SEMIKRON

Absolute Maximum Ratings			
Symbol	Term	Value	Unit
V_S	Supply voltage prim.	18	V
V_{iH}	Input signal voltage (High)	5 + 0,3	V
$Iout_{PEAK}$	Output peak current @ 10µs	1.5	A
$Iout_{AVmax}$	Output average current (f_{sw}=5kHz)	90	mA
f_{max}	max. switching frequency	5	kHz
V_{CE}	Collector-Emitter voltage	1700	V
dv/dt	Rate of rise and fall of voltage secondary to primary side	50	kV/µs
V_{isolIO}	Isolation test voltage Standard input–output (2 sec. AC)	3500	V
R_{Gonmin}	Minimum rating for Rgon	1,5	Ω
$R_{Goffmin}$	Minimum rating for Rgoff	1,5	Ω
T_{op}	Operating temperature	- 25 ... + 85	°C
T_{stg}	Storage temperature	- 40 ... + 85	°C

Electrical Characteristics (T_a = 25°C)		Values			
Symbol	Term	min	typ	max	Units
V_S	Supply voltage primary side (regulated)	14,4	15	15,6	V
	Supply voltage primary side (unregulated)	20	24	30	V
I_{SO}	Supply current primary side (no load)		67		mA
	Supply current primary side (operation, f_{swmax}=5 kHz)		77		mA
R_{GE}	Internal gate-emitter resistance		22		kΩ
$t_{d(on)IO}$	Input-output turn-on propagation time			20	µs
$t_{d(off)IO}$	Input-output turn-off propagation time			25	µs
$t_{d(err)}$	Error input-output propagation time		10		µs
t_{pERR_RESET}	Error reset time		300		ms
Input IGBT extern ON (Open Collector)					
V_{iOn}	Chopper On @ I_{iOn} > 5mA			5	V
V_{iOff}	Chopper Off @ I_{iOff} < 1mA	11,5			V
Input Error Reset (Open Collector)					
$V_{iResetActive}$	RESET avtive			2	V
$V_{iResetNoAct}$	RESET inactive	12			V
Output IGBT					
V_{Gon}	Turn-On Gate Voltage	13,8	14,5	15,2	V
V_{Goff}	Turn-Off Gate Voltage			0,6	V
R_{Gon}	Gate On Resistance		15		Ω
R_{Goff}	Gate Off Resistance		15		Ω
$Q_{out/pulse}$	max. rating for output charge per pulse			5	µC
DC – Link voltage threshold (SKAI100E – Europe)					
$V_{ChopperOn}$	Chopper On	661	681	701	V
$V_{ChopperOff}$	Chopper Off	647	667	687	V
$V_{ChopperError}$	Chopper Error	725	730	735	V
DC – Link voltage threshold (SKAI100U – USA)					
$V_{ChopperOn}$	Chopper On	779	802	826	V
$V_{ChopperOff}$	Chopper Off	762	786	809	V
$V_{ChopperError}$	Chopper Error	854	860	866	V
ϑ_{Fault}	over temperature	110	115	120	°C
C_{ps}	Coupling capacity primary-secondary	–	12	–	pF
m	weight		44		g
T x B x H	Dimensions		125 x 62 x 27		mm

SEMIDRIVER ®
Brake Chopper
SKAI 100 E / U

- driver for dc link chopper circuits
- US Version (SKAI 100U) and European Version (SKAI 100E)
- other voltage levels on request

Preliminary Data

Features

- standard logic compatible input buffers
- short circuit protection by V_{CE}
- chopper frequency up to 5kHz
- adjustable values for hysteresis and max. dc link voltage
- isolation by transformers
- supply undervoltage protection (13 V)
- available in standard SKiiP PACKs and optional in standard modules
- external Reset possible

Typical Applications

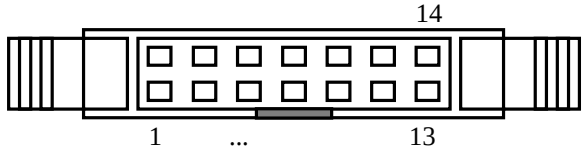
- DC link voltage controller

Pin Array SKiiP Brake Chopper – Driver with 14 pin connector DIN 41651

Primary Side Pin Array

X1 :

Pin No.	Designation	Explanation
1	reserved	
2	CHOPPER ext. ON	LOW = IGBT „ON“
3	Error OUT	LOW = NO ERROR; open Collector Output [1]
4	RESET	LOW = RESET Brake Chopper [2]
5	reserved	
6	+ 24 VDC IN	optional supply 15V DC or 24V DC possible
7	+ 24 VDC IN	
8	+ 15 VDC IN	
9	+ 15 VDC IN	
10	BSP (GND)	
11	BSP (GND)	
12	reserved	
13	reserved	
14	reserved	

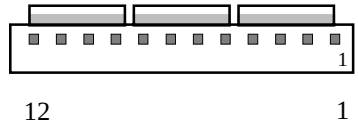


X1

Secondary Side Pin Array

X11 : 12 - pin MOLEX connector,

Pin No.	Designation	Explanation
1	E2 (HB)	
2	G2 (HB)	
3	Temp. - Sensor (HB) 1	(also optional as connection control)
4	Temp. - Sensor (HB) 2	(also optional as connection control)
7	C2 (HB)	
8	E1 (HB)	connected with each other
9	G1 (HB)	
12	C1 (HB)	dc link voltage Detection



[1] ext. pull up resistor by customer – control unit necessary
[2] only successful, when error is eliminated

Brake chopper driver

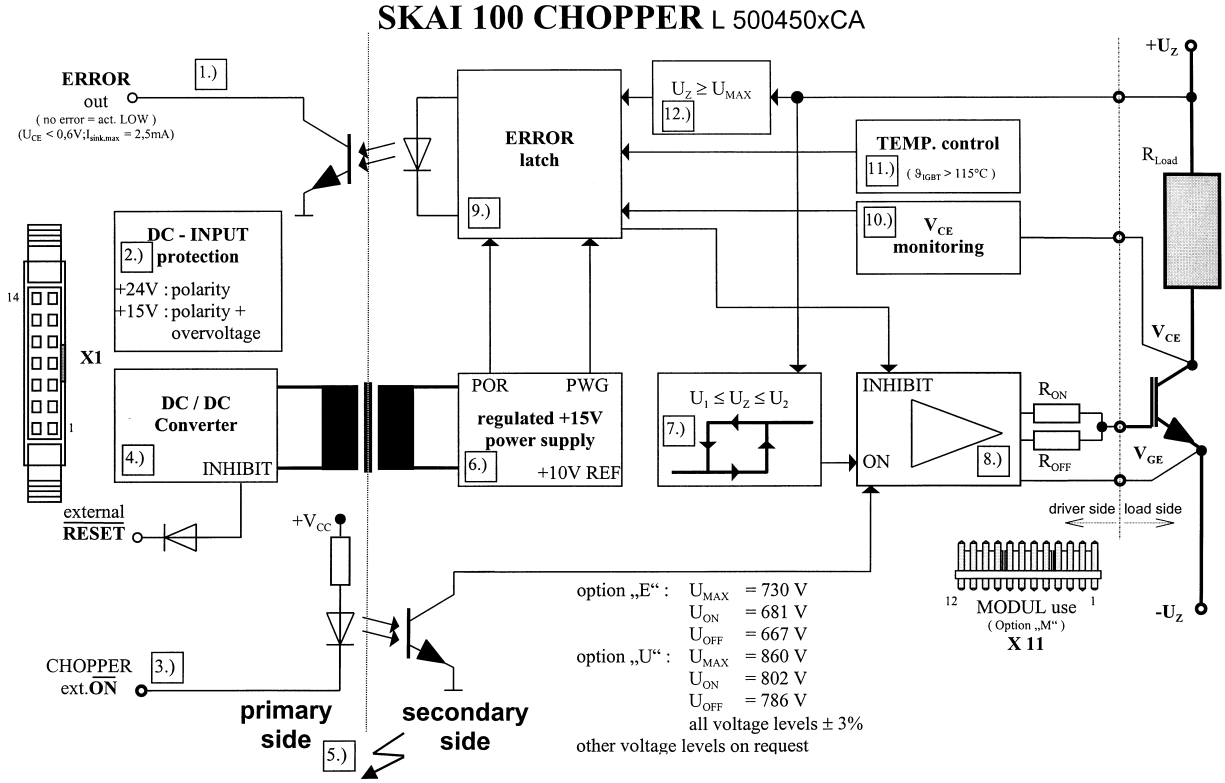


Fig. 1 Block Diagram Brake Chopper Driver

Explanation block diagram

The numbers in the block diagram (Fig. 1) refer to the following paragraphs.

1. Error output
Setting of the error latch will create an error signal at the ERROR OUT (PIN 3). This output has an open collector transistor which is optically controlled. An external pull up resistor (max. 30 V / 2,5 mA) must be connected on the controller board to logic HIGH level. An active LOW from the driver means NO ERROR.

2. Power supply
The driver may be supplied either with 24 VDC (20 ... 30 V) or with regulated + 15 V_{DC} ± 4%.

3. The input signal **CHOPPER ext. ON** (PIN 2) can be used for external switching (for example for discharging the DC-link while having a service). External ON switching is only possible, if the chopper's error latch is not set and does not depend on the actual value of the DC link voltage.
The max. switching frequency should not exceed 5 kHz. As designed for open collector drive, this input is not depending on a certain controller logic level. Active LOW from the controller means CHOPPER=ON.

4. DC / DC converter
Provides an isolated power supply with low coupling capacity for the gate drive and it's logic. An active LOW input at RESET (PIN 4) from the controller blocks the power supply for the secondary side. Due to the POWER GOOD (PWG) signal the error memory will be set.
⇒ ERROR OUT (PIN3) = HIGH

5. Isolation barrier
All drivers 100% tested.

6. In this section the **regulated + 15 V_{DC}** on secondary side, the internal reference voltage 10 V REF, the signals POWER GOOD (PWG) and POWER ON RESET (POR) are generated.

7. The **hysteresis regulator** generates, in dependence of the DC link voltage, the ON and OFF commands for the brake chopper. Once the hysteresis comparator triggered, the minimum ON time for a discharging pulse is typ. 30 µs. Two standard versions for 1200 V SKiiPPACKs ® are available.

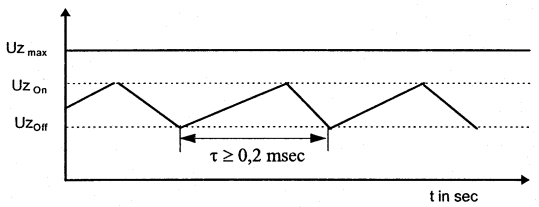
Adjusted by factory:

Version E (U_{line} = 400 V_{AC})

UZmax	UZon	UZoff
730 V	681 V	667 V

Version U (U_{line} = 460 V_{AC})

UZmax	UZon	UZoff
860 V	802 V	786 V



All levels will have a tolerance of ± 3%.

8. Driver

The IGBT is switched on with a positive regulated 15 V_{DC} gate-emitter voltage. Because no opposite IGBT is present switching off to 0 V_{DC} is possible. The maximum sink and source peak current from the power buffer into the gate is 1,5 A.

9. Error Memory

The error memory is set by various error signals. Switching ON the chopper IGBT is only possible if the error memory is in NO ERROR state. Once the error latch is set, it will remain in ERROR condition until no more error is present and
a) input RESET (PIN 4) receives an active LOW pulse longer than t_{pERR_RESET} > 300 ms,
or
b) re-applying the 15 V or 24 V power (POWER ON RESET = POR)

Reasons for the setting of the error-memory into ERROR state are:

1. Undervoltage
limit value when using 15 V_{DC} (± 4%): < 13,5 V
limit value when using 24 V_{DC} (20 ... 30 V): < 16 V
2. Short circuit (V_{CE} monitoring)
3. Uz > U_{zmax}
4. T_{chip} > 115 °C ± 5 °C

10. VCE monitoring

The IGBT is protected against short circuit by V_{CE}-supervision. Through the collector-emitter voltage evaluation, a short circuit is detected and forces the Gate of the IGBT to 0 V. The error latch is set and the output ERROR OUT (PIN 3) will turn to controller logic HIGH level.

11. Temperature sensing

This circuit controls the heatsink temperature near IGBT chip level. If the max. value is reached, the error-memory is set and any pulses are blocked.
Error signal temperature threshold level:

ϑ_{err} = **115 °C** ± 5 °C

12. $V_{dc\text{-}linkmax}$ sensing

A well designed brake chopper resistor will be able to control the DC link voltage at any time. But if this resistor is broken the DC link voltage will rise even with the chopper IGBT in ON state. If Uz reaches the max. permissible Uzmax, the error memory is set and the ERROR OUT (PIN 3) will turn to HIGH.

- **Power supply**

Every SKiiPPACK® driver can be supplied by an unregulated 24 (20 V - 30 V) supply, or by a regulated
15 V ± 4% source.

- **SEMIKRON recommends the use of the same supply voltage for the 3-phase bridge and the brake-chopper.**

- **A safety feature monitors an undervoltage condition of the power supply:**

Limits when using 15 V_{DC} ± 4%: 13,5 V
Limits when using 24 V_{DC} (20 ... 30 V): 16 V

One of these limit values reached, the IGBTs will be switched off and the error latch is set.

Transient overvoltage of the 15V - supply will not create an error signal, but the unit is protected by suppressor diode.

- **The driver is protected against reverse connection of the 24 V_{DC} supply voltage.**

The suppressor diode will be destroyed if there is a false connection of the 15V_{DC} supply voltage.