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Application Note
Power Semiconductors

Application Note
for DI28-17-E series IGBT drivers
by Proton-Electrotex, JSC

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Description

DI28-17-E is a dual-channel plug-and-play IGBT driver for MIAA and MIFA-type IGBT modules with collector current up to 450A and voltage class up to 1700 V.

Driver type designation:

DI	2	8	-	17	-	E	-	1	
DI									IGBT driver
	2								Number of output channels
		8							Maximal pulse output current
				17					Voltage class of IGBT module
						E			Electrical interface
						O			Optical interface
								1	For MIAA modules
								2	For MIFA modules

Dimensions

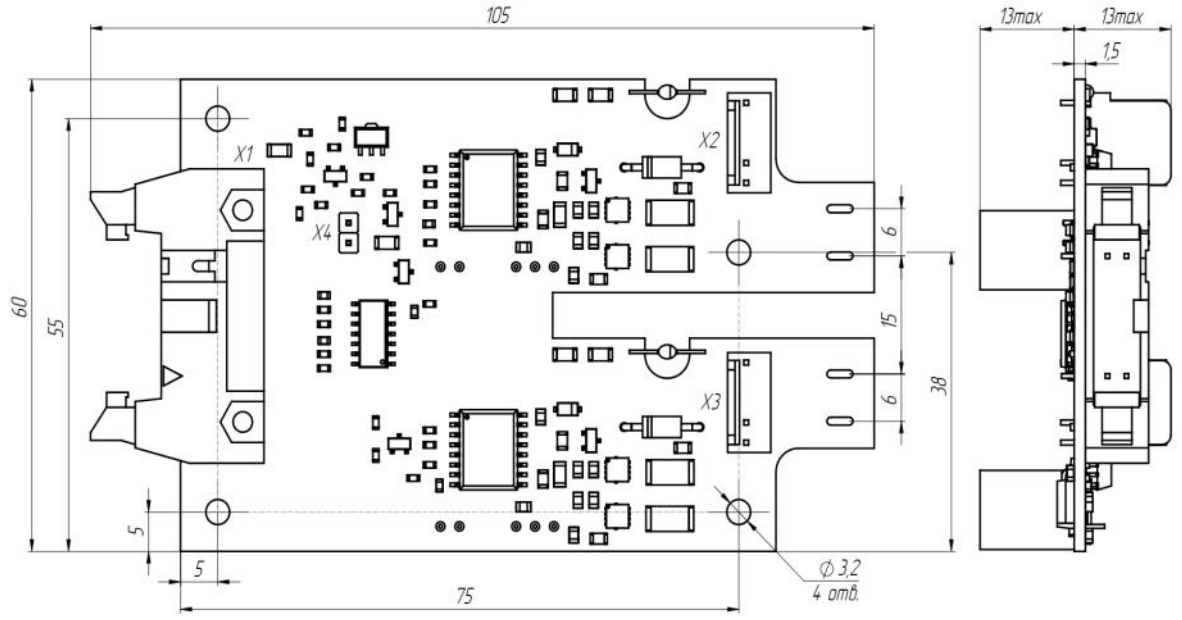

Figure 1 – Outline of the DI28-17-E-1 driver

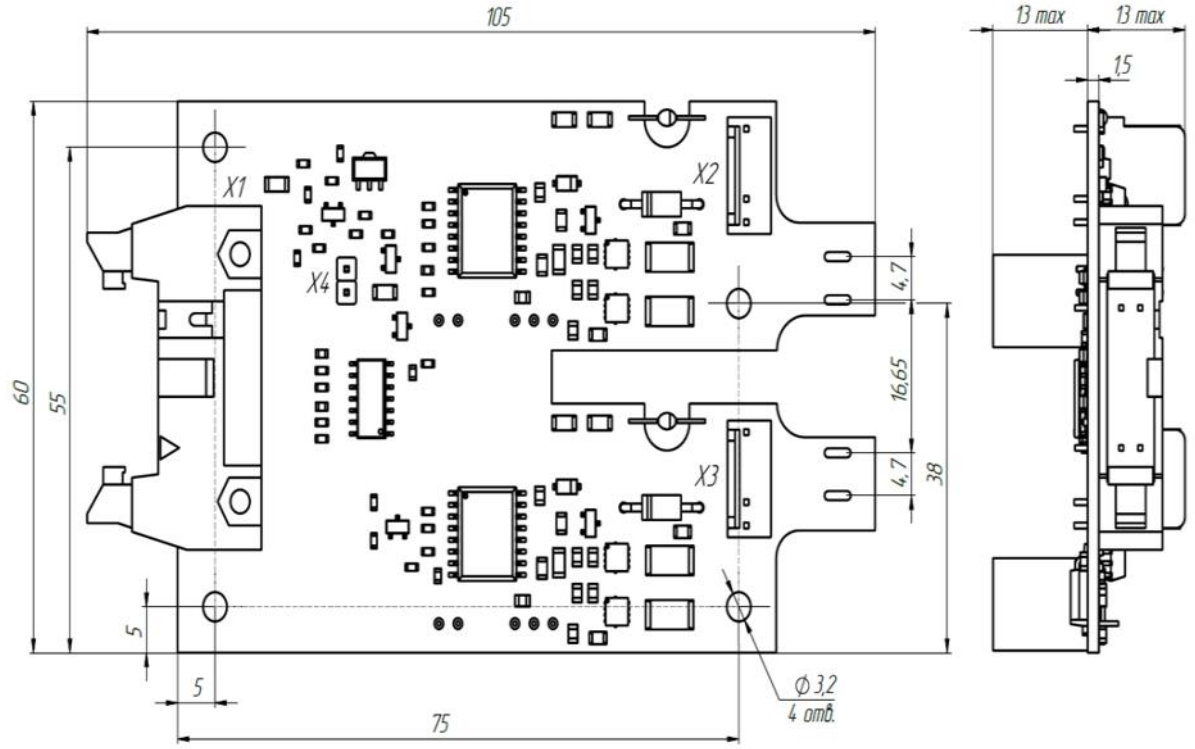

Fig. 2 – Outline of the DI28-17-E-2 driver

Connection X1 — IDCC-14;
Connection X2, X3 – WF-5;
Connection X4 — PLS-2;
Recommended cable to connect the driver – DS1057-14-30 (FRC-14-30);
Recommended connection for the driver – IDC-14F (DS1016-14);
Recommended jumper for the X4 connection – MJ-O-6 (DS1027-2 A);

Description of the input connection X1 – IDCC-14

Pin number	Purpose	Pin number	Purpose
1	Power supply +15V	2	GND
3	Not connected	4	GND
5	Signal A	6	GND
7	F out 1	8	GND
9	Signal B	10	GND
11	F out 2	12	GND
13	F out (common)	14	GND

Recommended connection interface

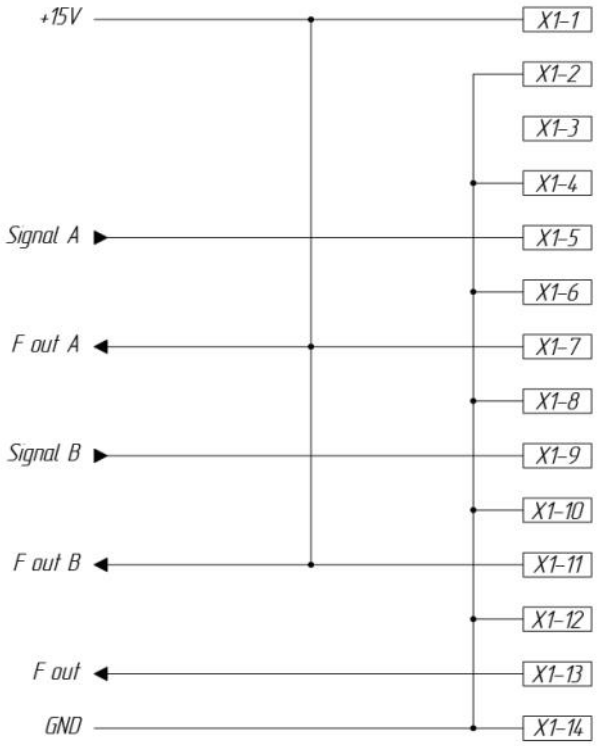

Figure 3 – Recommended interface to connect the driver from the user's side

Description of X1 connection (IDCC-14)

General

It includes:

1 power supply input +15V
2 control signal inputs (Signal A / Signal B)
2 discrete error outputs for each channel.
1 driver common error output

The driver is equipped with a 14-pin connector. All even pins are used as "GND". All GND pins are linked and must be connected to an external driver control system.

Driver power supply

Operation of the driver requires a stabilized supply voltage +15 +/-0,5V. If the supply voltage drops below the minimum value, the driver's undervoltage protection will engage and block the input control signals until the supply voltage rises to the range of +14,5 V.

The maximum current consumption of the driver in dual-channel operation is 0.4 A at a frequency of 15 kHz.

Selecting the operation mode

The driver can operate in 2 modes – independent control (direct mode) and half-bridge mode. If the X4 connection is missing a jumper, the operation mode is half-bridge. To engage the direct mode, it is needed to link pins of the X4 connection with a MJ-O-6 jumper (DS1027-2 A).

Operation

Independent control (direct mode)

This mode of operation allows to control switching of an IGBT module regardless of the state of the second switch. This mode allows to open two switches of the IGBT module simultaneously. The driver operation diagram in this mode is shown in Figure 4.

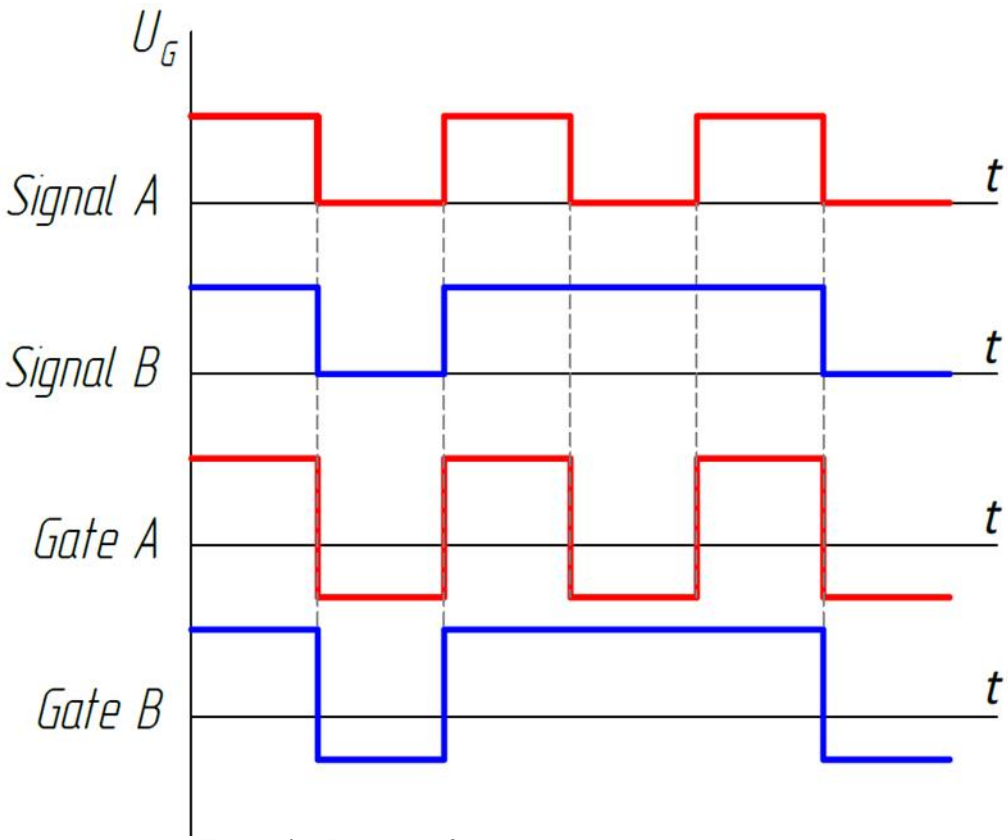

Figure 4 – Diagram of the driver operation in direct mode

Half-bridge mode

This operation mode allows to control the IGBT module depending on the state of the second switch. This mode makes it impossible to open the two switches of the IGBT module simultaneously. If two control signals are applied to the control channels, the driver will turn off both switches. A delay (“dead time”) is formed before turning on a channel, making it impossible to turn on the two switches simultaneously. The dead time is fixed at 3.2 μs. The diagram of the driver operation in half-bridge mode is shown in Figure 5.

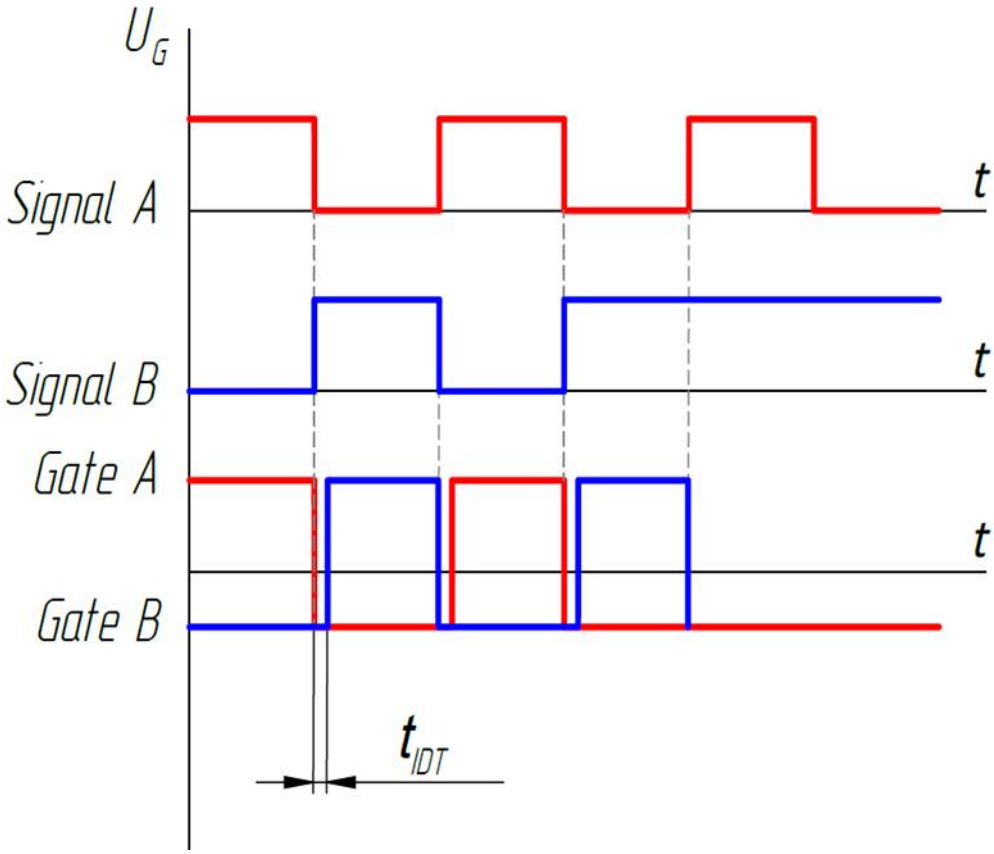

Figure 5 – Diagram of the driver operation in half-bridge mode

Signal A / Signal B

It is a control discrete input to connect the PWM signal of an external control system to the driver. The output is equipped with a Schmitt trigger to prevent "bouncing". The logic-1 level is + 8V and higher. The logic-0 level +6.4V and lower.

F out A / F out B

It is a discrete output based on an open collector. It does not have its own pull-up resistor, so it is necessary to connect an external power supply according to Figure 3. If logic-1 level is applied to the output of the contact F out A / F out B, the driver is in the working state. If logic-0 level is applied to the output, the driver is in an error state for one of the following reasons:

Undervoltage in the high-voltage part of the A / B channel driver

DESAT circuit was triggered (collector-emitter voltage exceeds +8V or is interrupted)

The driver will stay in the error state until the cause of the error has been resolved.

F out

It is a discrete driver output signaling the presence of any errors.

Description of the driver: If the output of the contact F out is logic-1, the driver is in a working state. If the output of the contact is logic-0 then the driver is in an error state for one of the following reasons:

Channel A is in error.

Channel B is in error.

Driver voltage below minimum (+14.5 V)

The driver will stay in the error state until the cause of the error has been resolved.

Power supply monitor

Designed to protect the driver from undervoltage. The lower protection threshold is +13.7V $V_{F\ ON}$. Protection turn off threshold is +14.5V $V_{F\ OFF}$. If the protection is engaged, the driver will switch to the error state and a logic-0 will be applied to the F out pin. The driver will stay in the error state until the cause of the error has been resolved. The power monitor operation diagram is shown in Figure 6.

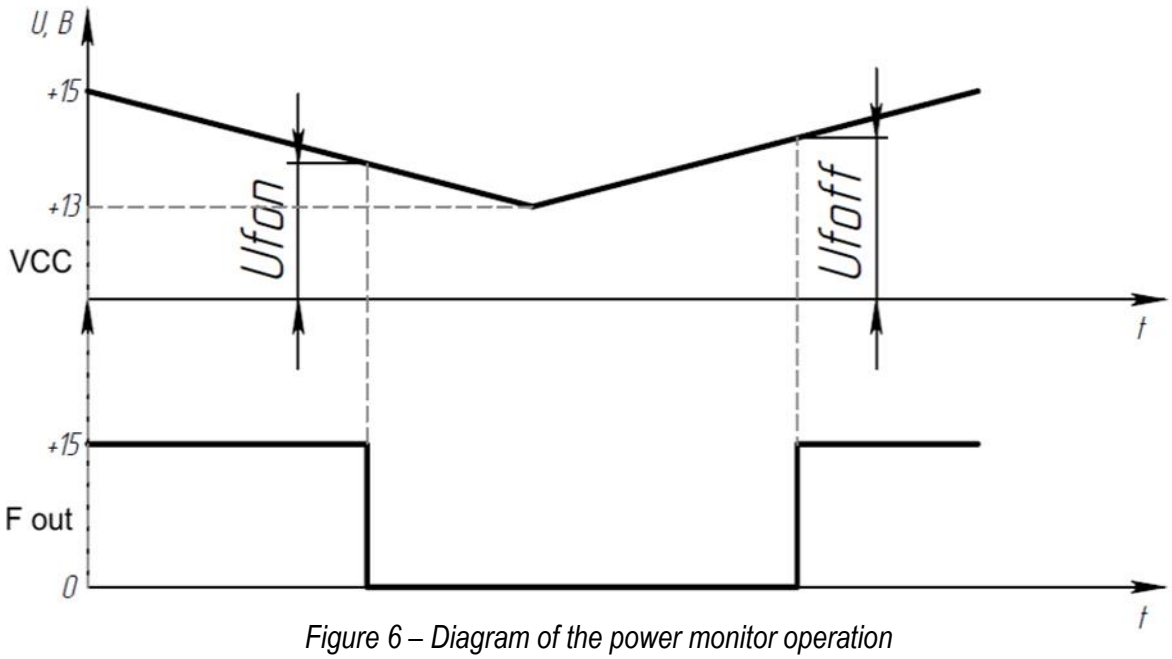

Figure 6 – Diagram of the power monitor operation

DESAT

The DESAT circuit protects the IGBT module against short-circuit and high-amplitude currents. This circuit starts to monitor the voltage drop between the collector-emitter terminals of the IGBT transistor after an 8 µs delay following the start of turning on the IGBT. If the voltage drop exceeds +8V, the driver will turn off the IGBT module using the “soft” shutdown function and block the input control signals. The driver outputs Fout A / B and F out will be put into an error state. The driver will stay in the error state until the cause of the error has been resolved.
Operation of the DESAT circuit is shown on diagram in Figure 7.

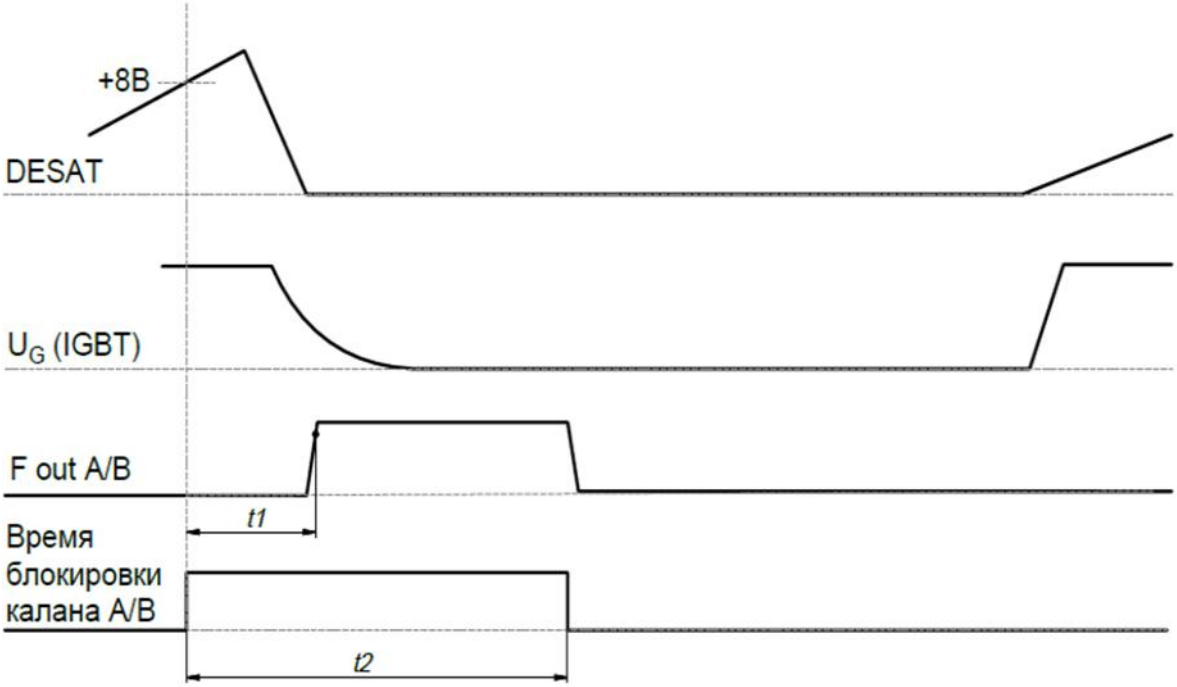

Figure 7 – The DESAT circuit operation

t1 – error triggering delay time 500 ns

t2 – time of channel control blocking 1,5 µs

Soft IGBT shutdown

In the short-circuit event, even a small inductance of plane-parallel buses is enough for an abrupt IGBT shutdown to cause an overvoltage pulse, in most cases causing failure of the transistor switch. Therefore, when a short-circuit current occurs, the driver will turn off the IGBT using a “soft shutdown” method that will safely turn-off the transistor. The soft shutdown operation is shown in Figure 7.

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