

## 2 Описание

CG\_bq – универсальная плата контролер питания для автономных высоконагруженных встраиваемых систем. Плата обеспечивает бесперебойную подачу питания от сети или аккумулятора.

## 1 Основные особенности

- Используемая микросхема Texas Instruments BQ25895
- Поддержка литий-ионных аккумуляторов 1S (3.7В)
- Максимальный ток заряда аккумулятора – 5А
- Наличие постоянно включенного выхода 3.3В – 500 мА
- Наличие управляемого выхода 5В – 3А
- Ток потребления в режиме покоя с включенной линией 5В – 1500 мкА
- Ток потребления в режиме покоя с выключенной линией 5В – 30 мкА
- Наличие I2C интерфейса для управления процессом заряда и питания
- Защита аккумулятора от переразряда
- Защита аккумулятора от переплюсовки
- Наличие USB-C разъема
- Расположение выходных разъемов совместимо с макетными платами
- Компактные размеры – 19\*22 мм

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### 3 Характеристики устройства

Параметр	Значение			Размерность
	не менее	рабочее	не более	
Напряжение питания	4.7	5	5.5	В
Напряжение преобразователя	-	5	-	В
Напряжение аккумулятора	2.7	3.7	4.2	В
Ток потребления от АКБ (5В вкл.)	1500	-	-	мкА
Ток потребления от АКБ (5В выкл.)	30	-	-	мкА
КПД преобразователя, ток 1А, АКБ 3.7В	-	91	-	%
Рабочий температурный диапазон	-20	+20	+40	°С
Рабочий диапазон влажности	0	60	98	%

Таблица 1 (технические характеристики)

## 4 Карта регистров

Для работы I2C линии необходима внешняя подтяжка на мастер устройстве.  
Дефолтный адрес – 0x6A

### REG00

Bit	Field	Type	Reset	Description
7	EN_HIZ	R/W	by REG_RST by Watchdog	Enable HIZ Mode 0 – Disable (default) 1 – Enable
6	EN_ILIM	R/W	by REG_RST by Watchdog	Enable ILIM Pin 0 – Disable 1 – Enable (default: Enable ILIM pin (1))
5	IINLIM[5]	R/W	by REG_RST	1600mA
4	IINLIM[4]	R/W	by REG_RST	800mA
3	IINLIM[3]	R/W	by REG_RST	400mA
2	IINLIM[2]	R/W	by REG_RST	200mA
1	IINLIM[1]	R/W	by REG_RST	100mA
0	IINLIM[0]	R/W	by REG_RST	50mA Input Current Limit Offset: 100mA Range: 100mA (000000) – 3.25A (111111) Default: 0001000 (500mA) (Actual input current limit is the lower of I2C or ILIM pin) IINLIM bits are changed automatically after input source type detection is completed USB Host SDP w/ OTG=Hi (USB500) = 500mA USB Host SDP w/ OTG=Lo (USB100) = 500mA USB CDP = 1.5A USB DCP = 3.25A Adjustable High Voltage (MaxCharge) DCP = 1.5A Unknown Adapter = 500mA Non-Standard Adapter = 1A/2A/2.1A/2.4A

### REG01

Bit	Field	Type	Reset	Description
7	BHOT[1]	R/W	by REG_RST by Watchdog	Boost Mode Hot Temperature Monitor Threshold 00 – $V_{BHOT1}$ Threshold (34.75%) (default) 01 – $V_{BHOT0}$ Threshold (Typ. 37.75%) 10 – $V_{BHOT2}$ Threshold (Typ. 31.25%) 11 – Disable boost mode thermal protection
6	BHOT[0]	R/W	by REG_RST by Watchdog	
5	BCOLD	R/W	by REG_RST by Watchdog	Boost Mode Cold Temperature Monitor Threshold 0 – $V_{BCOLD0}$ Threshold (Typ. 77%) (default) 1 – $V_{BCOLD1}$ Threshold (Typ. 80%)
4	VINDPM_OS[4]	R/W	by REG_RST	1600mV
3	VINDPM_OS[3]	R/W	by REG_RST	800mV
2	VINDPM_OS[2]	R/W	by REG_RST	400mV
1	VINDPM_OS[1]	R/W	by REG_RST	200mV
0	VINDPM_OS[0]	R/W	by REG_RST	100mV Input Voltage Limit Offset Default: 500mV (00101) Range: 0mV – 3100mV Minimum VINDPM threshold is clamped at 3.9V Maximum VINDPM threshold is clamped at 15.3V When VBUS at noLoad is $\leq 6V$ , the VINDPM_OS is used to calculate VINDPM threshold When VBUS at noLoad is $> 6V$ , the VINDPM_OS multiple by 2 is used to calculate VINDPM threshold.

### REG02

Bit	Field	Type	Reset	Description
7	CONV_START	R/W	by REG_RST by Watchdog	ADC Conversion Start Control 0 – ADC conversion not active (default). 1 – Start ADC Conversion This bit is read-only when CONV_RATE = 1. The bit stays high during ADC conversion and during input source detection.
6	CONV_RATE	R/W	by REG_RST by Watchdog	ADC Conversion Rate Selection 0 – One shot ADC conversion (default) 1 – Start 1s Continuous Conversion
5	BOOST_FREQ	R/W	by REG_RST by Watchdog	Boost Mode Frequency Selection 0 – 1.5MHz 1 – 500KHz (default) Note: Write to this bit is ignored when OTG_CONFIG is enabled.
4	ICO_EN	R/W	by REG_RST	Input Current Optimizer (ICO) Enable 0 – Disable ICO Algorithm 1 – Enable ICO Algorithm (default)
3	HVDCP_EN	R/W	by REG_RST	High Voltage DCP Enable 0 – Disable HVDCP handshake 1 – Enable HVDCP handshake (default)
2	MAXC_EN	R/W	by REG_RST	MaxCharge Adapter Enable 0 – Disable MaxCharge handshake 1 – Enable MaxCharge handshake (default)

1	FORCE_DPDM	R/W	by REG_RST by Watchdog	Force D+/D- Detection 0 – Not in D+/D- or PSEL detection (default) 1 – Force D+/D- detection
0	AUTO_DPDM_EN	R/W	by REG_RST	Automatic D+/D- Detection Enable 0 – Disable D+/D- or PSEL detection when VBUS is plugged-in 1 – Enable D+/D- or PEL detection when VBUS is plugged-in (default)

**REG03**

Bit	Field	Type	Reset	Description
7	BAT_LOADEN	R/W	by REG_RST by Watchdog	Battery Load (I <sub>BATLOAD</sub> ) Enable 0 – Disabled (default) 1 – Enabled
6	WD_RST	R/W	by REG_RST by Watchdog	I2C Watchdog Timer Reset 0 – Normal (default) 1 – Reset (Back to 0 after timer reset)
5	OTG_CONFIG	R/W	by REG_RST by Watchdog	Boost (OTG) Mode Configuration 0 – OTG Disable 1 – OTG Enable (default)
4	CHG_CONFIG	R/W	by REG_RST by Watchdog	Charge Enable Configuration 0 - Charge Disable 1- Charge Enable (default)
3	SYS_MIN[2]	R/W	by REG_RST	0.4V
2	SYS_MIN[1]	R/W	by REG_RST	0.2V
1	SYS_MIN[0]	R/W	by REG_RST	0.1V
0	Reserved	R/W	by REG_RST by Watchdog	Reserved (default = 0)

**REG04**

Bit	Field	Type	Reset	Description
7	EN_PUMPX	R/W	by Software by Watchdog	Current pulse control Enable 0 - Disable Current pulse control (default) 1 - Enable Current pulse control (PUMPX_UP and PUMPX_DN)
6	ICHG[6]	R/W	by Software by Watchdog	4096mA
5	ICHG[5]	R/W	by Software by Watchdog	2048mA
4	ICHG[4]	R/W	by Software by Watchdog	1024mA
3	ICHG[3]	R/W	by Software by Watchdog	512mA
2	ICHG[2]	R/W	by Software by Watchdog	256mA
1	ICHG[1]	R/W	by Software by Watchdog	128mA
0	ICHG[0]	R/W	by Software by Watchdog	64mA

Fast Charge Current Limit  
Offset: 0mA  
Range: 0mA (0000000) – 5056mA (1001111)  
Default: 2048mA (0100000)  
Note:  
ICHG=000000 (0mA) disables charge  
ICHG > 1001111 (5056mA) is clamped to register value 1001111 (5056mA)

**REG05**

Bit	Field	Type	Reset	Description
7	IPRECHG[3]	R/W	by Software by Watchdog	512mA
6	IPRECHG[2]	R/W	by Software by Watchdog	256mA
5	IPRECHG[1]	R/W	by Software by Watchdog	128mA
4	IPRECHG[0]	R/W	by Software by Watchdog	64mA
3	ITERM[3]	R/W	by Software by Watchdog	512mA
2	ITERM[2]	R/W	by Software by Watchdog	256mA
1	ITERM[1]	R/W	by Software by Watchdog	128mA
0	ITERM[0]	R/W	by Software by Watchdog	64mA

Precharge Current Limit  
Offset: 64mA  
Range: 64mA – 1024mA  
Default: 128mA (0001)

Termination Current Limit  
Offset: 64mA  
Range: 64mA – 1024mA  
Default: 256mA (0011)

**REG06**

Bit	Field	Type	Reset	Description
7	VREG[5]	R/W	by Software by Watchdog	512mV
6	VREG[4]	R/W	by Software by Watchdog	256mV
5	VREG[3]	R/W	by Software by Watchdog	128mV
4	VREG[2]	R/W	by Software by Watchdog	64mV
3	VREG[1]	R/W	by Software by Watchdog	32mV
2	VREG[0]	R/W	by Software by Watchdog	16mV
Charge Voltage Limit Offset: 3.840V Range: 3.840V – 4.608V (110000) Default: 4.208V (010111) Note: VREG > 110000 (4.608V) is clamped to register value 110000 (4.608V)				
1	BATLOWV	R/W	by Software by Watchdog	Battery Precharge to Fast Charge Threshold 0 – 2.8V 1 – 3.0V (default)
0	VRECHG	R/W	by Software by Watchdog	Battery Recharge Threshold Offset (below Charge Voltage Limit) 0 – 100mV (VRECHG) below VREG (REG06[7:2]) (default) 1 – 200mV (VRECHG) below VREG (REG06[7:2])

**REG07**

Bit	Field	Type	Reset	Description
7	EN_TERM	R/W	by Software by Watchdog	Charging Termination Enable 0 – Disable 1 – Enable (default)
6	STAT_DIS	R/W	by Software by Watchdog	STAT Pin Disable 0 – Enable STAT pin function (default) 1 – Disable STAT pin function
5	WATCHDOG[1]	R/W	by Software by Watchdog	I2C Watchdog Timer Setting 00 – Disable watchdog timer 01 – 40s (default)
4	WATCHDOG[0]	R/W	by Software by Watchdog	10 – 80s 11 – 160s
3	EN_TIMER	R/W	by Software by Watchdog	Charging Safety Timer Enable 0 – Disable 1 – Enable (default)
2	CHG_TIMER[1]	R/W	by Software by Watchdog	Fast Charge Timer Setting 00 – 5 hrs 01 – 8 hrs
1	CHG_TIMER[0]	R/W	by Software by Watchdog	10 – 12 hrs (default) 11 – 20 hrs
0	Reserved	R/W		Reserved (Default = 1)

**REG08**

Bit	Field	Type	Reset	Description
7	BAT_COMP[2]	R/W	by Software by Watchdog	80mΩ
6	BAT_COMP[1]	R/W	by Software by Watchdog	40mΩ
5	BAT_COMP[0]	R/W	by Software by Watchdog	20mΩ
IR Compensation Resistor Setting Range: 0 – 140mΩ Default: 0Ω (000) (i.e. Disable IRComp)				
4	VCLAMP[2]	R/W	by Software by Watchdog	128mV
3	VCLAMP[1]	R/W	by Software by Watchdog	64mV
2	VCLAMP[0]	R/W	by Software by Watchdog	32mV
IR Compensation Voltage Clamp above VREG (REG06[7:2]) Offset: 0mV Range: 0-224mV Default: 0mV (000)				
1	TREG[1]	R/W	by Software by Watchdog	Thermal Regulation Threshold 00 – 60°C 01 – 80°C
0	TREG[0]	R/W	by Software by Watchdog	10 – 100°C 11 – 120°C (default)

**REG09**

Bit	Field	Type	Reset	Description
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7	FORCE_ICO	R/W	by Software by Watchdog	Force Start Input Current Optimizer (ICO) 0 – Do not force ICO (default) 1 – Force ICO Note: This bit is can only be set only and always returns to 0 after ICO starts
6	TMR2X_EN	R/W	by Software by Watchdog	Safety Timer Setting during DPM or Thermal Regulation 0 – Safety timer not slowed by 2X during input DPM or thermal regulation 1 – Safety timer slowed by 2X during input DPM or thermal regulation (default)
5	BATFET_DIS	R/W	by Software	Force BATFET off to enable ship mode 0 – Allow BATFET turn on (default) 1 – Force BATFET off
4	Reserved	R/W		Reserved (Default = 0)
3	BATFET_DLY	R/W	by Software	BATFET turn off delay control 0 – BATFET turn off immediately when BATFET_DIS bit is set (default) 1 – BATFET turn off delay by $t_{SM\_DLY}$ when BATFET_DIS bit is set
2	BATFET_RST_EN	R/W	by Software	BATFET full system reset enable 0 – Disable BATFET full system reset 1 – Enable BATFET full system reset (default)
1	PUMPX_UP	R/W	by Software by Watchdog	Current pulse control voltage up enable 0 – Disable (default) 1 – Enable Note: This bit is can only be set when EN_PUMPX bit is set and returns to 0 after current pulse control sequence is completed
0	PUMPX_DN	R/W	by Software by Watchdog	Current pulse control voltage down enable 0 – Disable (default) 1 – Enable Note: This bit is can only be set when EN_PUMPX bit is set and returns to 0 after current pulse control sequence is completed

**REG0A**

Bit	Field	Type	Reset	Description
7	BOOSTV[3]	R/W	by Software by Watchdog	512mV
6	BOOSTV[2]	R/W	by Software by Watchdog	256mV
5	BOOSTV[1]	R/W	by Software	128mV
4	BOOSTV[0]	R/W	by Software by Watchdog	64mV
3	Reserved	R/W	by Software by Watchdog	Reserved (default = 0)
2	Reserved	R/W	by Software by Watchdog	Reserved (default = 0)
1	Reserved	R/W	by Software by Watchdog	Reserved (default = 1)
0	Reserved	R/W	by Software by Watchdog	Reserved (default = 1)

**REG0B**

Bit	Field	Type	Reset	Description
7	VBUS_STAT[2]	R	N/A	VBUS Status register BQ25895 000: No Input 001: USB Host SDP 010: USB CDP (1.5A) 011: USB DCP (3.25A) 100: Adjustable High Voltage DCP (MaxCharge) (1.5A) 101: Unknown Adapter (500mA) 110: Non-Standard Adapter (1A/2A/2.1A/2.4A) 111: OTG Note: Software current limit is reported in IINLIM register
6	VBUS_STAT[1]	R	N/A	
5	VBUS_STAT[0]	R	N/A	
4	CHRG_STAT[1]	R	N/A	Charging Status 00 – Not Charging 01 – Pre-charge ( $< V_{BATLOWV}$ ) 10 – Fast Charging 11 – Charge Termination Done
3	CHRG_STAT[0]	R	N/A	
2	PG_STAT	R	N/A	Power Good Status 0 – Not Power Good 1 – Power Good

1	SDP_STAT	R	N/A	USB Input Status 0 – USB100 input is detected 1 – USB500 input is detected Note: This bit always read 1 when VBUS_STAT is not 001
0	VSYS_STAT	R	N/A	VSYS Regulation Status 0 – Not in VSYSMIN regulation (BAT > VSYSMIN) 1 – In VSYSMIN regulation (BAT < VSYSMIN)

**REG0C**

Bit	Field	Type	Reset	Description
7	WATCHDOG_FAULT	R	N/A	Watchdog Fault Status Status 0 – Normal 1- Watchdog timer expiration
6	BOOST_FAULT	R	N/A	Boost Mode Fault Status 0 – Normal 1 – VBUS overloaded in OTG, or VBUS OVP, or battery is too low in boost mode
5	CHRG_FAULT[1]	R	N/A	Charge Fault Status 00 – Normal 01 – Input fault (VBUS > V <sub>ACOV</sub> or VBAT < VBUS < V <sub>VBUSMIN</sub> (typical 3.8V) ) 10 - Thermal shutdown 11 – Charge Safety Timer Expiration
4	CHRG_FAULT[0]	R	N/A	
3	BAT_FAULT	R	N/A	Battery Fault Status 0 – Normal 1 – BATOVP (VBAT > V <sub>BATOVP</sub> )
2	NTC_FAULT[2]	R	N/A	NTC Fault Status Buck Mode: 000 – Normal 001 – TS Cold 010 – TS Hot Boost Mode: 000 – Normal 101 – TS Cold 110 – TS Hot
1	NTC_FAULT[1]	R	N/A	
0	NTC_FAULT[0]	R	N/A	

**REG0D**

Bit	Field	Type	Reset	Description
7	FORCE_VINDPM	R/W	by Software	VINDPM Threshold Setting Method 0 – Run Relative VINDPM Threshold (default) 1 – Run Absolute VINDPM Threshold
6	VINDPM[6]	R/W	by Software	6400mV
5	VINDPM[5]	R/W	by Software	3200mV
4	VINDPM[4]	R/W	by Software	1600mV
3	VINDPM[3]	R/W	by Software	800mV
2	VINDPM[2]	R/W	by Software	400mV
1	VINDPM[1]	R/W	by Software	200mV
0	VINDPM[0]	R/W	by Software	100mV

Absolute VINDPM Threshold  
Offset: 2.6V  
Range: 3.9V (0001101) – 15.3V (1111111)  
Default: 4.4V (0010010)  
Note:  
Value < 0001101 is clamped to 3.9V (0001101)  
Register is read only when FORCE\_VINDPM=0 and can be written by internal control based on relative VINDPM threshold setting  
Register can be read/write when FORCE\_VINDPM = 1

**REG0E**

Bit	Field	Type	Reset	Description
7	THERM_STAT	R	N/A	Thermal Regulation Status 0 – Normal 1 – In Thermal Regulation
6	BATV[6]	R	N/A	1280mV
5	BATV[5]	R	N/A	640mV
4	BATV[4]	R	N/A	320mV
3	BATV[3]	R	N/A	160mV
2	BATV[2]	R	N/A	80mV
1	BATV[1]	R	N/A	40mV
0	BATV[0]	R	N/A	20mV

ADC conversion of Battery Voltage (V<sub>BAT</sub>)  
Offset: 2.304V  
Range: 2.304V (0000000) – 4.848V (1111111)  
Default: 2.304V (0000000)

**REG0F**

Bit	Field	Type	Reset	Description
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7	Reserved	R	N/A	Reserved: Always reads 0	
6	SYSV[6]	R	N/A	1280mV	ADDC conversion of System Voltage ( $V_{SYS}$ ) Offset: 2.304V Range: 2.304V (0000000) – 4.848V (1111111) Default: 2.304V (0000000)
5	SYSV[5]	R	N/A	640mV	
4	SYSV[4]	R	N/A	320mV	
3	SYSV[3]	R	N/A	160mV	
2	SYSV[2]	R	N/A	80mV	
1	SYSV[1]	R	N/A	40mV	
0	SYSV[0]	R	N/A	20mV	

**REG10**

Bit	Field	Type	Reset	Description	
7	Reserved	R	N/A	Reserved: Always reads 0	
6	TSPCT[6]	R	N/A	29.76%	ADC conversion of TS Voltage (TS) as percentage of REGN Offset: 21% Range 21% (0000000) – 80% (1111111) Default: 21% (0000000)
5	TSPCT[5]	R	N/A	14.88%	
4	TSPCT[4]	R	N/A	7.44%	
3	TSPCT[3]	R	N/A	3.72%	
2	TSPCT[2]	R	N/A	1.86%	
1	TSPCT[1]	R	N/A	0.93%	
0	TSPCT[0]	R	N/A	0.465%	

**REG11**

Bit	Field	Type	Reset	Description	
7	VBUS_GD	R	N/A	VBUS Good Status 0 – Not VBUS attached 1 – VBUS Attached	
6	VBUSV[6]	R	N/A	6400mV	ADC conversion of VBUS voltage ( $V_{BUS}$ ) Offset: 2.6V Range 2.6V (0000000) – 15.3V (1111111) Default: 2.6V (0000000)
5	VBUSV[5]	R	N/A	3200mV	
4	VBUSV[4]	R	N/A	1600mV	
3	VBUSV[3]	R	N/A	800mV	
2	VBUSV[2]	R	N/A	400mV	
1	VBUSV[1]	R	N/A	200mV	
0	VBUSV[0]	R	N/A	100mV	

**REG12**

Bit	Field	Type	Reset	Description	
7	Unused	R	N/A	Always reads 0	
6	ICHGR[6]	R	N/A	3200mA	ADC conversion of Charge Current ( $I_{BAT}$ ) when $V_{BAT} > V_{BATSHORT}$ Offset: 0mA Range 0mA (0000000) – 6350mA (1111111) Default: 0mA (0000000) Note: This register returns 0000000 for $V_{BAT} < V_{BATSHORT}$
5	ICHGR[5]	R	N/A	1600mA	
4	ICHGR[4]	R	N/A	800mA	
3	ICHGR[3]	R	N/A	400mA	
2	ICHGR[2]	R	N/A	200mA	
1	ICHGR[1]	R	N/A	100mA	
0	ICHGR[0]	R	N/A	50mA	

**REG13**

Bit	Field	Type	Reset	Description	
7	VDPM_STAT	R	N/A	VINDPM Status 0 – Not in VINDPM 1 – VINDPM	
6	IDPM_STAT	R	N/A	IINDPM Status 0 – Not in IINDPM 1 – IINDPM	
5	IDPM_LIM[5]	R	N/A	1600mA	Input Current Limit in effect while Input Current Optimizer(ICO) is enabled Offset: 100mA (default) Range 100mA (0000000) – 3.25mA (1111111)
4	IDPM_LIM[4]	R	N/A	800mA	
3	IDPM_LIM[3]	R	N/A	400mA	
2	IDPM_LIM[2]	R	N/A	200mA	
1	IDPM_LIM[1]	R	N/A	100mA	

0	IDPM_LIM[0]	R	N/A	50mA
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**REG14**

Bit	Field	Type	Reset	Description
7	REG_RST	R/W	N/A	Register Reset 0 – Keep current register setting (default) 1 – Reset to default register value and reset safety timer Note: Reset to 0 after register reset is completed
6	ICO_OPTIMIZED	R	N/A	Input Current Optimizer (ICO) Status 0 – Optimization is in progress 1 – Maximum Input Current Detected
5	PN[2]	R	N/A	Device Configuration 111: BQ25895
4	PN[1]	R	N/A	
3	PN[0]	R	N/A	
2	TS_PROFILE	R	N/A	Temperature Profile 0 – Cold/Hot (default)
1	DEV_REV[1]	R	N/A	Device Revision: 01
0	DEV_REV[0]	R	N/A	

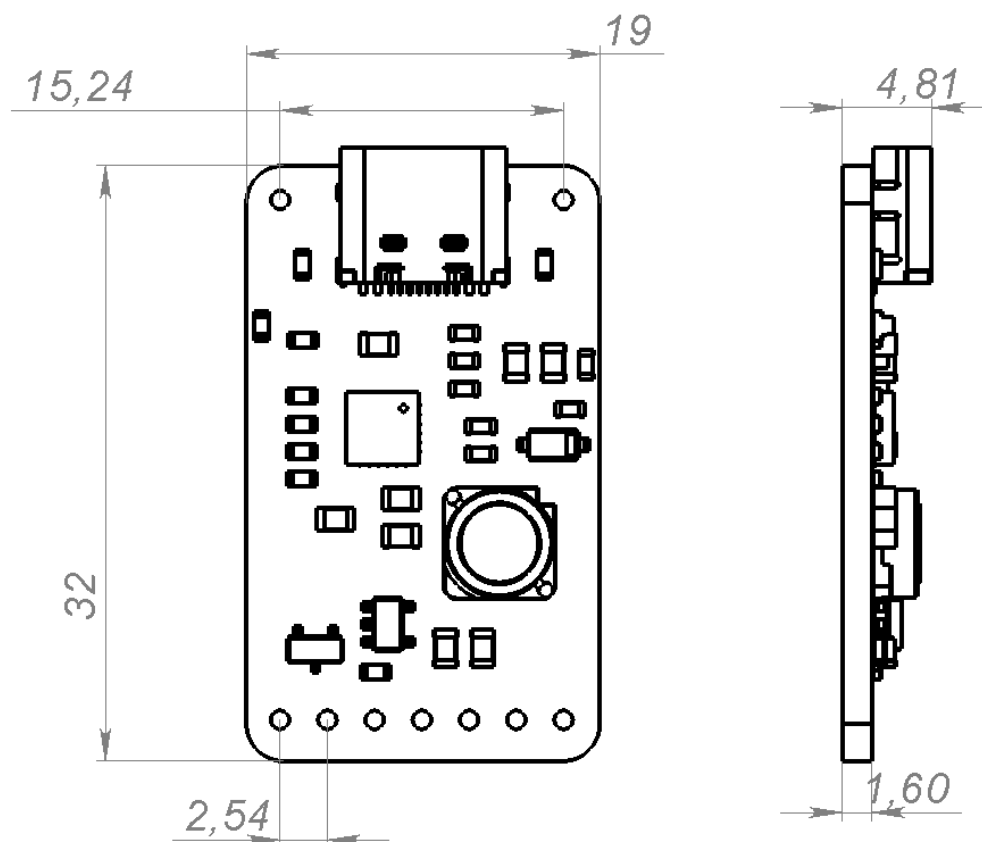
**5 Разъем подключения**

Цоколевка разъема указана в таблице

Контакт	Название	Назначение
1	BAT+	Вывод для подключения АКБ +
2	BAT-	Вывод для подключения АКБ -
3	SCL	Линия тактирования I2C
4	SDA	Линия данных I2C
5	GND	Общий вывод
6	3V3	Вывод с выходным напряжением 3.3В
7	5V	Вывод с выходным напряжением 5В

Таблица 2 (цоколевка разъема подключения)

## 6 Чертеж модуля



## 7 Дополнительные ресурсы

Контактная информация и сведения по работе с модулем представлены в приведенной ниже таблице.

Описание	Ссылка
Сайт производителя	<a href="http://climateguard.ru/">http://climateguard.ru/</a>
Сообщество в Telegram	<a href="https://t.me/climateguard_community">https://t.me/climateguard_community</a>

Таблица 3 (полезные ресурсы)