FEATURES

- USB Type-C 1.4 and PD 3.0 compliant
  - USB-IF Certified. TID: 875, XID: 5400
  - Support SOP' communication
  - Integrated transceiver (BMC PHY)
  - Support both structured VDM version 1.0 and 2.0
- High integration
  - Embedded both side Ra resistors
  - Embedded both side VCONN diodes
  - Embedded MTP
- Different package options:
  - DFN-6L(HFBP-6L) 2mmx2mm, 0.65mm pitch
  - DFN-8L 2mmx3mm, 0.5mm pitch
  - WLCSP-6B, 0.875mmx1.425mm, 0.4mm pitch
- Support multiple times programming or fuse lock
- Compatible with third party programming tools
- Support 2.7V ~ 5.5V operation on VCONN1 and VCONN2 pins
- Custom structured VDM writing through CC pin
- Slew rate control for BMC signal to reduce EMI
- 25V high voltage protection on CC, VCONN1 and VCONN2 pins
- Support Thunderbolt 3 40Gbps data communication
- Support Get Manufacturer Info command
- ±8 kV HBM ESD on CC, VCONN1 and VCONN2 pins

APPLICATIONS

- USB Type-C Cable ID

GENERAL DESCRIPTION

HUSB332 is a USB Type-C E-Marker for Cable ID applications. It is compliant with USB Type-C Specification Revision 1.4 and USB Power Delivery Specification Revision 3.0.

Powered from VCONN1 or VCONN2, HUSB332 can determine to act as SOP'. The built-in MTP can be programmed through CC line or I²C bus so that it will be flexible for in-system programming.

The HUSB332 operates over a wide supply range of 2.7 V to 5.5 V. It is available in DFN-6L(HFBP-6L), DFN-8L and WLCSP-6B packages. It is rated over the -40°C to +85°C temperature range.

TYPICAL APPLICATION CIRCUIT

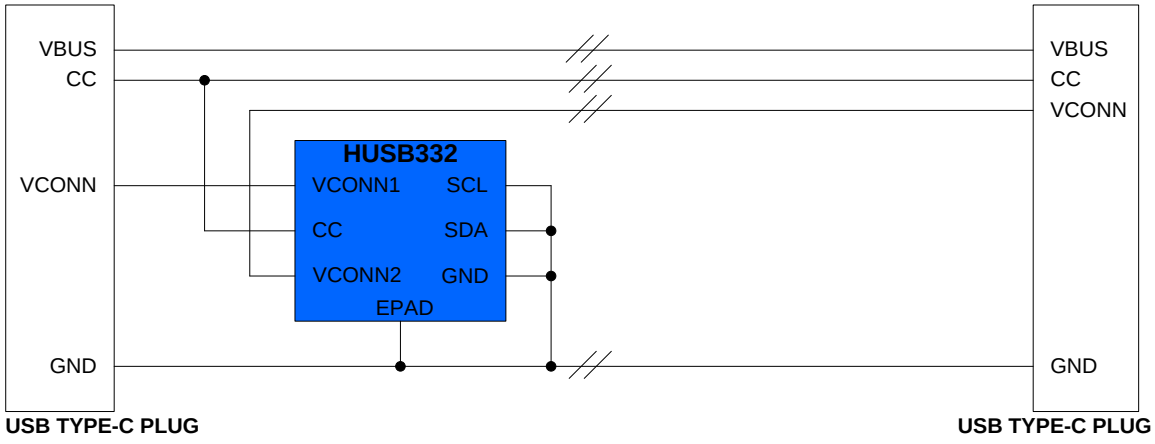


Figure 1.HUSB332 Application Diagram

REVISION HISTORY

Version	Data	Description
V1.0	June 8, 2019	Release version
V1.1	August 6, 2019	Update UVLO threshold
V1.2	September 6, 2019	Add DFN-8L package
V1.3	December 15, 2019	Add HUSB332_U22A
V1.4	May 5, 2020	Add WLCSP-6B package
V1.5	June 8, 2020	Update Figure 2, Figure 5 and Figure 6
V1.6	August 7, 2020	Update Package Dimension
V1.7	January 26, 2021	Add HFBP-6L package
V1.8	March 8, 2021	Add supply current in Table 1
V1.9	May, 2021	Update Ordering Guide Table

Contents

SPECIFICATIONS

GENERAL SPECIFICATIONS

V_{DD} = 5 V, T_A = 25°C, unless otherwise noted.

Table 1.

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
GENERAL PARAMETERS						
VCONN1/VCONN2 Voltage	V_{DD}		2.7	5	5.5	V
Under-voltage Lockout	V_{DD_UVLO}			2.6		V
Supply Current		Standby mode	1	2	3	mA
Operating Junction Temperature	T_J		-40		125	°C
Operating Ambient Temperature	T_A		-40		85	°C
BMC COMMON PARAMETERS						
Bit Rate	$f_{BitRate}$		270	300	330	Kbps
BMC TX PARAMETERS						
Maximum Difference between the Bit-rate during the Part of the Packet Following the Preamble and the Reference Bit-rate.	$p_{BitRate}$				0.25	%
Time to Cease Driving the Line after the And of the Last bit of the Frame.	$t_{EndDriveBMC}$				23	µs
Fall Time	t_{Fall}		300			ns
Time to cease driving the line after the final high-to-low transition.	$t_{HoldLowBMC}$		1			µs
Time from the End of Last Bit of a Frame until the Start of the First bit of the Next Preamble.	$t_{InterFrameGap}$		25			µs
Rise Time	t_{Rise}		300			ns
Time Before the Start of the First Bit of the Preamble when the Transmitter shall Start Driving the Line.	$t_{StartDrive}$		-1		1	µs
Voltage Swing	v_{Swing}		1.05	1.125	1.2	V
Transmit Low Voltage			-75		75	mV
Transmitter Output Impedance	z_{Driver}		33	54	-	Ω
BMC RX PARAMETERS						
Power Cable Termination	R_a		800		1200	Ω
Time Window for Detecting Bus Non-idle	$t_{TransitionWindow}$		12		20	µs
Number to Count to Detect Bus Non-idle	n_{Count}		3			
Time constant of a single pole filter to limit broad-band noise ingression	$t_{RxFilter}$		100			ns
Receiver Input Impedance	z_{BmcRx}		10			MΩ

ABSOLUTE MAXIMUM RATINGS

Table 2.

Parameter	Rating
VCONN1, VCONN2 and CC to GND	−0.5V to +25V
NC Pins to GND	−0.5V to +3.6V
Storage Temperature Range	−65°C to +150°C
Operating Junction Temperature Range	−40°C to +125°C
ESD HBM (Human Body Model) on CC, VCONN1 and VCONN2 pins	±8 kV
ESD HBM (Human Body Model) on SDA and SCL pins	±5 kV
ESD MM (Machine Model)	200 V
Soldering Conditions	JEDEC J-STD-020

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

THERMAL RESISTANCE

θ_{JA} is specified for the worst-case conditions, that is, a device soldered in a circuit board for surface-mount packages.

Table 3. Thermal Resistance

Package Type	θ_{JA}	θ_{JC}	Unit
DFN-6L(HFBP-6L)	45.5	11.7	°C/W
DFN-8L	31.5	7.5	°C/W
WLCSP-6B	-	-	°C/W

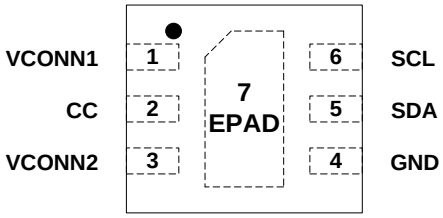
Maximum Power Dissipation

The maximum safe power dissipation in the HUSB332 package is limited by the associated rise in junction temperature (T_J) on the die. At approximately 150°C, which is the glass transition temperature, the plastic changes its properties. Even temporarily exceeding this temperature limit may change the stresses that the package exerts on the die, permanently shifting the parametric performance of the HUSB332. Exceeding a junction temperature of 175°C for an extended period of time can result in changes in the silicon devices that potentially cause failure.

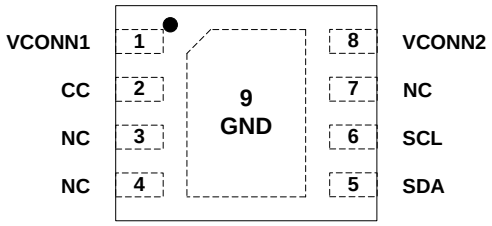
ESD CAUTION

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

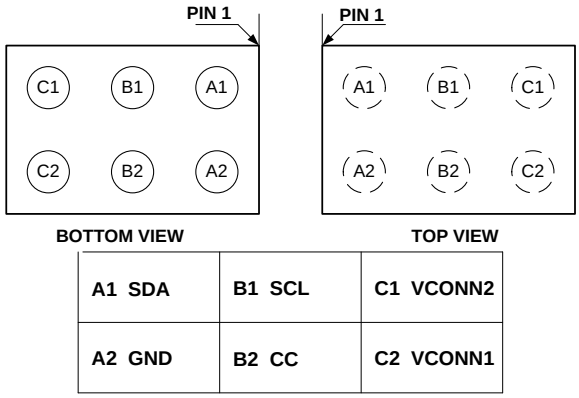
PIN CONFIGURATION AND FUNCTION DESCRIPTIONS



DFN-6L(HFBP-6L) 2 mm x 2 mm



DFN-8L 2 mm x 3 mm



WLCSP-6B 0.875 mm x 1.425 mm

Figure 2. Pin Configuration, View From Top

Table 4. DFN-6L(HFBP-6L) Pin Function Descriptions

Pin No.	Pin Name	Pin Description
1	VCONN1	The input pin supplied from VCONN.
2	CC	Type-C CC line input and output
3	VCONN2	The input pin supplied from the other side VCONN.
4	GND	Ground.
5	SDA	This Pin is Only Used for Debug. Please connect it to ground.
6	SCL	This Pin is Only Used for Debug. Please connect it to ground.
7	EPAD	Exposed pad.

Table 5. DFN-8L Pin Function Descriptions

Pin No.	Pin Name	Pin Description
1	VCONN1	The input pin supplied from VCONN.
2	CC	Type-C CC line input and output
3	NC	Not connection
4	NC	Not connection
5	SDA	This Pin is Only Used for Debug. Please connect it to ground.
6	SCL	This Pin is Only Used for Debug. Please connect it to ground.
7	NC	Not connection
8	VCONN2	The input pin supplied from the other side VCONN.

9	EPAD	Exposed pad used as GND pin.

Table 6. WLCSP-6B Pin Function Descriptions

Pin No.	Pin Name	Pin Description
A1	SDA	This Pin is Only Used for Debug. Please connect it to ground.
A2	GND	Ground.
B1	SCL	This Pin is Only Used for Debug. Please connect it to ground.
B2	CC	Type-C CC line input and output
C1	VCONN2	The input pin supplied from the other side VCONN.
C2	VCONN1	The input pin supplied from VCONN.

BLOCK DIAGRAM

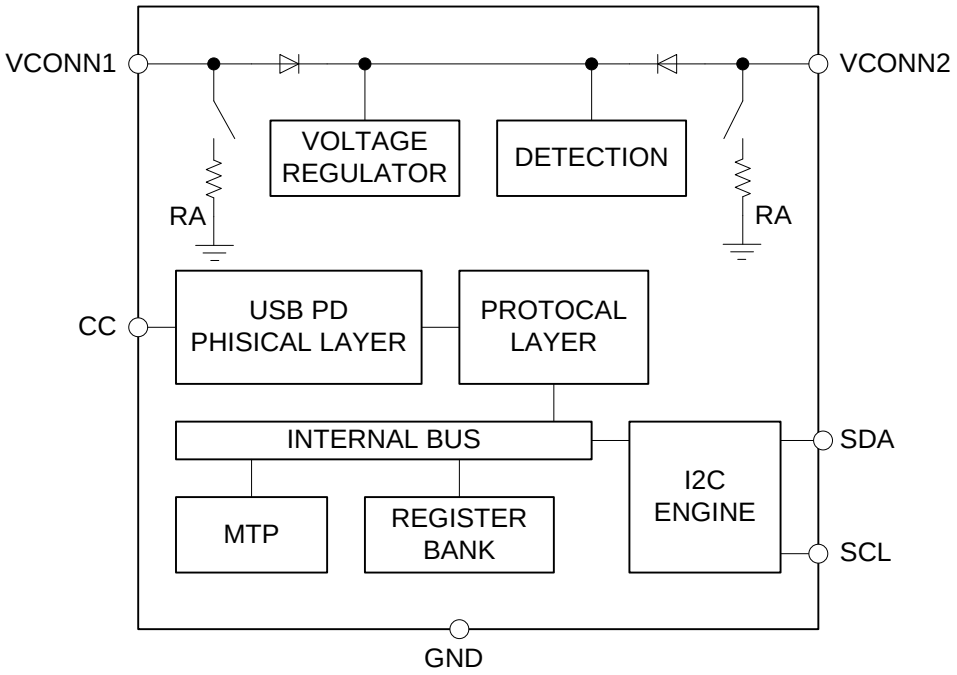


Figure 3. HUSB332 Block Diagram

APPLICATION INFORMATION

DISCOVER IDENTITY

The Discover Identity Command is provided to enable an Initiator (DFP) to identify its Port Partner and for an Initiator (VCONN Source) to identify the Responder (Cable Plug). The Discovery Identity Command is also used to determine whether a Cable Plug is PD-Capable by looking for a GoodCRC Message Response.

The Discover Identity Command shall be used to determine whether a given Cable Plug is PD. In this case a Discover Identity Command request sent to SOP' shall not cause a Soft Reset if a GoodCRC Message response is not returned since this can indicate a non-PD Capable cable. Note that a Cable Plug will not be ready for PD Communication until 50 ms after VCONN has been applied. During Cable Plug discovery, when there is an Explicit Contract, Discover Identity Commands are sent at a rate defined by the DiscoverIdentityTimer up to a maximum of nDiscoverIdentityCount times. See USB Power Delivery Specification Revision 3.0, Version 1.1 for details.

A PD-Capable Cable Plug shall return a Discover Identity Command ACK in response to a Discover Identity Command request sent to SOP'.

The Number of Data Objects field in the Message Header in the Discover Identity Command request shall be set to 1 since the Discover Identity Command request shall not contain any VDOs.

The Discover Identity Command ACK sent back by the Responder shall contain an ID Header VDO, a Cert Stat VDO, a Product VDO and the Product Type VDOs defined by the Product Type as shown in Figure 4.

Figure 4. Discover Identify Command Response

VDO DATA

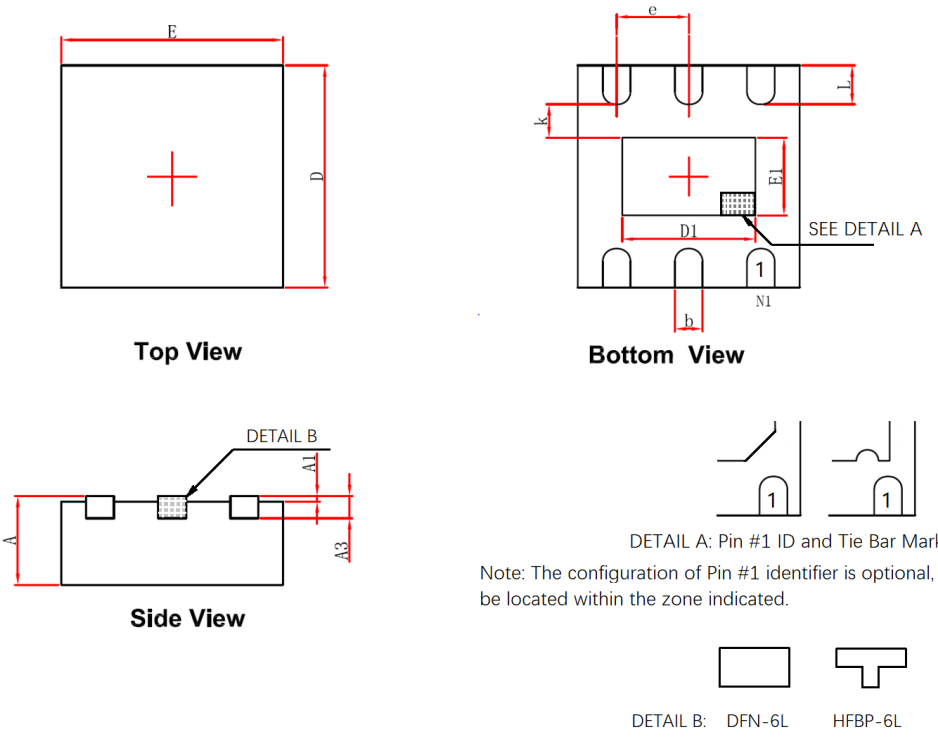
Table 7. VDO Map

Bit(s)	Field	Descriptions
ID Header VDO		
[31]	Data Capable as USB Host	USB Communications Capable as USB Host: • Shall be set to one if the product is capable of enumerating USB Devices. • Shall be set to zero otherwise
[30]	Data Capable as USB Device	USB Communications Capable as a USB Device: • Shall be set to one if the product is capable of being enumerated as a USB Device. • Shall be set to zero otherwise
[29:27]	Product Type Cable Plug	Product Type (Cable Plug): • 000b – Undefined • 001b..010b – Reserved, shall not be used. • 011b – Passive Cable • 100b – Active Cable • 101b..111b – Reserved, shall not be used.
[26]	Modal Operation Supported	Modal Operation Supported: • Shall be set to one if the product supports Modal Operation. • Shall be set to zero otherwise
[25:23]	Product type (DFP)	Product Type (DFP): • 000b – Undefined • 001b – PDUSB Hub • 010b – PDUSB Host • 011b – Power Brick • 100b - Alternate Mode Controller (AMC) • 101b..111b – Reserved, shall not be used.
[22:16]	Reserved	0
[15:0]	16-bit unsigned integer. USB vendor ID	USB-IF assigned VID
Cert Stat VDO		
[31:0]	32-bit unsigned integer, XID	Assigned by USB-IF
Product VDO		
[31:16]	16-bit unsigned integer. USB Product ID	Product ID assigned by Cable Vendor
[15:0]	16-bit unsigned integer .bcdDevices	Device Version assigned by Cable Vendor

Passive Cable VDO		
[31:28]	HW Version	0000b..1111b assigned by the VID owner
[27:24]	Firmware Version	0000b..1111b assigned by the VID owner
[23:21]	VDO Version	Version Number of the VDO (not this specification Version): • Version 1.0 = 000b Values 001b..111b are Reserved and shall not be used
[20]	Reserved	Shall be set to zero.
[19:18]	Type-C to USB Type-A/Type-B/Type-C/Captive	00: reserved 01: reserved 10: Type-C 11: Captive
[17]	Reserved	0
[16:13]	Cable Latency	0000b – Reserved, shall not be used 0001b – <10ns (~1m) 0010b – 10ns to 20ns (~2m) 0011b – 20ns to 30ns (~3m) 0100b – 30ns to 40ns (~4m) 0101b – 40ns to 50ns (~5m) 0110b – 50ns to 60ns (~6m) 0111b – 60ns to 70ns (~7m) 1000b –1000ns (~100m) 1001b –2000ns (~200m) 1010b – 3000ns (~300m) 1011b ….1111b Reserved, shall not be used Includes latency of electronics in Active Cable
[12:11]	Cable Termination Type	00b = VCONN not required. Cable Plugs that only support Discover Identity Commands shall set these bits to 00b. 01b = VCONN required 10b..11b = Reserved, shall not be used
[10:9]	Maximum VBUS Voltage	Maximum Cable VBUS Voltage: 00b – 20V 01b – 30V 10b – 40V 11b – 50V
[8:7]	Reserved	Shall be set to zero.
[6:5]	VBUS Current Handling Capability	00b = Reserved, shall not be used. 01b = 3A 10b = 5A 11b = Reserved, shall not be used.
[4]	VBUS Through Cable	0 = No 1 = Yes
[3]	Reserved.	Shall be set to 0.
[2:0]	USB SuperSpeed Signaling support	000b = USB 2.0 only, no SuperSpeed support 001b = [USB 3.2] Gen1 010b = [USB 3.2] / [USB 4] Gen2 011b = [USB 4] Gen3 100b.. 111b = Reserved, shall not be used See [USB Type-C 1.4] for definitions.

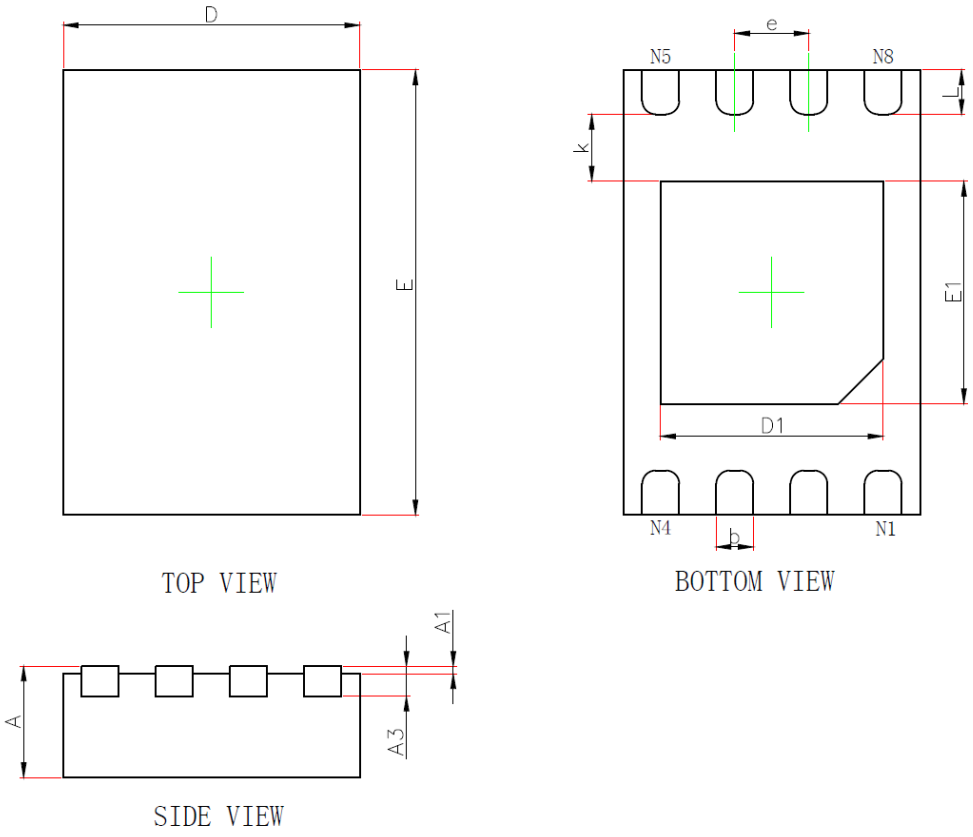
PACKAGE OUTLINE DIMENSIONS

PACKAGE DIMENSIONS



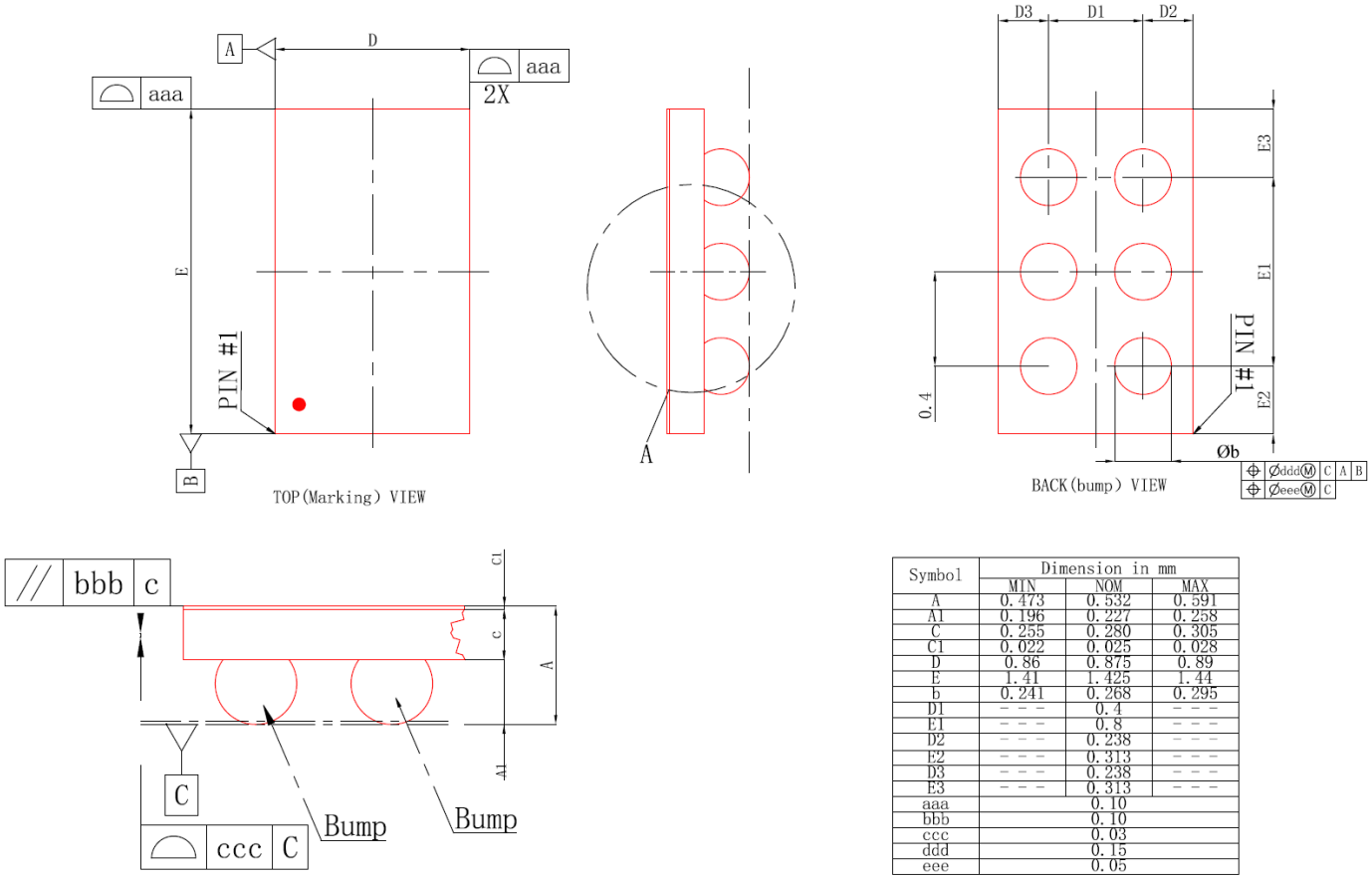
Symbol	Millimeter	
	Min	Max
A	0.700	0.800
A1	0.000	0.050
A3	0.180	0.250
D	1.924	2.076
E	1.924	2.076
D1	1.000	1.450
E1	0.500	0.850
k	0.2MIN	
b	0.200	0.350
e	0.65TYP	
L	0.250	0.426

Figure 5. DFN-6L(HFBP-6L) Package, 2 mm × 2 mm Body



Symbol	Millimeter	
	Min	Max
A	0.700	0.800
A1	0.000	0.050
A3	0.180	0.250
D	1.900	2.100
E	2.900	3.100
D1	1.400	1.600
E1	1.400	1.600
k	0.2MIN	
b	0.180	0.300
e	0.500BSC	
L	0.224	0.500

Figure 6. DFN-8L Package, 2 mm × 3 mm Body



Symbol	Dimension in mm		
	MIN	NOM	MAX
A	0.473	0.532	0.591
A1	0.196	0.227	0.258
C	0.255	0.280	0.305
C1	0.022	0.025	0.028
D	0.86	0.875	0.89
E	1.41	1.425	1.44
b	0.241	0.268	0.295
D1	- - -	0.4	- - -
E1	- - -	0.8	- - -
D2	- - -	0.238	- - -
E2	- - -	0.313	- - -
D3	- - -	0.238	- - -
E3	- - -	0.313	- - -
aaa		0.10	
bbb		0.10	
ccc		0.03	
ddd		0.15	
eee		0.05	

Figure 7. WLCSP-6B Package, 0.875 mm × 1.425 mm Body

PACKAGE MARKING

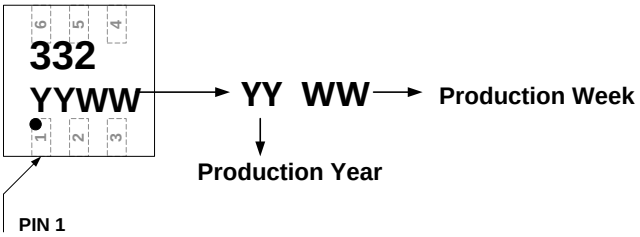


Figure 8. DFN-6L(HFBP-6L) Package Top Marking

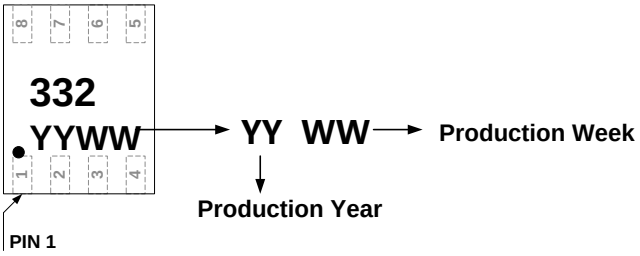


Figure 9. DFN-8L Package Top Marking

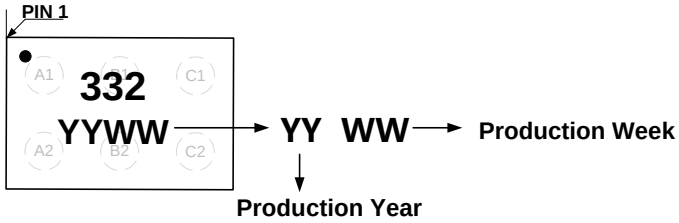


Figure 10. WLCSP-6B Package Top Marking

ORDERING GUIDE

Order Model	Description	Package	Ambient Temperature Range	Package Option
HUSB332_U31A	Default USB3.2 gen 2, 1m cable	DFN-6L	−40°C to +85°C	Tape & Reel, 4000
		HFBP-6L	−40°C to +85°C	Tape & Reel, 3000
HUSB332_U31B	Default USB3.2 gen 2, 1m cable	DFN-8L	−40°C to +85°C	Tape & Reel, 4000
HUSB332_U31C	Default USB3.2 gen 2, 1m cable	WLCSP-6B	−40°C to +85°C	Tape & Reel, 3000

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