DRIVE OF IGBT AND MOSFET TRANSISTORS
DR280P–B4

USER'S MANUAL

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CONTENTS

1 OVERVIEW

Driver of powerful transistors with field control is intended to control of two powerful transistors with field control (MOSFET or IGBT). The driver is an amplifier-former of transistors gate control signals with frequency up to 50 kHz. The driver includes built-in galvanic isolated DC-DC converter, providing necessary levels of enabling and disabling voltages on the transistor's gate. The driver is the full analogue of driver **«Skyper32Pro»**.

2 DRIVER COMPOSITION

2.1 The driver – a circuit plate with installed a driver module (DM), performed in a hermetic plastic housing, necessary tuning elements and connectors for connection of controlled transistor and control signals.

2.2 The driver contains the following functional parts:

1 Supply voltage stabilizer of driver with protection against abnormal turn-on polarity;
2 Build-in DC-DC converter with stabilization of enabling and disabling voltage level on controlled transistors gates;
3 Input logics;
4 Control circuit of control circuit gate;
5 Undervoltage and overvoltage protection circuit on controlled transistor gate;
6 Controlled transistor protection circuit against overcurrent.

3 FUNCTIONAL DRIVER FEATURES

3.1 The driver provides the following driving, controlling and protecting functions of controlled transistor:

1 Saturation voltage control on controlled transistor collector, its protective turn-off when leaving saturation state;
2 Threshold regulation of protective turn-off on saturation voltage;
3 Smooth driver junction from active state to inactive one when an "emergency" (leaving controlled transistor of saturation mode);
4 Control blocking when an "emergency"
5 Emergency signaling;
6 Simultaneous turn-on blocking of upper and lower arms;
7 Switching delay of upper and lower arms;
8 Switching delay regulation of upper and lower arms;
9 Driver supply voltage control (built-in comparators) on DC-DC converter output.

3.2 Overall drawing is shown at Figure 1, driver functional is presented at Figure 2.

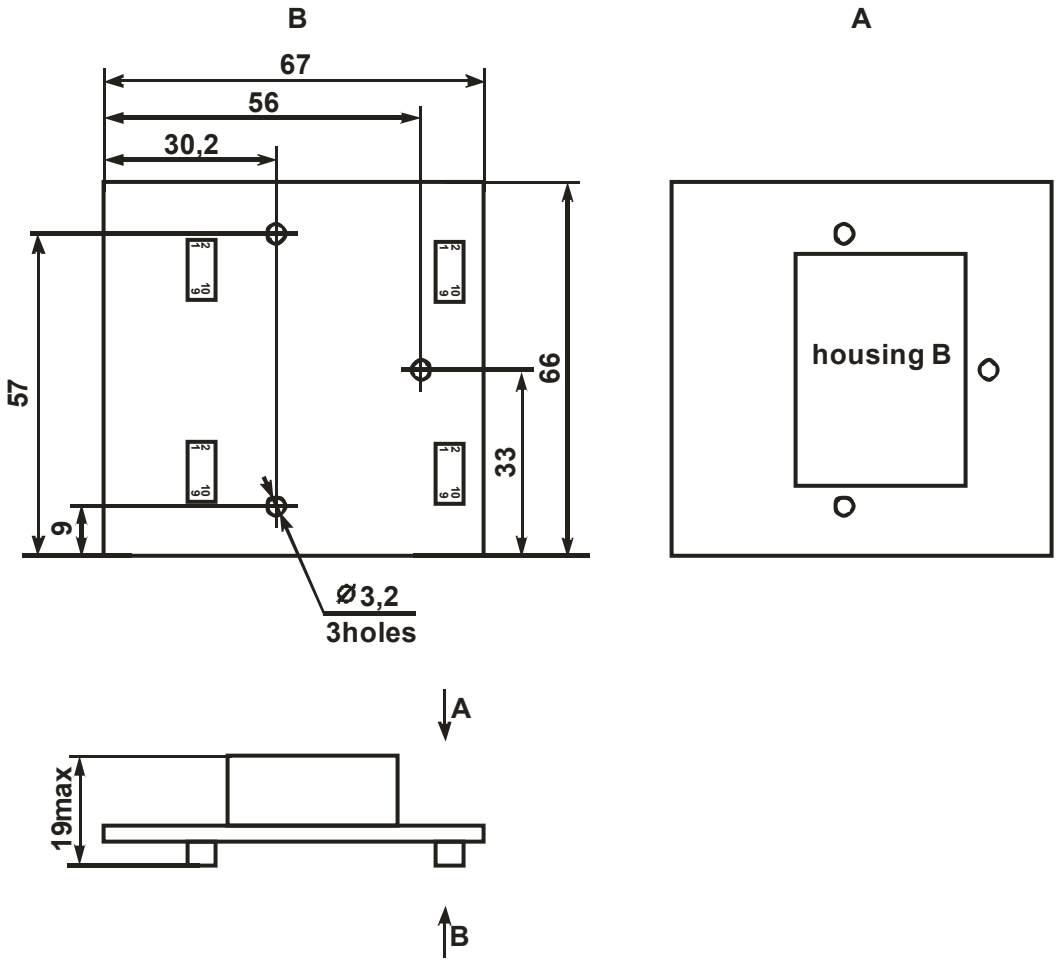

Figure 1 – Driver overall drawing

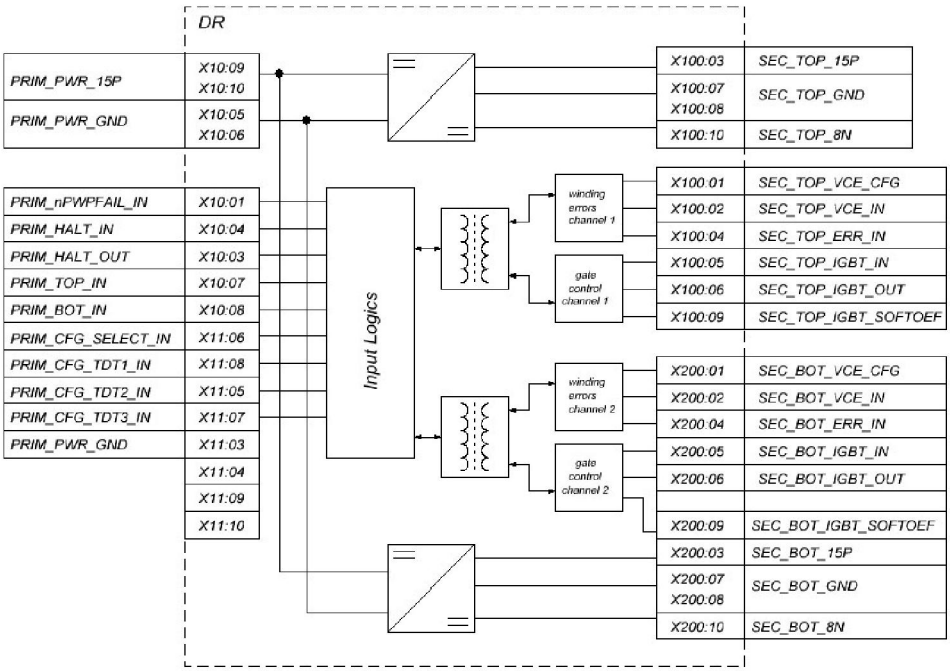

Figure 2– Driver functional circuits

3.3 Outputs description is shown in Table 1.

Table 1 – Driver outputs application

Outputs	Outputs assignment	Symbol
X10.01	Drain input. Driver drain is formed with an external signal. 0V – blocking; 15V - enable	PRIM_nPWRFAIL_IN
X10.02	----------	
X10.03	Driver readiness state output. 0V –ready to operation. 15V –not ready to operation.	PRIM_HALT_OUT
X10.04	Driver operation enable input. Enable is formed with external signal. 0B – enable. 15B – disable.	PRIM_HALT_IN
X10.05	Ground of power and controlling circuits	PRIM_PWR_GND
X10.06	Ground of power and controlling circuits	PRIM_PWR_GND
X10.07	Upper switch input signal (0V, 15V)	PRIM_TOP_IN
X10.08	Lower switch input signal (0V, 15V)	PRIM_BOT_IN
X10.09	Driver supplying voltage (+15V±5%)	PRIM_PWR_15P
X10.10	----------	
X11.01	----------	
X11.02	----------	
X11.03	Ground of power and controlling circuits	PRIM_PWR_GND
X11.04	Ground of power and controlling circuits	PRIM_PWR_GND
X11.05	Adjusting of blocking time bit 2	PRIM_CFG_TDT2_IN
X11.06	Channel blocking disable output	PRIM_CFG_SELECT_IN
X11.07	Adjusting of blocking time bit 3	PRIM_CFG_TDT3_IN
X11.08	Adjusting of blocking time bit 1	PRIM_CFG_TDT1_IN
X11.09	Ground of power and controlling circuits	PRIM_PWR_GND
X11.10	Ground of power and controlling circuits	PRIM_PWR_GND
X100.01	Adjusting of saturation voltage control circuit on control transistor (1 channel)	SEC_TOP_VCE_CFG
X100.02	Saturation voltage control circuit on controlled transistor (1 channel)	SEC_TOP_VCE_IN
X100.03	+15V 1 channel	SEC_TOP_15P
X100.04	Error signal output (open collector)	SEC_TOP_ERR_IN
X100.05	Driver output of 1 channel with adjusting of turn-on time	SEC_TOP_IGBT_ON
X100.06	Driver output of 1 channel with adjusting of turn-off time	SEC_TOP_IGBT_OFF
X100.07	Output signals ground output of 1 channel	SEC_TOP_GND
X100.08	Output signals ground output of 1 channel	SEC_TOP_GND
X100.09	Smooth turn-off adjustment output of 1 channel	SEC_TOP_IGBT_SOFTOFF
X100.10	-7V 1 channel	SEC_TOP_8N
X200.01	Saturation voltage control circuit adjustment on controlled transistor (2 channel)	SEC_BOT_VCE_CFG
X200.02	Saturation voltage control circuit on control transistor (2 channel)	SEC_BOT_VCE_IN
X200.03	+15V 2 channels	SEC_BOT_15P
X200.04	Error signal output (open collector)	SEC_BOT_ERR_IN
X200.05	Driver output of 2 channel with turn-on time adjustment	SEC_BOT_IGBT_ON
X200.06	Driver output of 2 channel with turn-off time adjustment	SEC_BOT_IGBT_OFF
X200.07	Ground of 2 channel output signals	SEC_BOT_GND
X200.08	Ground of 2 channel output signals	SEC_BOT_GND
X200.09	Smooth turn-off adjustment output of 2 channel	SEC_BOT_IGBT_SOFTOFF
X200.10	-7V 2 channel	SEC_BOT_8N

4 BASIC AND MAXIMUM PERMISSIBLE PARAMETERS

Table 2 – Basic and maximum permissible parameters at T = 25 °C)

Parameter	Symbol	Unit	Value			Notes
			min	typ.	max	
DC/DC unit characteristics						
Nominal supply voltage	U_S	V	13.5	15	16.5	
Maximum current consumption	I_S	mA			200	f = 0 Hz
Power of built-in supply source of driver module output part	P_{DC-DC}	W	4			for each channel
Voltage monitor characteristics						
Turn-off threshold	U_{UVLO+}	V			12	DC-DC output
Turn-on threshold	U_{UVLO-}	V	13			DC-DC output
Control inputs characteristics						
Input voltage of high level	U_{IH}	V	3	5	5.6	
			9	15	16.8	
Input resistance	R_{IN}	kΩ		5.9		
Time characteristics						
Signal turn-on delay time between input and output	$t_{d\ on(in-out)}$	µs		1		see Figure 7
Signal turn-off delay time between input and output	$t_{d\ off\ (in-out)}$	µs		1		see Figure 7
«Dead time» between signal changes on outputs of first and second channel	t_{TD}	µs	1.5		4.5	set by consumer; see Section 6
Maximum operating frequency	f_{max}	kHz			50	no-load; see Figure 5
Blocking time of fall voltage control on controlled transistor in open state	t_{BLOCK1}	µs	1		10	
Blocking time of controlled transistor after “emergency”	t_{BLOCK2}	s		3		
Transistor smooth emergency shutdown time	t_{off}	µs			2	
Output parameters						
High level output voltage	U_{OH}	V	+14	+16	+18	in all range of permissible loads
Low level output voltage	U_{OL}	V	-8	-7	-5	
Maximum output pulse current	I_{Omax}	A	-8		+8	
Mean output current	I_O	mA			160	for each channel
Output signal rise time	t_r	ns			200	no-load
Output signal fall time	t_f	ns			200	
Maximum current of status output «Error»	$I_{ERR\ max}$	mA			20	
Maximum voltage of status output «Error»	$U_{ERR\ max}$	V			30	
Residual voltage on signal output «Error»	$U_{O\ ERR}$	V	0	0.3	0.7	at I_{ERR} = 20 mA
Threshold voltage on measuring input MC, causing emergency shutdown	U_{MC}^{Th}	V		5.8		

Continuation of Table 2

Insulation parameters						
Maximum permissible reverse voltage on output “MC”	$U_{R(MC)}$	V			2000	
Insulation voltage between input and output	$U_{ISO(IN-OUT)}$	V			4000	DC, 1 minute
Insulation voltage between outputs of first and second channels	$U_{ISO(OUT1-OUT2)}$	V			2000	DC, 1 minute
Critical rate of voltage change on output	$(dU/dt)_{cr}$	kV/μs			20	
Operating and storing parameters						
Operating temperature range	T_A	°C	-45		+85	
Storing temperature	Ts	°C	-60		+100	
Параметры управляемого транзистора						
Maximum permissible voltage of controlled transistor	U_{CE} (U_{DS})	V			1700	

5 DRIVER OPERATION

Delivery of «log.1» to controlling input « PRIM_TOP_IN » or « PRIM_BOT_IN » will lead to opening of corresponding controlled transistor. Open state voltage fall increasing by more than U_{ms}^{Th} per time, exceeding t_{BLOCK1}, will lead to protection operation of open state voltage fall increasing (when current overload).

At “emergency” the transistor will open that is connected in accordance with the scheme with open collector (output «Error»). In 70 ms emergency reset will be performed by internal circuit of emergency reset and on rising edge of control signal «IN» the controlled transistor will be opened. If the emergency cause was not disposed then the protection cycle will be repeated.

Driver supply voltage decrease to protection operation threshold level against driver supply undervoltage «U_{uvlo-}» will lead to closing of controlled transistor regardless of input control signals. Control signals will recover on protection operation threshold against driver supply undervoltage «U_{uvlo+}».

When delivering the signals to the outputs «PRIM_TOP_IN» or «PRIM_BOT_IN» simultaneously «log. 1» there will be a control blocking and the controlled transistors will be closed, wherein the alarm about being a mistake is not appear.

Diagram explaining the driver operation is shown at Figures 3 and 4.

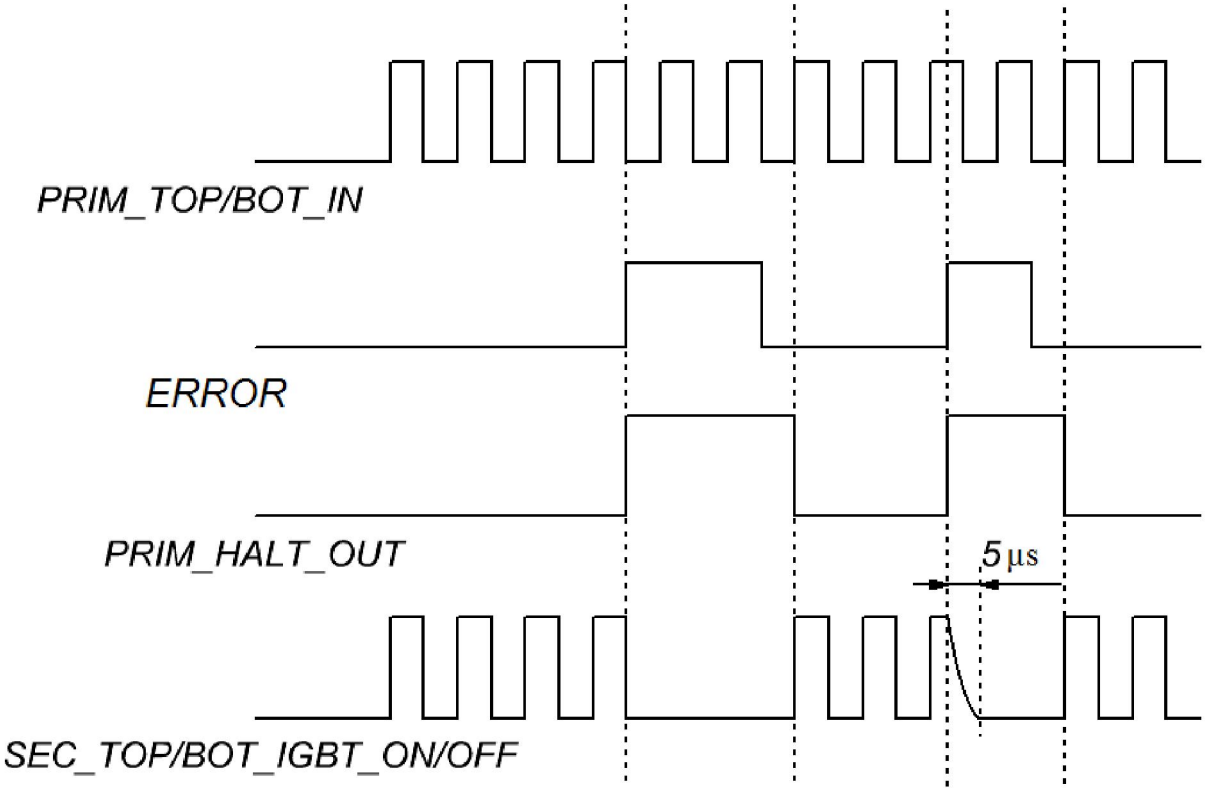

Figure 3 – Operating diagram of one driver's channel

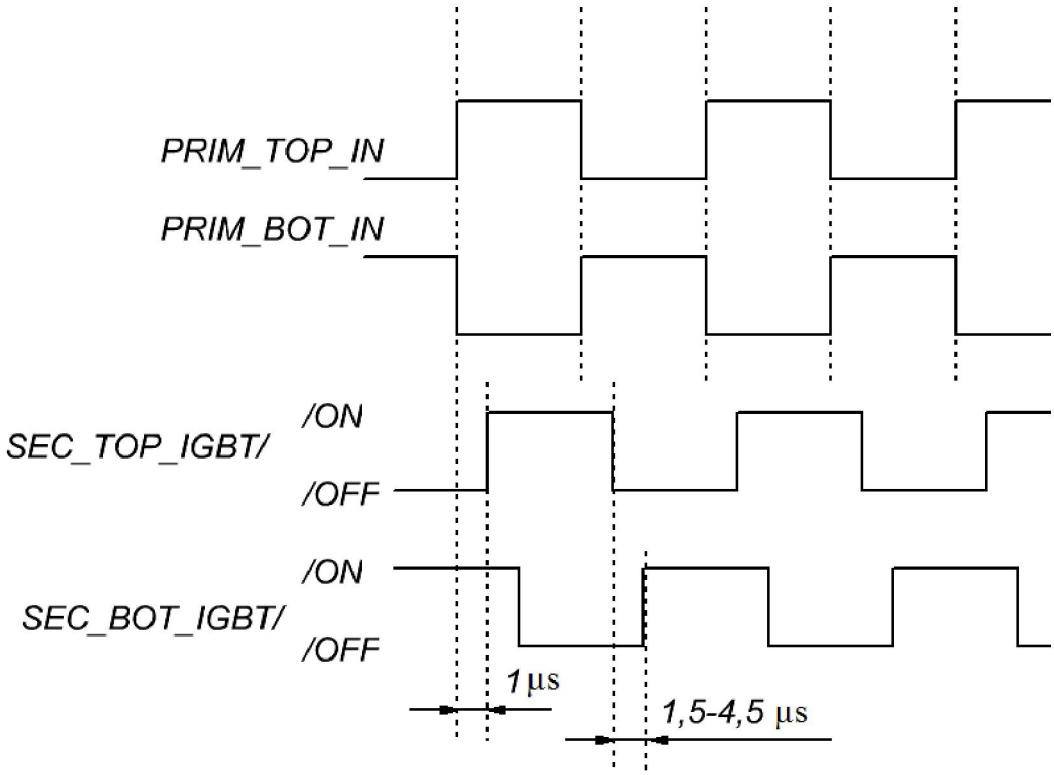

Figure 4 – Operating diagram of two driver's channels

The value of "dead time" is set by installing the outputs «PRIM_CFG_TDT1_IN», «PRIM_CFG_TDT2_IN», «PRIM_CFG_TDT3_IN» (see Table 3).

------- output is not used

0V – output is connected to ground output.

Table 3 – setting “dead time” value

“Dead time” between channels (µs)	PRIM_CFG_TPT1_IN	PRIM_CFG_TPT2_IN	PRIM_CFG_TPT3_IN	PRIM_CFG_SELECT_IN
1	0V	0V	-	-
1.5	0V	0V	0V	-
2	0V	-	-	-
2.5	0V	-	0V	-
3	-	0V	-	-
3.5	-	0V	0V	-
4	-	-	-	-
4.5	-	-	0V	-
without channels’ blocking	-	-	-	0V

6 GRAPHS EXPLAINING DRIVER OPERATION

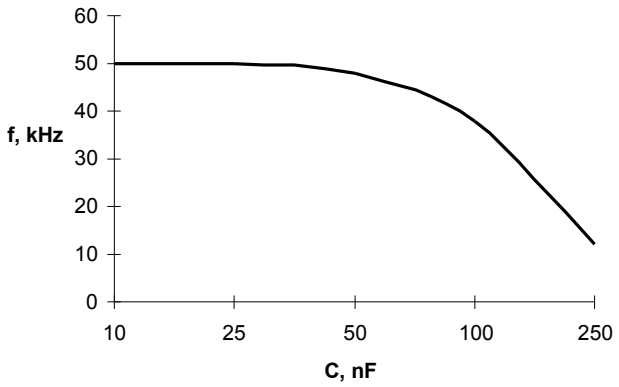

Figure 5 – Graph of driver safe operation area (with gate resistor 5 Ω)

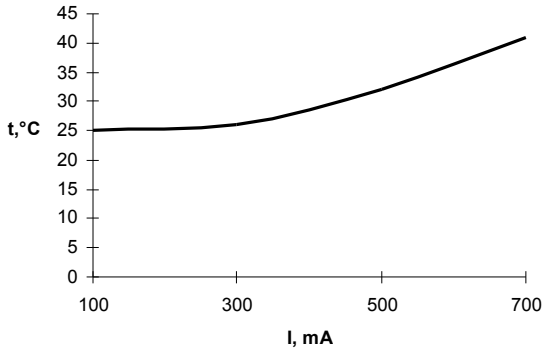

Figure 6 – Graph of driver housing temperature versus current consumption

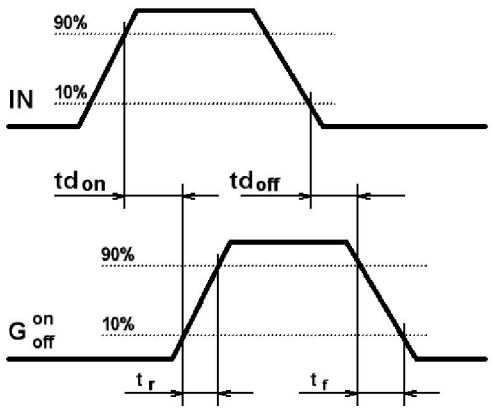

Figure 7 – Diagram explaining driver time characteristics
where IN – input control signal; G – signal on controlled transistor gate

7 INFORMATION ABOUT PRECIOUS METALS

Precious metals are not contained.

8 INSTRUCTIONS FOR USE

8.1 Tolerance requirements at mechanical impacts.

Mechanical impacts for drivers in accordance with qualifying standards of controlled power transistors are shown in Table 4.

Table 4 - Drivers tolerance requirements to mechanical impact factors

External exposure factors	External exposure factor value
Sinusoidal vibration: - frequency range, Hz; - acceleration amplitude, m/s^2 (g) Mechanical shock of single action: - peak shock acceleration, m/s^2 (g); - pulse duration of shock acceleration, ms	 0.5 - 100 150 (15) 40 (4) 50

8.2 Tolerance requirements at climatic impacts.

Climatic impacts in accordance with qualifying standards of controlled power transistors are shown in Table 5.

Table 5 - Tolerance requirements to climatic impact factors

Climatic factor	Climatic factor value
Lower ambient temperature: - operating, °C; - maximum, °C Higher ambient temperature: - operating, °C; - maximum, °C Relative humidity with temperature 35 °C without moisture condensation, %, max Ambient temperature change, °C	 minus 45 minus 60 +85 +100 98 from minus 60 до +100

9 RELIABILITY REQUIREMENTS

The manufacturer guarantees the quality of the module all the requirements of the user's manual if the consumer observes terms and conditions of storage, mounting and operation, as well as guidance on the application specified in the user's manual.

Operating warranty is 2 years from the acceptance date, in the case of requalification – from the date of the requalification.

Reliability probability of drivers for 25000 hours must be at least 0.95.

Gamma-percent life must be no less than 50000 hours by $\gamma = 90$ %.

Gamma-percent service life of the modules, subject to cumulative operating time is not more than gamma-percent life, not less than10 years, at $\gamma = 90$ %.

Gamma-percent storageability time of the modules, at $\gamma = 90$ % and storing – 10 years.

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