

## Introduction to Toshiba small package Bipolar Transistors

Toshiba offers a wide range of Bipolar Transistors (BJT : Bipolar junction transistor) mounted in small packages, including single-type and combined-type diodes.

### Toshiba, a leading company in transistors

Since Toshiba succeeded in developing a transistor in 1951, it has been one of the major transistor vendors [Note] who have continued to market products as a pioneer in the industry since the early days of semiconductors. We will continue to provide a wide range of highly reliable transistor products based on our experience in delivering products to many customers.

[Note] according to a survey by Toshiba (as of November 25<sup>th</sup>, 2021)

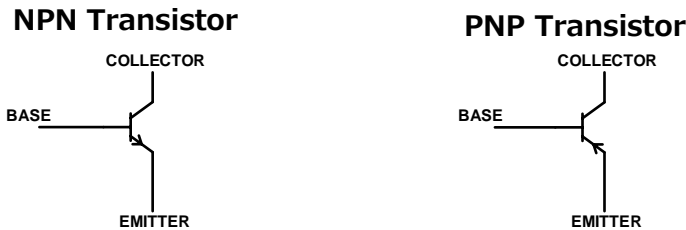


### High-quality, safe and secure delivery at plants in Japan and Thailand

Our transistor products are mainly surface-mount type small packages. High-quality, stable production at plants in Japan and Thailand enables safe and safety delivery. We will respond quickly and seriously to sudden delivery problems as well.

### Transistor overview

A bipolar transistor is one of the typical semiconductors that controls the current flowing through the collector by the base current, and to operate as "amplification" and "switching" on the electric circuit. As shown in the figure below, there are two types, NPN type and PNP type.





When selecting a transistor product, it is necessary to consider the breakdown voltage (V<sub>CEO</sub>: collector-emitter withstand voltage), current (I<sub>C</sub>: collector current), h<sub>FE</sub>: DC current amplification factor, package / mounting area, etc.






### Features of bipolar transistor

Bipolar transistors have the following advantages and disadvantages compared to MOSFETs. We recommend the optimum usage according to the circuit to be used.

	Bipolar transistor	MOSFET
Advantages	<ul style="list-style-type: none"> <li>- Strong ESD susceptibility</li> <li>- High breakdown voltage (V<sub>CEO</sub>)</li> <li>- The transistor turns on even if the base voltage is low.</li> </ul>	<ul style="list-style-type: none"> <li>- There are a few external parts</li> <li>- Switching speed is fast</li> <li>- Current does not flow into the gate terminal</li> </ul>
Disadvantages	<ul style="list-style-type: none"> <li>- Switching speed is slow</li> <li>- Large number of external parts</li> </ul>	<ul style="list-style-type: none"> <li>- ESD susceptibility is relatively weak</li> <li>- The gate voltage (V<sub>th</sub>) required to turn on the MOSFET is generally higher than bipolar transistors</li> <li>-It is necessary to pay attention to the influence of the body diode when using it</li> </ul>

• Bipolar Transistors selection table  
[Single product]

Classification	$ V_{CE0} $ (V)	$ I_C $ (mA)	CST3 (SOT-883)		VESM (SOT-723)		SSM (SOT-416)			
			Bottom View							
			1.0x0.6		1.2x1.2		1.6x1.6			
General Purpose	50	100	Part Number							
			NPN		PNP		NPN		PNP	
			<a href="#">2SC6026CT</a>	<a href="#">2SA2154CT</a>			<a href="#">2SC6026MFV</a>	<a href="#">2SA2154MFV</a>	<a href="#">2SC4738</a>	<a href="#">2SA1832</a>
	50	150			<a href="#">2SC6026MFV</a>	<a href="#">2SA2154MFV</a>	<a href="#">2SC4738</a>	<a href="#">2SA1832</a>		

Classification	$ V_{CE0} $ (V)	$ I_C $ (mA)	USM (SOT-323)		UFM (SOT-323F)		S-Mini (SOT-346)		SOT23 (SOT-23)		SOT-23F			
														
			2.0x2.1		2.0x2.1		2.9x2.5		2.9x2.4		2.9x2.8			
General Purpose	30	500	Part Number											
			NPN		PNP		NPN		PNP		NPN		PNP	
				<a href="#">2SA1588</a>				<a href="#">2SA1182</a>						
	50	150	<a href="#">2SC4116</a>	<a href="#">2SA1586</a>			<a href="#">2SC2712</a>	<a href="#">2SA1162</a>	<a href="#">TBC847</a>	<a href="#">TBC857</a>				
	50	200	<a href="#">TTC4116FU</a>	<a href="#">TTA1586FU</a>					<a href="#">TMBT3904</a>	<a href="#">TMBT3906</a>				
	50	500					<a href="#">2SC3325</a>	<a href="#">2SA1313</a>						
	45						<a href="#">TTC1949</a>	<a href="#">TTA1713</a>						
Low Noise	120	100	<a href="#">2SC4117</a>	<a href="#">2SA1587</a>			<a href="#">2SC2713</a>	<a href="#">2SA1163</a>						
Low Saturation	15	800					<a href="#">2SA1362</a>							
Muting	20	300	<a href="#">2SC4213</a>				<a href="#">2SC3326</a>							
High Current	20	2500				<a href="#">2SA2215</a>						<a href="#">TTA502</a>		
	25	800					<a href="#">2SC3265</a>	<a href="#">2SA1298</a>						
	50	1000			<a href="#">2SC6135</a>					<a href="#">TTC500</a>	<a href="#">TTA500</a>			
	50	1700				<a href="#">2SA2195</a>						<a href="#">TTA501</a>		
	50	2000										<a href="#">TTA501</a>		
	50	2500			<a href="#">2SC6100</a>					<a href="#">TTC501</a>				
	120	1000								<a href="#">TTC502</a>				
High Breakdown	300	100					<a href="#">2SA1721</a>							

☆ New Products

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