Ordering number : ENA0833A

LV5217GP

Bi-CMOS IC

3ch LED Driver

ON Semiconductor®

http://onsemi.com

Overview

This LV5217GP is 3-channel LED driver for cell phones. Each LED driver current can be adjusted by I2C bus. LV5217GP can perform various illumination effects with a full-color LED display.

Features

- Three color LED driver circuits.
- The LED current can be switched independently in 7-bit units (0.31 to 25.48mA).
- Independent on/off control of the three LED drivers (independent control of the 3 RGB colors).
- Each LED drive current level can be adjusted independently over the I^2C bus.
- Miniature package.
- Thermal shutdown circuit.

Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage 1	V_{CC} max		6.0	V
Supply voltage 2	V_{DD} max		6.0	V
Maximum input current	$V_{IN}B$		6.0	V
Maximum output current	I_O max		30.0	mA
STBY pin voltage	V_{STBY}		6.0	V
Allowable power dissipation	Pd max	Mounted on the specified board *	0.55	W
Operating temperature	Topr		-30 to +75	°C
Storage temperature	Tstg		-40 to +125	°C

The specified board * : 50mm × 40mm × 0.8mm glass epoxy (4-layer circuit board).

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

Recommended Operating Conditions at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage 1	V_{CC}		3.0 to 4.5	V
Supply voltage 2	V_{DD}		1.6 to 3.0	V

Electrical Characteristics Ta = 25°C, V_{CC} = 3.7V, V_{DD} = 1.8V, RT = 56kΩ, Unless otherwise specified.

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Overall Characteristics						
Current drain 1	$I_{CC}1$	STBY = L *1			5	μA
Current drain 2	$I_{CC}2$	STBY = H, LED ON= L *1 With the default serial data settings		0.7	2	mA
High-level input voltage 1	$V_{IN}H1$	Serial data signals, LEDON pin	V_{DD}×0.8			V
Low-level input voltage 1	$V_{IN}L1$	Serial data signals, LEDON pin	0		V_{DD}×0.2	V
High-level input voltage 2	$V_{IN}H2$	STBY pin	1.4			V
Low-level input voltage 2	$V_{IN}L2$	STBY pin	0		0.2	V
LED Driver Block						
Minimum output current	I_{MIN}	When the serial data is 0000001, V_O = 0.5V	0.0	0.2	1.0	mA
Maximum output current	I_{MAX}	When the serial data is 1111111, V_O = 0.5V	23.0	25.4	28.0	mA
LED current value accuracy	IDIF	When current value is set to 4mA (0010011)	-8		8	%
Differential linearity error	DLE	*2	-2		2	LSB
LED pin saturation voltage	VLED	At the maximum current setting			0.3	V
Leakage current	ILEAK	Drivers : off, V_O = 5V			1	μA

V_O : LED pin voltage.

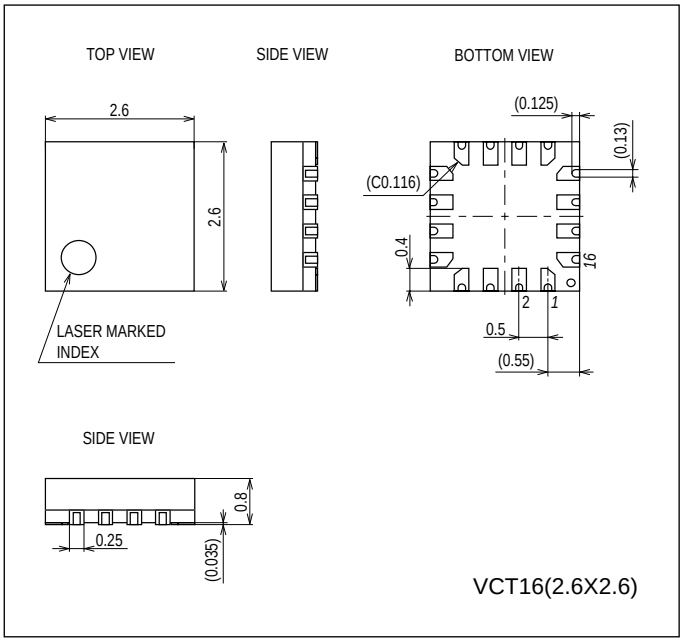
*1. The sum of the V_{CC} and V_{DD} current drain values.

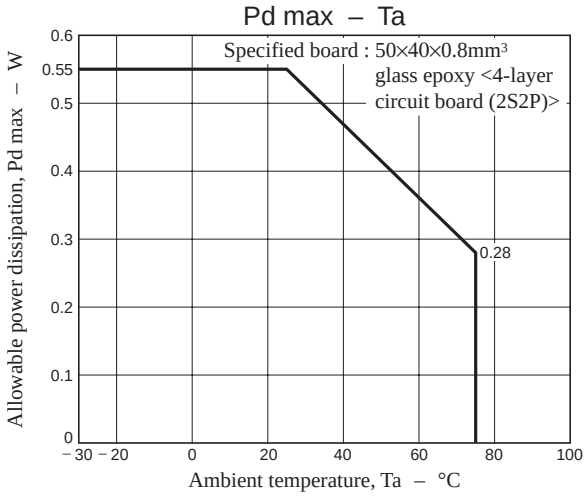
*2. Differential linearity error : The difference between the actual and ideal amounts when one low-order bit value is added.

Package Dimensions

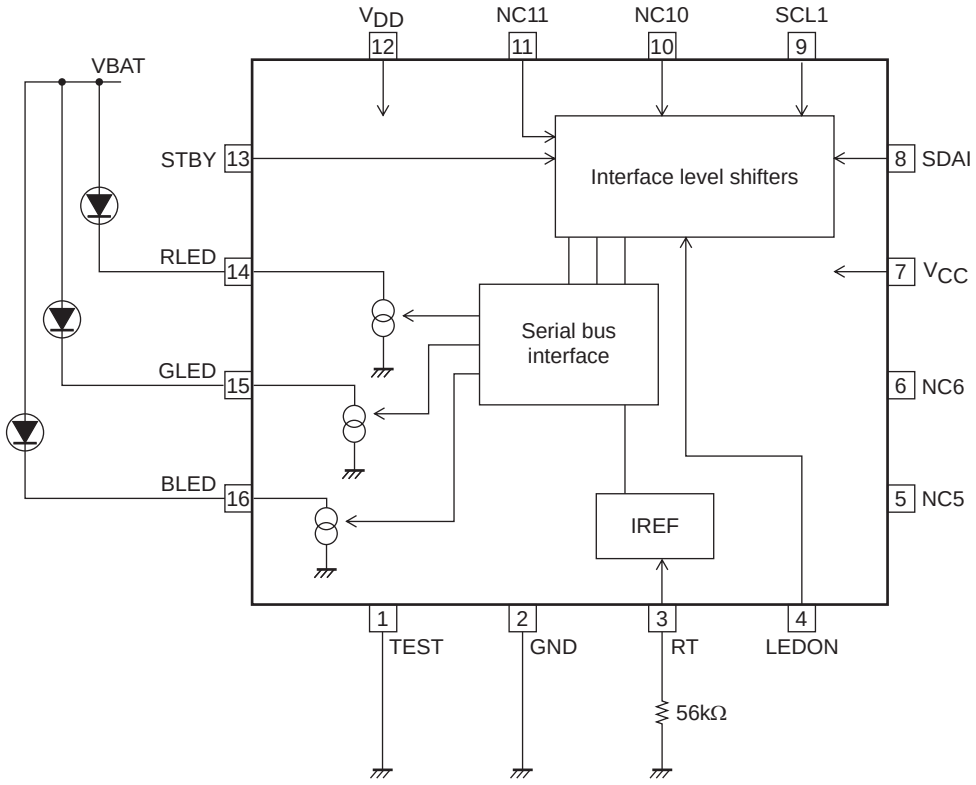
unit : mm (typ)

3318





Block Diagram

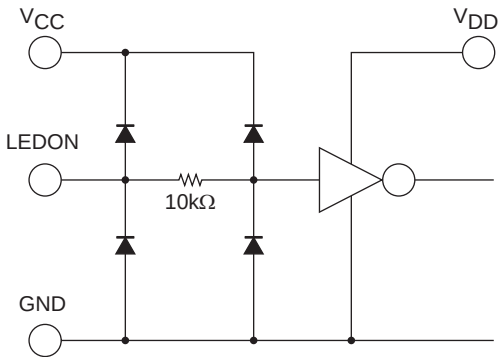
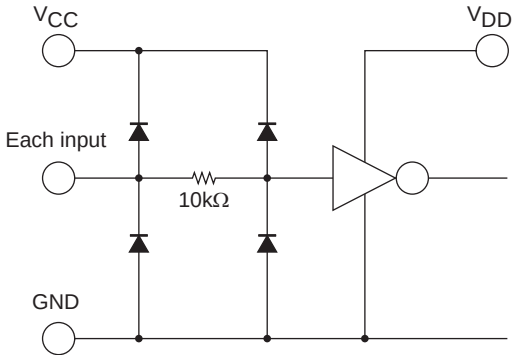
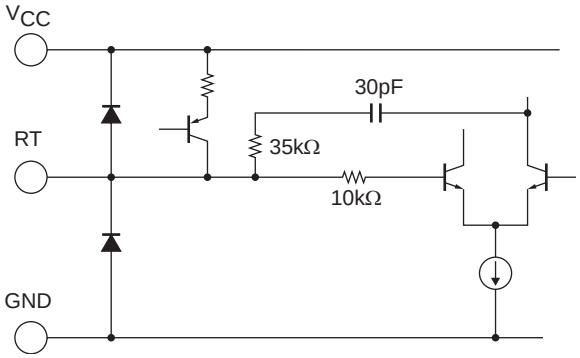
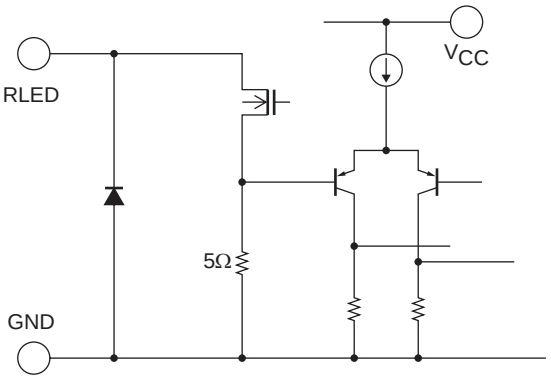


Note 1 : The TEST pin must be tied to ground.

Pin Functions

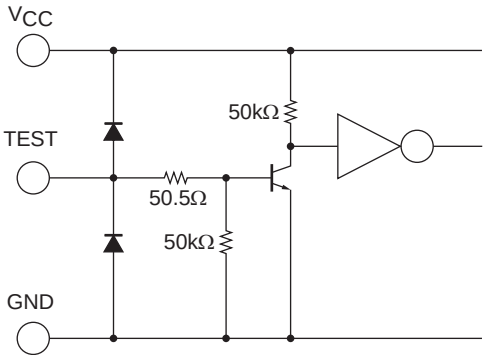
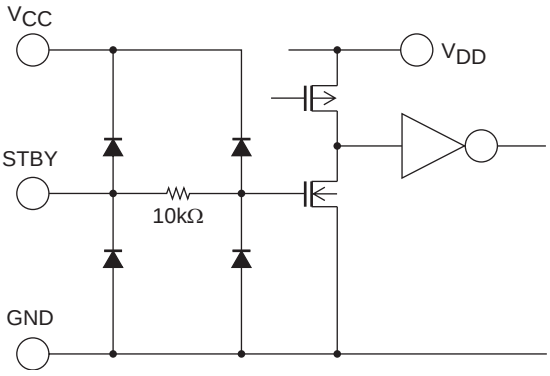
Pin No.	Pin name	Function
1	TEST	Test signal input: This pin must be connected to ground.
2	GND	Ground
3	RT	Reference current setting resistor connection
4	LEDON	External LED control pin
5	NC5	No connection
6	NC6	No connection
7	V_{CC}	Circuit system power supply
8	SDAI	Serial data signal input
9	SCLI	Serial clock signal input
10	NC10	No connection
11	NC11	No connection
12	V_{DD}	Power supply for logic system
13	STBY	Standby mode control
14	RLED	Red LED driver output
15	GLED	Green LED driver output
16	BLED	Blue LED driver output

Pin Functions

Pin No.	Symbol	Description	Equivalent circuit
4	LEDON	Control inputs for the three external colored LEDs. When an RSW, GSW, or BSW bit in the serial data is set to 1, the corresponding LED will be on when the voltage applied to the corresponding pin is high, and off when the voltage applied is low.	
8 9	SDAI SCLI	I^2C signal inputs	
3	RT	Reference current setting resistor connection. A reference current is created by connecting an external resistor between this pin and ground. The pin voltage is roughly 1.2V. The LED driver current can be changed by changing this current value.	
14 15 16	RLED GLED BLED	Driver outputs for the three color LEDs. Feedback is applied to control the current flowing in the output transistors to be the set value. Each of the driver output current levels can be set independently with the serial data.	

Continued on next page.

Continued from preceding page.

Pin No.	Symbol	Description	Equivalent circuit
1	TEST	Test signal input. This pin must be connected to ground.	
13	STBY	Standby mode pin. The LV5217GP goes to standby mode when the STBY pin is at the low level.	
7	V_{CC}	Circuit system power supply	
12	VDD	Power supply for Logic	
3	GND	Ground	

Power Supply Application

1. Either bring up V_{CC} and V_{DD} at the same time, or bring up V_{CC} first then V_{DD}.
2. Then, set the serial data. (After the serial data has been set, a period of about 2μs is required as the startup time for the IC internal circuits.)
3. Finally, clear the STBY pin states.

Serial Data Map

Register address								Data							
A7	A6	A5	A4	A3	A2	A1	A0	D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	0	0	0	0	RSW	R[6:0]						
								0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	GSW	G[6:0]						
								0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	0	BSW	B[6:0]						
								0	0	0	0	0	0	0	0

Upper row : Register name, Lower row : default value

Serial Data Mode Settings

R mode

0	0	0	0	0	0	0	0	D7	D6	D5	D4	D3	D2	D1	D0

LEDR output setting

D7	RSW
0	OFF (default)
1	ON

G mode

0	0	0	0	0	0	0	1	D7	D6	D5	D4	D3	D2	D1	D0

LEDR output setting

D7	GSW
0	OFF (default)
1	ON

B mode

0	0	0	0	0	0	1	0	D7	D6	D5	D4	D3	D2	D1	D0

LEDR output setting

D7	BSW
0	OFF (default)
1	ON

D6-D0 current setting (Common to R, G and B)

D6	D5	D4	D3	D2	D1	D0	Current [mA]
0	0	0	0	0	0	0	0.1 (Default) *1
0	0	0	0	0	0	1	0.31
0	0	0	0	0	1	0	0.52
0	0	0	0	0	1	1	0.72
0	0	0	0	1	0	0	0.93
0	0	0	0	1	0	1	1.13
0	0	0	0	1	1	0	1.34
0	0	0	0	1	1	1	1.54
0	0	0	1	0	0	0	1.74
0	0	0	1	0	0	1	1.94
0	0	0	1	0	1	0	2.14
0	0	0	1	0	1	1	2.34
0	0	0	1	1	0	0	2.54
0	0	0	1	1	0	1	2.74
0	0	0	1	1	1	0	2.95
0	0	0	1	1	1	1	3.15
0	0	1	0	0	0	0	3.35
0	0	1	0	0	0	1	3.46
0	0	1	0	0	1	0	3.76
0	0	1	0	0	1	1	3.97
0	0	1	0	1	0	0	4.17
0	0	1	0	1	0	1	4.37
0	0	1	0	1	1	0	4.57
0	0	1	0	1	1	1	4.76
0	0	1	1	0	0	0	4.97
0	0	1	1	0	0	1	5.17
0	0	1	1	0	1	0	5.37
0	0	1	1	0	1	1	5.57
0	0	1	1	1	0	0	5.78
0	0	1	1	1	0	1	5.98
0	0	1	1	1	1	0	6.18
0	0	1	1	1	1	1	6.39
0	1	0	0	0	0	0	6.60
0	1	0	0	0	0	1	6.80
0	1	0	0	0	1	0	6.99
0	1	0	0	0	1	1	7.19
0	1	0	0	1	0	0	7.39
0	1	0	0	1	0	1	7.60
0	1	0	0	1	1	0	7.80
0	1	0	0	1	1	1	7.99
0	1	0	1	0	0	0	8.19
0	1	0	1	0	0	1	8.40
0	1	0	1	0	1	0	8.60
0	1	0	1	0	1	1	8.80
0	1	0	1	1	0	0	9.00
0	1	0	1	1	0	1	9.20
0	1	0	1	1	1	0	9.40
0	1	0	1	1	1	1	9.60
0	1	1	0	0	0	0	9.80
0	1	1	0	0	0	1	10.00
0	1	1	0	0	1	0	10.20
0	1	1	0	0	1	1	10.40
0	1	1	0	1	0	0	10.60
0	1	1	0	1	0	1	10.80

Continued on next page.

Continued from preceding page.

D6	D5	D4	D3	D2	D1	D0	Current [mA]
0	1	1	0	1	1	0	11.00
0	1	1	0	1	1	1	11.20
0	1	1	1	0	0	0	11.40
0	1	1	1	0	0	1	11.60
0	1	1	1	0	1	0	11.80
0	1	1	1	0	1	1	12.00
0	1	1	1	1	0	0	12.20
0	1	1	1	1	0	1	12.40
0	1	1	1	1	1	0	12.60
0	1	1	1	1	1	1	12.80
1	0	0	0	0	0	0	12.99
1	0	0	0	0	0	1	13.19
1	0	0	0	0	1	0	13.39
1	0	0	0	0	1	1	13.59
1	0	0	0	1	0	0	13.79
1	0	0	0	1	0	1	13.98
1	0	0	0	1	1	0	14.18
1	0	0	0	1	1	1	14.38
1	0	0	1	0	0	0	14.58
1	0	0	1	0	0	1	14.78
1	0	0	1	0	1	0	14.97
1	0	0	1	0	1	1	15.17
1	0	0	1	1	0	0	15.37
1	0	0	1	1	0	1	15.57
1	0	0	1	1	1	0	15.77
1	0	0	1	1	1	1	15.96
1	0	1	0	0	0	0	16.16
1	0	1	0	0	0	1	16.36
1	0	1	0	0	1	0	16.56
1	0	1	0	0	1	1	16.76
1	0	1	0	1	0	0	16.96
1	0	1	0	1	0	1	17.15
1	0	1	0	1	1	0	17.35
1	0	1	0	1	1	1	17.55
1	0	1	1	0	0	0	17.75
1	0	1	1	0	0	1	17.95
1	0	1	1	0	1	0	18.15
1	0	1	1	0	1	1	18.34
1	0	1	1	1	0	0	18.54
1	0	1	1	1	0	1	18.74
1	0	1	1	1	1	0	18.94
1	0	1	1	1	1	1	19.14
1	1	0	0	0	0	0	19.33
1	1	0	0	0	0	1	19.53
1	1	0	0	0	1	0	19.73
1	1	0	0	0	1	1	19.93
1	1	0	0	1	0	0	20.13
1	1	0	0	1	0	1	20.32
1	1	0	0	1	1	0	20.52
1	1	0	0	1	1	1	20.72
1	1	0	1	0	0	0	20.92
1	1	0	1	0	0	1	21.12
1	1	0	1	0	1	0	21.31
1	1	0	1	0	1	1	21.51
1	1	0	1	1	0	0	21.71

Continued on next page.

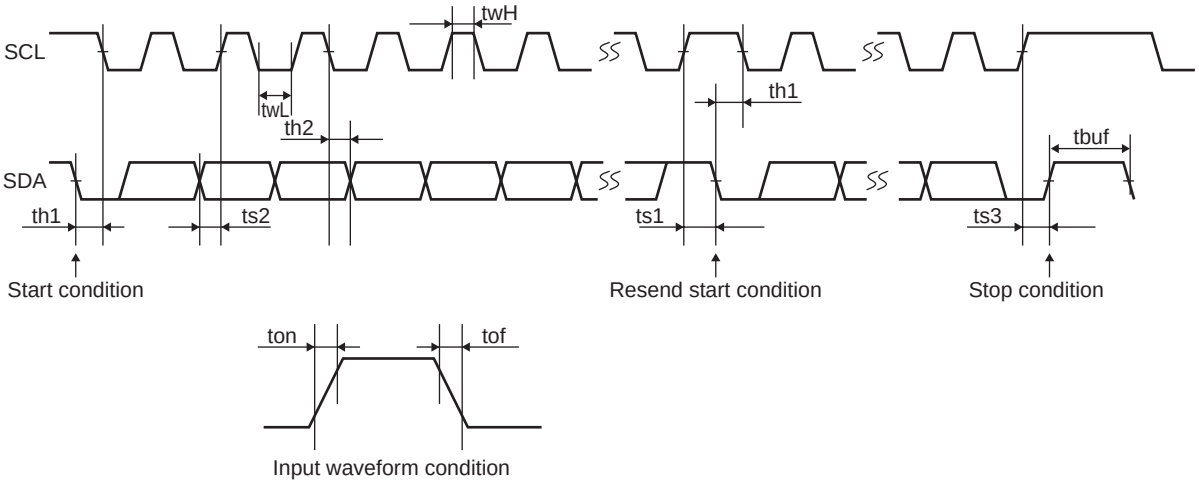
Continued from preceding page.

D6	D5	D4	D3	D2	D1	D0	Current [mA]
1	1	0	1	1	0	1	21.91
1	1	0	1	1	1	0	22.11
1	1	0	1	1	1	1	22.30
1	1	1	0	0	0	0	22.50
1	1	1	0	0	0	1	22.70
1	1	1	0	0	1	0	22.90
1	1	1	0	0	1	1	23.10
1	1	1	0	1	0	0	23.29
1	1	1	0	1	0	1	23.49
1	1	1	0	1	1	0	23.69
1	1	1	0	1	1	1	23.89
1	1	1	1	0	0	0	24.09
1	1	1	1	0	0	1	24.29
1	1	1	1	0	1	0	24.48
1	1	1	1	0	1	1	24.68
1	1	1	1	1	0	0	24.88
1	1	1	1	1	0	1	25.08
1	1	1	1	1	1	0	25.28
1	1	1	1	1	1	1	25.48

* Note 1 : There is significant current variance, so care should be taken for use. The current value can be set when D7 is “0.”

Serial Bus Communication Specifications

I^2C serial transfer timing conditions



Standard mode

Parameter	symbol	Conditions	min	typ	max	unit
SCL clock frequency	fscl	SCL clock frequency	0		100	kHz
Data setup time	ts1	The SCL setup time from the SDA rising edge	4.7			µs
	ts2	The SDA setup time from the SCL rising edge	250			ns
	ts3	The SCL setup time from the SDA rising edge	4.0			µs
Data hold time	th1	The SCL hold time from the SDA falling edge	4.0			µs
	th2	The SDA hold time from the SCL falling edge	0			µs
Pulse width	twL	SCL low period pulse width	4.7			µs
	twH	SCL high period pulse width	4.0			µs
Input waveform conditions	ton	SCL, SDA (input) rising time			1000	ns
	tof	SCL, SDA (input) falling time			300	ns
Bus free time	tbuf	Time between STOP and TART conditions	4.7			µs

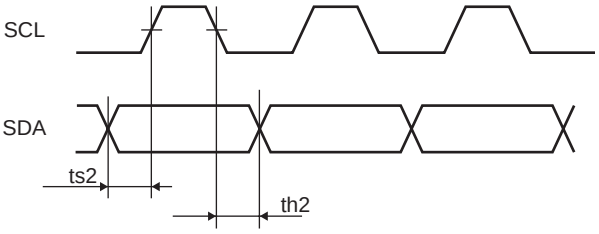
High-speed mode

Parameter	Symbol	Conditions	min	typ	max	unit
SCL clock frequency	fscl	SCL clock frequency	0		400	kHz
Data setup time	ts1	The SCL setup time from the SDA rising edge	0.6			µs
	ts2	The SDA setup time from the SCL rising edge	100			ns
	ts3	The SCL setup time from the SDA rising edge	0.6			µs
Data hold time	th1	The SCL hold time from the SDA falling edge	0.6			µs
	th2	The SDA hold time from the SCL falling edge	0			µs
Pulse width	twL	SCL low period pulse width	1.3			µs
	twH	SCL high period pulse width	0.6			µs
Input waveform conditions	ton	SCL, SDA (input) rising time			300	ns
	tof	SCL, SDA (input) falling time			300	ns
Bus free time	tbuf	Time between STOP condition and TART condition	1.3			µs

I²C bus transmission method

START condition and STOP condition

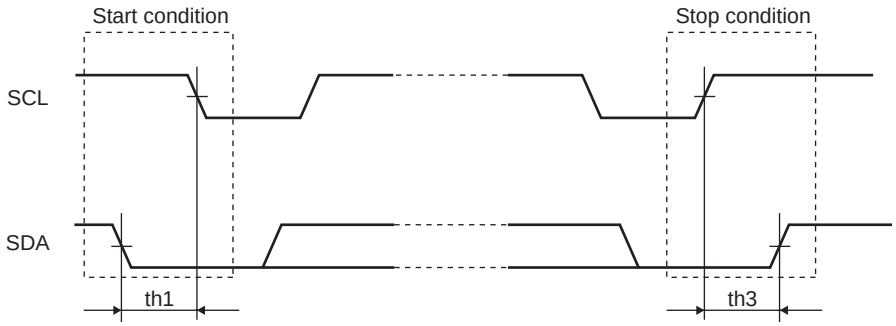
When transferring data over an I²C bus, SDA must basically be held in certain states while SCL is High, as shown in the figure below.



Both SCL and SDA are high when not performing data transfer.

When both SCL and SDA are high, changing SDA from high to low generates the START condition and starts access.

Changing SDA from low to high while SCL is high generates the STOP condition and ends access.



Data transfer and confirmation response

After the START condition is generated, data is transferred one byte (8 bits) at a time. Data can be transferred continuously for any number of bytes. The ACK signal is sent from the receiving to the transmitting side each time 8 bits of data are transferred.

The transmitting side releases the SDA line immediately after the SCL clock pulse corresponding to the 8th data transfer bit as it falls to Low, and the receiving side then sends the ACK signal by setting SDA Low.

After the receiving side sends the ACK signal, if the next byte transfer is still in receive mode, the receiving side releases the SDA line at the falling edge of the 9th SCL clock.

The I²C bus does not have a CE signal, so instead a 7-bit slave address is assigned to each device. The first byte of each transfer is assigned to this 7-bit slave address and a command (R/W) indicating the transfer direction of the following data. Note that only Write mode is valid for this IC.

The 7-bit address is transferred in order from the MSB, and the 8th bit is Low to indicate Write mode.

The LV5217GP slave address is prescribed as “1110101.”