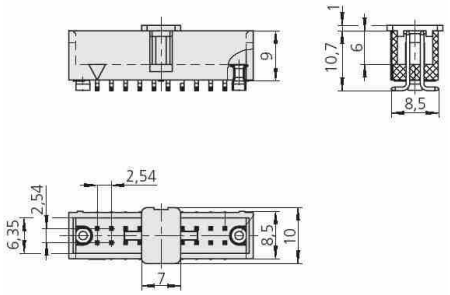
Figure 3: Adaptor Board





7. PIN Array

Figure 4: Connector X20 (Assmann AWHW 20G SMD)



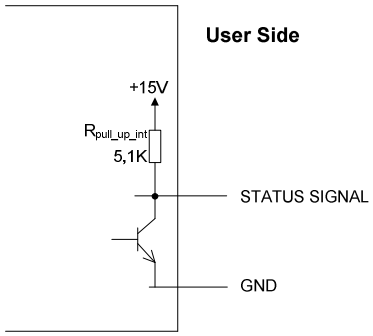
Product information of suitable female connectors and distributor contact information is available at e.g. http://www.harting.com (part number 09 18 520 6 813).

Table 2: PIN Array			
PIN	**Signal**	**Function**	**Specification**
X20:01	IF_PWR_15P	Drive power supply	Stabilised +15V ±4%
X20:02	IF_PWR_GND	GND for power supply	
X20:03	IF_PWR_15P	Drive power supply	Stabilised +15V ±4%
X20:04	IF_PWR_GND	GND for power supply	
X20:05	IF_PWR_15P	Drive power supply	Stabilised +15V ±4%
X20:06	IF_PWR_GND	GND for power supply	
X20:07	reserved		
X20:08	IF_PWR_GND	GND for power supply	
X20:09	IF_CMN_nHALT	Driver core status signal (bidirectional signal with dominant recessive behaviour)	Digital 15V logic; LOW (dominant) = driver disabled; HIGH (recessive) = ready to operate
X20:10	reserved		
X20:11	reserved		
X20:12	IF_CMN_GND	GND for signal IF_CMN_nHALT	
X20:13	reserved		
X20:14	reserved		
X20:15	IF_HB_TOP	Switching signal input (TOP switch)	Digital 15 V logic; 10 kOhm impedance; LOW = TOP switch off; HIGH = TOP switch on
X20:16	IF_HB_BOT	Switching signal input (BOTTOM switch)	Digital 15 V logic; 10 kOhm impedance; LOW = BOT switch off; HIGH = BOT switch on
X20:17	reserved		
X20:18	IF_HB_GND	GND for signals IF_HB_TOP & F_HB_BOT	
X20:19	reserved		
X20:20	reserved		

8. Signal IF_CMN_nHALT

The Halt Logic Signals PRIM_HALT_IN and PRIM_HALT_OUT of the driver core are coupled to one bidirectional signal (IF_CMN_nHALT) with dominant recessive behaviour. IF_CMN_nHALT shows the driver core status. When IF_CMN_nHALT is HIGH (recessive), the driver core is ready to operate. When IF_CMN_nHALT is LOW (dominant), the driver core is disabled / not ready to operate because of e. g. detected failure or driver core system start.
A controller can hold with the IF_CMN_nHALT signal the driver core in a safe state (e.g. during a start up of a system or gathered failure signal of other hardware) or generate a coeval release of paralleled driver. Furthermore, paralleled drivers can send and receive IF_CMN_nHALT signals among each other by using a single-wire bus.

Figure 5: Connection IF_CMN_nHALT



9. Setting Dead Time

Table 3: DT adjustment

Designation	Pattern Name	Setting
R43 (connected to GND)	0603	PRIM_CFG_TDT2_IN Factory setting: 0Ω
R44 (connected to GND)	0603	PRIM_CFG_SELECT_IN Factory setting: not equipped
R45 (connected to GND)	0603	PRIM_CFG_TDT3_IN Factory setting: 0Ω
R46 (connected to GND)	0603	PRIM_CFG_TDT1_IN Factory setting: not equipped

Factory setting: 3,3µs

10. Setting Dynamic Short Circuit Protection

Table 4: R_{CE} & C_{CE}			
Designation	**Pattern Name**	**Setting**	
R162	1206	R_{CE} Factory setting: not equipped	TOP
C150	1206	C_{CE} Factory setting: not equipped	TOP
R262	1206	R_{CE} Factory setting: not equipped	BOT
C250	1206	C_{CE} Factory setting: not equipped	BOT

11. Collector Series Resistance

Table 5: R_{VCE}			
Designation	**Pattern Name**	**Setting**	
R150	MiniMELF	R_{VCE} * Factory setting: not equipped	TOP
R250	MiniMELF	R_{VCE} * Factory setting: not equipped	BOT

* 1200V IGBT operation: 0Ω
  1700V IGBT operation: 1kΩ / 0,4W

12. Adaptation Gate Resistors

Table 6: R_{Gon} & R_{Goff}			
Designation	**Pattern Name**	**Setting**	
R151, R152, R153 (parallel connected)	MiniMELF	R_{Gon} Factory setting: not equipped	TOP
R154, R155, R156 (parallel connected)	MiniMELF	R_{Goff} Factory setting: not equipped	TOP
R251, R252, R253 (parallel connected)	MiniMELF	R_{Gon} Factory setting: not equipped	BOT
R254, R255, R256 (parallel connected)	MiniMELF	R_{Goff} Factory setting: not equipped	BOT

13. Adaptation Decoupling Gate Resistors

For details to the decoupling gate resistors and recommended values, see Modules Explanations and Data Sheets SEMiX®.

Table 7: R_{G1}, R_{G2}			
Designation	**Pattern Name**	**Setting**	
R101	MELF	R_{G1} Factory setting: not equipped	TOP
R102	MELF	R_{G2} Factory setting: not equipped	TOP
R201	MELF	R_{G1} Factory setting: not equipped	BOT
R202	MELF	R_{G2} Factory setting: not equipped	BOT

14. Setting Soft Turn-Off

Table 8: R_{Goff_SC}			
Designation	**Pattern Name**	**Setting**	
R160, R161 (parallel connected)	MiniMELF	R_{Goff_SC} Factory setting: not equipped	TOP
R260, R261 (parallel connected)	MiniMELF	R_{Goff_SC} Factory setting: not equipped	BOT

15. Temperature Signal

The temperature sensor inside the SEMiX® module is directly connected to contacting points T1 and T2. For details to the temperature sensor, see Modules Explanations SEMiX®.

Safety Warnings:	
	The contacting points T1 and T2 are not electrical isolated. Due to high voltage that may be present at the contacting points T1 and T2, some care must be taken in order to avoid accident. There is no cover or potential isolation that protect the high voltage sections / wires from accidental human contact.

Please note:

If the contacting points T1 and T2 are used for adaptor of the temperature sensor, the Over Temperature Protection Ciruit must be disabled by taking out the resistors R175, R178 and R179.

16. Over Temperature Protection Circuit (OTP)

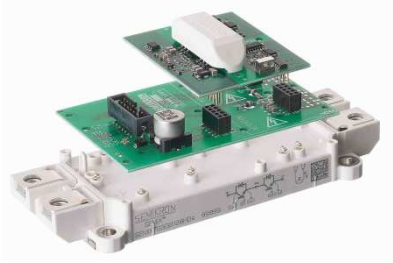
The external error input SEC_TOP_ERR_IN on the secondary side (high potential) of the driver core is used for an over temperature protection circuit to place the gate driver into halt mode.

Dimensioning OTP
[1] Define an over temperature trip level according to the application. [2] Calculate the nominal ohmic resistance value of the temperature sensor at the defined trip level (see "Modules – Explanations - SEMiX®" on SEMiX® product overview page at http://www.semikron.com). [3] The trip level on the adapter board is set with R172 by using the calculated resistance value. • **Factory setting R172: not equipped** • **If no resistor is used, a failure signal is generated.**

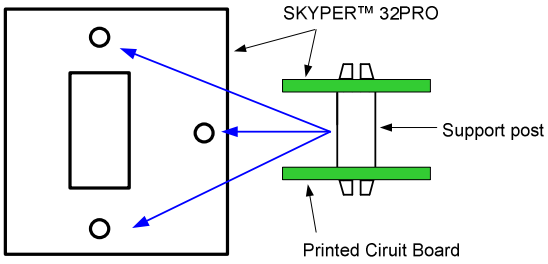
17. Mounting Notes

The electrical connections between adaptor board and SEMiX® are realised via spring contacts integrated in SEMiX® power modules and via landing pads on the bottom side of the adaptor board.

Figure 6: Adaptor Board & Driver Core Mounting



[1] Soldering of components (e.g. R_{Gon}, R_{Goff}, etc.) on adapter board.
[2] Adaptor Board has to be fixed to the SEMiX® module (see "Mounting Instruction and Application Notes for SEMiX® IGBT modules" on SEMiX® product overview page at http://www.semikron.com).
[3] Insert driver core into the box connector on adaptor board.



The connection between driver core and adaptor board should be mechanical reinforced by using support posts. The posts have to be spaced between driver core and adaptor board.

Product information of suitable support posts and distributor contact information is available at e.g. http://www.richco-inc.com (e.g. part number DLMSPM-8-01, LCBST-8-01).

18. Schematics

Figure 7: Schematic I Adaptor Board

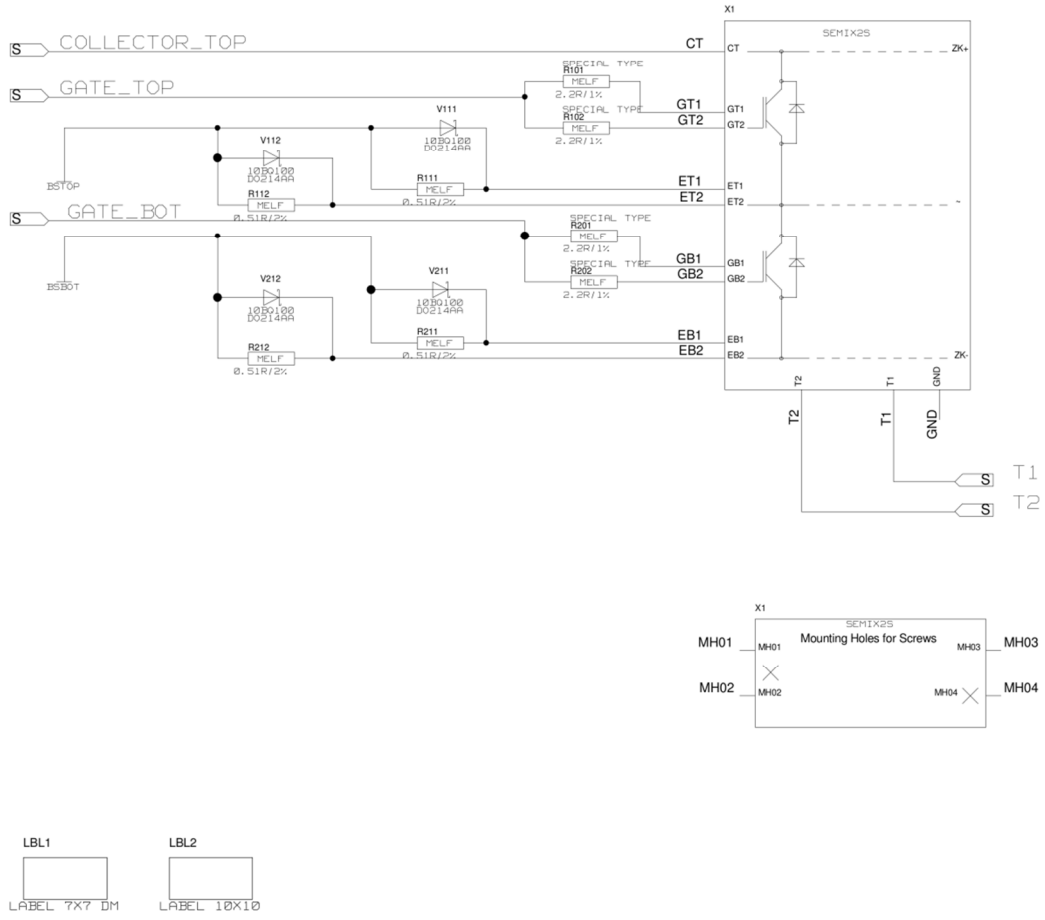


Figure 8: Schematic II Adaptor Board

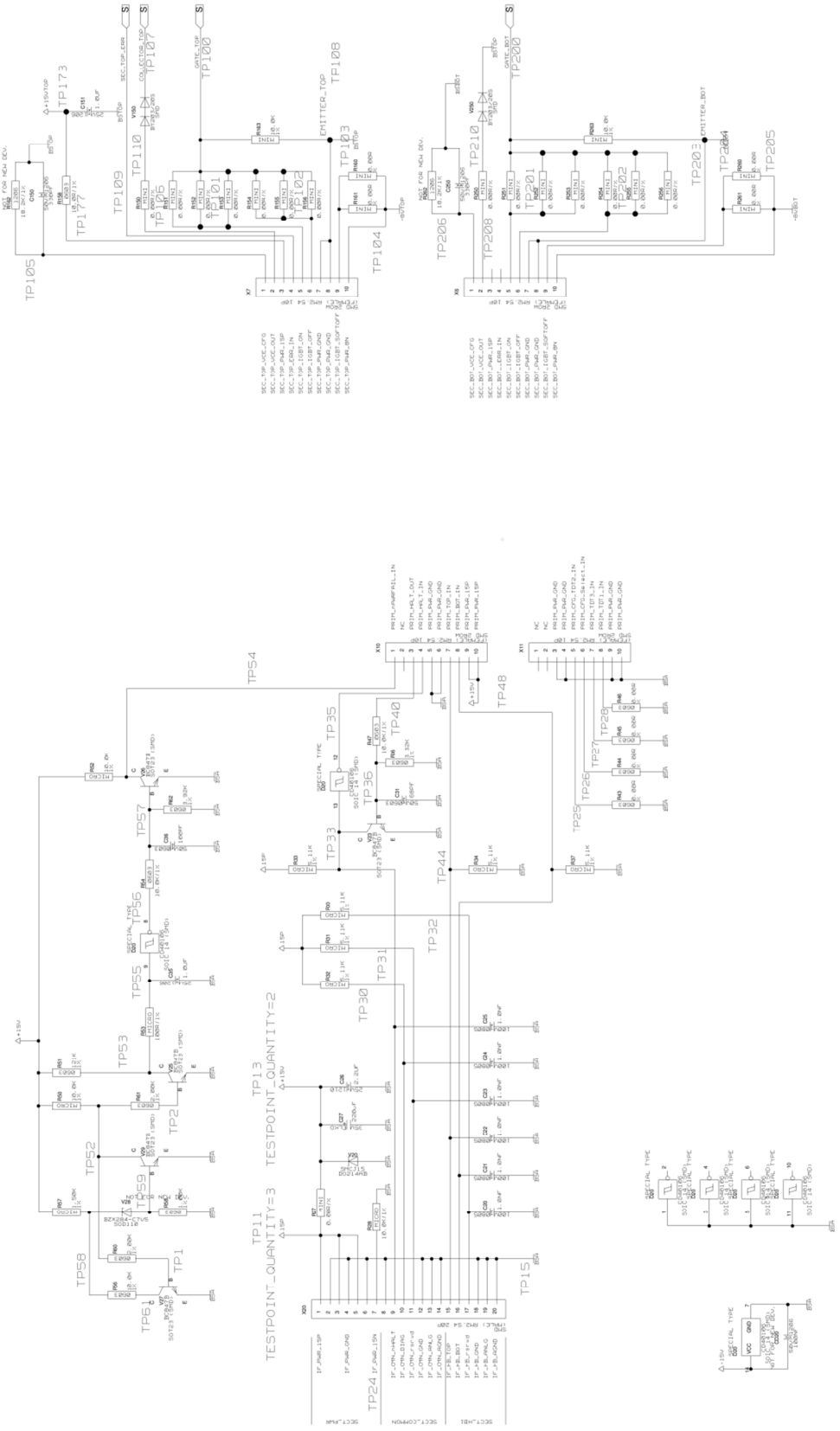
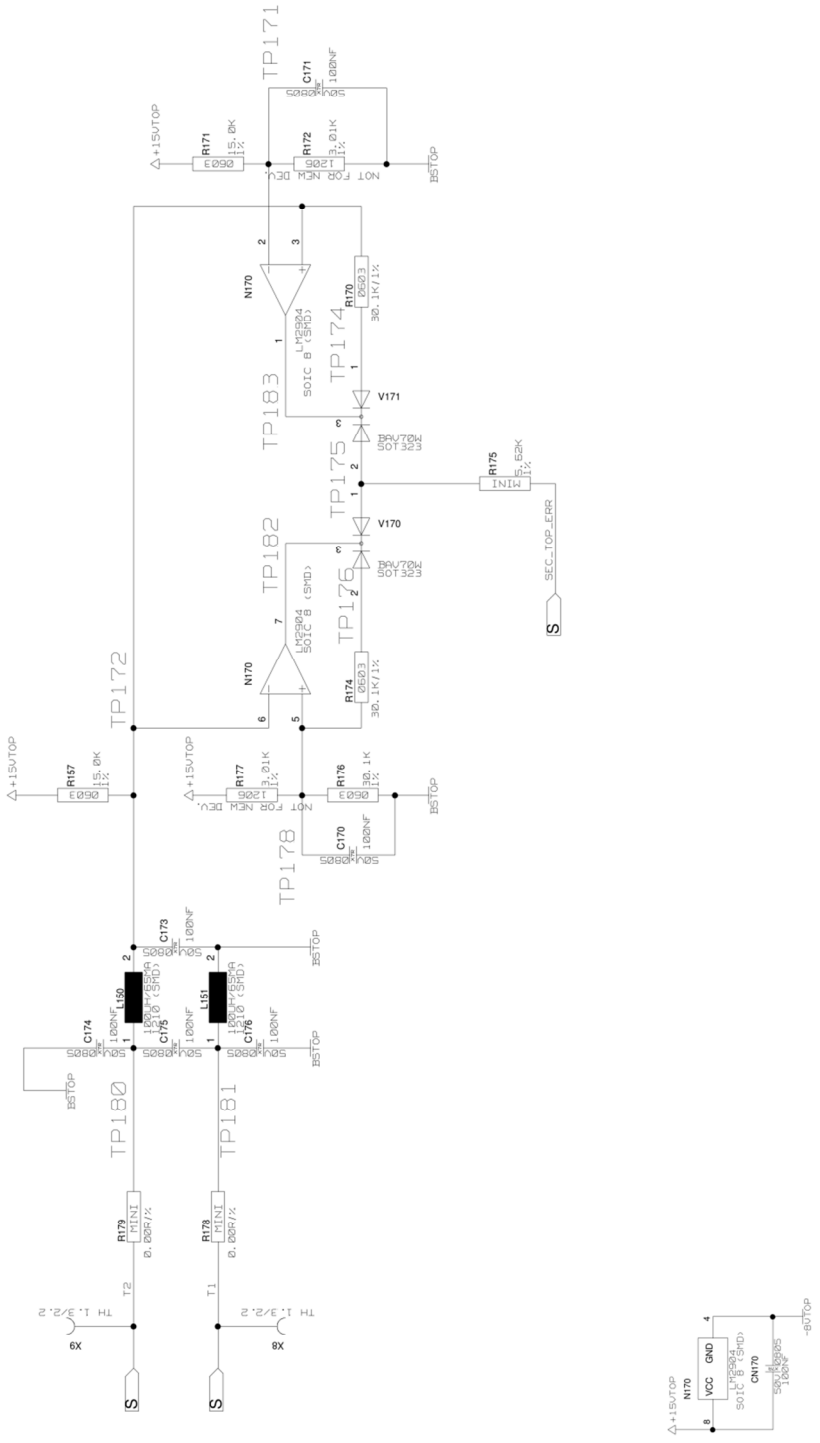


Figure 9: Schematic III Adaptor Board



19. Parts List

Figure 10: Parts List Adaptor Board

Count	Ref. Designator	Value	Pattern Name	Description
7	C170, C171, C173, C174, C175, C176, CN170	100nF	0805 (SMD)	Capacitor X7R
6	C20, C21, C22, C23, C24, C25	1nF	0805 (SMD)	Capacitor X7R
1	C26	2,2µF	1210 (SMD)	Capacitor X7R
1	C27	220uF/35V	SMD	Longlife-Elko
1	C31	68pF	0603 (SMD)	Capacitor NP0
2	C35, C151	1uF	1206 (SMD)	Capacitor X7R
1	C36	100pF	0603 (SMD)	Capacitor NP0
1	CD20	100nF	1206 (SMD)	Capacitor X7R
1	D20	74C14	SOIC 14 (SMD)	Logic-IC 74C...
2	L150, L151	100uH	1210 (SMD)	Inductor
1	N170	LM2904	SOIC 8 (SMD)	Operational Amplifier
4	R111, R112, R201, R211, R212	0,51Ohm	Melf (SMD)	2%
2	R157, R171	15,0KOhm	0603 (SMD)	1%
1	R158	10,0Ohm	0603 (SMD)	1%
2	R163, R263	10,0KOhm	MiniMelf (SMD)	1%
3	R170, R174, R176	30,1KOhm	0603 (SMD)	1%
1	R175	5,62KOhm	MiniMelf (SMD)	1%
1	R177	3,01KOhm	1206 (SMD)	1%
3	R27, R178, R179	0,00Ohm	MiniMelf (SMD)	
3	R28, R50, R52	10,0KOhm	MicroMelf (SMD)	1%
6	R30, R31, R32, R33, R34, R37	5,11KOhm	MicroMelf (SMD)	1%
1	R36	3,32KOhm	0603 (SMD)	1%
2	R43, R45	0,00Ohm	0603 (SMD)	
3	R47, R54, R56	10,0KOhm	0603 (SMD)	1%
1	R51	121KOhm	0603 (SMD)	1%
1	R53	100Ohm	MicroMelf (SMD)	1%
1	R57	1,50KOhm	MicroMelf (SMD)	1%
1	R58	1,00KOhm	0603 (SMD)	1%
2	R60, R61	2,00KOhm	0603 (SMD)	1%
1	R62	3,92KOhm	0603 (SMD)	1%
4	V111, V112, V211, V212	10BQ100	SMB (SMD)	Diode Schottky
2	V150, V250	BY203/20S	SMD	High Voltage Diode
2	V170, V171	BAV70W	SOT323 (SMD)	Double Diode
1	V20	SMCJ15	DO214AB (SMD)	Suppressor Diode
5	V23, V25, V26, V27, V29	BC847B	SOT23 (SMD)	NPN-Transistor
1	V28	BZX284-C7V5	SOD110 (SMD)	Zener-Diode
1	X20	20p.	SMD	Connector
4	X6, X7, X10, X11	RM2,54 10p.	SMD	Box Connector

TP: Test Point

Box Connector: SUYIN 254100FA010G200ZU

References

[1] www.SEMIKRON.com
[2] A. Wintrich, U. Nicolai, W. Tursky, T. Reimann, "Application Manual Power Semiconductors", ISLE Verlag 2011, ISBN 978-3-938843-666

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