Smart USB Charging Port Controller

General Description

The NT6001 is a smart USB interface IC specifically designed for dedicated charging port applications. The NT6001 automatically identifies the handheld devices attached to the USB port. Then it emulates the genuine chargers accordingly so that the attached device can draw maximum current from the charging port.

The NT6001 supports Apple iPad, Apple iPhone, Samsung Galaxy Note, BC1.2 or YD/T 1591 compliant devices, and majority of modern portable devices.

The NT6001 is available in tiny TSOT23-5L package.

Note: Apple, iPad, iPhone, Samsung and Galaxy Note are trademarks belonging to their respective owners.

Features

- **4.5V ~ 6.0V Single Supply Operation**
- **Smart USB Charger Identification Circuit**
  - **Support Apple iPad 2.4A Applications**
  - **Support Samsung Galaxy Note 2.0A Applications**
  - **Support BC1.2 & YD/T 1591 Battery Charging Specifications**
- **8kV High ESD**
- **-40°C ~ +125°C Operating Ambient Temperature**
- **TSOT23-5L Package**
- **RoHS Compliant and Halogen-Free**

Applications

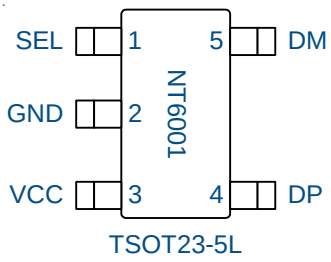
- **CLA Car Chargers**
- **Computer Peripherals**
- **Wall Adaptors**
- **USB Power Plugs**
- **Portable Power Banks**

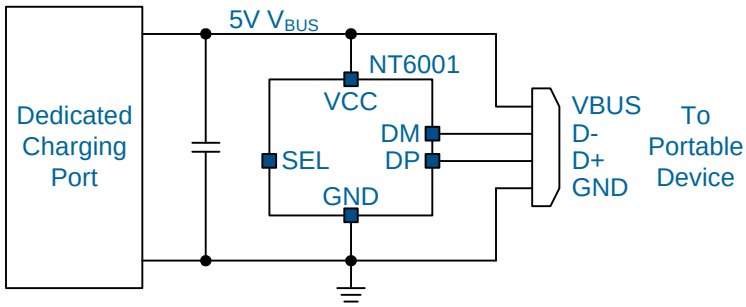
Ordering Information

Order Number	Package	Top Marking
NT6001AMT5	TSOT23-5L	N01A

Note: NT products are compatible with the current IPC/JEDEC J-STD-020 requirement. They are halogen-free, RoHS compliant and 100% matte tin (Sn) plating that are suitable for use in SnPb or Pb-free soldering processes.

Pin Configuration & Typical Application Circuit

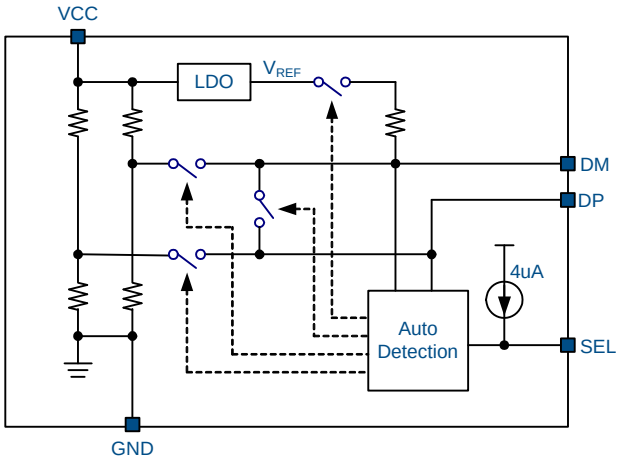




Functional Pin Description

Pin No.	Pin Name	Pin Function
1	SEL	**Operation Mode Selection.** This pin is internally pulled high by a 4uA current source.
2	GND	**Ground for the IC.** All voltage levels are measured with respect to this pin.
3	VCC	**Supply Voltage** to the IC.
4	DP	USB positive data-channel to external USB devices.
5	DM	USB negative data-channel to external USB devices.

Functional Block Diagram



The NT6001 is a smart USB interface IC specifically designed for universal power adaptors. It automatically detects the portable device attached to the USB port. Then it emulates the respective proprietary charger so that the portable device could be charged with its maximum rated current. The NT6001 supports Apple iPad, Apple iPhone, Samsung Galaxy Note, BC1.2 or YD/T 1591 compliant devices, and majority of modern portable devices.

Automatic Detection of Data Lines

When enabled, the NT6001 biases the data lines DP/DM at certain levels by internally resistive dividers according to the selected operation mode. Then it detects status of DP/DM to identify the type of the attached device. If the DP/DM voltages remain within their respective level, the NT6001 asserts that an *Apple* device is attached and keeps biasing the DP/DM pins with internally resistive dividers.

If the DP/DM voltages drift from their respective levels, the NT6001 asserts that a *non-Apple* device is attached and shorts the DP and DM pins by an internal switch.

Mode Selection

Three operatoin modes are available selected by the SEL pin as shown in Table 1. The SEL pin is internally pulled high by a 4uA current source. Set the SEL pin according to current rating of the dedicated charging port.

If the dedicated charging port can provide current as high as 2.4A, connect a 600kΩ resistor from SEL pin to GND. The attached *iPad 4* can draw up to 2.4A charging current.

If the dedicated charging port can provide current as high as 2.1A, let the SEL pin floating. The attached *iPad* can draw can draw up to 2.1A charging current.

If the dedicated charging port can only provide current as hgih as 1.5A, short the SEL pin to GND. The attached

iDevice can draw up to 1.0A charging current. If a BC1.2 compliant device is attached, it is allowed to draw up to 1.5A charging current.

Note that the NT6001 only controls behavior of data lines DP/DM of USB charging port. It does not involve any power related operation. The companion power converter must be capable of delivering 2.4A/2.1A/1.5A output current with rated output voltage according to the SEL status.

Table 1. Operation Mode Selection

SEL	iDevice			BC1.2 Compliant Device		
	DP	DM	Maximum Allowable Current	DP	DM	Maximum Allowable Current
600kΩ to GND	2.8V	2.8V	2.4A	Short Circuit		1.5A
Open	2.8V	2.1V	2.1A	Short Circuit		1.5A
Short to GND	2.1V	2.8V	1.0A	Short Circuit		1.5A

Absolute Maximum Rating

(Note1)

Supply Input Voltage, V_{CC} ---------- -0.3V to +7V

Other Pins ---------- +0.3V to (V_{CC} + 0.3V)

Storage Temperature Range ---------- -55°C to +150°C

Operation Temperature Range ---------- -40°C to +125°C

Lead Temperature Range (Soldering 10sec) ---------- 260°C

ESD Rating (Note2)

MM (Machine Mode) ---------- 600V

HBM (Human Body Mode) ---------- 8kV

Thermal Information

Package Thermal Resistance (Note3)

TSOT23-5L θ_{JA} ---------- 250°C/W

TSOT23-5L θ_{JC} ---------- 100°C/W

Power Dissipation, P_D @ T_A = 25°C

TSOT23-5L ---------- 0.4W

Recommended Operating Conditions

Operating Junction Temperature Range (Note4) ---------- -40°C to +125°C

Operating Ambient Temperature Range ---------- -40°C to +125°C

Note 1. Stresses listed as the above "Absolute Maximum Ratings" may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may remain possibility to affect device reliability.

Note 2. Devices are ESD sensitive. Handling precaution recommended.

Note 3. θ_{JA} is measured in the natural convection at T_A = 25°C on a high effective thermal conductivity test board of JEDEC 51-7 thermal measurement standard.

Note 4. The device is not guaranteed to function outside its operating conditions.

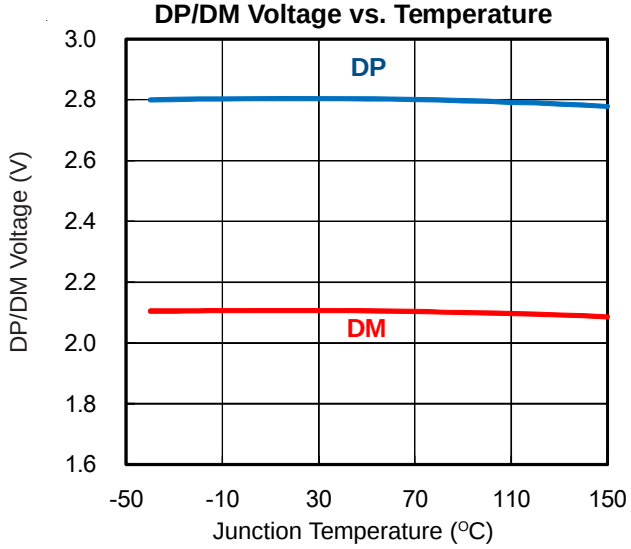
Electrical Characteristics

(V_{CC} = 5V, T_A = +25°C unless otherwise specified.)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Supply Input						
Supply Voltage Range	V_{CC}		4.5	--	6.0	V
Quiescent Current	I_{CC}	SEL pin open	--	0.42	--	mA
SEL						
SEL Pin Pull High Current	I_{SEL}	V_{SEL} = 2.4V	--	4	--	uA
Logic High Threshold Level	V_{SEL-H}	V_{SEL} Rising	--	V_{CC}-1.5	V_{CC}-1.0	V
Logic Low Threshold Level	V_{SEL-L}	V_{SEL} Falling	0.6	1.0	--	V
Logic Middel Range	V_{SEL-M}		1.5	--	V_{CC} - 2	V
DP/DM						
DP Floating Voltage	V_{DP}	V_{SEL} = High, Middle	--	2.8	--	V
		V_{SEL} = Low	--	2.1	--	
DM Floating Voltage	V_{DM}	V_{SEL} = Low , Middle	--	2.8	--	V
		V_{SEL} = High	--	2.1	--	
DP Pin Output Impedance	Z_{DP}		--	40	--	kΩ
DM Pin Output Impedance	Z_{DM}		--	40	--	kΩ
DP Rising Threshold for Exiting Apple Mode	V_{DP-R}	V_{SEL} = High, Middle	--	3.0	--	V
		V_{SEL} = Low	--	2.4	--	
DM Falling Threshold for Exiting Apple Mode	V_{DM-F}	V_{SEL} = Low , Middle	--	2.1	--	V
		V_{SEL} = High	--	1.5	--	
DP and DM Short Circuit Switch		Non-Apple device attached	--	70	--	Ω
DP/DM Terminal Voltage		V_{SEL} = High, Middle	--	1.2	--	V
Timing						
Delay Time for Exiting Apple Mode		$V_{DP} > V_{DP-R}$	--	850	--	us
Delay Time for Exiting Apple Mode		$V_{DM} < V_{DM-F}$	--	100	--	ms
Recycle Time for Entering Apple Mode			--	2.0	--	s
Pulse Width for Retrying to Apple Mode			--	2.0	--	ms

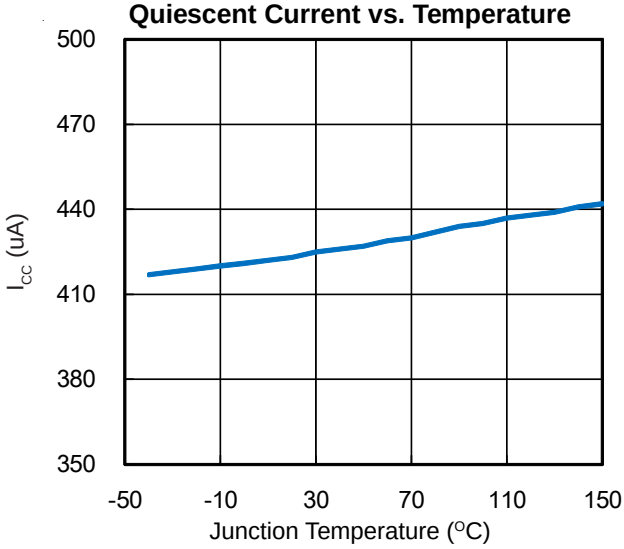
Typical Operation Characteristics

DP/DM Voltage vs. Temperature

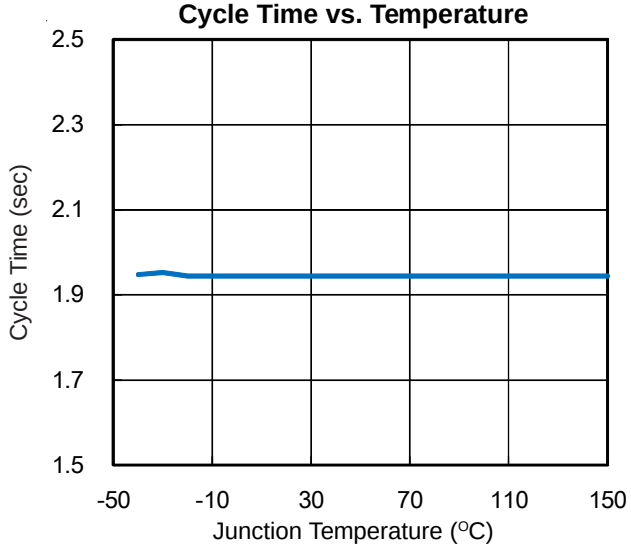


SEL = Floating

Quiescent Current vs. Temperature

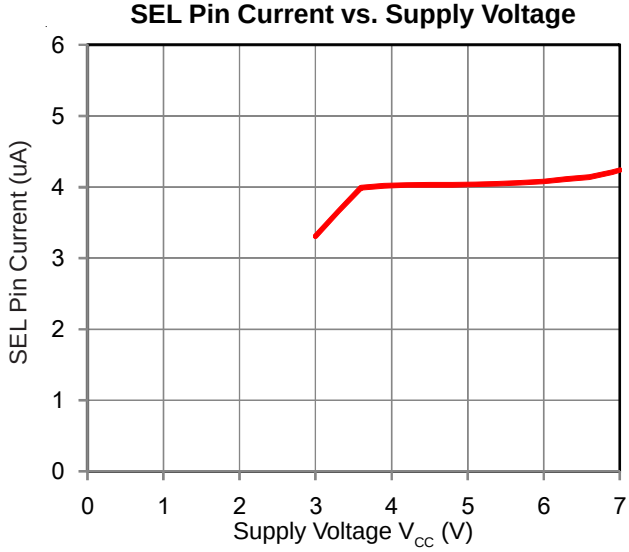


Cycle Time vs. Temperature



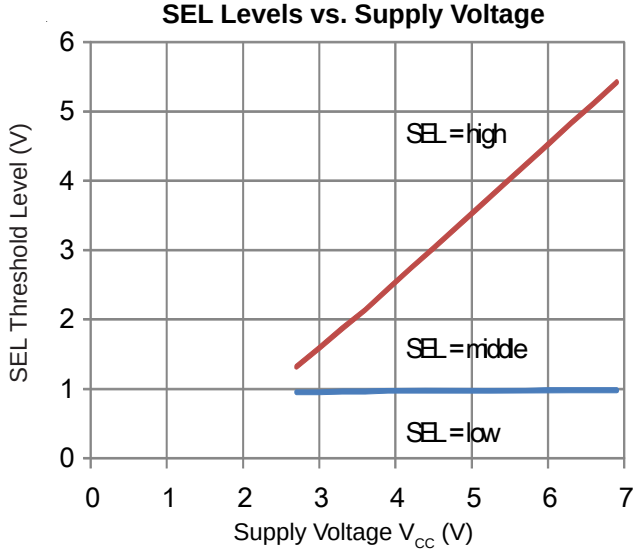
SEL = Floating

SEL Pin Current vs. Supply Voltage

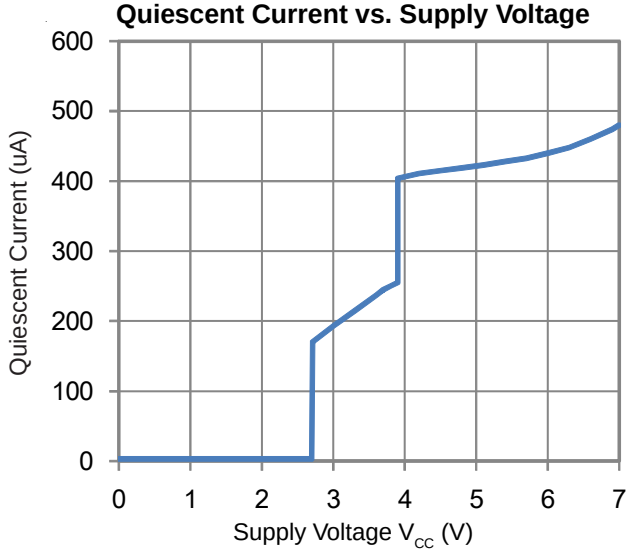


SEL = 2.4V

SEL Levels vs. Supply Voltage

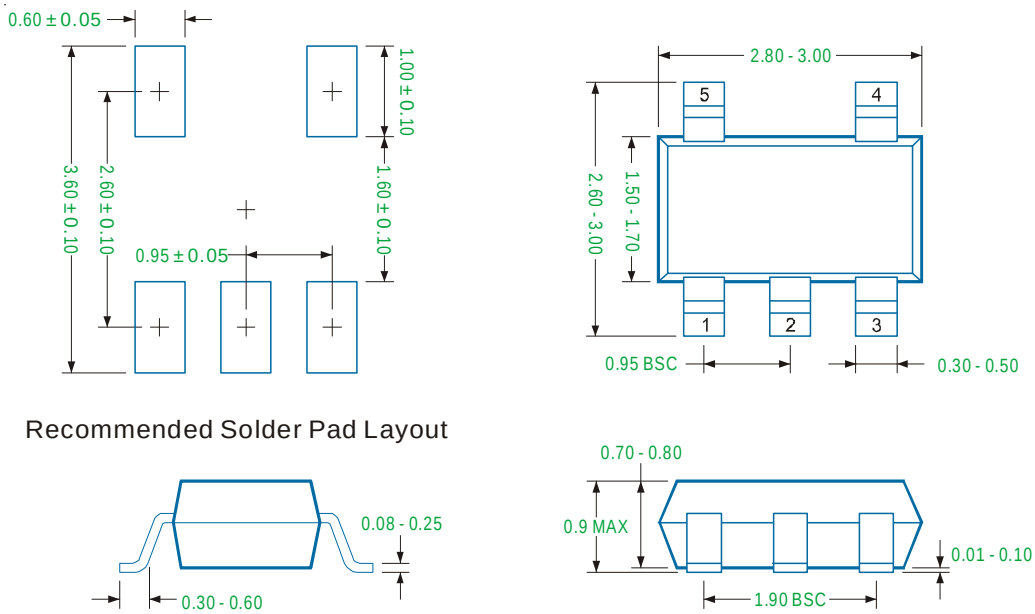


Quiescent Current vs. Supply Voltage



Package Information

TSOT23-5L



Note

1. Package Outline Unit Description:
   BSC: Basic. Represents theoretical exact dimension or dimension target
   MIN: Minimum dimension specified.
   MAX: Maximum dimension specified.
   REF: Reference. Represents dimension for reference use only. This value is not a device specification.
   TYP. Typical. Provided as a general value. This value is not a device specification.
2. Dimensions in Millimeters.
3. Drawing not to scale.
4. These dimensions do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15mm.