300mA, High-PSRR, Low Quiescent Current, Low-Dropout Linear Regulator

UM1520 ***DFN4 1.0×1.0/SOT23-5***

1 Description

The UM1520 series are low-dropout linear regulators that sources 300mA of output current. The devices feature low ON resistance, high PSRR, low noise, low quiescent current, good load&line transient response and smooth softstart that meets the requirements for a variety of applications.

The UM1520 series feature an internal soft-start circuit to avoid excessive inrush current, thus minimizing the input voltage drop during start-up. An active pulldown circuit quickly discharges the output when the LDO is disabled and provides a known start-up state. The EN input allows an external logic signal to enable or disable the regulated output. The devices are designed to work with small ceramic capacitors that allows for a small overall package size.

The UM1520 series are available in SOT23-5 and DFN4 1.0×1.0 packages. The operating free-air range is from -40°C to +85°C.

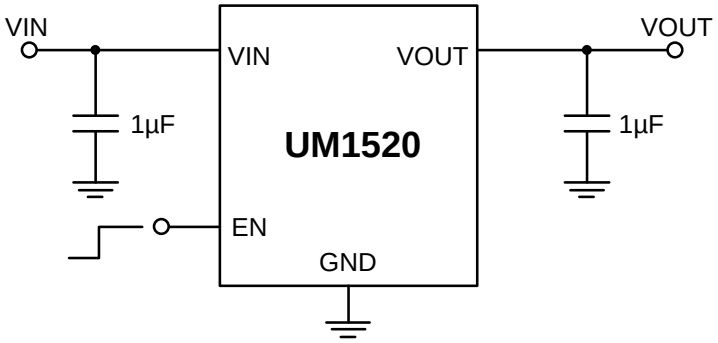
2 Applications

- Camera modules
- Audio/Video equipment
- Portable games devices
- Set-top boxes
- Battery-powered equipment

3 Features

- Input voltage range: 1.7V to 5.5V
- Guaranteed output current: 300mA
- Low quiescent current: 50μA (typ)
- Low shutdown current: 0.1μA (typ)
- High PSRR: 91dB (V_{IN}=3.3V, V_{OUT}=2.8V, I_{OUT} = 30mA, f = 3kHz, UM1520CDB4-280)
- Fixed output voltage range of UM1520: 1.1V, 1.2V, 1.8V, 2.5, 2.7V, 2.8V, 3.0V, 3.3V
- Extremely low inrush current
- Low Profile SOT23-5 and DFN4 1.0×1.0 Packages

4 Typical Application Circuits



5 Selection Guide

Part Number	Output Voltage Range (V)	Auto-discharge Function	Package
UM1520	1.1, 1.2, 1.8, 2.5, 2.7, 2.8, 3.0, 3.3	C versions: Available N versions: Not available	SOT23-5, DFN4 1.0×1.0

6 Ordering Information

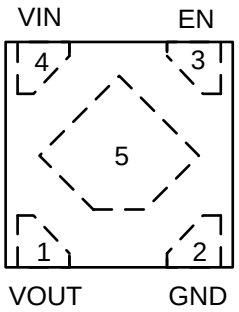
Part Number	Output Voltage	Mark Code	Package Type	Shipping Qty
UM1520CDB4-110	1.1 V	Q3	DFN4 1.0×1.0	3000pcs/7Inch Tape & Reel
UM1520CS5-110		5TR	SOT23-5	3000pcs/7Inch Tape & Reel
UM1520NDB4-110		R3	DFN4 1.0×1.0	3000pcs/7Inch Tape & Reel
UM1520NS5-110		5HD	SOT23-5	3000pcs/7Inch Tape & Reel
UM1520CDB4-120	1.2 V	Q7	DFN4 1.0×1.0	3000pcs/7Inch Tape & Reel
UM1520CS5-120		5TS	SOT23-5	3000pcs/7Inch Tape & Reel
UM1520NDB4-120		R7	DFN4 1.0×1.0	3000pcs/7Inch Tape & Reel
UM1520NS5-120		5HE	SOT23-5	3000pcs/7Inch Tape & Reel
UM1520CDB4-180	1.8 V	Q8	DFN4 1.0×1.0	3000pcs/7Inch Tape & Reel
UM1520CS5-180		5TT	SOT23-5	3000pcs/7Inch Tape & Reel
UM1520NDB4-180		R8	DFN4 1.0×1.0	3000pcs/7Inch Tape & Reel
UM1520NS5-180		5HJ	SOT23-5	3000pcs/7Inch Tape & Reel
UM1520CDB4-250	2.5 V	QC	DFN4 1.0×1.0	3000pcs/7Inch Tape & Reel
UM1520CS5-250		5HT	SOT23-5	3000pcs/7Inch Tape & Reel
UM1520NDB4-250		RC	DFN4 1.0×1.0	3000pcs/7Inch Tape & Reel
UM1520NS5-250		5HP	SOT23-5	3000pcs/7Inch Tape & Reel
UM1520CDB4-270	2.7 V	Q9	DFN4 1.0×1.0	3000pcs/7Inch Tape & Reel
UM1520CS5-270		5TY	SOT23-5	3000pcs/7Inch Tape & Reel
UM1520NDB4-270		R9	DFN4 1.0×1.0	3000pcs/7Inch Tape & Reel
UM1520NS5-270		5HN	SOT23-5	3000pcs/7Inch Tape & Reel

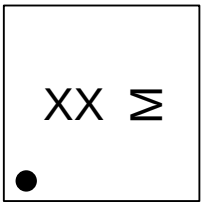
6 Ordering Information (continued)

Part Number	Output Voltage	Mark Code	Package Type	Shipping Qty
UM1520CDB4-280	2.8 V	Q4	DFN4 1.0×1.0	3000pcs/7Inch Tape & Reel
UM1520CS5-280		5TU	SOT23-5	3000pcs/7Inch Tape & Reel
UM1520NDB4-280		R4	DFN4 1.0×1.0	3000pcs/7Inch Tape & Reel
UM1520NS5-280		5HQ	SOT23-5	3000pcs/7Inch Tape & Reel
UM1520CDB4-300	3.0 V	QA	DFN4 1.0×1.0	3000pcs/7Inch Tape & Reel
UM1520CS5-300		5TZ	SOT23-5	3000pcs/7Inch Tape & Reel
UM1520NDB4-300		RA	DFN4 1.0×1.0	3000pcs/7Inch Tape & Reel
UM1520NS5-300		5HR	SOT23-5	3000pcs/7Inch Tape & Reel
UM1520CDB4-330	3.3 V	Q5	DFN4 1.0×1.0	3000pcs/7Inch Tape & Reel
UM1520CS5-330		5HA	SOT23-5	3000pcs/7Inch Tape & Reel
UM1520NDB4-330		R5	DFN4 1.0×1.0	3000pcs/7Inch Tape & Reel
UM1520NS5-330		5HS	SOT23-5	3000pcs/7Inch Tape & Reel

7 Pin Configuration and Function

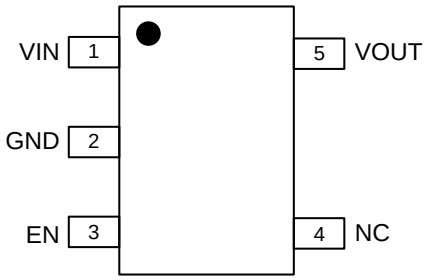
(Top View)

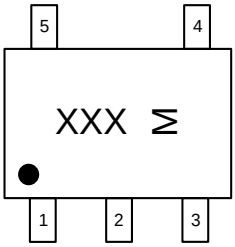




M: Month Code
UM1520xDB4-xxx
DFN4 1.0×1.0

(Top View)





M: Month Code
UM1520xS5-xxx
SOT23-5

7 Pin Configuration and Function (continued)

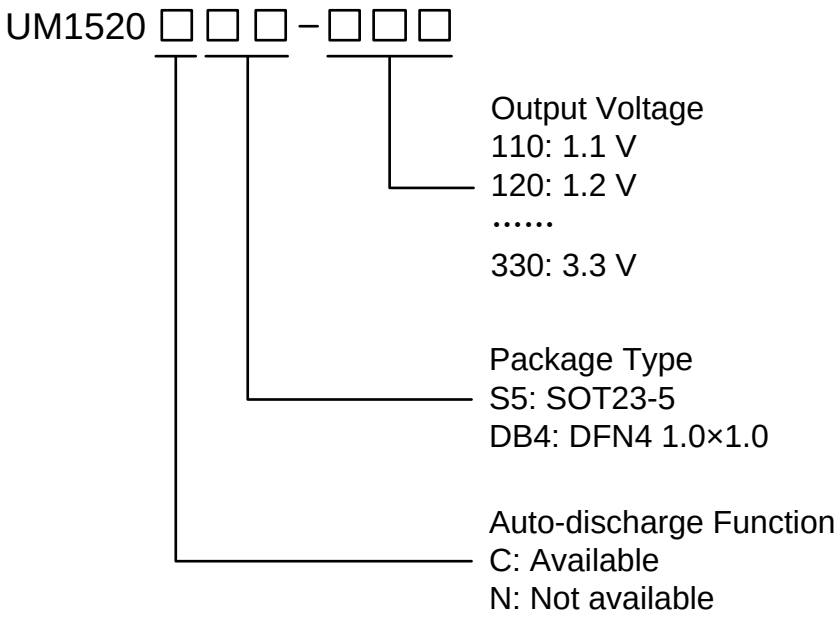
Table 7-1. Pin Functions of UM1520 DFN4 1.0×1.0 package

Pin No.	Pin Name	Function
1	VOUT	Voltage Regulated Output. Place a 1μF or more bypass capacitor as close to the VOUT and GND pins of the device as possible.
2	GND	Ground.
3	EN	Enable input. Integrate pull-down resistance. (High active)
4	VIN	Input voltage supply. Place a 1μF or more bypass capacitor as close to the VIN and GND pins of the device as possible.
5	Thermal Pad	Thermal pad for the DFN4 1.0×1.0 package. Connect this pad to GND or leave floating. Connect the thermal pad to a large-area GND plane for best thermal performance.

Table 7-2. Pin Functions of UM1520 SOT23-5 package

Pin No.	Pin Name	Function
1	VIN	Input voltage supply. Place a 1μF or more bypass capacitor as close to the VIN and GND pins of the device as possible.
2	GND	Ground.
3	EN	Enable input. Built-in pull-down resistance. (High active)
4	NC	Not connected.
5	VOUT	Voltage regulated output. Place a 1μF or more bypass capacitor as close to the VOUT and GND pins of the device as possible.

7.1 Naming Information



8 Specifications

8.1 Absolute Maximum Ratings (Note 1)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{IN}	Supply voltage range		-0.5		6.5	V
V_{OUT}	Output voltage range		-0.5		V_{IN}+0.3, max 6.5	V
V_{EN}	Voltage on EN pin		-0.5		6.5	V
V_{ESD}	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001	All pins		±6		kV
	Charged-device model (CDM), per ANSI/ESDA/JEDEC JS-002	All pins		±2		kV
I_{LU}	Latch up, per JEDEC JESD78			±200		mA
T_J	Operating junction temperature		-55		125	℃
T_{STG}	Storage temperature		-65		150	℃
T_L	Lead Temperature for Soldering 10 Seconds				260	℃

Note 1: Operation outside the Absolute Maximum Ratings may cause permanent device damage. Absolute maximum ratings do not imply functional operation of the device at these or any other conditions beyond those listed under Recommended Operating Conditions. If briefly operating outside the Recommended Operating Conditions but within the Absolute Maximum Ratings, the device may not sustain damage, but it may not be fully functional. Operating the device in this manner may affect device reliability, functionality, performance, and shorten the device lifetime.

8.2 Recommended Operating Conditions (Note 1)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{IN}	Supply Voltage range		1.7		5.5	V
V_{EN}	EN input voltage		0		5.5	V
I_{OUT}	Output current		0		300	mA
T_A	Operating free-air temperature range		-40		85	℃

Note 1: All voltages referenced to ground.

8.3 Package Thermal Information

Symbol	Parameter		Value	Unit
$R_{\theta JA}$	Junction-to-ambient thermal resistance	DFN4 1.0×1.0	215.4	℃/W
		SOT23-5	177.4	
$R_{\theta JC(TOP)}$	Junction-to-case (top) thermal resistance	DFN4 1.0×1.0	161.85	℃/W
		SOT23-5	102.1	
$R_{\theta JB}$	Junction-to-board thermal resistance	DFN4 1.0×1.0	156.4	℃/W
		SOT23-5	42.7	
Ψ_{JT}	Junction-to-top characterization parameter	DFN4 1.0×1.0	17.3	℃/W
		SOT23-5	13.5	
Ψ_{JB}	Junction-to-board characterization parameter	DFN4 1.0×1.0	170.4	℃/W
		SOT23-5	39.4	
$R_{\theta JC(BOT)}$	Junction-to-case (bottom) thermal resistance	DFN4 1.0×1.0	118	℃/W
		SOT23-5	31.2	

8.4 Electrical Characteristics

V_{IN} = $V_{OUT(SET)}$+0.5V or V_{IN} = 2V (whichever is greater), V_{EN} ≥ 1V, I_{OUT} = 1mA, C_{IN} = C_{OUT} = 1μF, T_A = 25℃ (unless otherwise noted).

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{IN}	Input voltage range			1.7		5.5	V
ΔV_{OUT}	Output voltage tolerance	T_A=25℃	$V_{OUT(SET)} \leq 1.2V$	-2		2	%
			$V_{OUT(SET)} > 1.2V$	1		1	
		-40℃≤ T_A ≤ 85℃	$V_{OUT(SET)} \leq 1.2V$	-3		3	
			$V_{OUT(SET)} > 1.2V$	2		2	
$LINE_{REG}$	Line regulation	$V_{OUT(SET)}$ + 0.5V≤ V_{IN} ≤ 5.5V			1	5	mV
$LOAD_{REG}$	Load regulation	I_{OUT} = 1mA to 300mA			1	15	mV
V_{ENH}	High input threshold on EN	-40℃ ≤ T_A ≤ 85℃		1			V
V_{ENL}	Low input threshold on EN	-40℃ ≤ T_A ≤ 85℃				0.3	V
V_{DO}	Dropout voltage	I_{OUT} = 300mA, V_{OUT} falls 100mV below $V_{OUT(SET)}$	$V_{OUT(SET)}$ = 1.1V		690	863	mV
			$V_{OUT(SET)}$ = 1.8V		308	385	
			$V_{OUT(SET)}$ = 2.8V		178	221	
			$V_{OUT(SET)}$ = 3.3V		157	198	
I_{SD}	Shutdown current	V_{EN} = 0V			0.1	1	μA
I_Q	Quiescent current	I_{OUT} = 0mA			50	90	μA

8.4 Electrical Characteristics (continued)

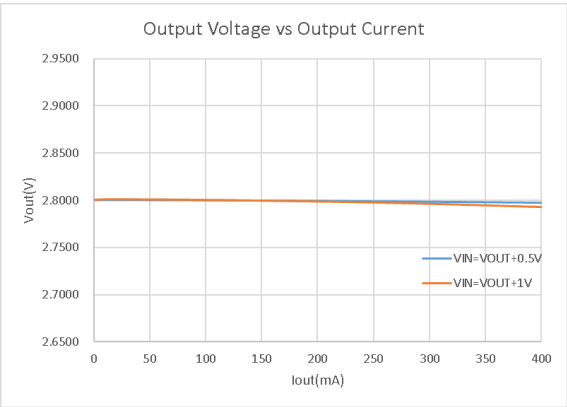
V_{IN} = $V_{OUT(SET)}$+0.5V or V_{IN} = 2V (whichever is greater), V_{EN} ≥ 1V, I_{OUT} = 1mA, C_{IN} = C_{OUT} = 1μF, T_A = 25℃ (unless otherwise noted).

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
PSRR	Power-supply ripple rejection	I_{OUT} = 30mA, f = 3kHz, V_{IN} = V_{OUT}+0.5V, UM1520CDB4280			91		dB
V_N	Output Voltage Noise	I_{OUT} = 50mA, BW = 10Hz to 100kHz	$V_{OUT(SET)}$ = 2.8V		50		μV_{RMS}
I_{CL}	Output current limit	V_{OUT} = 0.9×$V_{OUT(SET)}$		300			mA
I_{SC}	Short-circuit Current Limit	V_{OUT} = 0.1×$V_{OUT(SET)}$ (UM1520)			120		mA
I_{EN}	EN input leakage current	V_{EN} = 1V			190		nA
R_{DISC}	Auto discharge pulldown resistance	V_{IN} = 4.0V, V_{EN} = 0V, V_{OUT} = 2.8V			100		Ω
V_{TC}	Output voltage temperature coefficient	-40℃≤ T_A ≤ 85℃			±45		ppm/℃
T_{SDH}	Thermal shutdown threshold	Temperature rising			160		℃
T_{SDL}	Thermal shutdown reset threshold	Temperature falling			130		℃
t_{SU}	Start-up time	From V_{OUT} = 10% to V_{OUT} = 90% of $V_{OUT(SET)}$			110		μs

8.5 Typical Characteristics

V_{IN} = $V_{OUT(SET)}$+0.5V or V_{IN} = 2V (whichever is greater), V_{EN} ≥ 1V, I_{OUT} = 1mA, C_{IN} = C_{OUT} = 1μF, T_A = 25°C (unless otherwise noted).

UM1520CDB4-280



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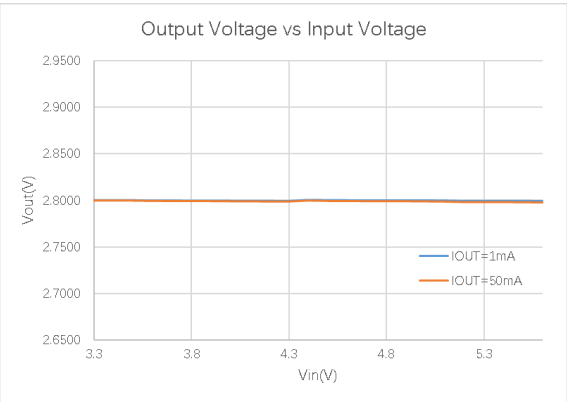

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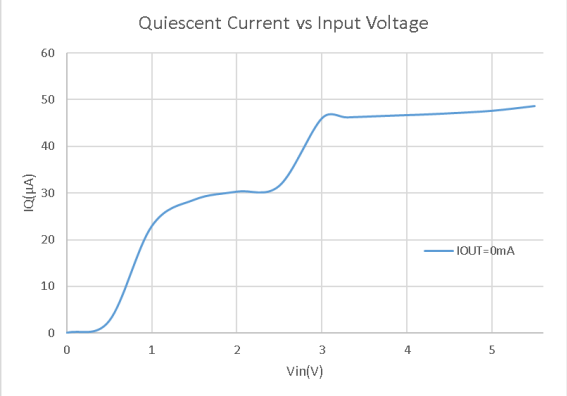

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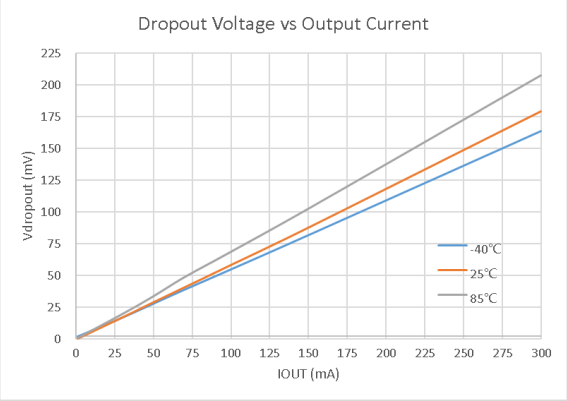

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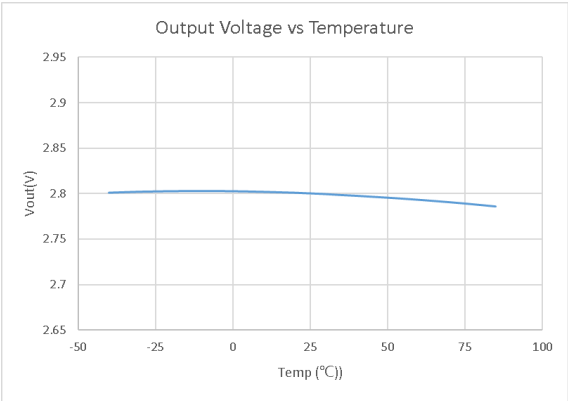

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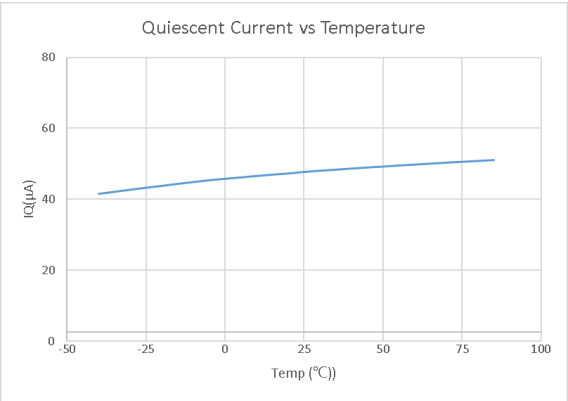
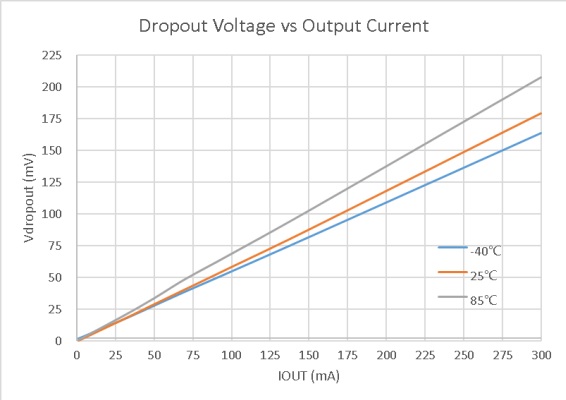


8.5 Typical Characteristic (continued)

V_{IN} = $V_{OUT(SET)}$+0.5V or V_{IN} = 2V (whichever is greater), V_{EN} ≥ 1V, I_{OUT} = 1mA, C_{IN} = C_{OUT} = 1μF, T_A = 25°C (unless otherwise noted).

UM1520CDB4-280



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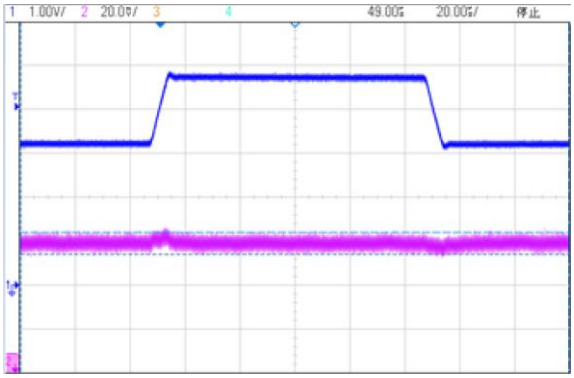
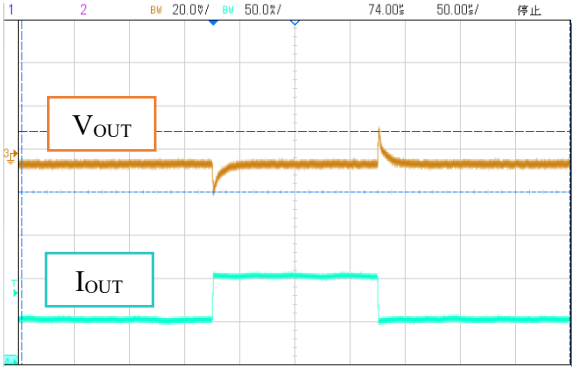


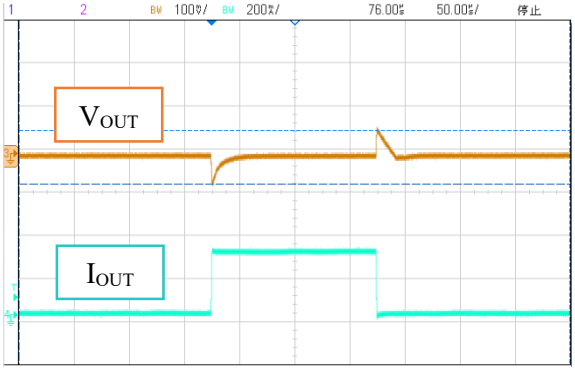
3.3V to 4.8V， I_{OUT} = 30mA, t_R = t_F = 10μs

UM1520CDB4-280



50mA to 100mA， t_R = t_F = 1μs

UM1520CDB4-280

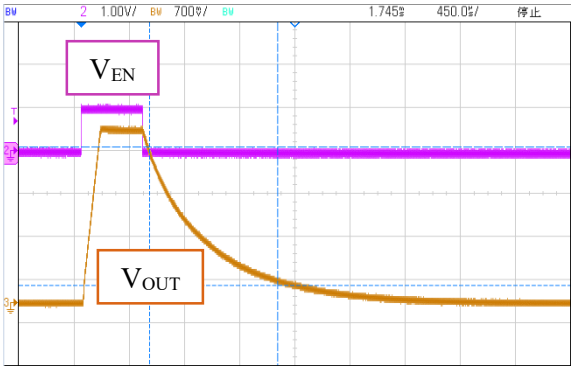


1mA to 300mA， t_R = t_F = 1μs

8.5 Typical Characteristic (continued)

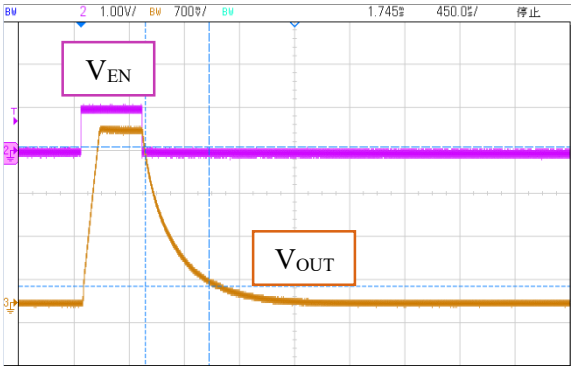
V_{IN} = $V_{OUT(SET)}$+0.5V or V_{IN} = 2V (whichever is greater), V_{EN} ≥ 1V, I_{OUT} = 1mA, C_{IN} = C_{OUT} = 1μF, T_A = 25°C (unless otherwise noted).

UM1520CDB4-280



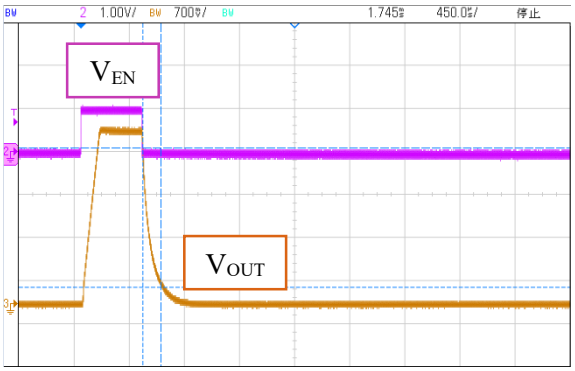
V_{IN} = 3.8V, I_{OUT} = 0mA

UM1520CDB4-280



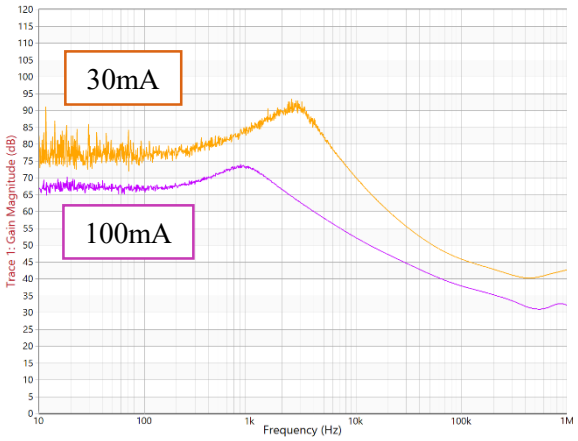
V_{IN} = 3.8V, I_{OUT} = 50mA

UM1520CDB4-280



V_{IN} = 3.8V, I_{OUT} = 150mA

UM1520CDB4-280



PSRR vs Frequency

9 Detailed Description

9.1 Overview

The UM1520 series can provide 300mA output current, high PSRR and good transient response in small packages. The devices are designed to operate with a single 1μF input capacitor and a single 1μF ceramic output capacitor that make it suitable for space-constrained applications.

9.2 Functional Block Diagram

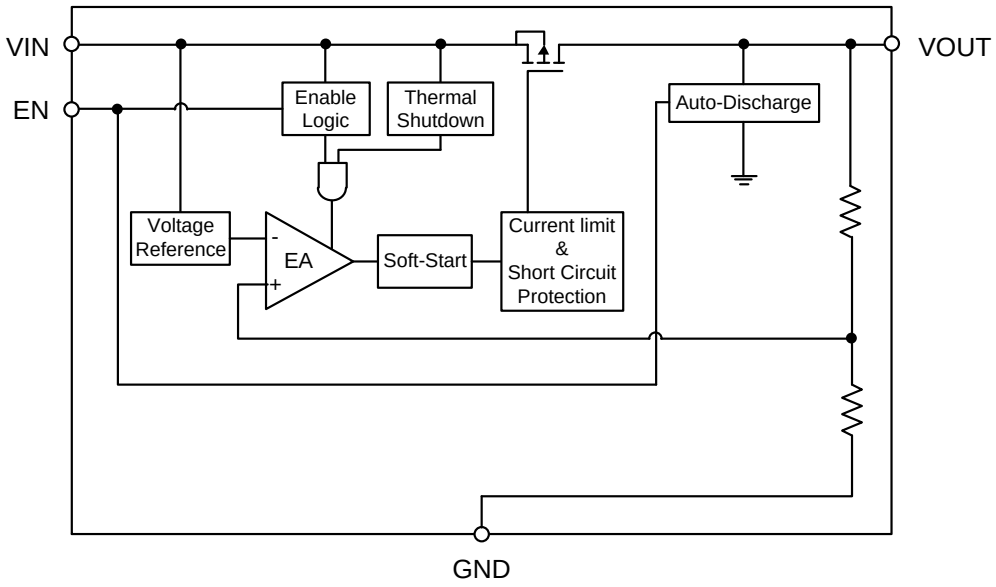


Figure 9-1. UM1520 Block Diagram

10 Feature Description

10.1 Enable Operation

The UM1520 series use EN pin to control the devices enable/disable. If the voltage of EN pin is less than 0.3V, the UM1520 series will enter disable state. In this state, the function modules of the devices and the power MOSFET are turned off. And then the auto-discharge circuit will enable that make output capacitor discharge through a ON-state NMOSFET to GND. In this state, the devices only consume 10nA current.

If the voltage of EN pin is higher than 1V, the UM1520 series are guaranteed to be enabled. The auto-discharge circuit will be disabled, and the devices will regulate the designed output voltage.

10.2 Auto-Discharge Function

The devices integrate a NMOSFET of 100Ω $R_{DS(ON)}$ between the output and ground, and the auto-discharge function makes output voltage discharge quickly when EN is disable state. This prevents residual charge voltage on the output capacitor that avoid powering up improperly of the systems connected to the regulator. It should be noted that auto discharge function is optional according to different versions.

10.3 Current Limit

The UM1520 series have an internal current limit circuit that protects the regulator during transient high-load current faults or shorting events. The devices limit the current to the output limit (I_{CL}) which protect the devices properly and guarantee the output capability of 300mA.

The UM1520 incorporate an internal current-limiting circuit to protect the regulator during transient high-load current faults or short-circuit events. The current limit employs a hybrid brick-wall foldback scheme. Under the foldback voltage ($V_{FOLDBACK}$), the current limit transitions from a brick-wall scheme to a foldback scheme. During high-load current faults where the output voltage exceeds $V_{FOLDBACK}$, the brick-wall scheme restricts the output current to the current limit value (I_{CL}). When the voltage drops below $V_{FOLDBACK}$, foldback current limiting activates, proportionally reducing the current as the output voltage approaches GND. In the event of an output short circuit, the device provides a typical current known as the short-circuit current limit (I_{SC}). Both I_{CL} and I_{SC} are specified in the Electrical Characteristics table.

When the device operates in current-limiting mode, the output voltage is not regulated. During a current-limiting event, the device begins to heat up due to increased power dissipation. Under brick-wall current limiting, the conducting transistor dissipates power [(V_{IN} – V_{OUT}) × I_{CL}]. When the output is short-circuited and falls below $V_{FOLDBACK}$, the conducting transistor dissipates power [(V_{IN} – V_{OUT}) × I_{SC}]. If thermal shutdown is triggered, the device turns off. After cooling, the internal thermal shutdown circuit reactivates the device. If the output current fault condition persists, the device cycles between current-limiting and thermal shutdown states.

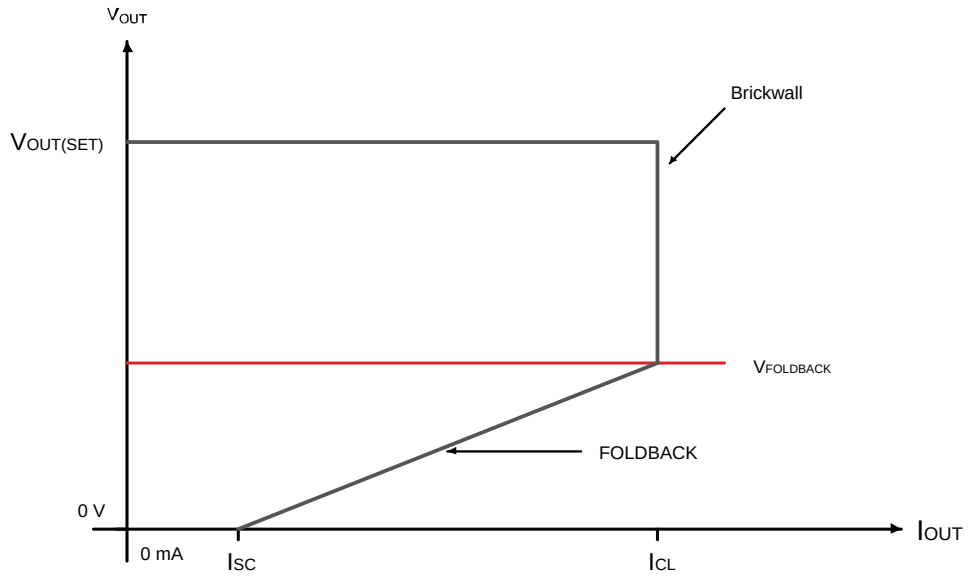


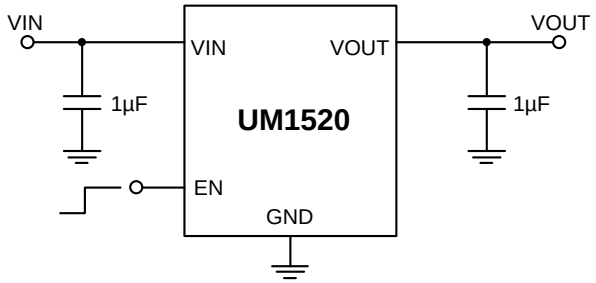
Figure 10-1. UM1520's Foldback function

10.4 Thermal Shutdown

The UM1520 series integrates thermal shutdown function, protect IC from excessively high temperature. When the chip temperature exceeds 160°C, the UM1520 series detects it as an over-temperature event, triggering thermal shutdown, which will turn off the main function module, including power MOSFET. This inhibits increase of chip's temperature. The IC would keep the protection-state on until the chip's temperature falls below to 130°C. At this moment, the over-temperature protection-state is released, IC resumes to work again. The hysteresis avoids IC's turning off and on frequently around the Thermal Shutdown threshold.

11 Application and Implementation

11.1 Typical Application circuit



11.2 Application Information

11.2.1 Input and Output Capacitor Recommendations

The device is designed to be stable using low equivalent series resistance (ESR) ceramic capacitors at the input and output. Multilayer ceramic capacitors have become the industry standard for these types of applications and are recommended, but use good judgment. Ceramic capacitors that employ X7R, X5R, and C0G rated dielectric materials provide relatively good capacitive stability across temperature. However, using Y5V rated capacitors is discouraged because of large variations in capacitance

Although an input capacitor is not required for stability, good analog design practice is to connect a capacitor from VIN to GND. This capacitor counteracts reactive input sources and improves transient response, input ripple, and PSRR. For typical operation of the UM152x, connect a 1µF capacitor to the input. Use a higher value capacitor if large, fast rise-time, load, or line transients are anticipated. Additionally, use a higher-value capacitor if the device is located several inches from the input power source. Dynamic performance of the device is improved by using an output capacitor. For general applications, it is recommended to use the capacitors listed in the table below to ensure stable operation and balanced performance. For special application requirements, please contact UNION for technical support by email or phone.

Table 11-1. Recommended Components List

Component	PART No.	DESCRIPTION	MFR	TYP	UNIT
C_{IN}	GRM155R61A105KE15	10V, X5R, 0402	MURATA	1	µF
C_{OUT}	GRM155R61A105KE15	10V, X5R, 0402	MURATA	1	µF

Regardless of the ceramic capacitor type selected, the effective capacitance varies with operating voltage and temperature. Generally, expect the effective capacitance to decrease by as much as 50%. The input and output capacitors listed in the Recommended Components List account for an effective capacitance of approximately 50% of the nominal value.

11.3 Layout

11.3.1 Layout Guidelines

- Place input and output capacitors as close to the device as possible.
- Use copper planes for device connections to optimize thermal performance.
- Place thermal vias around the device to distribute the heat.

11.3.2 Layout Examples

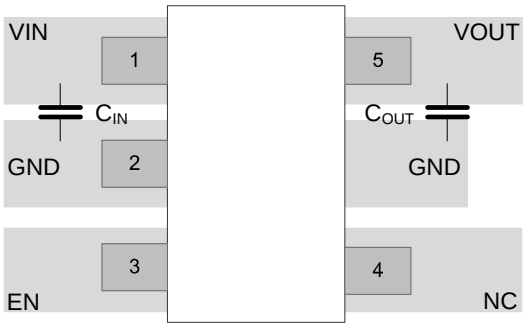


Figure 11-1. SOT-23-5 Package Typical Layout

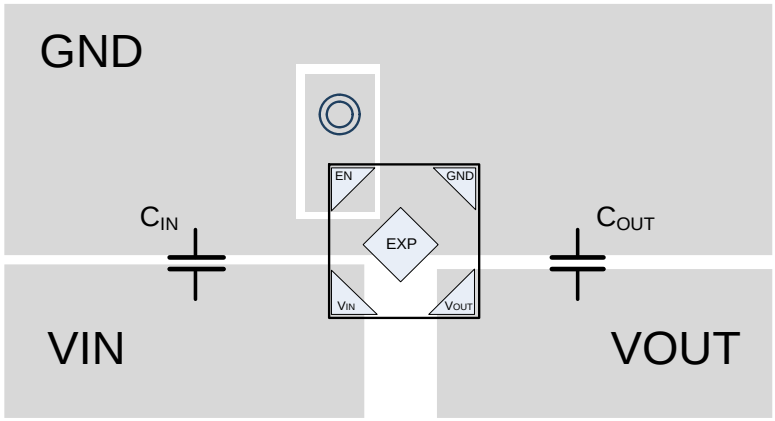
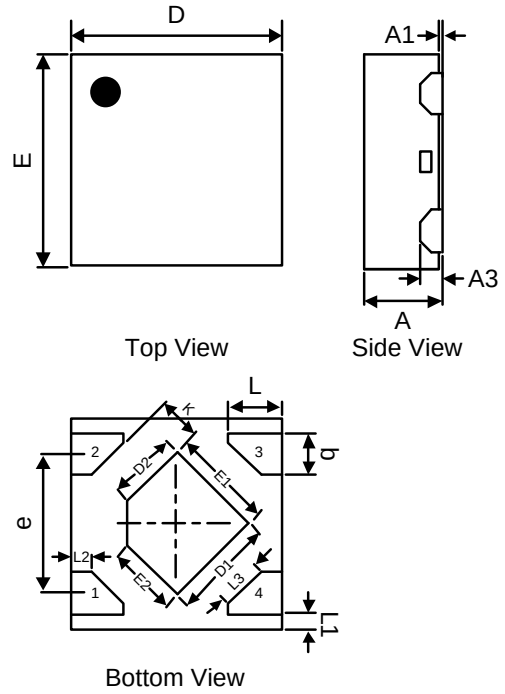


Figure 11-2. DFN4 1.0×1.0 Package Typical Layout

Package Information

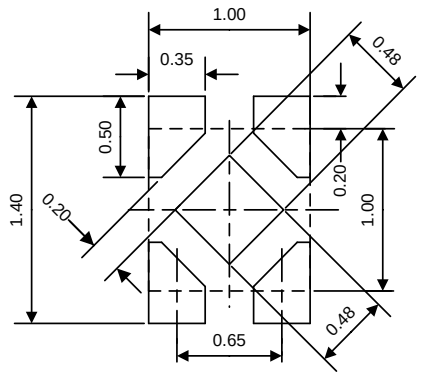
DFN4 1.0×1.0

Outline Drawing



Symbol	DIMENSIONS					
	MILLIMETERS			INCHES		
	Min	Typ	Max	Min	Typ	Max
A	0.35	0.37	0.40	0.014	0.015	0.016
A1	0.00	0.02	0.05	0.000	0.0008	0.002
A3	0.102 REF			0.004 REF		
b	0.15	0.20	0.25	0.006	0.008	0.010
D	0.95	1.00	1.05	0.038	0.040	0.042
E	0.95	1.00	1.05	0.038	0.040	0.042
D1	0.38	0.48	0.58	0.015	0.019	0.023
E1	0.38	0.48	0.58	0.015	0.019	0.023
D2	0.23	0.33	0.43	0.009	0.013	0.017
E2	0.23	0.33	0.43	0.009	0.013	0.017
e	0.65 BSC			0.026 BSC		
L	0.20	0.25	0.30	0.008	0.010	0.012
L1	0.075 REF			0.003 REF		
L2	0.103 REF			0.004 REF		
L3	0.208 REF			0.008 REF		
K	0.20 REF			0.008 REF		

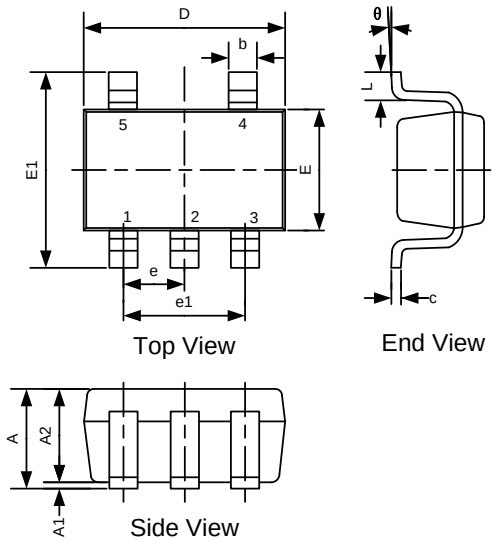
Land Pattern



NOTES:
1. Unit: mm;
2. General tolerance ±0.05mm unless otherwise specified;
3. The layout is just for reference.

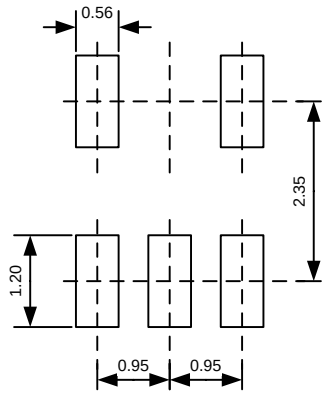
SOT23-5

Outline Drawing



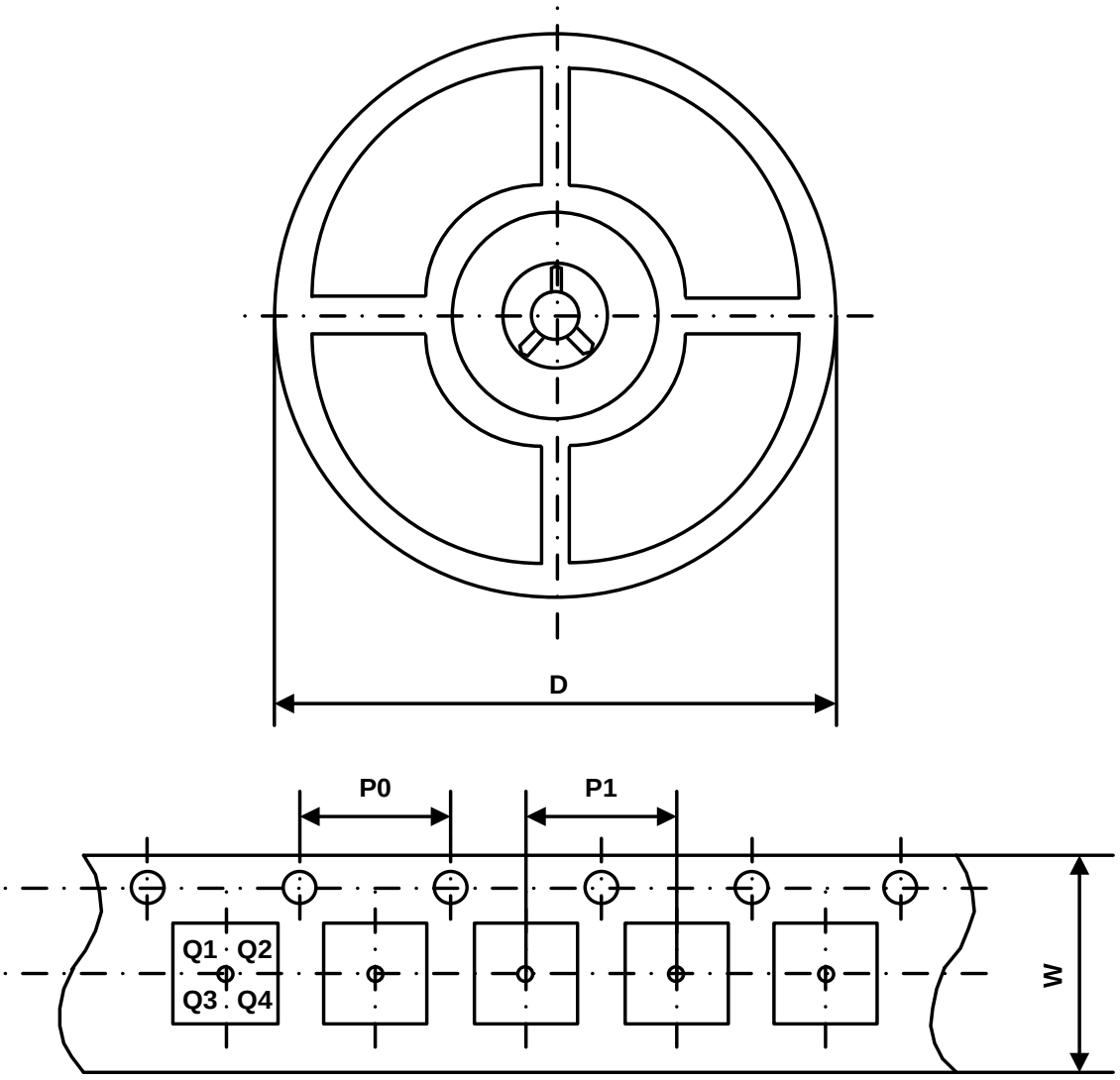
Symbol	DIMENSIONS					
	MILLIMETERS			INCHES		
	Min	Typ	Max	Min	Typ	Max
A	1.013	1.15	1.40	0.040	0.045	0.055
A1	0.00	0.05	0.10	0.000	0.002	0.004
A2	1.00	1.10	1.30	0.039	0.043	0.051
b	0.30	-	0.50	0.012	-	0.020
c	0.10	0.15	0.20	0.004	0.006	0.008
D	2.82	-	3.10	0.111	-	0.122
E	1.50	1.60	1.70	0.059	0.063	0.067
E1	2.60	2.80	3.00	0.102	0.110	0.118
e	0.95REF			0.037REF		
e1	1.90REF			0.075REF		
L	0.30	-	0.60	0.012	-	0.024
θ	0 °	-	8 °	0 °	-	8 °

Land Pattern



NOTES:
1. Unit: mm;
2. General tolerance ±0.05mm unless otherwise specified;
3. The layout is just for reference.

Packing Information



Part Number	Package Type	Carrier Width (W)	Pitch (P0)	Pitch (P1)	Reel Size (D)	PIN 1 Quadrant
UM1520xDB4-xxx	DFN4 1.0×1.0	8 mm	4 mm	2 mm	180 mm	Q1
UM1520xS5-xxx	SOT23-5	8 mm	4 mm	4 mm	180 mm	Q3

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