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Selection of gate drivers

General considerations

- The driver must be able to provide the necessary gate current (I_G) (output current / output power).
  The maximum average output current of the driver must be higher than the calculated value.
  I.e.: SEMiX404GB12E4s
  F_S = 4kHz
  Q_G = 2,26µC

Symbol	Conditions	Values	Unit
Q_G	V_{GE} = -8V +15V	2260	nC

Pic 1: Datasheet of SEMiX404GB12E4s

I_{OUTav} = 4kHz x 2,26µC = 9mA < I_{OUTav_max} of the gate driver

- The maximum peak gate current (I_{GM}) of the driver must be equal to or greater than the maximum calculated peak gate current.
  I.e.: SEMiX404GB12E4
  The following values can be found in the driver's data sheet:
  RG = 3Ω (external gate resistor; can be modified by the customer)
  RG_int = 1,88 Ω (internal gate resistor, cannot be modified by the customer)
  VG(ON) = +15V
  VG(OFF) = -7V

$$I_{G\_PEAK} = \frac{VG(ON)\text{-}VG(OFF)}{RG+RG(INT)} = \frac{+15V-(-7V)}{3\Omega+1{,}88\Omega} = 4{,}5A$$

- The output capacitors of the driver must be able to deliver the gate charge (Q_G) needed to charge and discharge the gate of the IGBT. In the data sheet of SEMIKRON drivers the maximum charge per pulse is given. This value must be duly considered when selecting a suitable driver.

Symbol	Conditions	Values	Unit
$Q_{out/pulse}$	Max. rating for output charge per pulse	50	µC

Pic 2: Datasheet of SKYPER 42 R

Q_G of the IGBT module < Gate charge of the output capacitors of the IGBT driver
I.e.: SEMiX404GB12E4
2,26µC (SEMiX) <50µC (SKYPER42R) -> ok

- Other parameters worth mentioning: insulation voltage, dv/dt capability

Important

When using SEMIKRON IGBT driver cores an adapter board as connection between the IGBT module and the gate driver core is necessary. As alternative for customer-specific adapter boards, SEMIKRON offers optimized adapter boards for spring and wire contacted boards.

Pic 3: Adapter boards for spring (left) and wire (right) contacted boards

DriverSel – The easy IGBT driver selection tool

The easiest way of finding the right driver is using the DriverSel tool. It is a free software tool that is available at:

http://shop.semikron.com/Service-and-Support/Knowledge-Base/SEMISEL/

The option “Driver Select Tool” in Semisel shall be selected.

Driver Select Tool

Preselect	Vcc = 1200 V	
Product	SEMITRANS (119)	
Device	SKM150GB12T4	
Number of IGBT Modules	1	
Switching Frequency f_{sw}	10	kHz
Applied Gate Resistor	6	Ohm

Update

Result

Driver Channels	2
Collector Emitter Voltage	1200 V
Required average current	8.5 mA
Gate Charge	0.85 mC

Driver

Name	$I_{out(av)}$ /mA	i_{out} /A	V_{isol} /kV	$V_{ce\ max}$ /V	R_{gmin} / Ohm	Channels
1x SKHI22A R or SKHI22B R(1	40	8	2.5	1200	3.0	2
1x SKHI23/12 R	50	8	2.5	1200	2.7	2
1x SKYPER 32 R or SKYPER 32PRO R	50	15	4.0	1200	1.5	2

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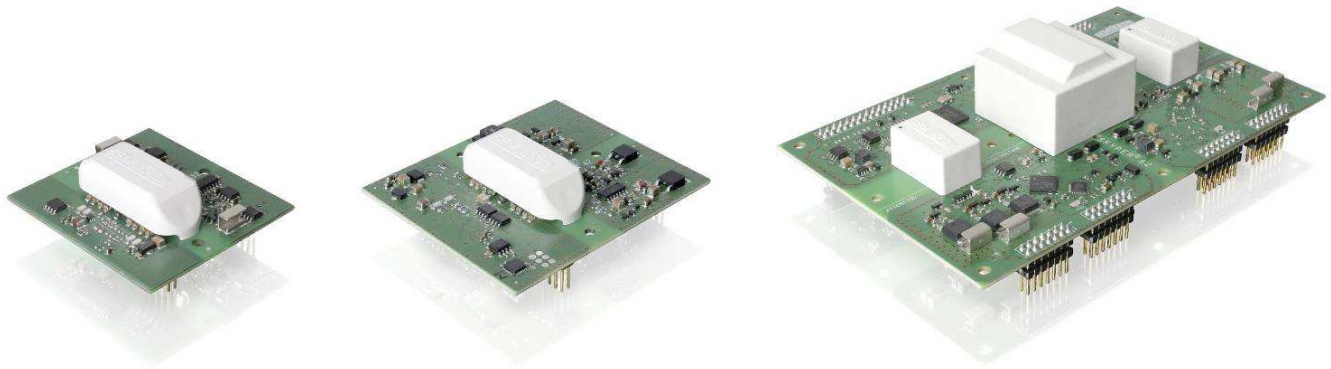
Matrix Overview : Power rating vs. No. of channels

	Power rating			
Channels	**MiniSKiiP, SEMITOP**	**SEMiX & SEMITRANS, SKiM**	**SEMiX & SEMITRANS up to 3 parallel modules**	**Up to 6 parallel modules**
1			SKHI 10	
2		SKHI 22, SKHI 23, SKHI 24, SKYPER 32/32 PRO, adapter boards for SEMITRANS & SEMiX	SKYPER 42 adapter boards for parallel SEMiX, SEMITRANS and SKiM modules	SKYPER 52
4		Board MLI SKYPER 32PRO		
6/7	SKHI 61 SKHI 71	Driverboard for SKiM 63		



Pic 5: SKYPER 32, 42 and 52

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SEMIKRON drivers and main parameter values

Gate driver	Channels	Technology	Vce (V)	Vg_on (V)	Vg_off (V)	Iout_peak (A)	Iout_av_max (mA)	Q_out/pulse (uC)	f_max (kHz)	V_isol (kV)	Typical circuit
SKHI 10/12 R	1	SMT	1200	15	-8	8	100	9,6	100	2500	Single switch, DC/DC chopper
SKHI 10/17 R	1	SMT	1700	15	-8	8	100	9,6	100	4000	Single switch, DC/DC chopper
SKHI 21A R	2	Hybrid	1200	15	0	8	40	4	50	2500	MOSFET Half-bridge
SKHI 22A R	2	Hybrid	1200	15	-7	8	40	4	50	2500	Half-bridge
SKHI 22A H4 R	2	Hybrid	1700	15	-7	8	40	4	50	4000	Half-bridge
SKHI 22B R	2	Hybrid	1200	15	-7	8	40	4	50	2500	Half-bridge
SKHI 22B H4 R	2	Hybrid	1700	15	-7	8	40	4	50	4000	Half-bridge
SKHI 23/12 R	2	SMT	1200	15	-8	8	50	4,8	100	2500	Half-bridge
SKHI 23/17 R	2	SMT	1700	15	-8	8	50	4,8	100	4000	Half-bridge
SKHI 24 R	2	Hybrid	1200	15	-8	15	80	5	50	4000	Half-bridge
SKYPER 32 R	2	Core	1700	15	-7	15	50	2,5	50	4000	Half-bridge
SKYPER 32PRO R	2	Core	1700	15	-7	15	50	6,3	50	4000	Half-bridge
SKYPER 42 R	2	Core	1700	15	-8	30	150	50	100	4000	Half-bridge
SKYPER 52 R	2	Core	1700	15	-15	50	300	100	100	4000	Half-bridge
SKHI 61 R	6	Hybrid	900	14,9	-6,5	2	20	1	50	2500	6-pack
SKHI 71 R	7	Hybrid	900	14,9	-6,5	2	20	1	50	2500	6-pack + brake chopper

Adapter boards to be used as interface between driver and power module

	Suitable for	
Adapter board	**Driver**	**Modules with housing**
Board 1 SKYPER 32R	SKYPER 32R	SEMITRANS (<400A)
Board 1 SKYPER 32PRO R	SKYPER 32PRO R	SEMITRANS (<400A)
Board 2S SKYPER 32R	SKYPER 32R	SEMiX 2S
Board 2S SKYPER 32PRO R	SKYPER 32PRO R	SEMiX 2S
Board 3S SKYPER 32R	SKYPER 32R	SEMiX 3S
Board 3S SKYPER 32PRO R	SKYPER 32PRO R	SEMiX 3S
Board 4S SKYPER 32R	SKYPER 32R	SEMiX 4S
Board 4S SKYPER 32PRO R	SKYPER 32PRO R	SEMiX 4S
Board 2 generic SKYPER 42R	SKYPER 42R	SEMITRANS (>400A)
Board 2 //3S SKYPER 42R	SKYPER 42R	SEMiX 3S
Board 2 //4S SKYPER 42R	SKYPER 42R	SEMiX 4S
Board 1 SKYPER 52R	SKYPER 52R	

The following application notes show more detailed information on the selection and connection of gate drivers:

IGBT Driver Calculation

http://www.semikron.com/skcompub/de/SID-79C8D130-71E73682/AN-7004_IGBT_Driver_Calculation_rev00.pdf

Connection of Gate Drivers to IGBT and Controller

http://www.semikron.com/skcompub/de/SID-79C8D130-71E73682/AN-7002_Connection_of_Gate_Drivers_to_IGBT_and_Controller_rev00.pdf