Intelligent Half-Bridge Drivers
for IGBTs and Power MOSFETs

Description

The intelligent half-bridge drivers of the IHD type series have been developed specifically for the reliable driving and secure protection of IGBT or power-MOSFET pairs.

All intelligent drivers of the IHD type series have mutually compatible contacts and differ only in their drive performance.

There is no logical link or mutual blocking between the control inputs of the two channels. This makes the drive components fully universal so that they can be used for half-bridge, asymmetrical half-bridge and midpoint tapping circuits as well as for all other PWM converters and resonance topologies.

Product Highlights

✔ Suitable for IGBTs and power MOSFETs
✔ Protect the power transistors
✔ Extremely reliable, long service life
✔ High gate current of ±1.5A to ±8A
✔ Electrical isolation 4000 Vac
✔ Electrically isolated status acknowledgement
✔ Monitoring of power supply and self-monitoring
✔ Switching frequency DC to MHz
✔ Duty cycle: 0... 100%
✔ High dv/dt immunity, guaranteed >50,000V/µs
✔ Shorten development time

Applications

✔ Inverters
✔ Motor drive technology
✔ Traction
✔ Railroad power supplies
✔ Converters
✔ Power engineering
✔ Switch-mode power supplies
✔ Radiology and laser technology
✔ DC/DC converter
✔ Research
✔ RF generators and converters

IHD 215/280/680

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Absolute Maximum Ratings

Parameter	Test conditions	min	max	unit
Supply voltage V_{cc}	Pin 10 to Pin 9	-0,5	16	Vdc
Gate peak current I_{out}	IHD 215xx Pin 25 and 36	-1,5	+1,5	A
	IHD 280xx Pin 25 and 36	-8	+8	A
	IHD 680xx Pin 25 and 36	-8	+8	A
Test voltage (50Hz/1min)	INxx to SOxx		50	Vac
	INxx to GND und Vcc (see note 17)		4000	Vac
	INxx to output stages (see note 17)		4000	Vac
	GND/Vcc to output stages		4000	Vac
Operating temperature	IHDxxxAN	0	+70	°C
	IHDxxxAI	-40	+85	°C
Storage temperature	all types	-45	+90	°C

Pin Designation

Pin	Desig.	Function
1	SO1+	Status output + (CH.1)
2	SO1-	Status output - (CH.1)
3	IN1-	Input inverting (CH.1)
4	IN1+	Input non-inverting (CH.1)
5		free
6		free
7		free
8		free
9	GND	Power supply GND
10	Vcc	Power supply plus terminal
11		free
12		free
13		free
14		free
15	SO2+	Status output + (CH.2)
16	SO2-	Status output - (CH.2)
17	IN2-	Input inverting (CH.2)
18	IN2+	Input non-inverting (CH.2)

Pin	Desig.	Function
36	G1	Gate driver output (CH.1)
35	COM1	Virtual common (CH.1)
34	Cs1	Blocking capacitor (CH.1)
33	E1	Emitter / Source (CH.1)
32	REF1	External reference (CH.1)
31	Cb1	Blocking time capacitor (CH.1)
30	ME1	Vce measurement (CH.1)
29		free
28		free
27		free
26		free
25	G2	Gate driver output (CH.2)
24	COM2	Virtual common (CH.2)
23	Cs2	Blocking capacitor (CH.2)
22	E2	Emitter / Source (CH.2)
21	REF2	External reference (CH.2)
20	Cb2	Blocking time capacitor (CH.2)
19	ME2	Vce measurement (CH.2)

Legend:
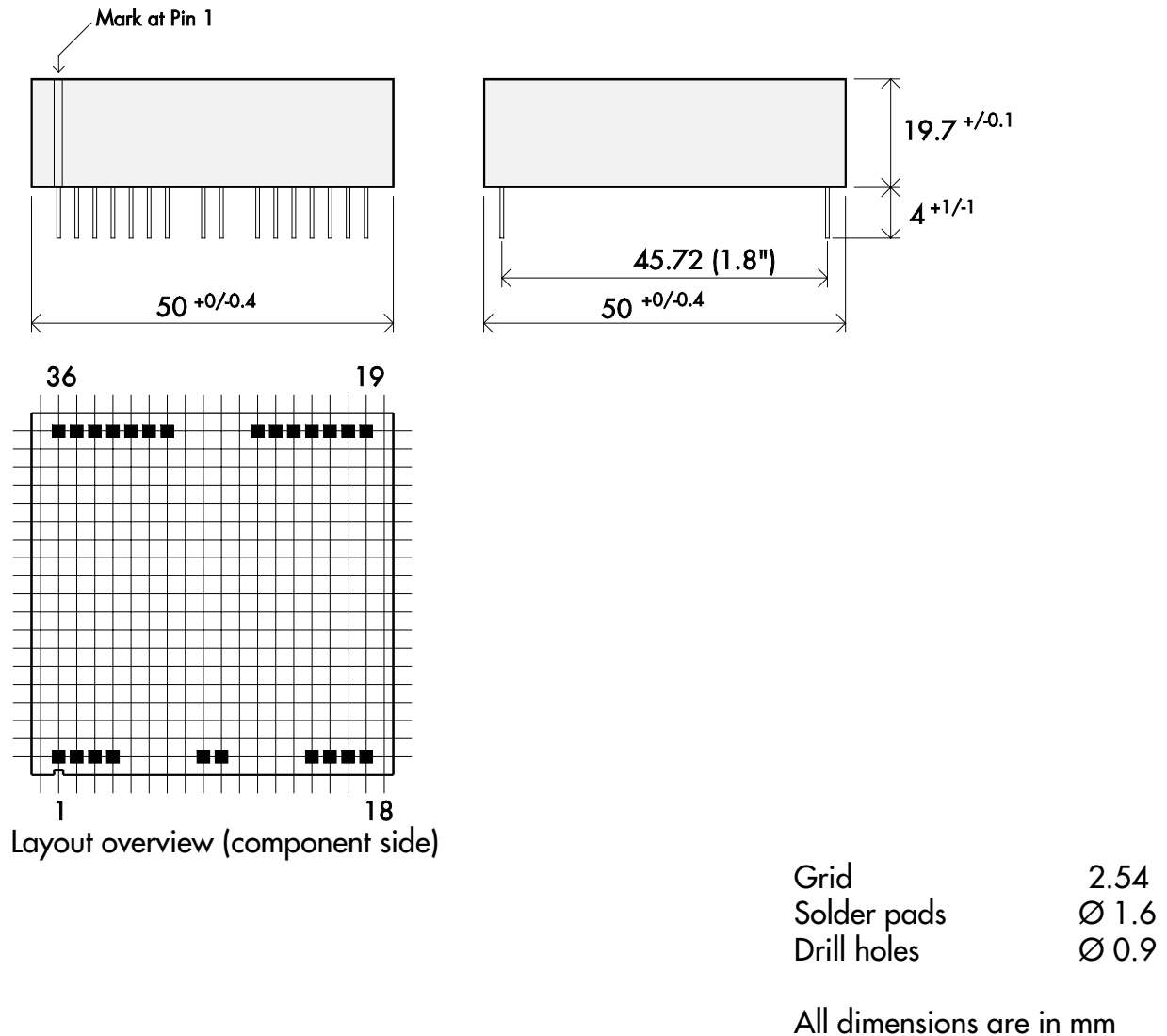(CH.1) = Channel 1; (CH.2) = Channel 2
Pins with the designation *free" are not physically present

Block and Connection Diagram

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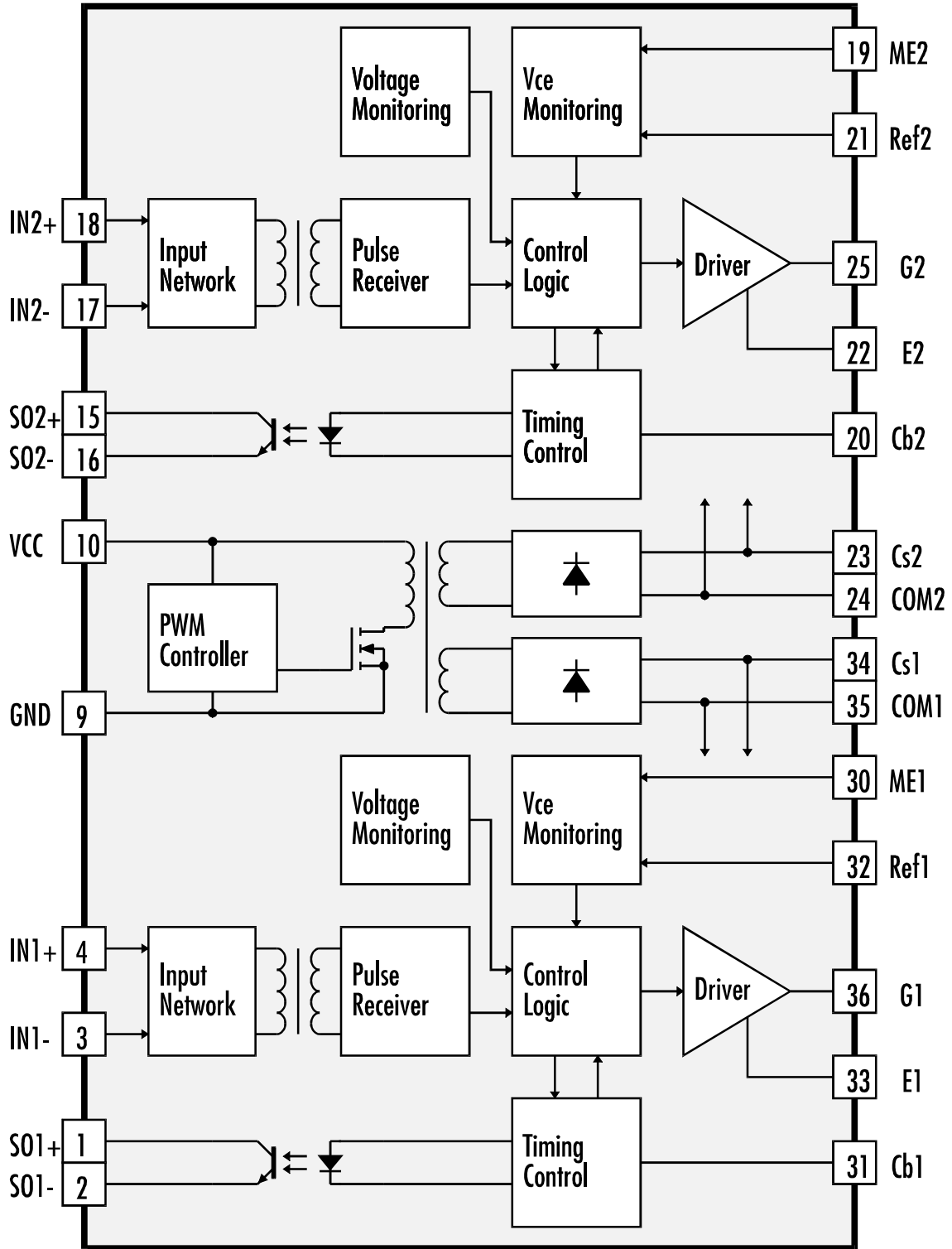
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Mechanical Dimensions

Mark at Pin 1

19.7 $^{+/-0.1}$

4 $^{+1/-1}$

45.72 (1.8")

50 $^{+0/-0.4}$

50 $^{+0/-0.4}$

36   19

1   18

Layout overview (component side)

Grid	2.54
Solder pads	Ø 1.6
Drill holes	Ø 0.9

All dimensions are in mm

Case & Coating

Component	Material
Case product	Noryl (PPE mod.), non-halogenate flame retardants
Coating mass	Polyurethane base, temperature-cycle resistant

General Characteristics

Quality	Standard			
Manufacturing	ISO9001 certified			

Reliability	Standard		typ	units
MTBF IHD215/280xx	MIL HDBK 217F (see Note 12)		> 2,000,000	hours
MTBF IHD680xx	MIL HDBK 217F (see Note 12)		> 1,840,000	hours

Thermal Characteristics	Test Conditions	min	max	units
Operating temperature	IHDxxxAN (see Note 13)	0	+70	°C
	IHDxxxAI (see Note 13)	-40	+85	°C
Storage temperature	all types	-40	+85	°C

Electrical Characteristics

Power Supply	Test Conditions	min	typ	max	units
Supply voltage V_{cc} (see Note 1)	Pin 10 to Pin 9	12	15	16	Vdc
Supply current I_{cc} (see Note 2)	without load		90		mA
Max. supply current I_{cc}	IHD215xx (see Note 3)			200	mA
Max. supply current I_{cc}	IHD280xx (see Note 3)			200	mA
Max. supply current I_{cc}	IHD680xx (see Note 3)			500	mA
Efficiency η	internal DC/DC converter		75		%
Turn-on threshold V_{th}	all types		10		Vdc
Hysteresis on-/off (see Note 4)	all types		0.6		Vdc

Inputs INx+ zu INx-	Test Conditions	min	typ	max	units
Input voltage V_{in} (see Note 5)	all types	14	15	16	Vdc
Input current I_{in} (see Note 6)	all types		180		mA(peak)
Input capacitance C_{in}	all types		470		pF
Coupling capacitance C_{io}	all types		10		pF
Rise time $t_{r(in)}$ (see Note 7)	all types	0		50	ns
Fall time $t_{f(in)}$ (see Note 7)	all types	0		50	ns

Vce-Monitoring	Test Conditions	min	typ	max	units
Inputs ME1 {and ME2}	to E1/COM1 {E2/COM2}	-0.5		V_{cc}	Vdc

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Electrical Characteristics (Continuation)

Timing Characteristics	Test Conditions	min	typ max	units
Delay time input to output	turn-on $t_{pd(on)}$		60	ns
	turn-off $t_{pd(off)}$		60	ns
Delay time status output	at failure (see Note 16)		20	µs

Outputs G1 and G2	Test Conditions	min	typ max	units
Output current I_{out} (see Note 8)	IHD 215xx	-1,5	+1,5	A
	IHD 280xx	-8	+8	A
	IHD 680xx	-8	+8	A
Output rise time $t_{r(out)}$ (see Note 9)	all types		15 30	ns
Output fall time $t_{f(out)}$ (see Note 9)	all types		15 30	ns
Total output power	IHD 215xx		2	W
(DC/DC-Converter)	IHD 280xx		2	W
	IHD 680xx		6	W
Outputs SO1/SO2 (see Note 14)	all types		1	mA

Electrical Isolation	Test Conditions	min	typ max	units
Operating voltage (see Note 10)	continuous or repeated		600 1000	Vdc
Test voltage	(50Hz/1min) (see Note 17)		4000	Vaceff
Partial discharge extinction volt.	IEC270 (see Note 15)		1100	Veff
max. $\Delta V/\Delta t$ at $\Delta V = 1000V$	all types (see Note 11)	50	100	kV/µs

All data refer to +25°C and V_{cc} = 15V unless otherwise specified

Footnotes to the key data

1) At a supply voltage greater than 16V, the open-circuit voltages on the two output sides of the DC/DC converter may exceed 18V. This can lead to the destruction of the driver and protection circuits on the output side.

2) Only internal consumption of the drivers, static.

3) Exceeding of the current drawn indicates overload of the DC/DC converter. The next higher-rated type should be used.

4) The turn-off threshold is lower than the turn-on threshold by the magnitude of the hysteresis. The turn-on and turn-off thresholds allow the drivers to be run at operating voltages of 12V to 15V and cannot be changed.

5) The drive signal should have the same amplitude as the power supply of the IHDxxx. At Vcc = 15V the drive signal should also be 15V, at Vcc = 12V a drive signal of 12V suffices. Deviations of ± 1V are permissible.

6) Peak value during less than 100ns, after which a current of approximately 10mA flows and decays slowly thereafter.

7) If the rising or falling times are too high (i.e. driving is too slow), reliable transfer of the drive information cannot be guaranteed.

8) The gate current must be limited to its maximum value by a gate resistor.

9) At a load of 10nF in series with 20Ω.

10) Maximum continuous or repeatedly-applied DC voltage or peak value of the repeatedly-applied AC voltage between the inputs and outputs as well as between the power supply inputs and all other terminals and between output 1 and output 2. Caution: in the case of a continuously-applied DC voltage of over 600Vdc between the signalization outputs and the outputs G1, E1 or G2, E2, the long-term characteristics of the optocouplers used for the state acknowledgment may become impaired. However, types rated and selected for higher partial-discharge voltages are also available (see note 15).

11) This specification guarantees that the drive information will be transferred reliable even at a high dc-link voltage and fastest switching operations.

12) The MTBF (mean time between failures) is calculated to MIL HDBK 217F at an ambient temperature of 40°C, a typical load and when the driver is exposed to a current of air. Further information on reliability may be obtained from CONCEPT upon request.

13) The application-specific self-heating of the drivers - specially at high load - must be taken into account.

14) The outputs SO1/SO2 are designed for an operating current of 1mA. A 50-year service life of the optocouplers used is predicted at 1mA and an ambient temperature of 40°C.

15) The partial discharge is not measured for the standard types. For main power applications, a sufficient safety margin exists between the typical operating voltage of < 600Vdc and the partial discharge extinction voltage of typically about 1500 Vpeak. Tested and selected types with guaranteed partial-discharge immunity can be supplied for applications with maximum requirements and higher operating voltages (such as railroad applications).

16) In the case of a fault, the driver turns the power semiconductor off almost without a delay. The acknowledgment runs through an optocoupler that has a delay time of about 20µs. This means that the power transistor has already been turned-off for about 20µs when the fault message reaches the control side.

17) The test voltage of 4000 Vac(rms)/50Hz may be applied only once during a minute. It should be noted that with this (strictly speaking obsolete) test method, some (minor) damage occurs to the isolation layers due to the partial discharge. Consequently, this test is not performed at CONCEPT as a series test. In the case of repeated isolation tests (e.g. module test, equipment test, system test) the subsequent tests should be performed with a lower test voltage: the test voltage is reduced by 500V for each additional test. The more modern if more elaborate partial-discharge measurement is better suited than such test methods as it is almost entirely non-destructive.

Functional Description

Overview

The intelligent half-bridge drivers of the IHD series are universal driver modules designed for power MOSFETs and IGBTs in switching operation.

All IHD types have mutually compatible contacts and differ only in their drive performance (maximum gate current and output power of the DC/DC converter) .

The IHD types with higher output powers are outstandingly well suited for large modules or a number of parallel-connected transistors as well as for high-frequency applications.

The intelligent half-bridge drivers of the IHD series represent a complete solution for all drive and protection problems in connection with power MOSFET and IGBT power stages. Practically no additional

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components are required in the control circuit or in the power section.

Reliable operation

Gate driving with a positive and negative control voltage (depending on the selected supply voltage between ± 12V and ± 15V) allows reliable operation of IGBT modules of any size from any manufacturer. Thanks to the great interference immunity achieved by using a negative gate voltage, a number of power MOSFET or IGBT modules can be connected in parallel without having to worry about parasitic switching operations or oscillations.

The components of the IHD type series contain - for each of the two channels - an electrical isolation between the control and power sides, an overcurrent and short-circuit protection circuit for the power transistors, a supply-voltage monitoring circuit, a state acknowledgment circuit as well as an electrically-isolated supply of the drive electronics via an integrated DC/DC converter.

The two drive channels operate independently of each other, there is no mutual logical linking or blocking.

Genuine electrical isolation

The electrical isolation realized on the basis of the transformer principle at operating voltages of up to 1000V (corresponding to a test voltage of 4000V) between the control and power sections as well as the extremely high interference immunity of at least 50,000V per microsecond predestine the drive modules of the IHD series to applications in which large potential differences and large potential jumps occur between the power section and the control electronics.

Application benefits

The extraordinarily short delay times of the drivers of the IHD series permit their use in high-frequency switchmode power-supplies, high-frequency converters and resonance converters. Thanks to their extremely short delay times through the driver, they ensure trouble-free operation in bridge circuits, and their outstanding properties also preclude any offset problems.

The use of driver modules of the IHD series means that power stages with power MOSFETs or IGBTs can be realized within an extremely short time.

Short-circuit and over-current protection

One of the basic functions of the intelligent half-bridge drivers of the IHD series is to ensure reliable protection of the controlled power transistors against overcurrent and short circuit. The current measurement is based on the determination of the drain source or collector-emitter voltage at the activated transistor. If a threshold defined by the user is exceeded, the power transistor is turned off and remains blocked in this state for a defined minimum time. After this time has elapsed, the transistor is turned on again synchronously with the next turn-on edge of the drive signal.

This protection concept can be used to protect IGBT half-bridges and three-phase modules in an effective and reliable way.

Layout of the terminals

The terminal pins of the drive modules of the IHD series are arranged so that the layout can be kept very simple and the logic signal flow (input signal ⇒ drive circuit ⇒ power transistors) is maintained. A distance of 45 mm is observed between the drive signal and the power potential!

Note on pin description

As the drivers of the IHD series have two channels, all pins are present in duplicate with the exception of the power supply. In the description, the pin numbers and designations are given for channel 1. Those for channel 2 are shown in braces {}.

For the second channel, the same applies as for the first channel that is explicitly described.

Pin 3 and 4 {pin 17 and 18}: Inputs IN1+ and IN1- {IN2+ and IN2-}

The drive signals are applied to the difference inputs IN1+ and IN1-. The input

IN1- is usually connected to the ground of the control electronics. A positive edge at input IN1+ causes the corresponding power transistor to be turned on, a negative edge switches it off again (Fig. 1). If the drive signal has to be inverted, then input IN1+ is applied to the electronics ground and the control signal to input IN1- (Fig. 2).

In the drivers of the IHD series, the electrical isolation of the control signals is realized by the use of pulse transformers. Care should be taken when applying the drive signal that the control electronics can supply the voltages and charge/discharge currents required by the IHD and that the edge slope corresponds to the data-sheet specifications. In addition, the input driver must be protected against latch-up, as reactive effects from the switching operations are transferred to the input drivers via the coupling capacitance of the internal transformer. The MC33151 from Motorola is a tried and tested input driver for both channels.

The drive modules of the IHD series should be positioned as closely as possible to the relevant power transistors. The leads from the control electronics to the inputs IN1+ and IN1- can be about 25 cm in length.
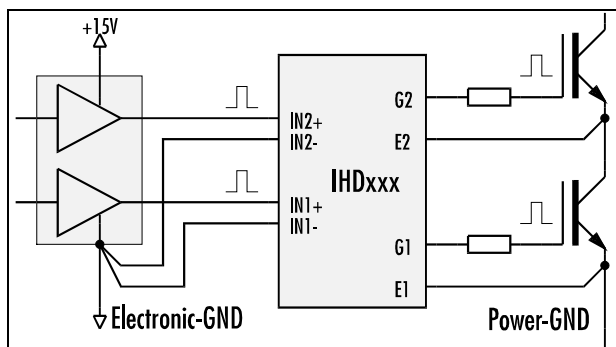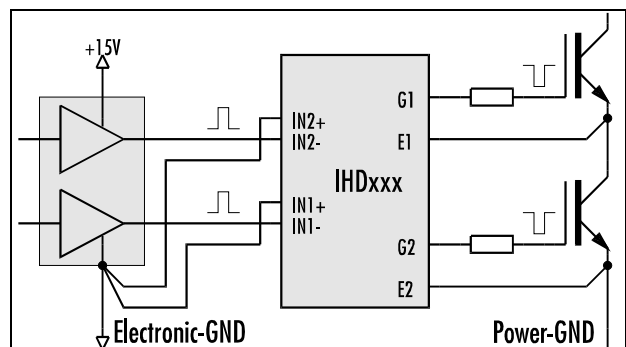

Fig. 1 Non-inverting input configuration

Fig. 2 Inverting input configuration

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The leads IN1+ and IN1- must run in parallel and be well coupled (parallel tracks or twisted pairs).

The minus leads must always be run back separately for both channels to the input driver so that reliable operation can be ensured (see Fig. 3).

Whereas reliable transmission is no problem in the case of very long pulses, the entire configuration must be checked with a view to very short drive pulses: although many level shifters and most driver ICs generate a fast and distortion-free turn-on edge at such short pulses (less than 100 ns), the turn-off edge that follows shortly afterwards may be distorted or slowed down. In such a case, a driver may be turned on by a short pulse but may not turn off again due to the distorted turn-off edge. The input driver upstream of the IHD must thus be optimized to ensure that the turn-off edge is always just as fast and distortion-free - especially with short pulses - as the turn-on edge. In (digital) systems that intrinsically preclude the occurrence of drive pulses shorter than about 200 ns, this operating case need not be specially checked.

Pin 1 and 2 {pin 15 and 16}: Outputs SO1+ and SO1- {SO2+ and SO2-}

The outputs SO1+ and SO1- are used for the status acknowledgment. These are the collector (SO1+) and emitter (SO1-) of an opto-coupler transistor. The through-switched state of this transistor corresponds to an "everything OK" message. If the voltage supply is too low or the protective function is activated, the transistor opens (see Fig. 4). The outputs are designed for an operating current of 1 mA. Despite electrical isolation with respect to all other contact pins, these outputs can be used exclusively at the potential of the control side ($\pm$ 50V difference to the drive signal), as there is only a minimum distance to the terminals of the inputs IN1+ and IN1-.

The capacitive coupling between transmitter and receiver in the optocoupler means that under certain conditions short spikes may occur at the outputs SO1/SO2 due to high level jumps of the power transistors. It is therefore recommended to connect an RC network with a time constant of about 5...10 microseconds after the status outputs.

It is further recommended not to hardwire two or more status acknowledgment outputs but to feed their individual signals to the monitoring electronics. This simplifies diagnosis and troubleshooting in the event of errors to a very decisive degree.
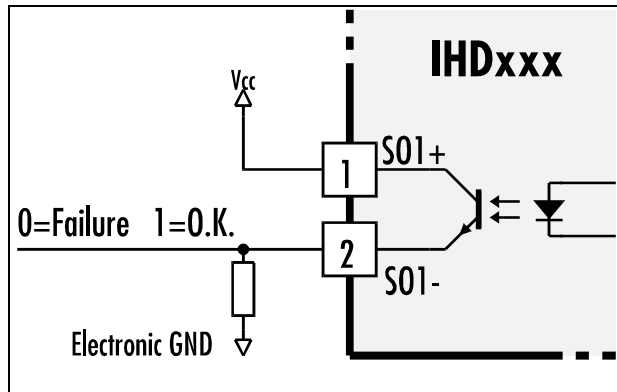

Fig. 3 Correct input driver wiring

Fig. 4 Status acknowledgement outputs

Pin 9 and 10
GND and Vcc

These contacts are used for the power supply of the driver module. The nominal supply voltage is 12V to 15V. In order to ensure reliable starting of the integrated DC/DC converter, a low-inductance electrolytic capacitor with high ripple current capability must be placed in the immediate proximity of pins 9 and 10. Its capacitance should not be smaller than the sum of the capacitances connected to terminals Cs1 (pin 34) and Cs2 (pin 23). The current drawn is determined by the number of transistors driven, their gate capacitance and the switching frequency.

Due to the high isolation of the supply terminals compared with all other pins, the drivers of the IHD series can be supplied by any potential. It need not necessarily be identical with the input potential.

The internal turn-on thresholds were also designed to permit operation at 12V. This makes sense above all when using transistors that have very large short-circuit currents at higher gate voltages (low saturation types).

It should be noted that the drivers themselves are not protected against self-overload. A short circuit between the gate and emitter terminals - caused by a defective power semiconductor, for example - can lead to thermal destruction of the driver.

Pin 36 {pin 25}
Output G1{G2}

Output G1{G2} is the driver output for the gate driving. This is effected with $\pm$ 12V to $\pm$ 15V depending on the supply voltage, or with only a positive gate voltage depending on the power transistors used and the application (see description of pin 35, COM1).

The output stages of the drivers of the IHD series are very ruggedly dimensioned. The maximum permissible gate charge/discharge current has a value of 1.5A for the IHD215 and 8A for both the IHD280 and the IHD680. This allows the largest IGBT and power MOSFET modules to be driven. It is also possible to directly drive a number of power modules connected in parallel. The charge/discharge current must be limited by an external gate resistance. It should be noted that the total voltage rise (twice 12V to 15V) must be taken into account at $\pm$ driving of the gate.

The gate of the power transistor must be connected via a lead of shortest possible length with terminal G1 {G2}. To allow the switching speed to be set independently at both turn-on and turn-off, a design with two gate resistors and a diode can be used (see Fig. 5).
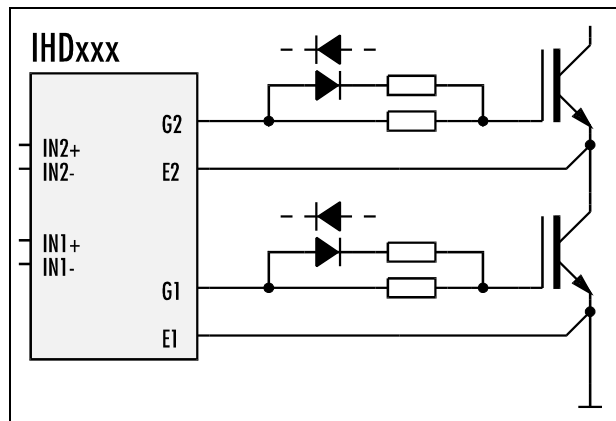
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Fig. 5 Asymmetrical gate resistors

It is mandatory to connect zener diodes (anti-series connected) directly between the gate and emitter for IGBTs. Their zener voltage must correspond exactly to the selected gate voltage (12V to 15V) (see Fig. 10). They prevent the gate voltage from rising due to parasitic effects (e.g. the Miller effect) to a value exceeding the nominal gate voltage. An excessive gate voltage increases the short-circuit current to an overproportional degree and can lead to destruction of the power semiconductors.

A sufficiently low-resistance termination of the gate is ensured by the driver module even when this is not supplied with the operating voltage.

Pin 33 {pin 22}
Terminal E1{E2}

This terminal must be connected to the emitter or source terminal of the power transistor. The connection to the emitter or source terminal of the power element must be as short and direct as possible. For modules with an auxiliary emitter or source this auxiliary terminal must be used. The terminal is also used as the low

end of the reference, whereby the latter should be connected to the terminal E1 of the driver module as directly as possible.

If the connections between a driver of the IHD series and a power transistor are implemented via link circuits, then a length of 10 cm should not be exceeded and the leads G1, E1 as well as the measurement terminal (collector or drain terminal) must be run in the form of twisted wires for each transistor (see Fig. 9).

Pin 30 {pin 19}
Terminal ME1{ME2}

This terminal is used for measuring the voltage drop at the activated power transistor (in an on-state condition) in order to ensure protection against short-circuit and overload. It should be noted that this terminal may under no circumstances be connected directly to the drain or collector of the power transistor. In order to protect the measurement terminal from the high drain or collector voltage of the deactivated power element, a circuit with a high reverse-blocking-voltage diode (Dme) or two series-connected diodes of type 1N4007 should be provided (see Figs. 6 and 10). It is absolutely mandatory to overdimension these diodes with respect to voltage.

A pull-up resistor integrated in the module ensures that when the power transistor is activated, a current flows through the measurement diode (Dme), the damping resistor (Rme) and the transistor. Thus the potential present at measurement input ME1 corresponds to the forward voltage

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of the activated transistor plus that of the diode and the voltage drop at Rme. Rme attenuates the reverse current peaks of the measurement diode Dme and should be set to 68Ω.

It should be noted that the power transistors do not turn on immediately - for IGBTs in particular, several microseconds may elapse before they have completely switched through. In conjunction with the integrated pull-up resistor and the external capacitor (Cme), this leads to a delay in the measurement after the power transistor is turned on. This delay shall henceforth be called the response time. The longer it takes the power transistors to turn on, the higher must the selected response time (and thus Cme) be. The formula for dimensioning Cme can be found on page 16.

It should also be borne in mind that negative voltages are not permitted at the measurement input.

Pin 31 {pin 20}
Terminal Cb1{Cb2}
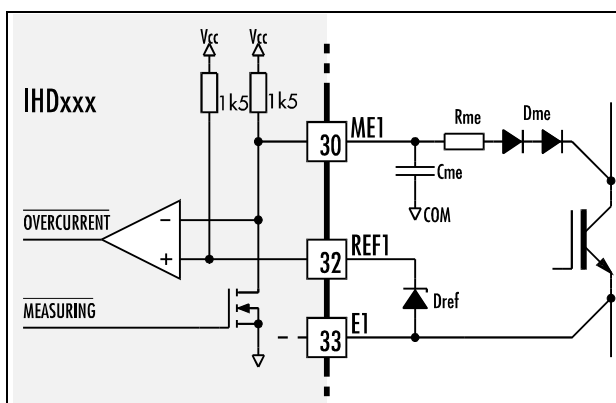
After the current monitoring circuit has

Fig. 6 Principle of the Vce monitoring

responded, the power transistor is turned off by the protection function of the intelligent driver and remains blocked in this state for a defined minimum time. This function is used to protect the component from thermal overload under a continuous or recurring short-circuit. This blocking time can be defined by connecting pin 31 (Cb1) via a capacitor to pin 35 (COM1) {or pin 20 (Cb2) to Pin 24 (COM2)} (see page 16 for the relevant formula). The capacitance of the blocking capacitor should not exceed a value of 470nF.

During the blocking period, the response of the protective function to overcurrent is signaled at outputs SO1+ and SO1- {SO2+ and SO2-}.

After the blocking period has elapsed, the power transistor is not turned on again until the following turn-on edge arrives (see Fig. 7).

Pin 32 {pin 21}
Terminal REF1{REF2}

An external zener diode is connected to this pin as a reference. It defines the maximum voltage drop across the activated power transistor at which the protective function of the drive circuit is activated and thus the power transistor is turned off.

The protective functions of the intelligent half-bridge drivers of the IHD series always become active when the voltage at ME1 {ME2} (measurement drain/collector) is higher than that at REF1 {REF2} (see Figs. 6 & 7).

The reference potential is pin 33 (E1). The reference may not be blocked by capacitors under any circumstances.

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The reference diode must be located as close as possible to the driver module.

Pin 34 {pin 23}
Terminal Cs1{Cs2}

Low-inductance blocking capacitors with high ripple current capability (electrolytic capacitors are usually used) are connected to these outputs. They decouple the DC/DC converter on the secondary side and must be able to supply the pulse currents (up to 8A) for charging/discharging the gate capacitances. They are connected between Cs1 {Cs2} and COM1 {COM2}. As the charge/discharge currents for the gate capacitance are largely drawn from these electrolytic capacitors, these must be located in the immediate proximity of the driver module. The terminal assignment is optimally suited for this purpose. Capacitance values of up to 100 µF per channel are recommended. Greater values should not be used to ensure that the integrated DC/DC converter starts with no problems.

In order to avoid the operating voltage from „running-up" on the secondary side, a 16V-zener diode or a transient suppressor must be connected in parallel to the blocking capacitors. These diodes are required on both channels, even if one channel is not used. They should be rated for a power dissipation of 1.3W.
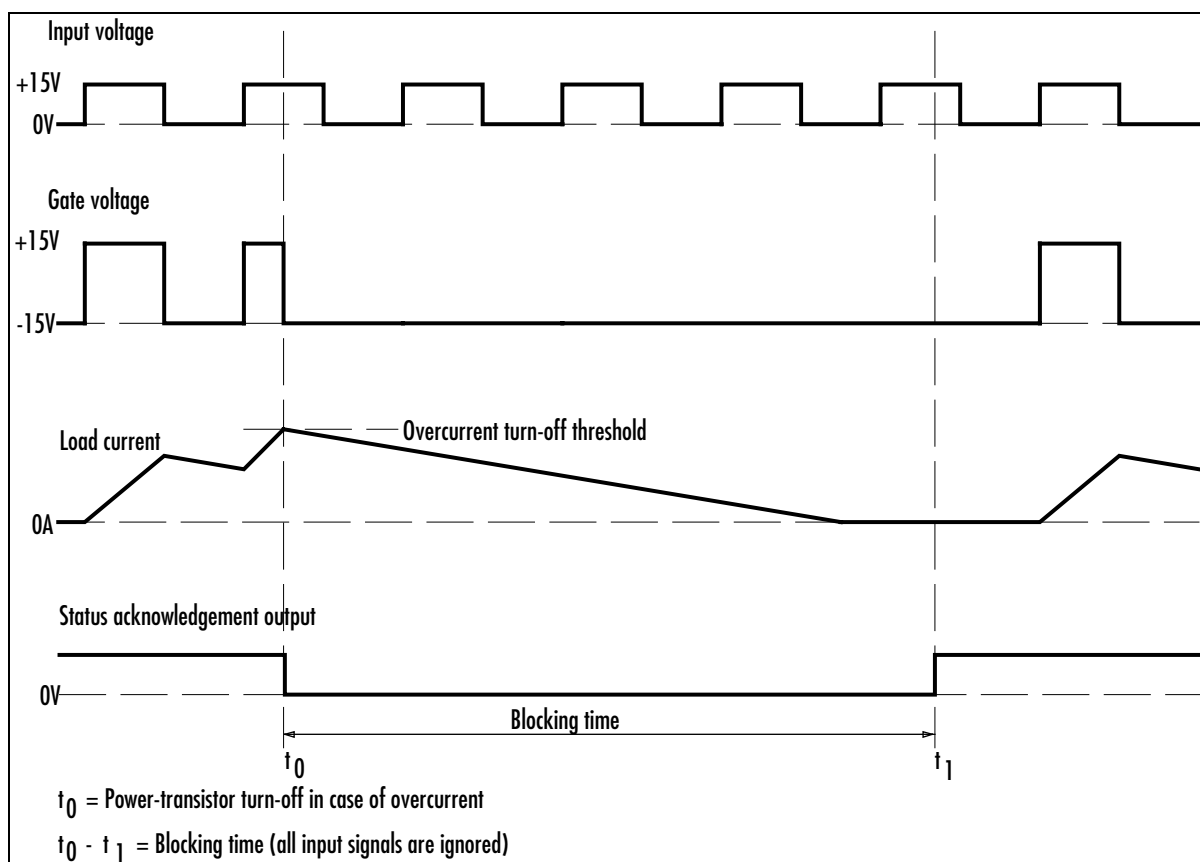

Fig. 7 Function principle of the blocking time

modules.

Pin 35 {pin 24} Terminal COM1{COM2}

This is the ground terminal of the secondary-side blocking capacitor. It is simultaneously used as the reference potential for the measurement filter and the capacitors Cb1 {Cb2}.

In place of E1 {E2}, the terminal COM1 {COM2} can also be connected to the source of a power MOSFET. In this case, the reference must also applied to this terminal. This circuit allows power MOSFETs to be driven without a negative gate voltage. The transistor is then driven in its deactivated state with 0V (unipolar gate driving, see Fig. 8).

The terminal E1 {E2} is unused in this circuit and may under no circumstances be connected with COM1 {COM2}.

As a rule, this method of gate driving is not useful for IGBTs, as it is necessary to work with a negative gate voltage, especially with Japanese chips and larger

Configuration within the Power Section

The drivers of the IHD series should be located as closely as possible to the power transistors. The connecting leads to the transistors should be as short as possible, i.e. they can be up to 10 cm long depending on the gate current and switching speed. In contrast, the input leads may be about 25 cm in length (see Fig. 9). But as has already been described, care should be taken to ensure that all leads are run in a neat pattern.
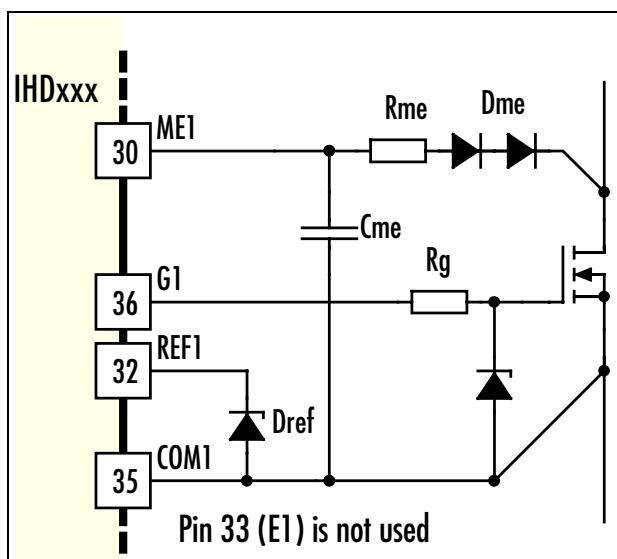

Fig. 8 Unipolar gate driving (0/+15V)
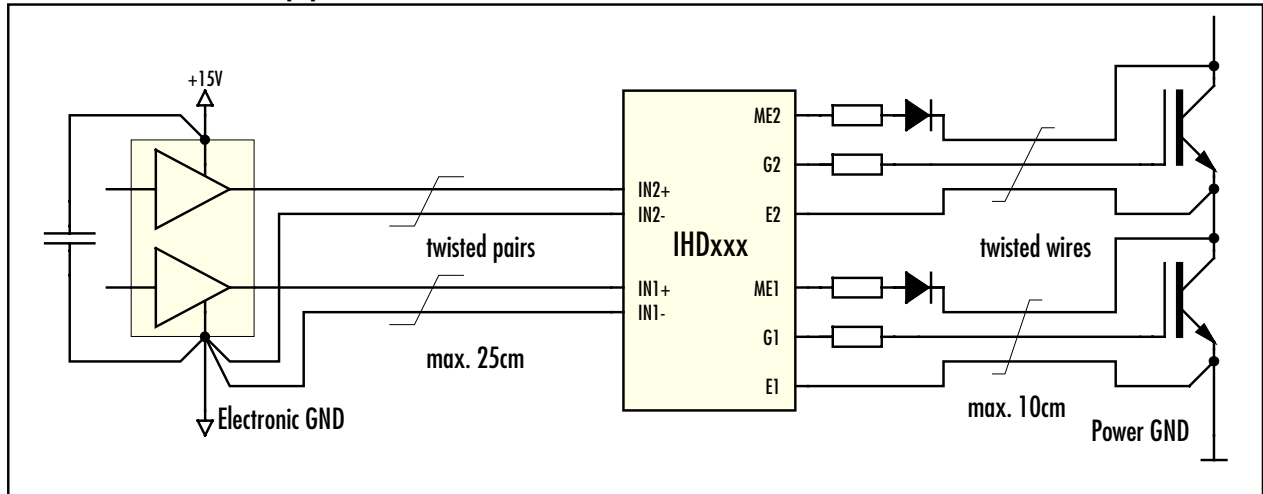
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Fig. 9 Correct input and output wiring

Formulas for Circuit Calculations

Illustrative Application: 80 kW Converter

Response Time Capacitor

$$C_{me} = \frac{t_a}{1,5k\Omega \ \ln \left(\frac{V_{cc}}{V_{cc} - V_{ref}}\right)}$$

Blocking Time Capacitor

at ±15V gate driving

$$C_b = \frac{t_b}{71,6k\Omega}$$

$$C_{b\ max} = 470nF$$

at unipolar gate driving (0/+15V)

$$C_b = \frac{t_b}{100k\Omega \ \ln \left(\frac{2 \cdot V_{cc}}{V_{ref}}\right)}$$

$$C_{b\ max} = 470nF$$

Fig. 10 shows one phase of a three-phase converter for a power of about 80 kW. The useful output power naturally depends on the dc-link voltage and the switching frequency of the converter. The IHD680 allowed the converter to be operated with frequencies up to far above 20 kHz in principle, although at these frequencies considerable switching losses occur in the IGBTs and the output power must be correspondingly reduced. The driver power of the IHD680 is also sufficient for a parallel circuit comprising several modules of this type. For switching frequencies below 10 kHz, one IHD280 is sufficient for this IGBT module.

The complete three-phase converter is available in the circuit displayed (Fig. 10) as a completely assembled and tested evaluation board from CONCEPT (see also the section on „Evaluation boards"). The evaluation board is also equipped with an electrolytic battery of very low-inductance design.
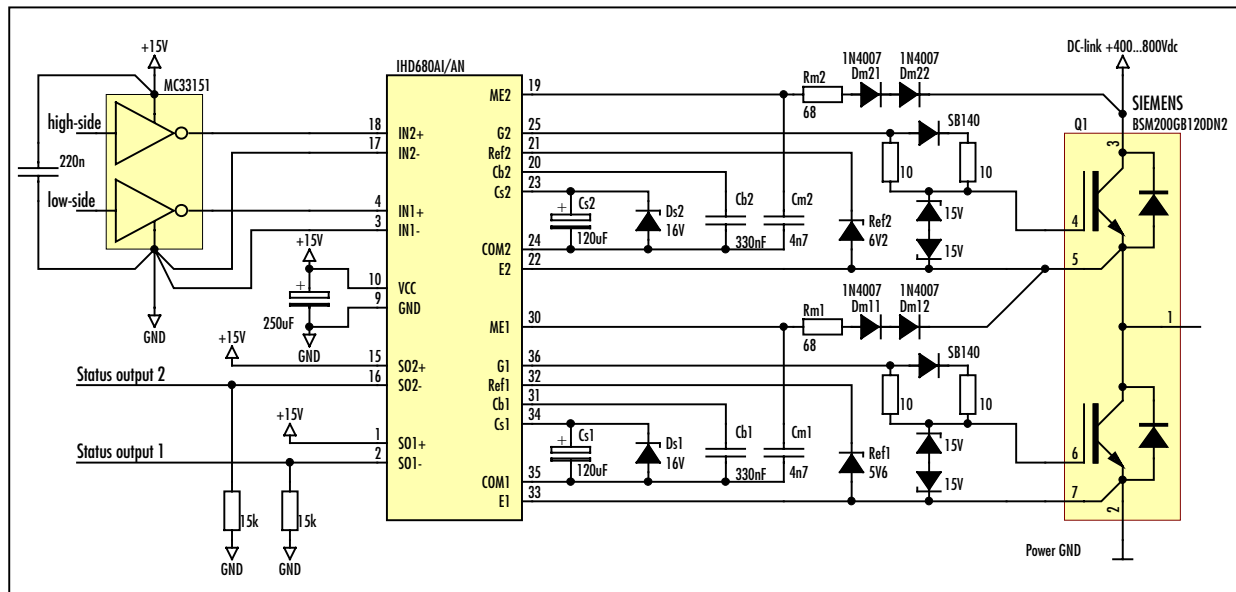
Fig. 10 Application with a IHD680AI/AN: One phase of a 80kW-Inverter

As indicated in the circuit diagram, the drive leads should be connected as closely as possible to the IGBTs. Special connectors are provided for the gate and emitter. Unfortunately, however, the module has no collector-sense terminals. The auxiliary emitter terminal of the „upper" IGBT is an obvious choice for the Vce measurement of the „lower" IGBT (see also Fig. 11). The Vce measurement output should under no circumstances be connected to power terminal 1 of the module, as this is very unfavorably positioned as regards its geometry and the di/dt change in the load current falsifies the measurement. For the Vce measurement of the „upper" IGBT there is no alternative to using power terminal 3 (see also Fig. 11). But this has a more favorable geometry than terminal 1 and the result is acceptable. The voltage drop caused by the di/dt current change in the module-internal feeder lead from terminal 3 to the IGBT chip also explains why reference diode Ref2 shows a higher value than Ref1 so that the overcurrent protection for both IGBTs becomes active at about the same current values.
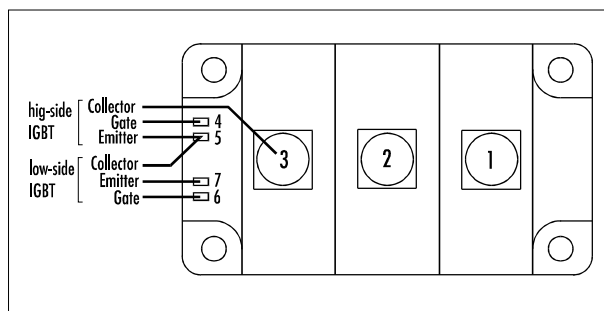
Evaluation Boards

To allow the user to enter quickly and smoothly into IGBT technology and into the protection concept used for the intelligent half-bridge drivers of the IHD series, CONCEPT offers various evaluation boards and power stages. Completely assembled and tested half-bridge evaluation boards are available with various types of IGBT.

Fig. 11 Correct driver connection with an IGBT half-bridge module

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In addition, CONCEPT offers ready designed and assembled three-phase bridges with IGBT modules. Additional documentation on these is available upon request.

These boards can be used in conjunction with the documentation to build ready-to-use prototype equipment in a few hours.

Supplementary Services

CONCEPT makes the practical experience gained over many years by its development and application engineers available to all interested users. CONCEPT offers various services within the scope of this offer:

Consulting and Training

CONCEPT provides consulting and training services to customers on optimal procedures, the ideal circuit topology and the avoidance of possible difficulties in the development of power electronics.

Technical Support

CONCEPT offers you expert help for your questions and problems:

E-Mail: support@ct-concept.com

Internet: www.CT-Concept.com

Fax international ++41 32 / 322 22 51 (in Switzerland: 032 / 322 22 51)

Tel international ++41 32 / 322 42 36 (in Switzerland: 032 / 322 42 36)

Application

CONCEPT calculates and dimensions power sections and driver circuits according to the customer's specifications and supplies complete circuit diagrams, parts lists and electrical and thermal key data of the circuit. The customer then implements the layout and construction of the equipment himself.

Customer-Specific Systems

CONCEPT develops and produces complete equipment and systems according to the customer's specifications.

Quality

The obligation to high quality is one of the central features laid down in the mission statement of CT-Concept Technology Ltd. Total Quality Management (TQM) covers all stages of product development and production up to delivery. The drivers of the IHD series are manufactured according to the ISO9001 quality standard.

Exclusion Clause

CONCEPT reserves the right to make modifications to its technical data and product specifications at any time without prior notice. The general terms and conditions of delivery of CT-Concept Technology Ltd. apply.

Fax Reply Form

Please use a photocopier to enlarge to A4 size. Check elevant box [✘]. Please complete the form and fax it to CONCEPT or to your local CONCEPT distribution partner!

Please send us further information:

❑ Overview of all intelligent drivers from CONCEPT
❑ Overview of DC/DC converters with high isolation voltage from CONCEPT
❑ Overview of the evaluation boards

We would like a quotation for:

❑ _____ pcs intelligent drivers of type IHD _____, by date:_____
❑ _____ pcs intelligent drivers of type IHD _____, by date:_____
❑ _____ pcs intelligent drivers of type IHD _____, by date:_____

We would be interested in the following services:

(See description in the data sheet)

❑ Consulting and training
❑ Troubleshooting and support for technical problems
❑ Application (dimensioning of power stages)
❑ Customer-specific systems

My address:

Forename, Surname

Department/Function

Company

Telephone   Fax

E-Mail

Our business activities are in the sector of

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Ordering Information

Drivers for low power (2W converter, ±1,5A gate current)

Standard version (0...70°C)   IHD 215 AN
Industry version (-40...+85°C)   IHD 215 AI

Drivers for medium power (2W converter, ±8A gate current)

Standard version (0...70°C)   IHD 280 AN
Industry version (-40...+85°C)   IHD 280 AI

Drivers for high power (6W converter, ±8A gate current)

Standard version (0...70°C)   IHD 680 AN
Industry version (-40...+85°C)   IHD 680 AI

Other Drivers

Please ask for following overviews from CONCEPT (also to be found on the Internet):
"Overview of Intelligent Drivers Standard Program"
"Overview of SCALE Drivers"

Evaluation boards

Please ask for an overview of our evaluation boards

Manufacturer   Your Distribution Partner

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