USB Type-C Power Delivery Sink Controller

Hynetek Semiconductor Co., Ltd.

HUSB237

FEATURES

- Standalone USB PD sink controller
  - Support USB PD sink, up to 20 V / 5 A
  - Dead battery support
- Support QC2.0 12 V
- 4.5 V to 22 V operation range
- 25 V tolerance on VBUS, CC1, CC2 pins
- External resistor or capacitor to set the target RDO voltage
- Support SOP', eMarker emulator for cable application with output current>3 A
- Power consumption 1.15 mA@5 V
- Package: DFN2x2-6L，SOT23-5L
- ±2 kV HBM ESD Rating for USB IO pins

APPLICATIONS

PD sink devices

USB-C cables

Wireless charger

GENERAL DESCRIPTION

The HUSB237 is a highly integrated USB Power Delivery (PD) controller as sink role for up to 100W power rating.

The HUSB237 integrates the CC logic, USB PD protocol and the legacy protocols, and it supports BC1.2 SDP, CDP and DCP, QC2.0.

The HUSB237 can be used in electronic devices that have legacy barrel connectors or USB micro-B connectors for power such as IoT (Internet of Things) devices, wireless charger, drones, smart speakers, power tools, and other rechargeable devices.

The HUSB237 is available in DFN2x2-6L or SOT23-5L package.

TYPICAL APPLICATION CIRCUIT

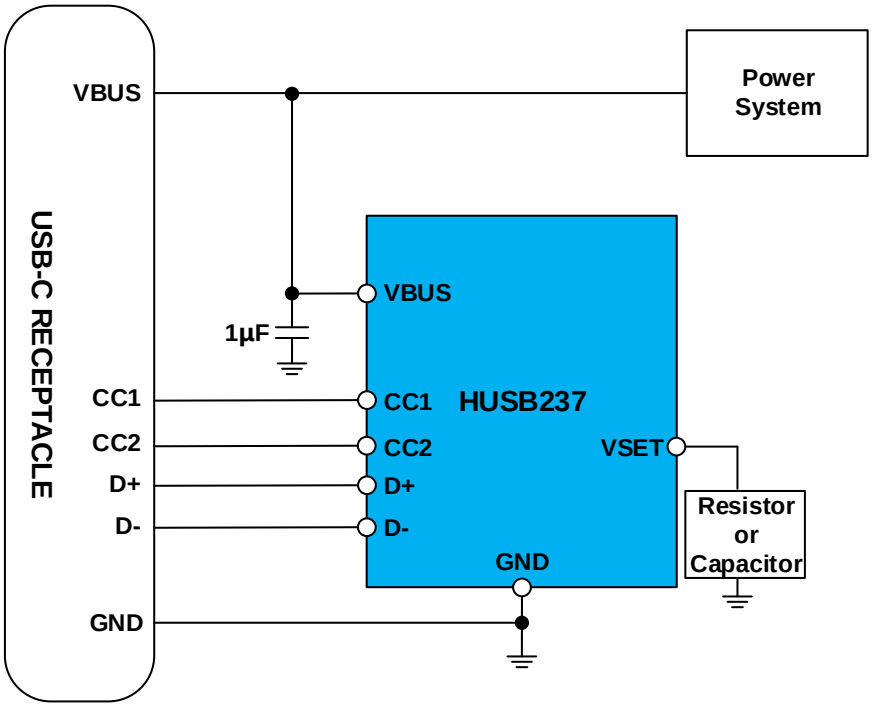

Figure 1. Typical Application Circuit

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REVISION HISTORY

Version	Date	Descriptions
Rev. 1.0	03/2024	Initial version

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

TOP VIEW

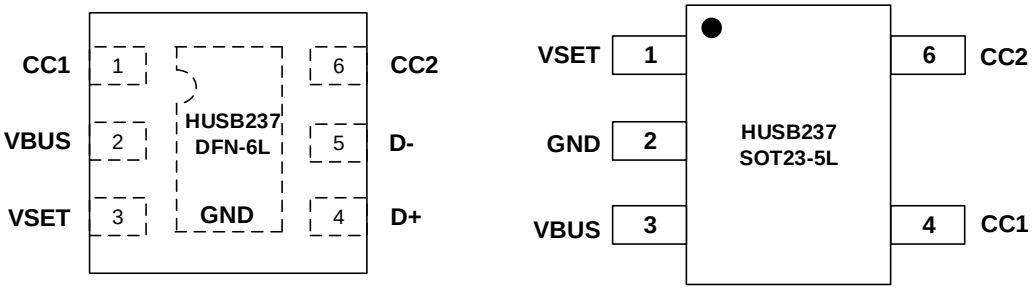


Figure 2. Pin Configuration

Table 1. DFN-6L Pin Function Descriptions

Pin No.	Pin Name	Type[1]	Description
1	CC1	AIO	Configuration line 1 used to negotiate a voltage/current with the attached adapter.
2	VBUS	P	Power supply input. Connect this pin to VBUS of USB Type-C connector and bias this pin via a 1 μF ceramic capacitor.
3	VSET	AI	Connect a resistor or capacitor to indicate the maximum voltage needed by the system from the attached power adapter.
4	D+	DIO	Positive line of USB 2.0 data line for BC1.2.
5	D-	DIO	Negative line of USB 2.0 data line for BC1.2.
6	CC2	AIO	Configuration line 2 used to negotiate a voltage/current with the attached adapter.
7	GND	P	Ground reference. All signals are referred to this pin.

Table 2. SOT23-5L Pin Function Descriptions

Pin No.	Pin Name	Type[2]	Description
1	VSET	AI	Connect a resistor or capacitor to indicate the maximum voltage needed by the system from the attached power adapter.
2	GND	P	Ground reference. All signals are referred to this pin.
3	VBUS	P	Power supply input. Connect this pin to VBUS of USB Type-C connector and bias this pin via a 1 μF ceramic capacitor.
4	CC1	AIO	Configuration line 1 used to negotiate a voltage/current with the attached adapter.
5	CC2	AIO	Configuration line 2 used to negotiate a voltage/current with the attached adapter.

1 Legend:
A = Analog Pin
P = Power Pin
D = Digital Pin
I = Input Pin
O = Output Pin
OD = Open Drain Pin

RECOMMENDED OPERATING CONDITIONS

Table 3.

Parameter	Rating
VBUS Input Voltage Range	3 V to 22 V
Operating Temperature Range (Junction)	−40 °C to +125 °C
Ambient Temperature Range	-40 °C to 85 °C

SPECIFICATIONS

VBUS = 5 V, T_A = 25 °C, unless otherwise noted.

Table 4.

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
Power Supply						
VBUS UVLO Threshold	$V_{BUS\_UVLO\_R}$			3.78	4.2	V
	$V_{BUS\_UVLO\_F}$		3.3	3.65		V
VBUS Current	I_{VBUS}			1.15		mA
VSET						
Pull up Source Current	I_{SNK_VSET}	On VSET pin		20		µA
Detect Debounce Time	$t_{DB\_SNK\_VSET}$	For VSET pin		2		ms
SNK_VSET Setting Resistor or Capacitor	R_{SNK_VSET0}		0		100	Ω
	R_{SNK_VSET1}			75		kΩ
	R_{SNK_VSET2}			open		kΩ
	C_{SNK_VSET3}			4.7		nF
	C_{SNK_VSET4}			20		nF
Type-C Pins (CC1, CC2)						
Dead Battery Clamp Voltage	V_{SNKDB0}	with R_p=80 µA ±20% Current from Source	0.25		1.5	V
	V_{SNKDB1}	with R_p=180 µA ±8% Current from Source	0.45		1.5	V
	V_{SNKDB2}	with R_p=330 µA ±8% Current from Source	0.85		2.18	V
Sink Pull Down Resistor	R_d		4.6	5.1	5.6	kΩ
CC Impedance	z_{OPEN}	CC1 or CC2 are disabled from R_d	1000			kΩ
R_a Detection Threshold	vR_{a_SNK}	Connected as Sink		0.2		V
R_d Detection Threshold	vR_{d_SNKDEF}	Connected as Sink with I_{RP_DEF} attached		0.66		V
	$vR_{d\_SNK1.5A}$	Connected as Sink with $I_{RP\_1.5A}$ attached		1.23		V
CC Comparator Update Debounce	$t_{CCUpdate}$	Time for a CC Comparator to output a valid state change		2		ms
BC1.2 and HVDCP Detection						
BC1.2 Source voltage	$V_{DPM\_SRC\_0V6}$		0.5	0.6	0.7	V
BC1.2 Source Path Resistance	R_{DPM_SRC}	V_{DPM_SRC}=0.65V, from V_{DPM_SRC} to D+ and D- pin			65	Ω
BC1.2 Sink Current	I_{DPM_SNK}		50	100	150	µA
D+ Source Voltage for 3.3V	$V_{DP\_SRC\_3P3}$		3.0	3.3	3.6	V
D+ 3.3V Pull-up Resistance	$R_{DP\_SRC\_3P3}$		0.9	1.24	1.57	kΩ
Data Detect Voltage	V_{DAT_REF}		250	325	400	mV

ABSOLUTE MAXIMUM RATINGS

Table 5.

Parameter	Rating
VBUS,CC1, CC2	−0.3 V to +25 V
D+, D−, VSET	−0.3 V to +6 V
Operating Temperature Range (Junction)	−40 °C to +125 °C
Soldering Conditions	JEDEC J-STD-020
Electrostatic Discharge (ESD)	
Human Body Model (HBM)	±2000V

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

THERMAL RESISTANCE

Thermal performance is directly linked to printed circuit board (PCB) design and operating environment. Close attention to PCB thermal design is required.

θ_{JA} is the natural convection junction to ambient thermal resistance measured in a one cubic foot sealed enclosure.

θ_{JC} is the junction to case thermal resistance.

Table 6. Thermal Resistance

Package Type	θ_{JA}	θ_{JC}	Unit
DFN-6L	103.5	75.2	°C/W
SOT23-5L	221	140.5	°C/W

ESD CAUTION

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.

FUNCTIONAL BLOCK DIAGRAM

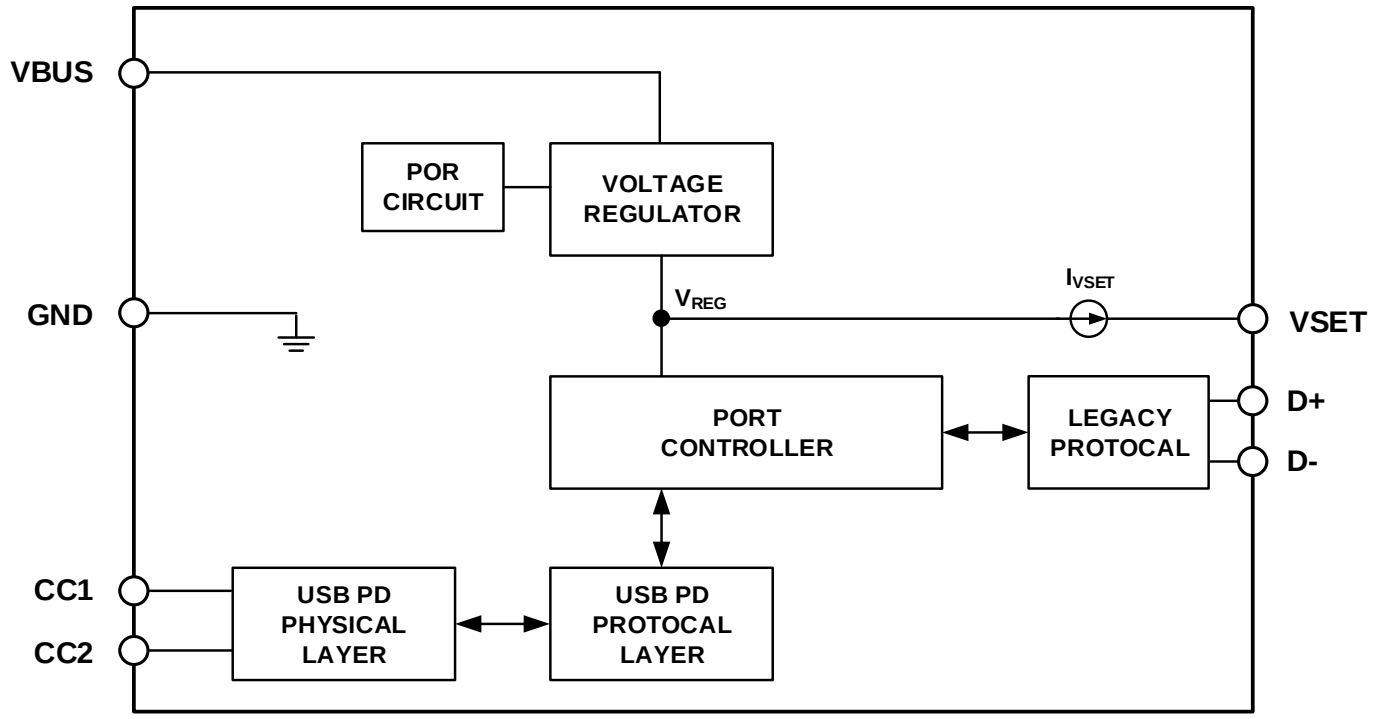


Figure 3. HUSB237 Functional Block Diagram

THEORY OF OPERATION

OVERVIEW

The HUSB237 is a highly integrated USB Power Delivery (PD) controller as sink role. It supports PD protocol and legacy charging protocols detection and requests the desired power per the user settings. When HUSB237 is connected to power source, it applies Rd to both CC lines, trying to establish USB Type-C connection. After the USB Type-C connection is established, it monitors the CC, DP and DM lines to determine corresponding charging protocol.

VBUS PIN

It is the input power source.

INPUT POWER SOURCE

VBUS pin is the power supply input of the HUSB237, which is derived from the output of the PD source. Connect a 1 μF decoupling MLCC between VBUS pin and GND pin as close as possible.

VSET PIN

This pin is used to set the request voltage when the HUSB237 connected as a Sink. This pin is pulled up internally. Connect a resistor or capacitor with 1% tolerance between VSET and GND to indicate the target RDO voltage value as shown in Table 7.

Table 7. VSET Setting

VSET Pin Configuration	Preferred Voltage (V)
0 Ω	5
75 kΩ	9
open	12
4.7 nF	15
20 nF	20

The RDO voltage of the HUSB237 is determined by the VSET.

TYPICAL APPLICATION CIRCUITS

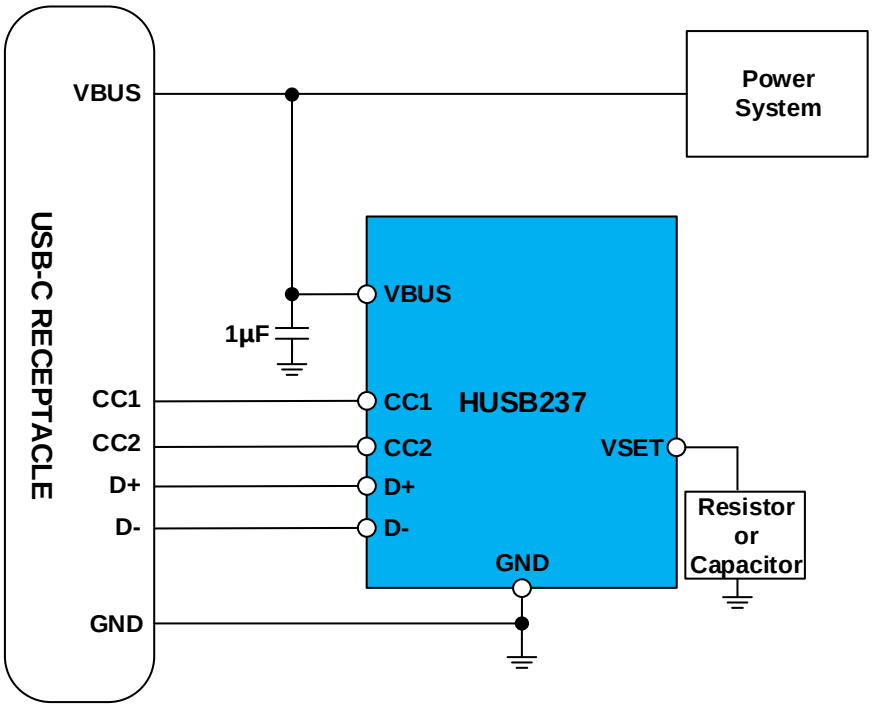
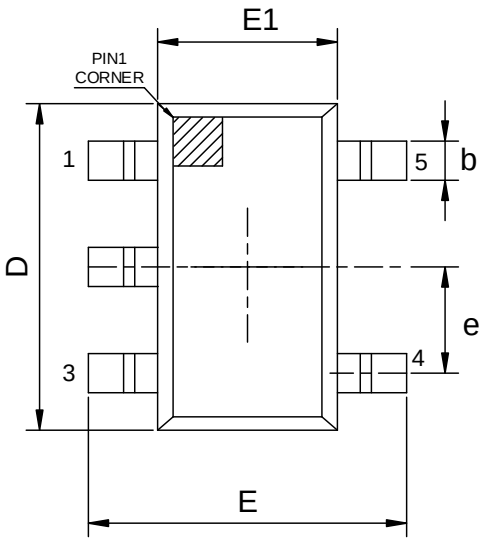
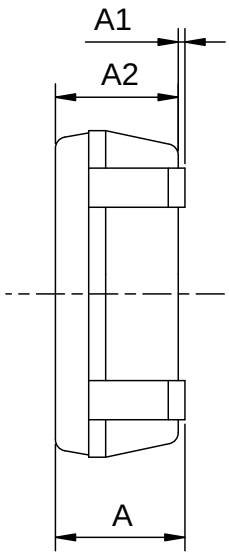


Figure 4. Typical Application Circuit

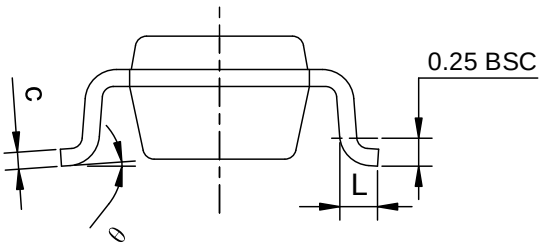
PACKAGE OUTLINE DIMENSIONS



TOP VIEW



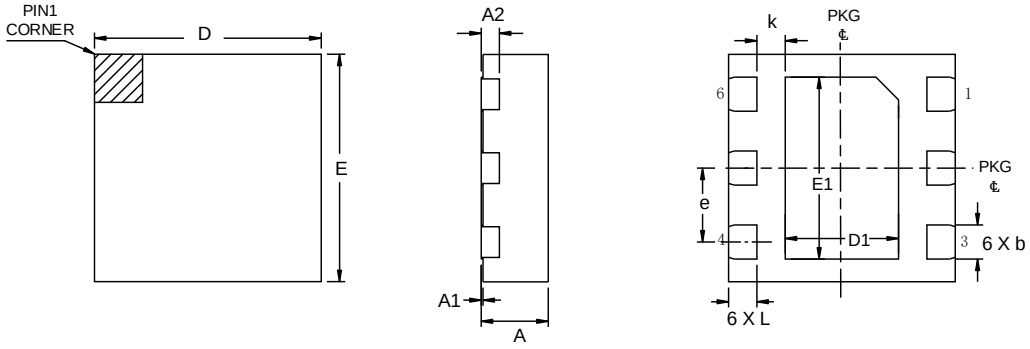
SIDE VIEW



SIDE VIEW

SYMBOLS	DIMENSION IN MILLIMETERS		
	MIN	NOM	MAX
A	1.05	1.15	1.25
A1	0.00	0.06	0.10
A2	1.00	1.10	1.20
b	0.30	0.40	0.50
c	0.10	0.152	0.20
D	2.82	2.92	3.02
E	2.65	2.80	2.95
E1	1.50	1.61	1.70
e	0.95 BSC		
L	0.30	0.42	0.57
θ	0°	-	8°

Figure 5. SOT23-5L Package



TOP VIEW **SIDE VIEW** **BOTTOM VIEW**

SYMBOLS	DIMENSION IN MILLIMETERS		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A2		0.203 REF	
b	0.25	0.30	0.35
D		2.00 BSC	
E		2.00 BSC	
D1	0.63	1.00	1.10
E1	1.18	1.60	1.70
e		0.65 BSC	
L	0.20	0.25	0.35
k		0.15 MIN.	

Figure 6. 2 mm × 2 mm DFN-6L Package

PACKAGE TOP MARKING

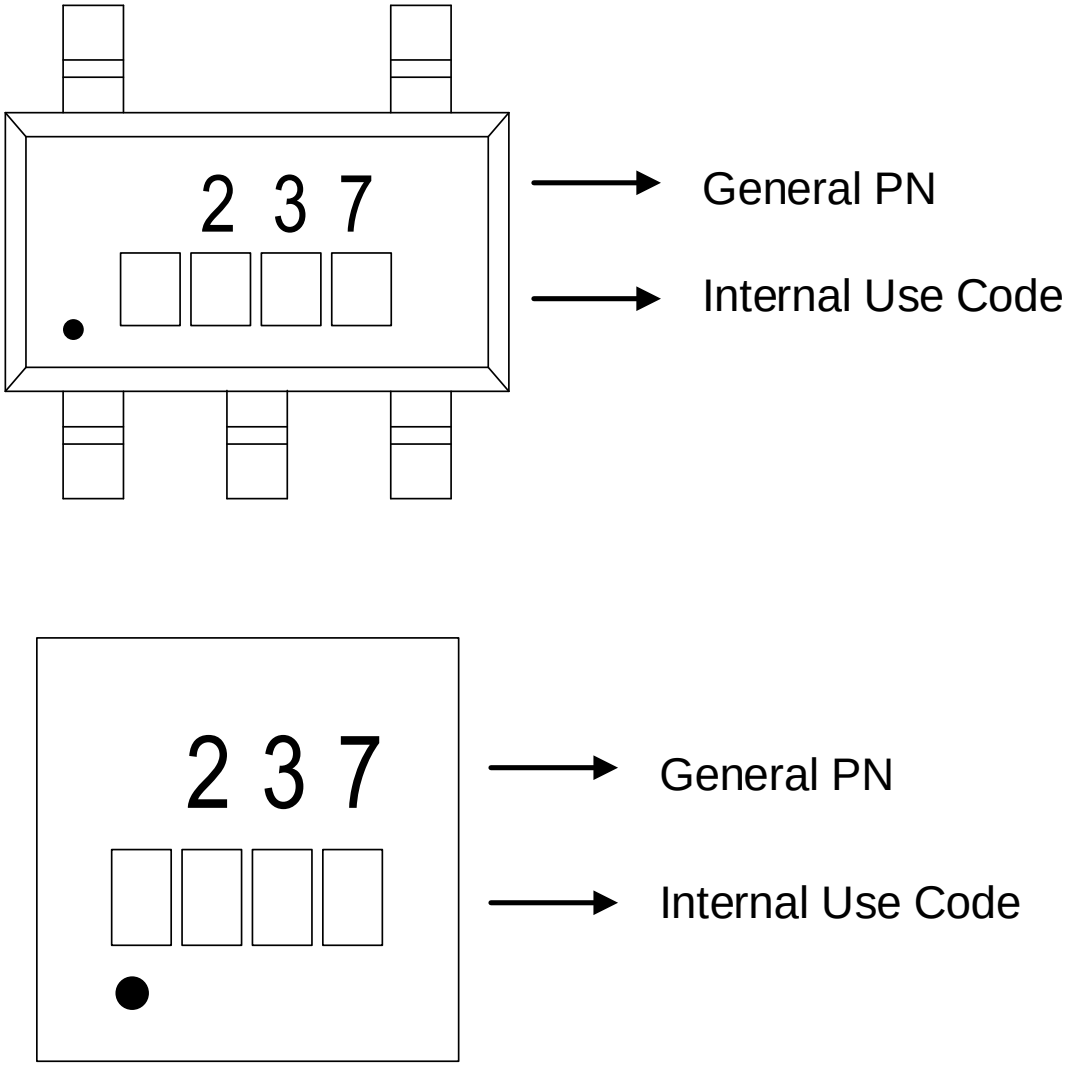
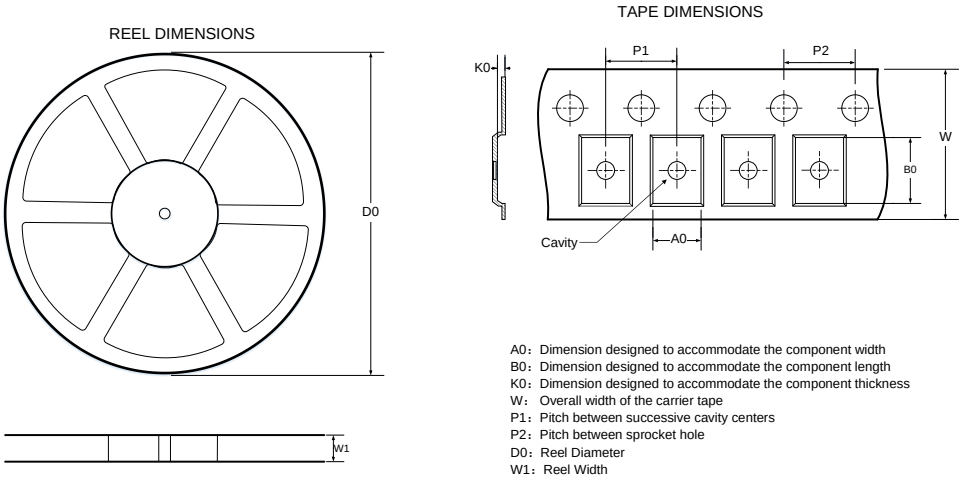


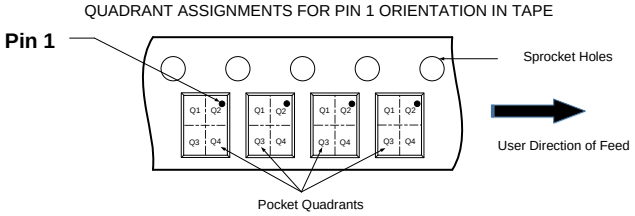
Figure 7. Package Top Marking

ORDERING GUIDE

Model	Temperature Range	Default Configuration	MSL	Package Option
HUSB237-AA001-DN06R	-40℃ to 125℃	Support Sop'	MSL3	Tape & Reel, 4000
HUSB237-AB001-ST05R	-40℃ to 125℃	Support Sop'	MSL3	Tape & Reel, 3000

TAPE AND REEL INFORMATION





DIMENSIONS AND PIN1 ORIENTATION

Device	Package Type	D0 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant	Quantity
HUSB237-AAXXX-DN06R	DFN2X2-6L	178.00	9.50	2.30	2.30	1.10	4.00	4.00	8.00	Q2	4000
HUSB237-ABXXX-ST05R	SOT23-5L	178.00	9.50	3.22	3.25	1.38	4.00	4.00	8.00	Q3	3000

All dimensions are nominal

Figure 8. Tape and Reel Information

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