Ordering number : EN*A2222

LC824206XA

Advance Information

ON Semiconductor®

http://onsemi.com

5:1 Micro USB Switch with Accessory detection and OVP

Overview

The LC824206XA is the IC suitable for use in multi function and high performance switch as well as compatible accessory detector which supports micro USB connector for DSC, DVC and mobile phone.
This IC includes low impedance USB supply switch (100 mΩ) which enables high speed battery charge as well as USB2.0-capable switch with low input capacitance, negative input-capable low distortion audio switch, UART, microphone (Mono, Stereo), and various video signal switches, in addition MHL (Mobile High definition Link) switch is integrated.
Also, this IC integrates auto detector for accessories which is capable of detecting accessories compliant to CEA936-A automotive kit, ACA standard and Battery Charging Specification (BCS) rev.1.2 which includes MCPC standard established in June 2010. In addition, it's capable of detecting a lot of charger accessories, such as Dedicated (D+/D- short) charger, Apple charger, SONY charger, CDP (Charging Downstream Port) charger, USB charger and so on.
Switching operation is controlled via I^2C serial interface.

Function

■ Configuration
- Audio-SW (Mono/Stereo, Negative signal capable)
- USB2.0-SW (LowSpeed/ FullSpeed/ HighSpeed-capable)
  - MHL-mode : MHL-TMDS signal by USB-2ch
- UART-SW
- CBUS/Video-SW
  - MHL-mode : MHL-CBUS signal
  - NTSC-mode : Composite (CVBS) signal
- MIC-SW (DP/VBUS switch, Mono/Stereo-capable)
- VBUS-SW
  - High speed battery charge –capable (100 mΩ)
  - Integrated OVP, OCP, TSD
  - DP/DM short-circuit detection, VBUS auto detection
  - Various charger detection (Dedicated, Apple, SONY, CDP, USB)
- ID detection function
  - Integrated 5-bit ADC
  - I^2C Interrupt function

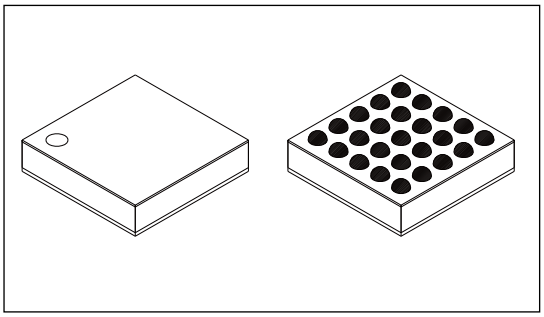
■ Package
- WLCSP Pin25, 2.17 mm × 2.17 mm, 0.4 mm pitch
- Halogen-free, lead-free-capable

■ Operating temperature
- –30 to 85°C

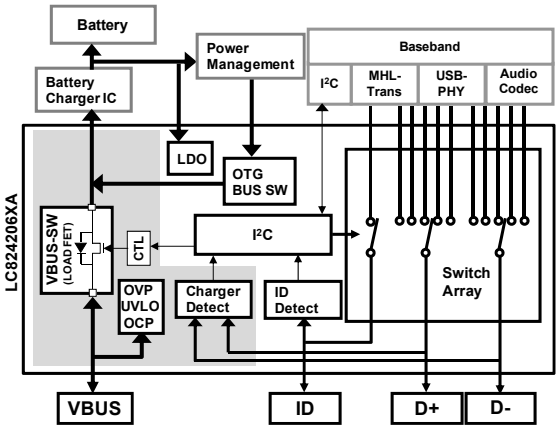
■ Supply voltage
- VBAT: 3.1 to 4.6 V
- VBUS: 4.5 to 5.5 V

■ ID detection for the accessories
- MCPC standard, CEA936-A automotive kit standard, ACA standard-compliant, Battery Charging Specification rev.1.2 compliant

■ Application
- DSC, DVC, mobile phone



WLP25J(2.17X2.17)



Application Diagram

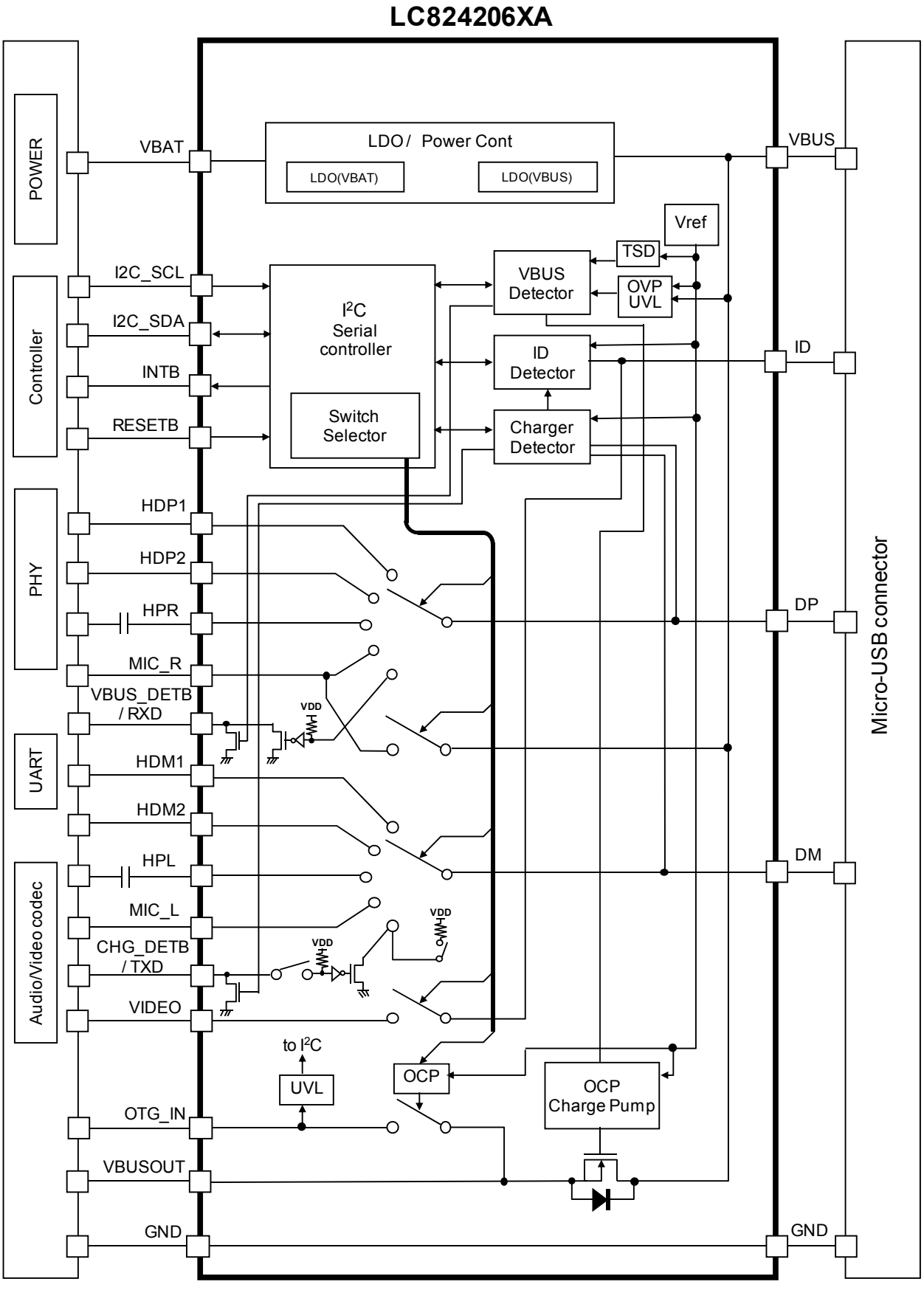
This document contains information on a new product. Specifications and information herein are subject to change without notice.

ORDERING INFORMATION

See detailed ordering and shipping information on page 15 of this data sheet.

Semiconductor Components Industries, LLC, 2013

Block Diagram



Pin Assignment

Top Through View

	1	2	3	4	5
A	VBAT	OTG_IN	VBUSOUT	VBUS	VBUS
B	INTB	RESETB	VBUSOUT	HPL	DM
C	I2C_SCL	MIC_L	HDM1	HDM2	DP
D	I2C_SDA	MIC_R	HDP1	HDP2	ID
E	CHG _DETB /TXD	VBUS _DETB /RXD	CBUS /VIDEO	HPR	GND

Pin Description

Ball No.	Name	Direction	Description
A1	VBAT	P	Power Supply for SW-IC
A2	OTG_IN	P	VBUS Power Supply for USB OTG Accessories
A3,B3	VBUSOUT	O	VBUS Output
A4,A5	VBUS	P/I	Power Supply for USB and Battery, MIC input
B1	INTB	O	Interrupt signal*
B2	RESETB	I/P	Hard Reset input / Power Supply (VDDIO) for I/O circuit of I^2C
B4	HPL	I	Audio Left input
B5	DM	I/O	USB bus, Audio output, MIC_L input, UART input, MHL(TDMS)minus output
C1	I2C_SCL	I	I^2C Serial Clock signal
C2	MIC_L	O	Stereo MIC L output
C3	HDM1	I/O	USB differential data I/O minus #1
C4	HDM2	I/O	USB differential data I/O minus #2 MHL(TMDS)minus input
C5	DP	I/O	USB bus, Audio output, MIC_R input, UART output*, MHL(TDMS)plus output
D1	I2C_SDA	I/O	I^2C Serial Data signal*
D2	MIC_R	O	Stereo MIC R output, MIC(VBUS) output
D3	HDP1	I/O	USB differential data I/O plus #1
D4	HDP2	I/O	USB differential data I/O plus #2 MHL(TMDS)plus output
D5	ID	I/O	ID input, CBUS(MHL)output, Video(CVBS)output
E1	CHG_DETB / TXD	O (I)	Charger Detection output* / UART transmission data input
E2	VBUS_DETB / RXD	O (O)	VBUS Detection output* / UART receive data output*
E3	CBUS/VIDEO	I	CBUS(MHL)input, Video(CVBS)input
E4	HPR	I	Audio Right input
E5	GND	P	Ground

* Open Drain

Notice) If Video function is not needed, please use the port of Video as NC pins.

Notice) Even if you supply 5 V for VBUS at the time of the UART communication, the charger detection information and VBUS information are not output on the ports of VBUS_DETB and CHG_DETB.

Absolute Maximum Ratings at Ta = 25°C

Parameter		Ratings	Unit
Maximum supply voltage	VBAT	−0.3 to 6.0	V
	VBUS	−0.3 to 28.0	V
Maximum input/output voltage (DP/DM to signal pin)	USB1,2_Path	−0.5 to 4.6	V
	UART_Path	−0.3 to 4.6	V
	AUDIO_Path	−1.5 to 4.6	V
	AUDIO input range	3.0	Vpp
	MIC(DP)_Path	−0.5 to 4.6	V
	MIC(DP) input range	2.0	Vpp
	Stereo-MIC_Path	−0.5 to 4.6	V
	Stereo-MICinput range	2.0	Vpp
	MHL(TMDS)_Path	−0.3 to 4.6	V
Maximum input/output voltage (VBUS pin to MIC pin)	MIC(VBUS)_Path	−0.3 to 4.6	V
	MIC(VBUS) input range	2.0	Vpp
Maximum input/output voltage (CBUS/VIDEO pin to ID pin)	CBUS/VIDEO_Path (CBUS/CVBS)	−1.5 to 4.6	V
	VIDEO input range (CVBS)	3.0	Vpp
	ID	−0.3 to 6.0	V
Maximum input/output voltage	VBUSOUT (output only)	−0.3 to 6.0	V
	OTG_IN	−0.3 to 6.0	V
	Others*1)	−0.3 to 4.6	V
Allowable loss*2)	Pd (Ta = 25°C)	690	mW
Operating temperature range	Topr	−30 to +85	°C
Storage temperature range	Tstg	−55 to +125	°C

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.

*1) The Others means I2C_SCL, I2C_SDA, INTB, RESETB, CHG_DETB, and VBUS_DETB pin.

*2) The values were obtained with glass epoxy board of 50 x 40 x 0.9t mm.

Recommended Operating Conditions at Ta = 25°C

Parameter	Symbol	Min	Max	Unit	Condition
VBAT voltage	VBAT	3.1	4.6	V	
VBUS voltage	VBUS	4.5	5.5	V	
AUDIO input range	VSW_AUDIO	−1.4	1.4	V	
MIC(DP) input range	VSW_MICDP	0	2.5	V	Bias < 2.0 V, 1.0 Vpp
MIC(VBUS) input range	VSW_MICVBUS	0	2.5	V	Bias < 2.0 V, 1.0 Vpp
Stereo-MIC input range	VSW_SMIC	0	2.5	V	Bias < 2.0 V, 1.0 Vpp
CBUS input range	VSW_VCBUS	0	1.9	V	
VIDEO input range	VSW_VIDEO	−1.4	1.4	V	1.0 Vpp
USB input range	VUSBin	0	3.6	V	
USB2(MHL) input range	VMHLin	0	3.6	V	
UART input range	VUARTin	0	3.6	V	
OTG voltage*1)	VOTGin	4.5	5.5	V	
Other signal input*2)	Vin	0	3.6	V	
Allowed capacitance of load of accessory ID pin	IDcap		300	pF	

* 1) OTG current is permitted to 350 mA.
* 2) Other signal input signifies I2C_SCL, I2C_SDA, RESETB, pin.

Electrical Characteristics at Ta = 25°C

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
■VBAT Current Consumption						
Sleep Mode Current	IDDS2	VBUS = open, RESETB from 0 V to VDDIO, I2C_SCL = I2C_SDA = VDDIO, Others_pin = open	-	9	15	μA
Active Mode Current (Audio + VBUS MIC-mode)	IDD1	AUDIO-mode(287k) VBUS = open, RESETB = VDDIO, I2C_SCL = I2C_SDA = VDDIO, Others_pin = open	-	80	100	μA
Active Mode Current (USB mode)	IDD2	USB-mode(open) VBUS = 5.0 V, RESETB = VDDIO, I2C_SCL = I2C_SDA = VDDIO, Others_pin = open	-	80	100	μA
■AUDIO-SW						
Signal Range	VIN_LR		−1.4	-	1.4	V
AUDIO_SW ON Resistance	RLR	HPR/HPL = -10 mA, DP/DM = -1.3 V, Calculated by R = V / 0.01	-	6.5	11	Ω
Pull Down Resistance	RHPLR		25	50	100	kΩ
■USB-SW						
Signal Range	VIN_USB		0	-	3.6	V
USB_SW ON Resistance	RONUSB	DP/DM = 0 V, HDP1/HDM1 SINK = 10 mA, Calculated by R = V / 0.01		3.2	4.7	Ω
■MHL-SW						
Signal Range	VIN_USB		0	-	3.6	V
MHL_SW ON Resistance	RONUSB	DP/DM = 1.6 V, HDP2/HDM2 SINK = 10 mA, Calculated by R = V / 0.01		5	6.5	Ω
■StereoMIC-SW (include DP_MIC)						
Signal Range	VIN_MIC3		0	-	2.5	V
MIC_SW ON Resistance	RMIC3	DP/DM = 0.1 V, MIC_R/MIC_L = -10 mA, Calculated by R = V / 0.01	-	7.5	14	Ω
■MIC-SW (VBUS Input)						
Signal Range	VIN_MIC2		0	-	2.5	V
MIC_SW ON Resistance	RMIC2	VBUS = 0.1 V, MIC_R = -10 mA, Calculated by R = V / 0.01	-	11.5	14.5	Ω
■VIDEO-SW (analog mode)						
Signal Range	VIN_VCVBS	VSW_VIDEO = 1.0 Vpp	−1.4	-	1.4	V
VIDEO_SW ON Resistance analog mode	RVCVBS	CBUS/Video = -1.4 V, ID = -10 mA, Calculated by R = V / 0.01	-	4	7.5	Ω
■VIDEO-SW (MHL mode)						
Signal Range	VIN_VCBUS	VSW_VIDEO = 1.0 Vpp	0	-	2.0	V
VIDEO_SW ON Resistance MHL mode (CBUS)	RVCBUS	CBUS/Video = 0 V, ID = -10 mA, Calculated by R = V / 0.01 VBUS = 4.5 V	-	4	7.5	Ω

Electrical Characteristics at Ta = 25°C

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
■UART-SW						
TX (DM)						
Low Level Output Voltage	VOL_TX	SINK = 1 mA	-	-	0.4	V
Pull Up Resistance	RTX		5	10	15	kΩ
TXD						
High Level Input Voltage	VIHTXD		1.5	-	-	V
Low Level Input Voltage	VILTXD		-	-	0.7	V
Pull Up Resistance	RTXD		5	10	15	kΩ
RX (DP)						
High Level Input Voltage	VIHRX		1.5	-	-	V
Low Level Input Voltage	VILRX		-	-	0.7	V
Pull Up Resistance	RRX		5	10	15	kΩ
RXD						
Low Level Output Voltage	VOL_RXD	SINK = 1 mA	-	-	0.4	V
■VBUS-SW						
VBUS_SW ON Resistance	RVBUS	VBUS = 5.0 V, VBUSOUT = -300 mA, Calculated by R = V / 0.3	-	100	190	mΩ
VBUS Detection Voltage	VVBUSH_DET	VBAT = 3.8 V	3.8	4.0	4.2	V
VBUS Cancel Voltage	VVBUSL_DET	VBAT = 3.8 V	3.0	3.2	3.4	V
OVP Threshold Voltage	VOVP	VBAT = 3.8 V	5.8	6.0	6.4	V
Over Current Limit	ICL2	VBUS_ILIMIT = Mid	500	-	(1000)	mA
	ICL3	VBUS_ILIMIT = High	800	-	(1500)	mA
	ICL4	VBUS_ILIMIT = Super	1500	-	-	mA
■OTG-SW						
OTG_SW ON Resistance	ROTG	OTG_IN = 5 V, VBUS = -100 mA Calculated by R = V / 0.1	-	1.5	2.8	Ω
OTG_IN UVL Voltage	VOTGH_DET	VBAT = 3.8 V	3.0	3.2	3.4	V
VBUS Detection Voltage @OTG_ON	VOTGL_DET	VBAT = 3.8 V	3.0	3.2	3.4	V
■ I2C_SCL, I2C_SDA						
High Level Input Voltage	VIH_I2C	VBAT = 3.8 V VDDIO = 1.8 to 3.6 V	0.7*VDDIO	-	VDDIO+0.5	V
Low Level Input Voltage	VIL_I2C	VBAT = 3.8 V VDDIO = 1.8 to 3.6 V	-0.3	-	0.3*VDDIO	V
Hysteresis of inputs	VHYS_I2C	VBAT = 3.8 V VDDIO = 1.8 to 3.6 V	0.05*VDDIO	-	-	V
■ RESETB						
High Level Input Voltage	VIH_IO		1.5	-	-	V
Low Level Input Voltage	VIL_IO		-	-	0.3	V
■ I2C_SDA, INTB						
Low Level Output Voltage	VOL_I2C	SINK = 3 mA	-	-	0.4	V
■ CHG_DETB						
Low Level Output Voltage	VOL_DETB	SINK = 3 mA	-	-	0.4	V
■ VBUS_DETB						
Low Level Output Voltage	VOL_DETB	SINK = 0.5 mA	-	-	0.4	V

Function Description

Charger Detection

By using charger detector circuit including built-in D+/D- short-circuit detector, you can judge the connection of DP pin and DM pin and then detect charger according to USB Charger and Battery Charging Specification Revision 1.2 as well as CEA936-A automotive kit specification. This IC can detect the charger of the following list.

Detectable charger list
Standard Downstream Port (USB mode)
Dedicated Charging Port (D+/D- short ACC)
Charging Downstream Port (USB mode)
Apple Charger
SONY Charger
D- High Charger (Basic CarKit Type1,2 ACC)
VBUS only ACC (No Charger Detect)

Accessory ID Detection

Accessory is detected according to CEA936-A automotive kit and ACA standard including MCPC standard using ID detection circuit including built-in 5-bit ADC. Accessories are judged from the resistance value of accessory (RID) connected to ID pin. ID range of RID varies depends on each standard. See Resistance (RID) and Detectable accessory for the further details.

Resistance (RID) and Detectable Accessory

RID	Detectable Accessory	Comments
Open	No Accessory	
Open	AC Adapter (Fast Charger)	(D+/D- : Shorted)
Open(over 1M)	USB-Mode	(D+/D- : Not shorted)
750k + 47k (759k-835k)	Audio with MIC (Mono)	
	Audio with MIC (Mono) +Charger (Std Charger) with VBUS	(D+/D- : Not shorted)
510k + 47k (531k-583k)	Audio (Mono Earphone) + MIC (D+ in)	Carkit (Type2)
	Audio (Mono Earphone) + Charger (Std Charger) + MIC (D+ in) with VBUS	(D+/D- : Not shorted)
440k (436k-444k)	Fast Charger (Typ2 Charger)	Charger 5Wire/Type2 (D+/D- : Shorted)
	Carkit (Type2)	BasicCarkit 5Wire/type2 also used for Muting (D- : High)
390k (379k-408k)	Video-Audio	
	Video-Audio with VBUS	(D+/D- : Not shorted)

Resistance (RID) and Detectable Accessory

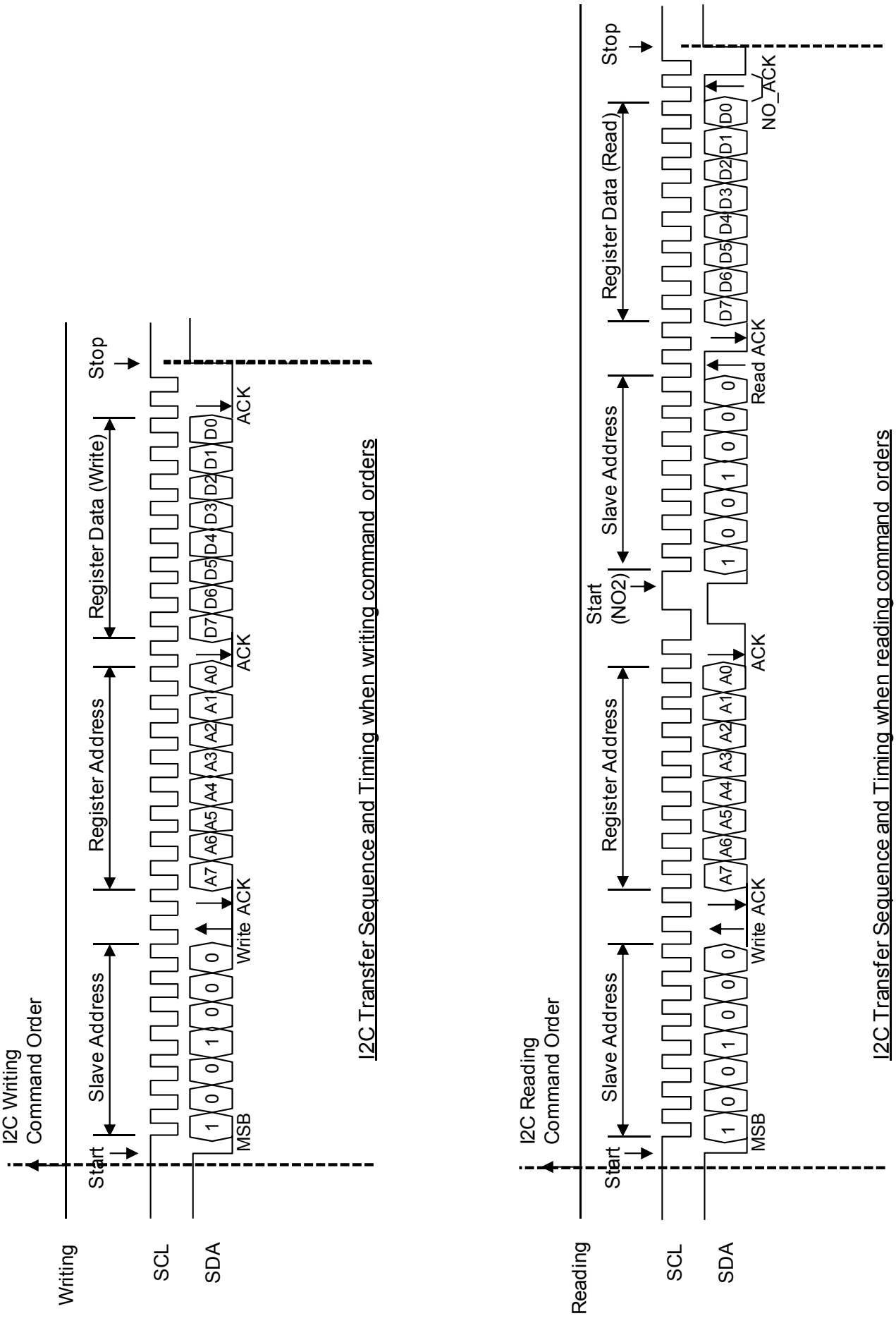
RID	Detectable Accessory	Comments
240k + 47k (275k-294k)	Audio with MIC (Stereo)	
	Audio with VBUS (Stereo)	MIC-SW turns off when VBUS Detection
200k (198k-202k)	Std Charger (Typ1Charger)	Charger 5Wire/Type1 (D+/D- : Shorted)
	Carkit (Type1)	BasicCarkit 5Wire / type1 also used for Muting (D- : High)
150k-180k	UART	
119k-124k-132k	RID_A	ACA A-device (RID_A) Vbus come fm Charger
100k-102k (96k-106k)	Audio (Stereo)	Headset / Stereo
		Phone Powered Accessory (D+/D- : Not shorted)
65k- 68k-72k	RID_B	ACA B-device, no connect (RID_B) Vbus come fm Charger can SRP
35k-36.5k-39k	RID_C	ACA B-device, no connect (RID_C) Vbus come fm Charger no SRP
20k	Custom Accessory	
14k	Stereo-MIC	
9.8k	Stereo-MIC	
7k	Custom Accessory	
4k	Custom Accessory	
3.1k	Custom Accessory with VBUS	(D+/D- : Not shorted)
2.5k	Custom Accessory	
0.8k-1.2k	MHL with VBUS	(D+/D- : Not shorted)
75	Video	
	Video with VBUS	(D+/D- : Not shorted)
0-10	USB-OTG Host	

Table of Resistance (RID) and Selecting switch.

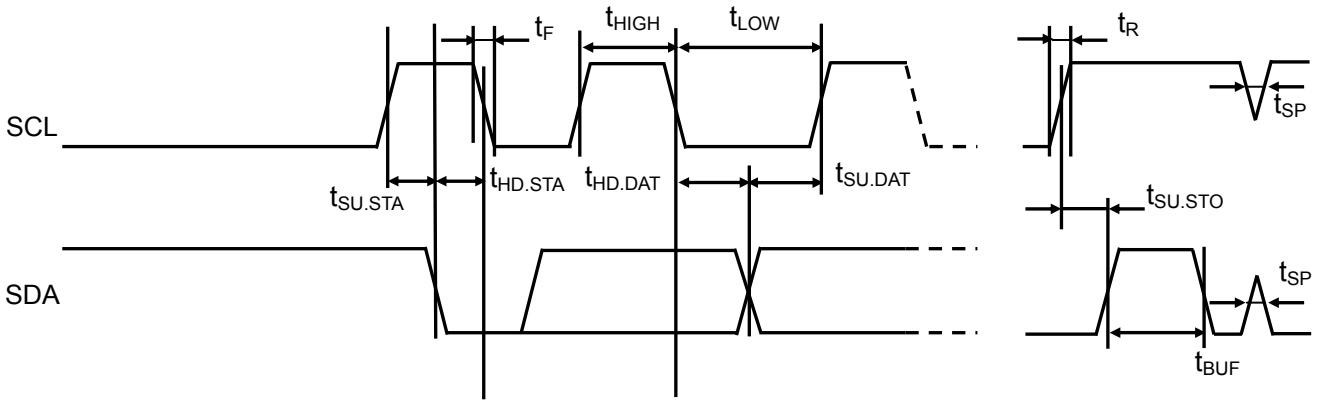
RID	Detectable Accessory	SW Selection							
		VBUS	USB1	USB2	UART	AUDIO	MIC	CBUS /VIDEO	OTG
Open	No Accessory	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	AC Adapter (Fast Charger)	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	USB-Mode	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
750k + 47k	Audio with MIC (Mono)	OFF	OFF	OFF	OFF	ON (HPL)	ON (VBUS _MIC)	OFF	OFF
	Audio (Mono) + Charger (Std Charger)	ON	OFF	OFF	OFF	ON (HPL)	OFF	OFF	OFF
510k + 47k	Audio (Mono) + MIC (D+in)	OFF	OFF	OFF	OFF	ON (HPL)	ON (D+in)	OFF	OFF
	Audio (Mono Earphone) + Charger (Std Charger) + MIC (D+in)	ON	OFF	OFF	OFF	ON (HPL)	ON (D+in)	OFF	OFF
440k	Fast Charger (Type2)	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	Carkit (Type2)	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF
390k	Video-Audio	OFF	OFF	OFF	OFF	ON	OFF	ON	OFF
	Video-Audio with VBUS	ON	OFF	OFF	OFF	ON	OFF	ON	OFF
240k + 47k	Audio with MIC (Stereo)	OFF	OFF	OFF	OFF	ON	ON (VBUS _MIC)	OFF	OFF
	Audio with VBUS (Stereo)	ON	OFF	OFF	OFF	ON	OFF	OFF	OFF
200k	Std Charger (Typ1Charger)	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	Carkit (Type 1)	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF
150k-180k	UART	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF
119k-124k-132k	RID_A	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
100k-102k	Audio (Stereo) Headset/Stereo	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF
	Phone Powered Accessory :D+/D- not shorted	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF
65k-68k-72k	RID_B	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF
35k-36.5k-39k	RID_C	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
20k	Custom Accessory*	-	-	-	-	-	-	-	-
14k	Stereo-MIC	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF
9.8k	Stereo-MIC	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF
7k	Custom Accessory*	-	-	-	-	-	-	-	-
4k	Custom Accessory*	-	-	-	-	-	-	-	-
3.1k	Custom Accessory with VBUS*	-	-	-	-	-	-	-	-
2.5k	Reserved	-	-	-	-	-	-	-	-
0.8k-1.2k	MHL	ON	OFF	ON	OFF	OFF	OFF	ON	OFF
75	Video	OFF	OFF	OFF	OFF	ON	OFF	ON	OFF
	Video with VBUS	ON	OFF	OFF	OFF	ON	OFF	ON	OFF
0-10	USB-OTG Host	OFF	ON	OFF	OFF	OFF	OFF	OFF	ON

Note *) Custom Accessory : User can define SW selection.

I²Cbus timing (serial I/F)

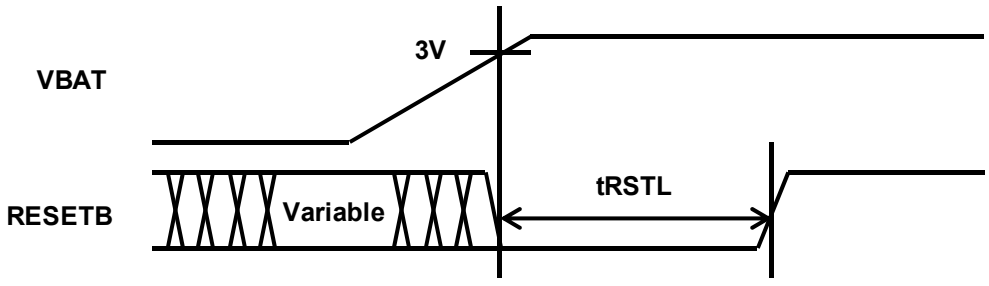


*I^{2}Cbus timing



Symbol	Parameter	Min	Max	Unit
tSCL	SCL clock fr.	0	400	kHz
tBUF	Bus release period	1.3		μs
tHD:STA	Hold time (Start)	0.6		μs
tLOW	SCL_Lo period	1.3		μs
tHIGH	SCL_Hi period	0.6		μs
tR	Rise time		300	ns
tF	Fall time		300	ns
tSU:STA	Setup time (Start)	0.6		μs
tSU:STO	Setup time (Stop)	0.6		μs
tSU:DAT	Setup time (Data)	100		ns
tHD:DAT	Hold time (Data)	0		ns
tSP	Removable spike width		50	ns

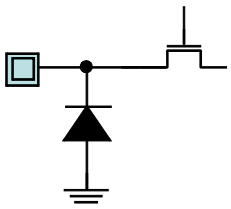
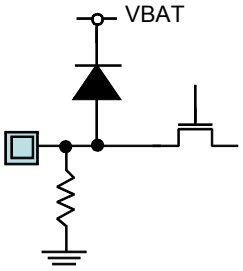
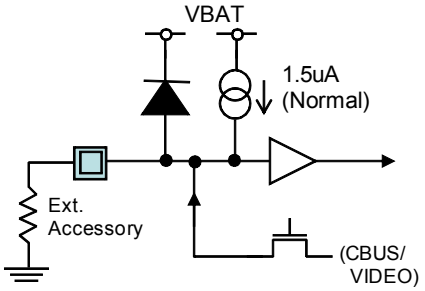
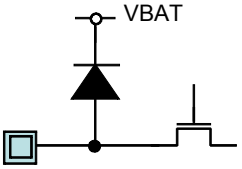
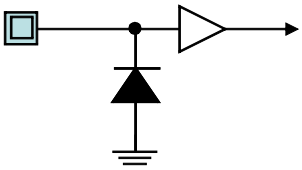
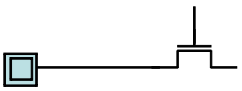
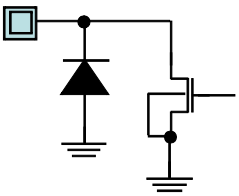
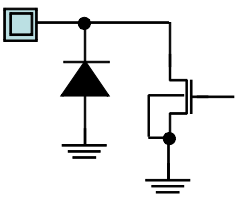
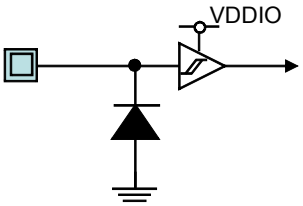
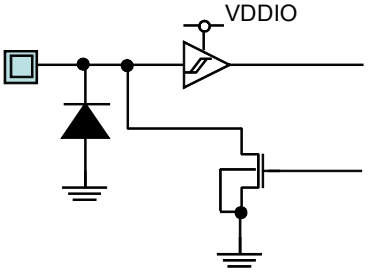
I^{2}C system reset



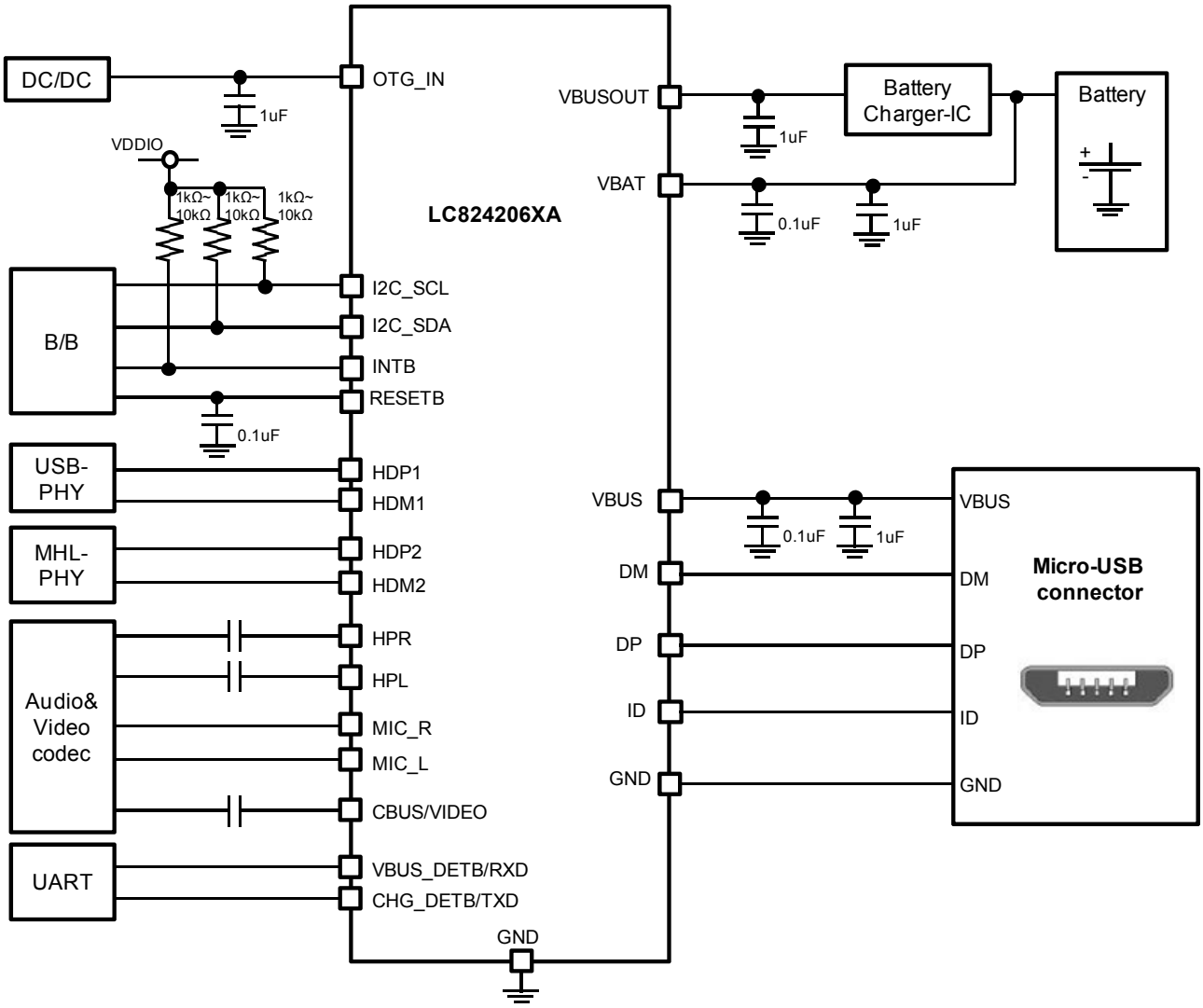
Symbol	Parameter	Min	Max	Unit
tRSTL * 1)	resetLow time	100		μs

* 1) RESETB is the reset signal of the group of register by I^{2}C. Therefore, you need Low period for tRSTL after powering VBAT.

I/O Equivalent Circuit

Port Name	Circuit	Port Name	Circuit
VBUS VBUSOUT OTG_IN		HPL HPR	
ID		MIC_L MIC_R CBUS /VIDEO	
RESETB (VDDIO)		DP DM HDP1 HDM1 HDP2 HDM2	
VBUS_DETB / RXD		INTB CHG_DETB / TXD	
I2C_SCL		I2C_SDA	

Application Circuit Example



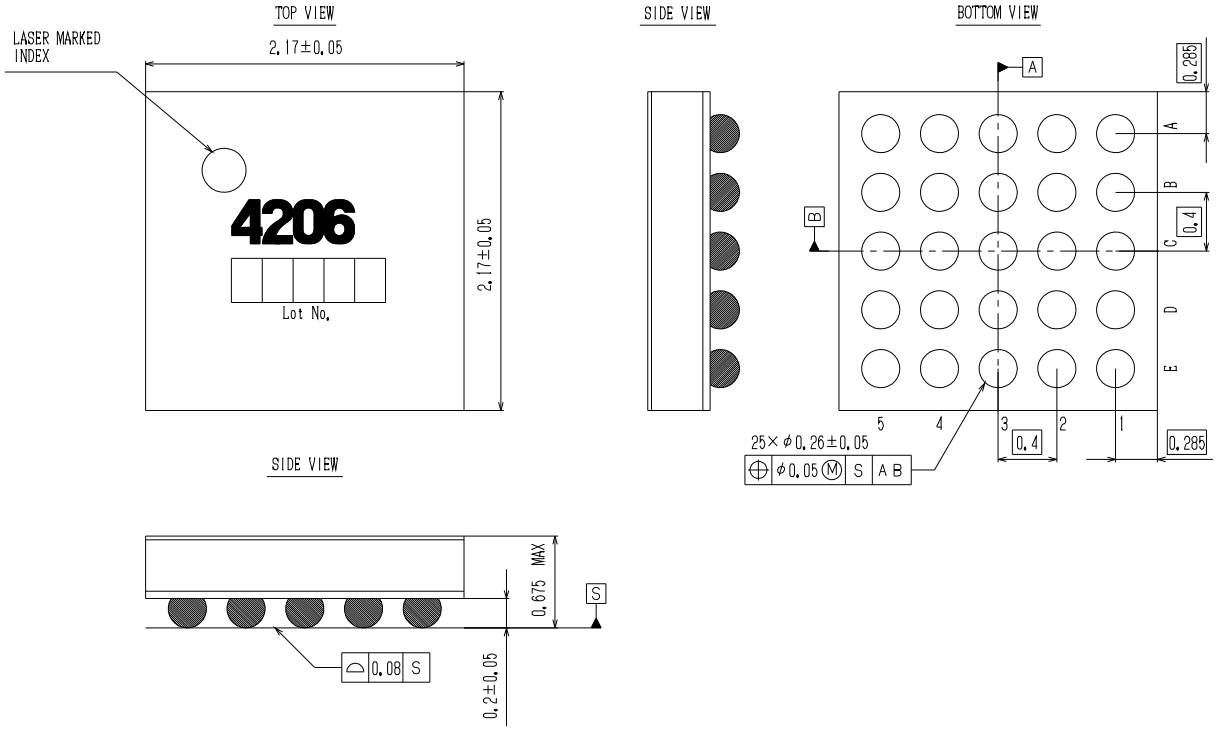
Caution:

(1) Connect a capacitor higher than 1 μF to VBUSOUT

(2) Make sure to connect capacitor (C cut) to VIDEO pin.

Package Dimensions

WLCSP 25pin 2.17 mm × 2.17 mm, 0.4 mm pitch
unit : mm



ORDERING INFORMATION

Device	Package	Shipping (Qty / Packing)
LC824206XA--VH	WLP25J(2.17X2.17) (Pb-Free / Halogen Free)	5000 / Tape & Reel

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