



BCT3236

36 CHANNELS LED DRIVER

GENERAL DESCRIPTION

The BCT3236 is a LED driver with independent 36 output channels, and the output current of each channel can be programmed to achieve 256 levels by I2C interface. The output current of each channel can be set at up to 38mA (Max.) by an external resistor and independently scaled by a factor of 1, 1/2, 1/3 and 1/4.

The chip can be turned off by pulling the SDB pin low by using the software shutdown feature to reduce power consumption.

BCT3236 is available in QFN5X5-44L (5mm × 5mm). It operates from 2.7V to 5.5V over the temperature range of -40°C to +85°C.

FEATURES

- 2.7V to 5.5V supply
- I2C interface, automatic address increment function
- Internal reset register
- Modulate LED brightness with 256 levels
- Each channel can be controlled independently
- Each channel can be scaled independently by 1, 1/2, 1/3 and 1/4
- -40°C to +85°C temperature range
- QFN5X5-44L (5mm × 5mm)

APPLICATIONS

Mobile phones and other hand-held devices for LED display
LED in home appliances.

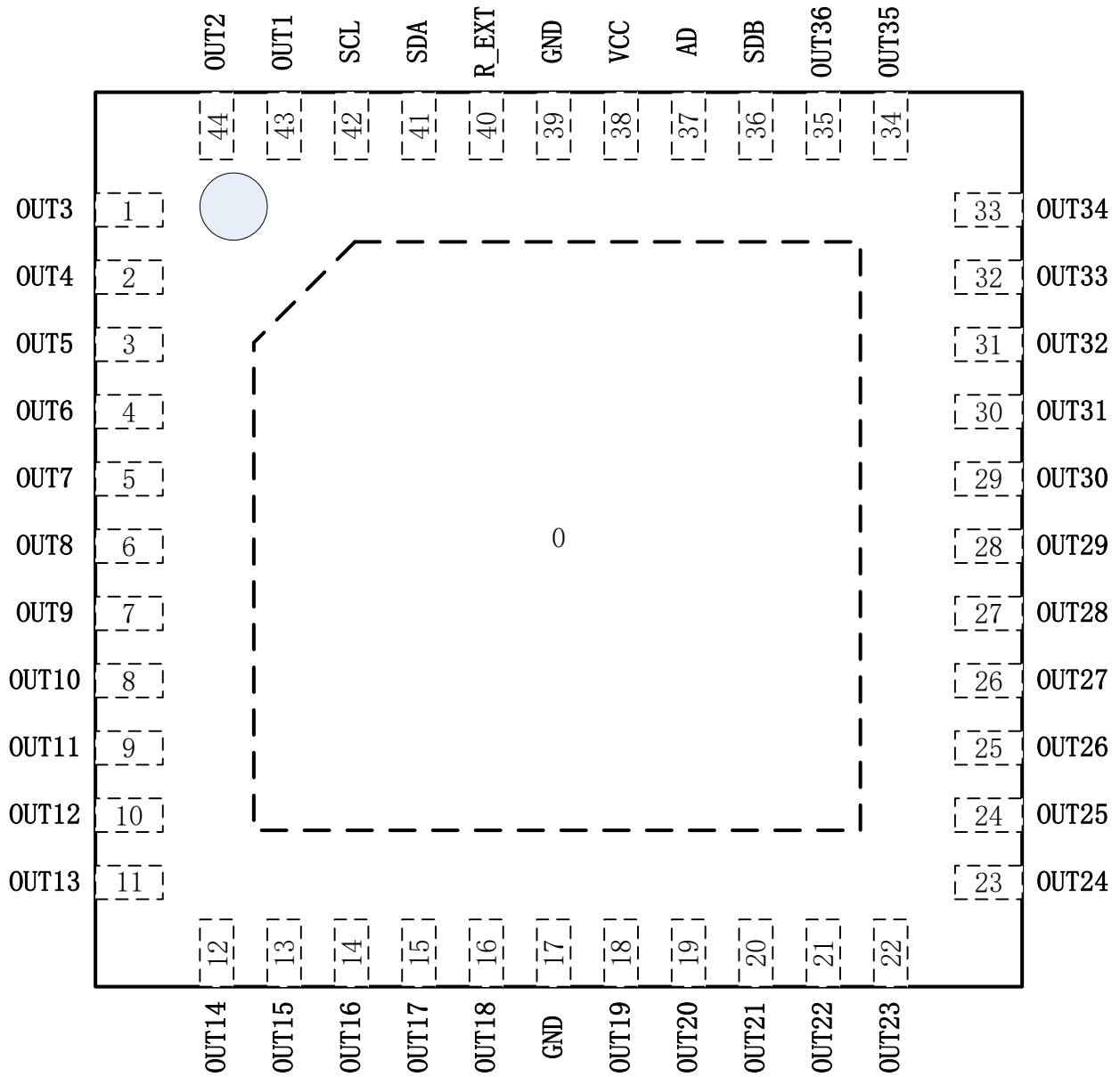
ORDERING INFORMATION

Order Number	Package Type	Temperature Range	Marking	QTY/Reel
BCT3236EGH-TR	QFN5X5-44L	-40°C to +85°C	B 3236 XXXXX	3000

Note:"XXXXX" in marking will be appeared as the batch code.

PIN CONFIGURATION

QFN5X5-44L



PIN DESCRIPTION

No.	Pin	Description
1~3	OUT3 ~ OUT5	Output channel 3~5 for LEDs.
4~16	OUT6 ~ OUT18	Output channel 6~18 for LEDs.
17,39	GND	Ground.
18~30	OUT19 ~ OUT31	Output channel 19~31 for LEDs.
31~35	OUT32 ~ OUT36	Output channel 32~36 for LEDs.
36	SDB	Shutdown the chip when pulled low.
37	AD	I2C address setting.
38	VCC	Power supply.
40	R_EXT	Input terminal used to connect an external resistor. This regulates the global output current.
41	SDA	I2C serial data.
42	SCL	I2C serial clock.
43,44	OUT1, OUT2	Output channel 1, 2 for LEDs.
0	Thermal Pad	Connect to GND.



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ABSOLUTE MAXIMUM RATINGS

Supply Voltage, V_{CC}	-0.3V to 6V
Voltage at SCL, SDA, SDB, OUT1 to OUT36.....	-0.3V to $V_{CC}+0.3V$
Maximum junction temperature, T_{JMAX}	150°C
Storage temperature range, T_{STG}	- 65°C ~ +150°C
Operating temperature range, T_A	-40°C ~ +85°C
Package thermal resistance (Mounted on JEDEC standard 4,layer(2s2p) PCB test board), $R_{\theta JA}$	32.65°C/W (QFN)
ESD (HBM).....	$\pm 4kV$

NOTE:

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other condition beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability

CAUTION

This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. Broadchip recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

Broadchip reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time. Please contact Broadchip sales office to get the latest datasheet.

ELECTRICAL CHARACTERISTICS

Typical values are TA = 25°C, VCC = 3.6V.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
V _{CC}	Supply voltage		2.7		5.5	V
I _{MAX}	Maximum global output current	V _{CC} = 4.2V, V _{OUT} = 0.8V R _{EXT} = 2kΩ, SL = "00" (Note 1)		38		mA
I _{OUT}	Output current	V _{OUT} = 0.6V R _{EXT} = 3.3kΩ, SL = "00"		23		mA
I _{CC}	Quiescent power supply current	R _{EXT} = 3.3kΩ		9		mA
I _{SD}	Shutdown current	V _{SDB} = 0V or software shutdown T _A = 25°C, V _{CC} = 3.6V	2	3	5	μA
I _{OZ}	Output leakage current	V _{SDB} = 0V or software shutdown, V _{OUT} = 5.5V			0.2	μA
V _{EXT}	Output voltage of R-EXT pin			0.58		V

Logic Electrical Characteristics (SDA, SCL, SDB)

V _{IL}	Logic "0" input voltage	V _{CC} = 2.7V			0.4	V
V _{IH}	Logic "1" input voltage	V _{CC} = 5.5V	1.4			V
I _{IL}	Logic "0" input current	V _{INPUT} = 0V		5 (Note 2)		nA
I _{IH}	Logic "1" input current	V _{INPUT} = V _{CC}		5 (Note 2)		nA

DIGITAL INPUT SWITCHING CHARACTERISTICS (NOTE 2)

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
f _{SCL}	Serial-Clock frequency				400	kHz
t _{BUF}	Bus free time between a STOP and a START condition		1.3			μs
t _{HD, STA}	Hold time (repeated) START condition		0.6			μs
t _{SU, STA}	Repeated START condition setup time		0.6			μs
t _{SU, STO}	STOP condition setup time		0.6			μs
t _{HD, DAT}	Data hold time				0.9	μs
t _{SU, DAT}	Data setup time		100			ns
t _{LOW}	SCL clock low period		1.3			μs
t _{HIGH}	SCL clock high period		0.7			μs

t_R	Rise time of both SDA and SCL signals, receiving	(Note 3)		$20+0.1 C_b$	300	ns
t_F	Fall time of both SDA and SCL signals, receiving	(Note 3)		$20+0.1 C_b$	300	ns

Note 1: The recommended minimum value of REXT is 2k Ω , or it may cause a large current.

Note 2: Guaranteed by design.

Note 3: C_b = total capacitance of one bus line in pF. ISINK \leq 6mA. t_R and t_F measured between 0.3 h VCC and 0.7 h VCC

DETAILED DESCRIPTION

I2C INTERFACE

The BCT3236 uses a serial bus, which conforms to the I2C protocol, to control the chip's functions with two wires: SCL and SDA. The BCT3236 has a 7-bit slave address (A7:A1), followed by the R/W bit, A0. Since BCT3236 only supports write operations, A0 must always be "0". The value of bits A1 and A2 are decided by the connection of the AD pin.

The complete slave address is:

Table 1 Slave Address (Write only):

Bit	A7:A3	A2:A1	A0
Value	01111	AD	0

AD connected to GND, AD = 00;

AD connected to VCC, AD = 11;

AD connected to SCL, AD = 01;

AD connected to SDA, AD = 10;

The SCL line is uni-directional. The SDA line is bi-directional (open-collector) with a pull-up resistor (typically 4.7k Ω). The maximum clock frequency specified by the I2C standard is 400kHz. In this discussion, the master is the microcontroller and the slave is the BCT3236

The timing diagram for the I2C is shown in Figure 2. The SDA is latched in on the stable high level of the SCL. When there is no interface activity, the SDA line should be held high.

The "START" signal is generated by lowering the SDA signal while the SCL signal is high. The start signal will alert all devices attached to the I2C bus to check the incoming address against their own chip address. The 8-bit chip address is sent next, most significant bit first. Each address bit must be stable while the SCL level is high.

After the last bit of the chip address is sent, the master checks for the BCT3236's acknowledge. The master releases the SDA line high (through a pull-up resistor). Then the master sends an SCL pulse. If the BCT3236 has received the address correctly, then it

holds the SDA line low during the SCL pulse. If the SDA line is not low, then the master should send a “STOP” signal (discussed later) and abort the transfer.

Following acknowledge of BCT3236, the register address byte is sent, most significant bit first.

BCT3236 must generate another acknowledge indicating that the register address has been received.

Then 8-bit of data byte are sent next, most significant bit first. Each data bit should be valid while the SCL level is stable high. After the data byte is sent, the BCT3236 must generate another acknowledge to indicate that the data was received.

The “STOP” signal ends the transfer. To signal “STOP”, the SDA signal goes high while the SCL signal is high.

ADDRESS AUTO INCREMENT

To write multiple bytes of data into BCT3236, load the address of the data register that the first data byte is intended for. During the BCT3236 acknowledge of receiving the data byte, the internal address pointer will increment by one. The next data byte sent to BCT3236 will be placed in the new address, and so on. The auto increment of the address will continue as long as data continues to be written to BCT3236 (Figure 5)

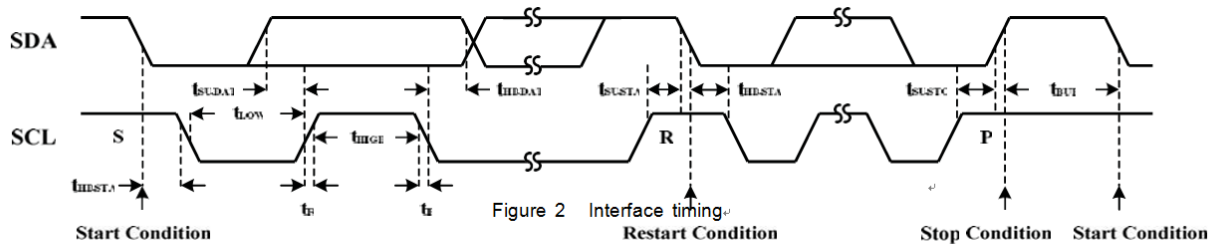


Figure 2 Interface timing

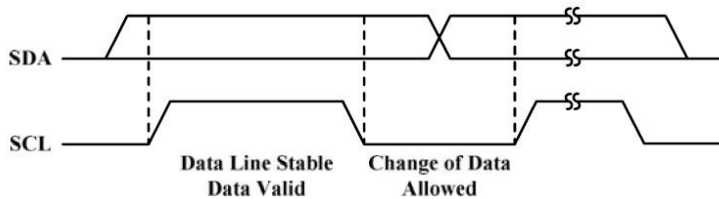


Figure 3 Bit transfer

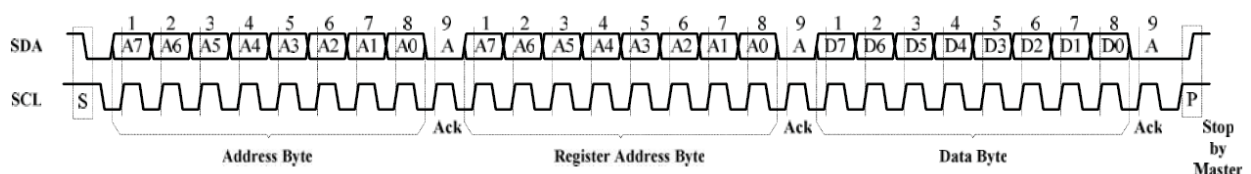


Figure 4 Writing to BCT3236(Typical)

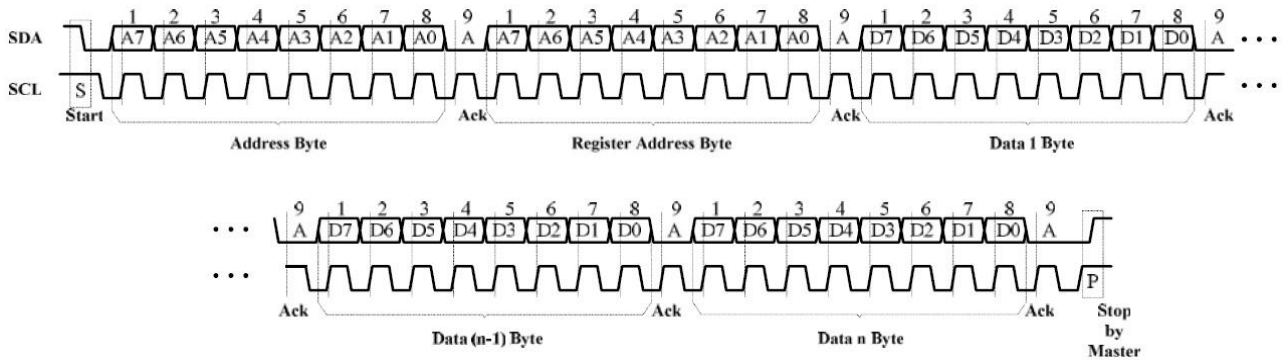


Figure 5 Writing to BCT3236(Automatic address increment)

Registers Definition

Table 2 Register Function

Address	Name	Function	Table	Default
00h	Shutdown Register	Set software shutdown mode	3	0000
01h~24h	Brightness Register	36 channels brightness register	4	0000
25h	Update Register	Load brightness register and LED Control Register's data	-	xxxx xxxx
26h~49h	LED Control Register	Channel 1 to 36 enable bit and current	5	0000 0000
4Ah	Global Control	setting Set all channels enable	6	
4Fh	Reset Register	Reset all registers into default value	-	xxxx xxxx

Table 3 00h Shutdown Register

Bit	D7:D1	D0
Name	-	SSD
Default	0000000	0

The Shutdown Register sets software shutdown mode of BCT3236

- SSD Software Shutdown Enable
- 0 Software shutdown mode
- 1 Normal operation

Table 4 01h~24h Brightness Register(OUT1~OUT36)



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Bit	D7:D0
Name	Brightness
Default	0000 0000

Brightness[7:0]

In normal mode, the eight bits setting the brightness of the output channel.

00000000 0/256 Light down
 00000001 2/256
 00000010 3/256

.....
 11111111 256/256 the brightest

25H Brightness Update Register

The data sent to the Brightness Registers and the LED Control Registers will be stored in temporary registers. A write operation of "0000 0000" value to the Update Register is required to update the registers (01h~24h, 26h~49h).

Table 5 26h~49h LED Control Register (OUT1~OUT36)

Bit	D7:D3	D2:D1	D0
Name	-	SL	OUT
Default	00000	00	0

The LED Control Registers store the on or off state of each LED and set the output current.

SL Output Current Setting (IOUT)

00 IMAX
 01 IMAX/2
 10 IMAX/3
 11 IMAX/4

OUT LED State

0 LED off
 1 LED on

Table 6 4Ah Global Control Register

Bit	D7:D1	D0
Name	-	G_EN
Default	0000 000	0

The Global Control Register set all channels enable.

G_EN Global LED Enable



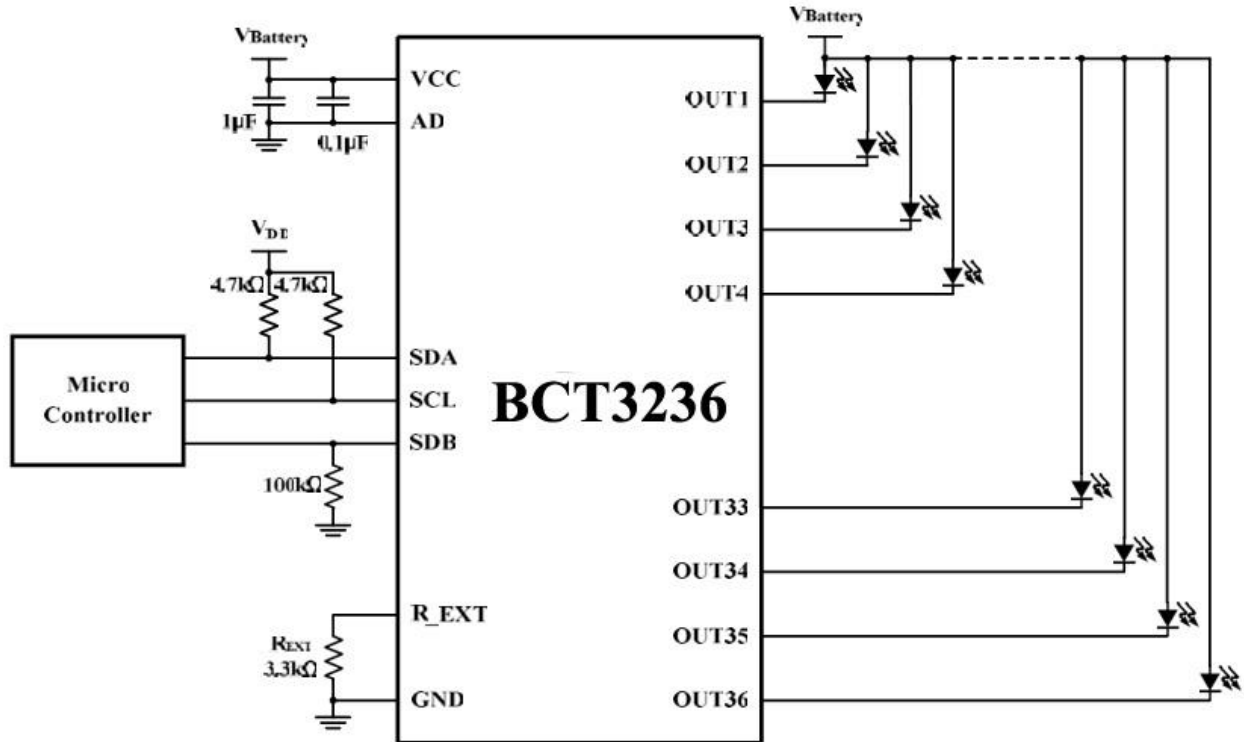
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-
- 0 Normal operation
 - 1 Shutdown all LEDs

4Fh Reset Register

Once user writes "0000 0000" data to the Reset Register, BCT3236 will reset all registers to default value. On initial power-up, the BCT3236 registers are reset to their default values for a blank display.

TYPICAL APPLICATION CIRCUIT

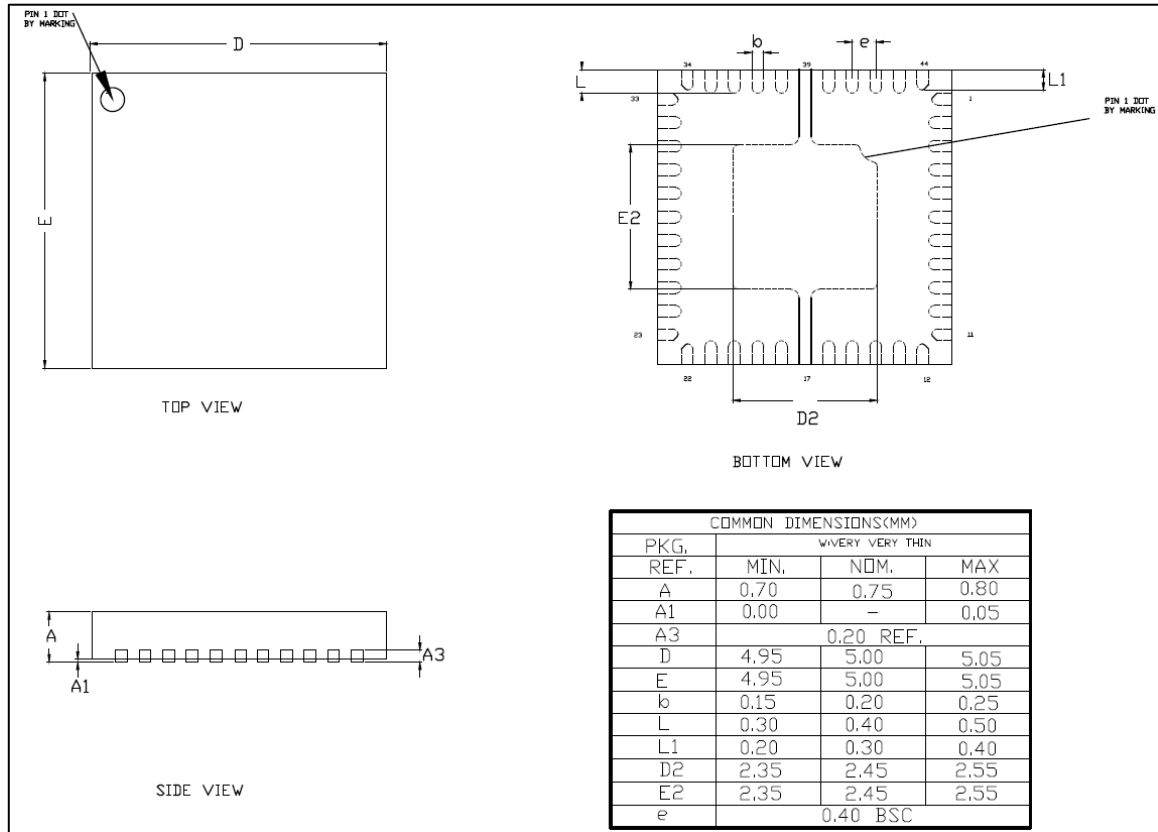


Note 1: The maximum global output current is set up to 23mA when $R_{EXT} = 3.3k\Omega$. The maximum global output current can be set by external resistor R_{EXT} , $I_{MAX} = 76/R_{EXT}$

Note 2: The IC should be placed far away from the mobile antenna in order to prevent the EMI.

PACKAGE INFORMATION

QFN5X5-44L

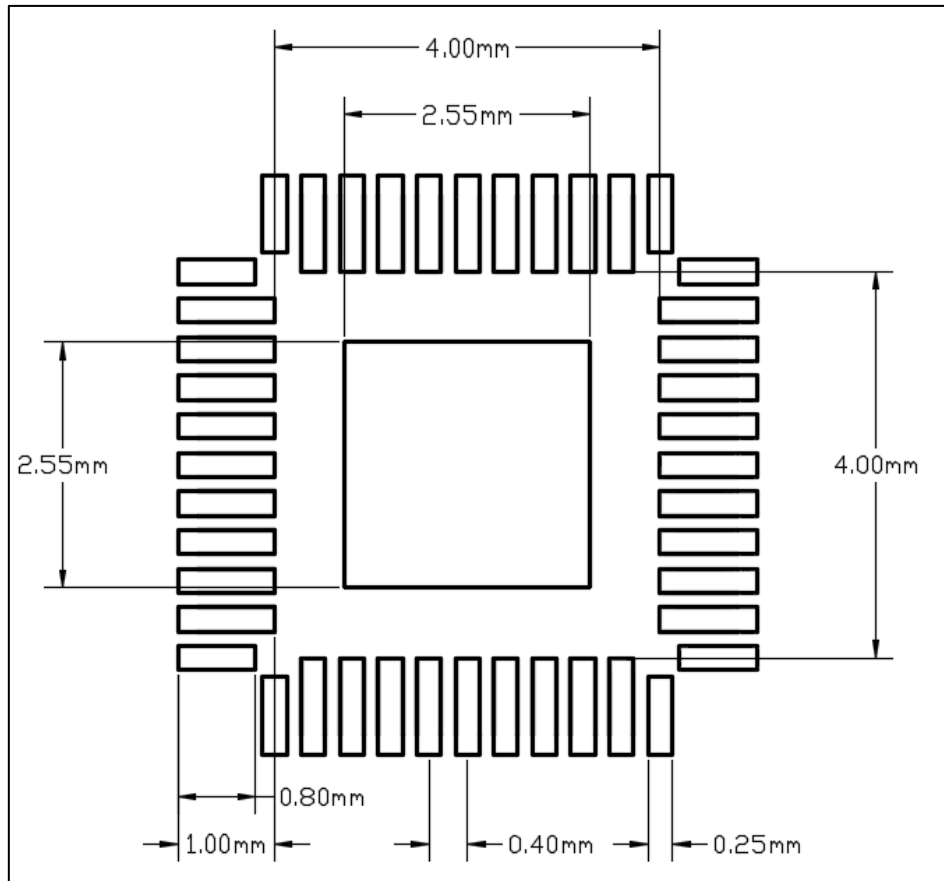


Note:

1. Controlling dimension: MM
2. Reference document: na close tool
3. The pin's sharp and thermal pad shows different sharp among different factories.

RECOMMENDED LAND PATTERN

QFN5X5-44L



Note:

1. Land pattern complies to IPC-7351.
2. This document (including dimensions, notes & specs) is a recommendation based on typical circuit board manufacturing parameters. Since land pattern design depends on many factors unknown (eg. user's board manufacturing specs), user must determine suitability for use.