



**THE DATASHEET OF  
NCX8193GUX**



# NCX8193

## Audio jack detection and configuration with false detection prevention

Rev. 2 — 21 November 2014

Product data sheet

### 1. General description

The NCX8193 is an advanced audio jack accessory detector and controller. It supports 3-pole and 4-pole connectors and detects the insertion of plugs into jacks using a fault detection technique. An internal microphone bias line switch allows a codec or application processor to control the audio jack configuration. The device supports a broad variety of after-market headphones.

### 2. Features and benefits

- Fail-safe headset and headphone detection
- Low-power standby mode
- Click free switching
- Low THD and noise microphone pass through channel
- Send/End button detection
- Low ON resistance: 0.9  $\Omega$  (typical) at a supply voltage of 2.8 V
- ESD protection:
  - ◆ HBM JEDEC JDS-001 Class 3B exceeds 8 kV
- Operating ambient temperature  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$

### 3. Applications

- Headphones with integrated microphone and remote control buttons

### 4. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
NCX8193GU	$-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$	XQFN10	plastic, extremely thin quad flat package; no leads; 10 terminals; body $1.8 \times 1.4 \times 0.5$ mm	SOT1160-2

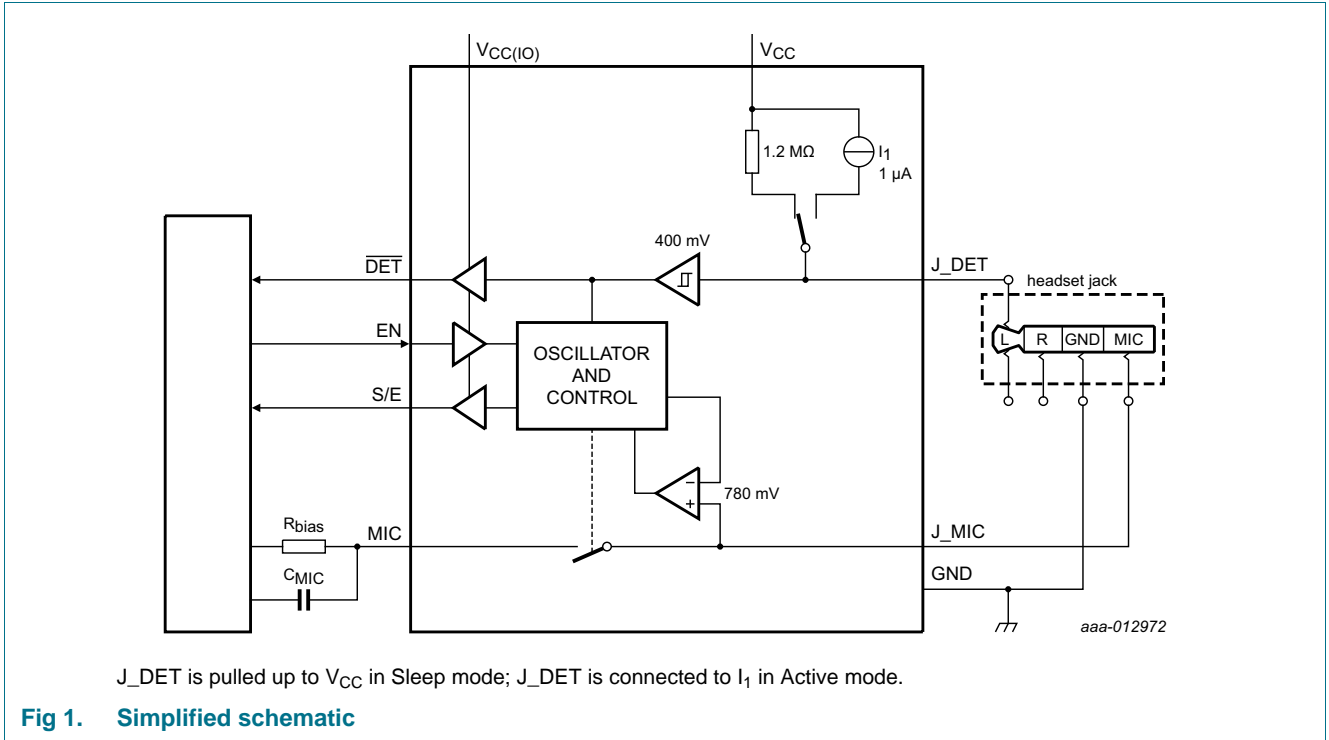
### 5. Marking

Table 2. Marking codes

Type number	Marking code
NCX8193GU	q8



## 6. Functional diagram



## 7. Pinning information

### 7.1 Pinning

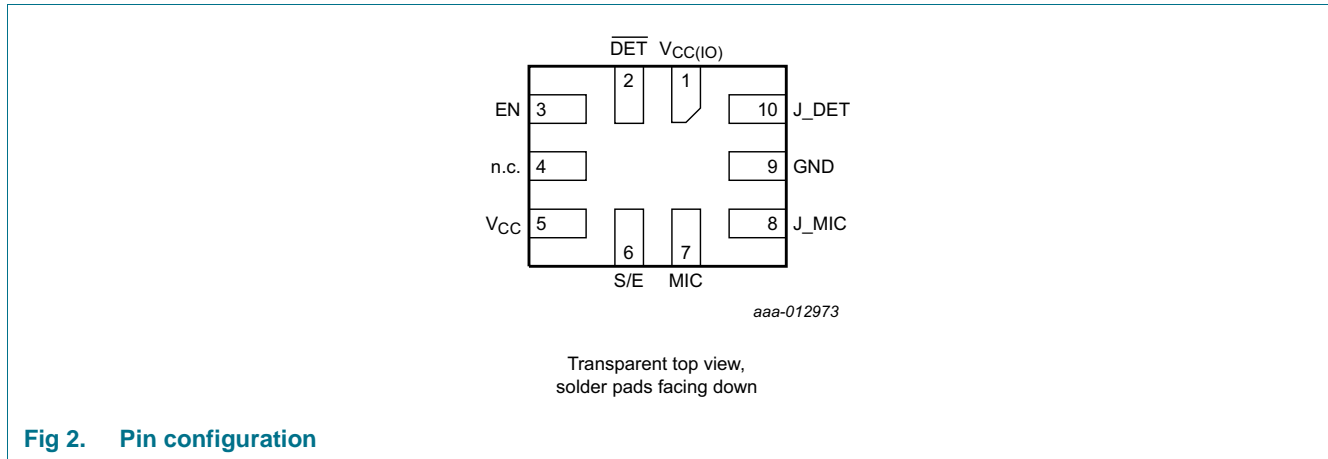


Fig 2. Pin configuration

### 7.2 Pin description

Table 3. Pin description

Symbol	Pin	Type	Description
$V_{CC(I/O)}$	1	Power	digital interface input/output supply voltage; headphone mode bias supply
$\overline{DET}$	2	O	plug detect; Plug inserted: $\overline{DET}$ = LOW; unplugged: $\overline{DET}$ = HIGH
EN	3	I	microphone bias path switch SWM control. closed: EN = HIGH; open: EN = LOW
n.c.	4	n.c.	not connected (preferably connected GND)
$V_{CC}$	5	Power	core supply (e.g. battery)
S/E	6	O	keypress-detect; key press: S/E = HIGH; NO key press: S/E = LOW
MIC	7	I/O	microphone bias connection audio codec side
J_MIC	8	I/O	microphone bias connection audio headset side
GND	9	ground	ground
J_DET	10	I/O	plug detection bias and logic level input

## 8. Functional description

The simplified schematic of the NCX8193 is shown in [Figure 1](#).

If no plug is inserted, J\_DET is pulled-up to V<sub>CC</sub> via a 1.2 MΩ resistor. Once J\_DET is pulled below 400 mV, the pull-up resistor is switched out and J\_DET is connected to a variable current source. The current source slowly increases its output current. If J\_DET remains lower than 300 mV,  $\overline{\text{DET}}$  is set LOW to indicate that a plug has been inserted.

In case  $\overline{\text{DET}}$  is set LOW, when EN is HIGH, J\_DET is connected to the current source and the integrated button press detection circuit on J\_MIC is active. The button press detection uses a trigger level of 780 mV. It enables a 1.8 V bias voltage in combination with an R<sub>bias</sub>, matching the series resistance of the microphone, to detect button presses. Not only call-end button press but also forward and reverse button press event levels can be passed from J\_MIC to MIC. The codec or processor decodes according to the individual button pressed. Refer to [Figure 3](#) and [Figure 4](#) for details.

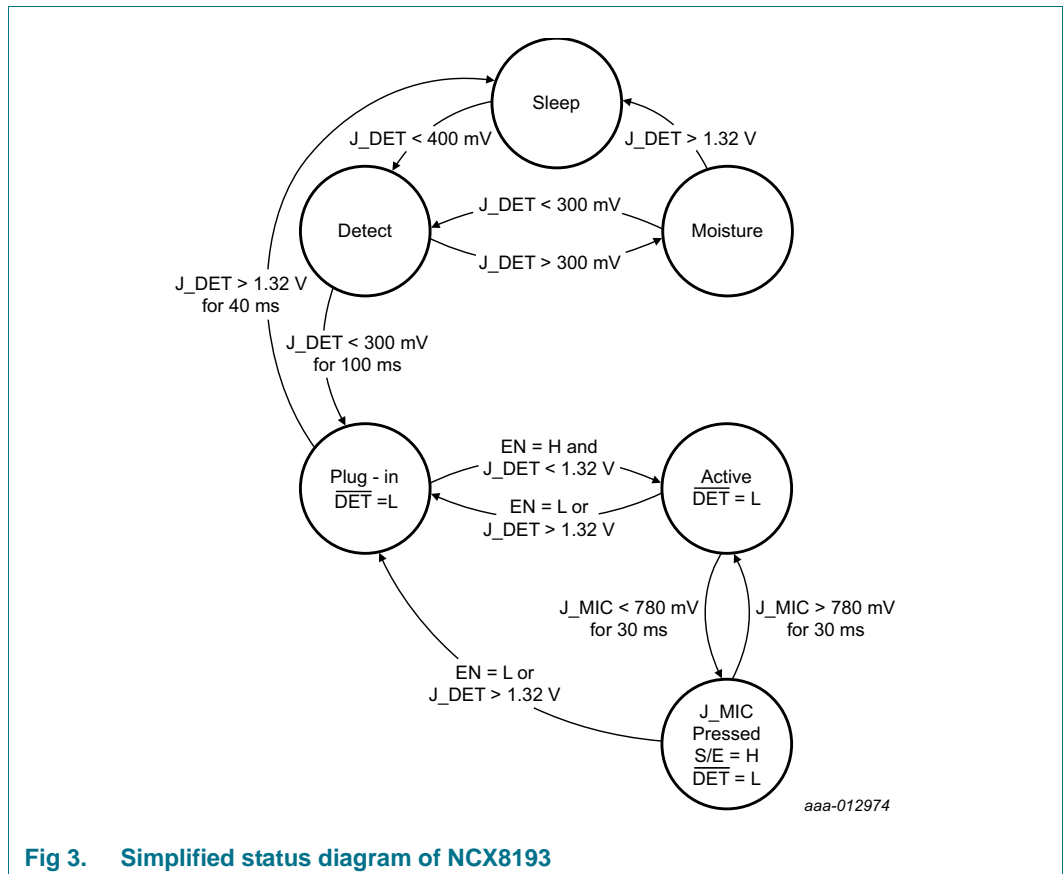


Fig 3. Simplified status diagram of NCX8193

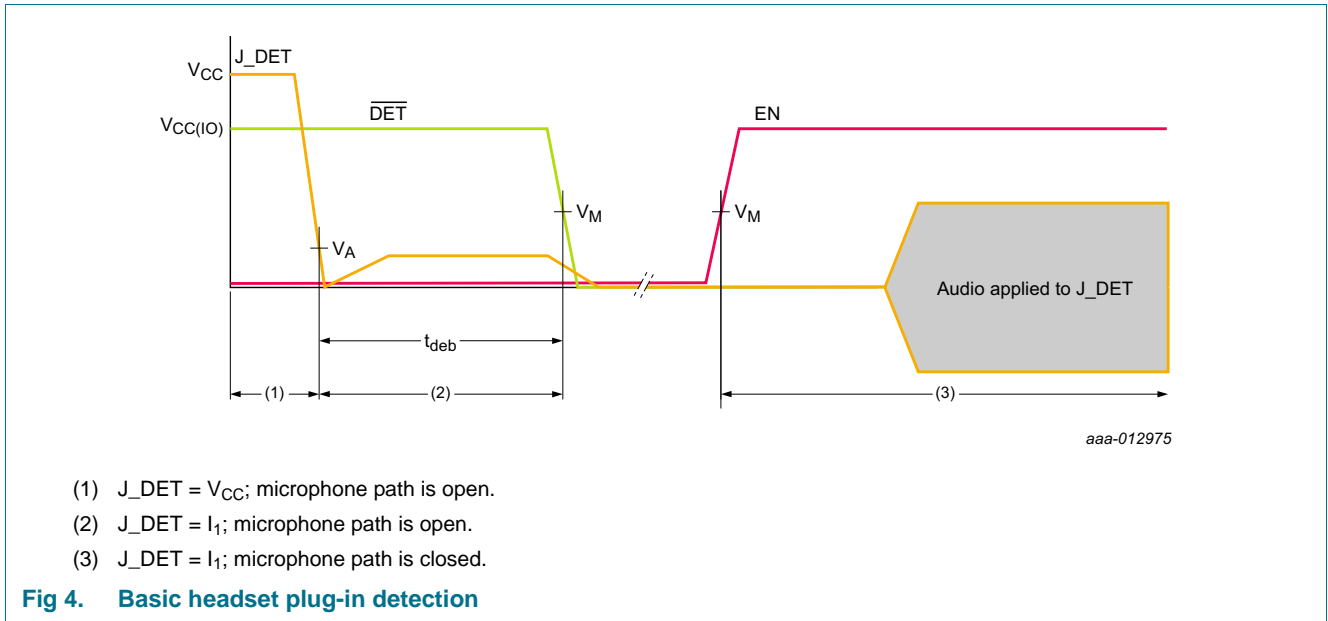


Table 4. Simplified status diagram signal and functional conditions<sup>[1]</sup>

		States					
		Sleep	Detect	Moisture	Plug-in	Active	J_MIC pressed
I/O	J_DET	H	L	0.3 V	audio signal	audio signal	audio signal
Input	EN	X	X	X	L	H	H
I/O	J_MIC	L	L	L	L	> 780 mV	< 780 mV
I/O	MIC	Z	Z	Z	Z	J_MIC	J_MIC
Output	$\overline{\text{DET}}$	H <sup>[2]</sup>	H	H	L	L	L
Output	S/E	L	L	L	L	L	H

[1] H = HIGH voltage level; L = LOW voltage level; X = don't care; Z = high-impedance OFF-state.

[2] In case an unplug event is detected,  $\overline{\text{DET}}$  remains LOW for 40 ms before returning to HIGH.

### 9. Application diagram

For stable operation of the NCX8913, place a 4.7  $\mu\text{F}$  capacitor between  $V_{CC}$  and GND and place a 1  $\mu\text{F}$  capacitor between  $V_{CC(10)}$  and GND. These bypass capacitors should be placed as close to the device as possible with low-ohmic connections from the power supplies and GND connections.

When the headset or accessory plug is inserted into audio jack, the J\_DET pin is shorted to the left (L) audio channel. Audio performance, within the audio range of 20 – 20 kHz, may be affected when connecting external circuitry to the J\_DET pin.

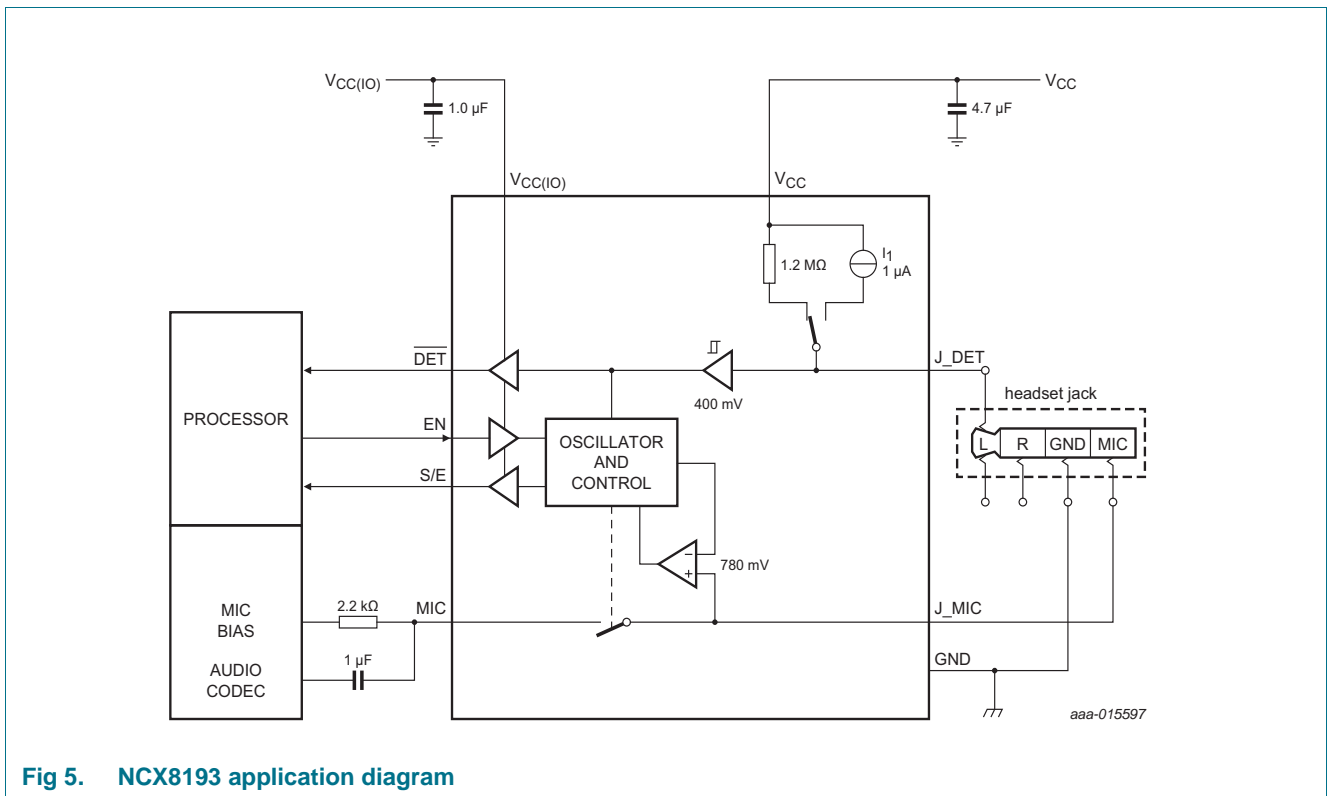


Fig 5. NCX8193 application diagram

### 10. Limiting values

Table 5. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CC}$	supply voltage		-0.5	+6.0	V
$V_{CC(10)}$	input/output supply voltage		-0.5	+6.0	V
$V_I$	input voltage	J_MIC; MIC	-0.5	$V_{CC}$	V
		EN	-0.5	$V_{CC(10)} + 0.1$	V
		J_DET	-1.5	$V_{CC}$	V
$V_O$	output voltage	DET; S/E	-0.5	$V_{CC(10)} + 0.3$	V
$\Delta V$	voltage difference	$V_{CC}$ to J_DET	-	6.0	V
$I_{sw}$	switch current	continuous current from MIC to J_MIC	-	50	mA

## Audio jack detection and configuration with false detection prevention

**Table 5. Limiting values ...continued**

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Max	Unit
$T_{j(max)}$	maximum junction temperature		-40	+125	°C
$T_{stg}$	storage temperature		-65	+150	°C
$P_{tot}$	total power dissipation		-	250	mW

## 11. Recommended operating conditions

**Table 6. Recommended operating conditions**

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CC}$	supply voltage		2.4	5.25	V
$V_{CC(IO)}$	input/output supply voltage	$V_{CC(IO)} \leq V_{CC}$	1.6	$V_{CC}$	V
$V_I$	input voltage	MIC; J_MIC	0	$V_{CC}$	V
$\Delta V$	voltage difference	$V_{CC}$ to J_DET	-	5.5	V
$T_{amb}$	ambient temperature		-40	+85	°C

## 12. Thermal characteristics

**Table 7. Thermal characteristics**

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient		<a href="#">[1]</a> 148	K/W

- [1]  $R_{th(j-a)}$  is dependent upon board layout. To minimize  $R_{th(j-a)}$ , ensure that all pins have a solid connection to larger copper layer areas. In multi-layer PCBs, the second layer should be used to create a large heat spreader area below the device. Avoid using solder-stop varnish under the device.

## 13. Static characteristics

**Table 8. Static characteristics**

At recommended operating conditions, unless otherwise specified typical values are measured with  $V_{CC} = 3.6$  V and  $V_{CC(IO)} = 1.8$  V. Voltages are referenced to GND (ground 0 V).

Symbol	Parameter	Conditions	$T_{amb} = 25$ °C			$T_{amb} = -40$ °C to $+85$ °C		Unit
			Min	Typ	Max	Min	Max	
<b>Digital control</b>								
$V_{IH}$	HIGH-level input voltage	EN	-	-	-	$0.7V_{CC(IO)}$	-	V
$V_{IL}$	LOW-level input voltage	EN	-	-	-	-	$0.3V_{CC(IO)}$	V
$V_{OH}$	HIGH-level output voltage	$\overline{\overline{DET}}$ ; S/E; $I_O = 0.5$ mA	-	-	-	$0.8V_{CC(IO)}$	-	V
$V_{OL}$	LOW-level output voltage	$\overline{\overline{DET}}$ ; S/E; $I_O = 0.5$ mA	-	-	-	-	$0.2V_{CC(IO)}$	V
$C_I$	input capacitance	J_DET	-	5	-	-	-	pF
		EN	-	1	-	-	-	pF

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**Table 8. Static characteristics ...continued**

At recommended operating conditions, unless otherwise specified typical values are measured with  $V_{CC} = 3.6\text{ V}$  and  $V_{CC(IO)} = 1.8\text{ V}$ . Voltages are referenced to GND (ground 0 V).

Symbol	Parameter	Conditions	$T_{amb} = 25\text{ °C}$			$T_{amb} = -40\text{ °C to }+85\text{ °C}$		Unit
			Min	Typ	Max	Min	Max	
<b>Microphone bias switch</b>								
$I_{S(OFF)}$	OFF-state leakage current	MIC; $V_{I(MIC)} = 850\text{ mV}$ ; see <a href="#">Figure 6</a>	-	-	-	-	0.1	$\mu\text{A}$
$R_{ON}$	ON resistance	MIC; $I_{O(J\_MIC)} = 30\text{ mA}$ ; $V_{I(MIC)} = 850\text{ mV}$ ; see <a href="#">Figure 7</a> and <a href="#">Figure 8</a>						
		$V_{CC} = 2.8\text{ V}$ ; see <a href="#">Figure 9</a>	-	0.9	-	-	1.5	$\Omega$
		$V_{CC} = 3.0\text{ V}$ ; see <a href="#">Figure 10</a>	-	0.9	-	-	1.5	$\Omega$
		$V_{CC} = 3.3\text{ V}$ ; see <a href="#">Figure 11</a>	-	0.9	-	-	1.5	$\Omega$
		$V_{CC} = 3.8\text{ V}$ ; see <a href="#">Figure 12</a>	-	0.9	-	-	1.5	$\Omega$
$R_{ON(flat)}$	ON resistance (flatness)	$I_{O(J\_MIC)} = 30\text{ mA}$ ; $0.8\text{ V} < V_{I(MIC)} < 1.2\text{ V}$						
		$V_{CC} = 2.8\text{ V}$ ; see <a href="#">Figure 9</a>	-	-	-	-	0.6	$\Omega$
		$V_{CC} = 3.0\text{ V}$ ; see <a href="#">Figure 10</a>	-	-	-	-	0.6	$\Omega$
		$V_{CC} = 3.3\text{ V}$ ; see <a href="#">Figure 11</a>	-	-	-	-	0.6	$\Omega$
		$V_{CC} = 3.8\text{ V}$ ; see <a href="#">Figure 12</a>	-	-	-	-	0.6	$\Omega$
$C_{S(OFF)}$	OFF-state capacitance	J_MIC; MIC	-	20	-	-	-	pF
$C_{S(ON)}$	ON-state capacitance	J_MIC; MIC	-	60	-	-	-	pF
<b>Audio/analog performance</b>								
THD	total harmonic distortion	$R_S = R_L = 600\ \Omega$ ; $V_{AC} = 0.5\text{ V (p-p)}$ ; $V_{DC} = 1.7\text{ V}$ ; $f_i = 20\text{ Hz to }20\text{ kHz}$ ; $V_{CC} = 3.8\text{ V}$ ; $V_{CC(IO)} = 1.8\text{ V}$ ; see <a href="#">Figure 13</a>	-	0.01	-	-	-	%
$\alpha_{iso}$	isolation (OFF-state)	$R_S = R_L = 32\ \Omega$ ; $V_{AC} = 0.1\text{ V (p-p)}$ ; $V_{DC} = 2.2\text{ V}$ ; $f_i = 20\text{ kHz}$ ; $V_{CC} = 3.8\text{ V}$ ; $V_{CC(IO)} = 1.8\text{ V}$ ; see <a href="#">Figure 14</a>	-	-100	-	-	-	dB
PSRR	power supply rejection ratio	$R_S = R_L = 600\ \Omega$ ; $V_{CC} = 3.8\text{ V}$ ; $V_{CC(IO)} = 1.8\text{ V}$ ; $V_{DC} = 1.7\text{ V}$ ; $V_{AC} = 0.3\text{ V (p-p)}$ ; $f_i = 217\text{ Hz}$ ; see <a href="#">Figure 15</a>	-	-110	-	-	-	dB

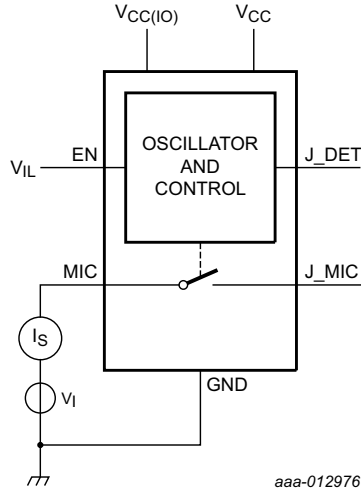
## Audio jack detection and configuration with false detection prevention

**Table 8. Static characteristics ...continued**

At recommended operating conditions, unless otherwise specified typical values are measured with  $V_{CC} = 3.6\text{ V}$  and  $V_{CC(10)} = 1.8\text{ V}$ . Voltages are referenced to GND (ground 0 V).

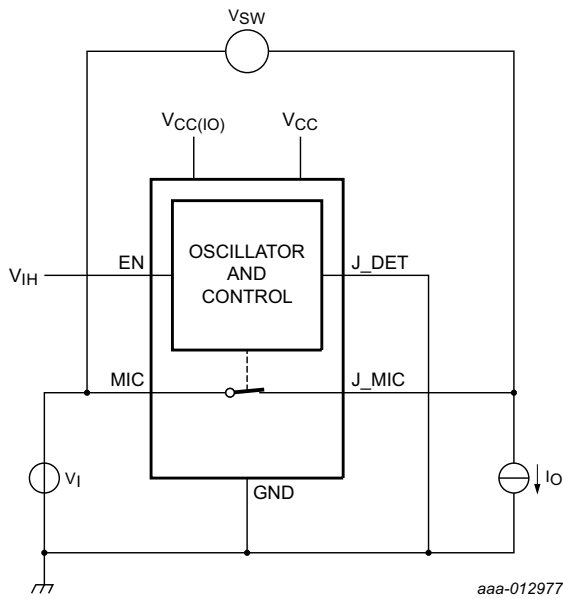
Symbol	Parameter	Conditions	$T_{\text{amb}} = 25\text{ °C}$			$T_{\text{amb}} = -40\text{ °C to }+85\text{ °C}$		Unit
			Min	Typ	Max	Min	Max	
<b>Headset detection</b>								
$V_{T-}$	negative-going threshold voltage	J_DET	-	-	-	-	400	mV
$V_{\text{ref}}$	reference voltage	J_DET; plug detect	-	300	-	270	330	mV
		J_DET; plug removed; $1.6\text{ V} < V_{CC(10)} < V_{CC}$	-	1.32	-	1.2	1.44	V
$f_{\text{max}}$	maximum frequency	J_DET	-	-	-	20000	-	Hz
$R_{\text{pu}}$	pull-up resistance	J_DET	-	1.2	-	0.9	1.6	$\text{M}\Omega$
$I_{\text{source}}$	source current	J_DET	-	1.0	-	-	-	$\mu\text{A}$
<b>Button press; S/E detect</b>								
$V_{\text{ref}}$	reference voltage	J_MIC	-	780	-	718	842	mV
<b>Current consumption</b>								
$I_{\text{CC}}$	supply current	power down; $V_{CC(10)} = 0\text{ V}$ ; $V_{CC} = 3.6\text{ V}$ ; J_DET = open	-	0.1	-	-	1	$\mu\text{A}$
$I_{\text{CC(tot)}}$	total supply current	$I_{\text{CC(10)}} + I_{\text{CC}}$ ; $1.6\text{ V} < V_{CC(10)} < 2.0\text{ V}$ ; $V_{CC} = 3.6\text{ V}$ ;						
		Sleep mode; J_DET = open	-	0.1	-	-	1	$\mu\text{A}$
		Plug-in mode	-	15	-	-	25	$\mu\text{A}$
		Active mode	-	15	-	-	25	$\mu\text{A}$

13.1 Test circuits and graphs



aaa-012976

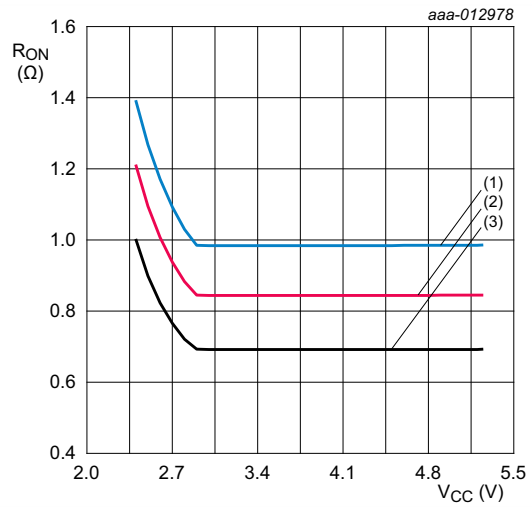
Fig 6. Test circuit for measuring OFF-state leakage current



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$R_{ON} = V_{SW} / I_o$

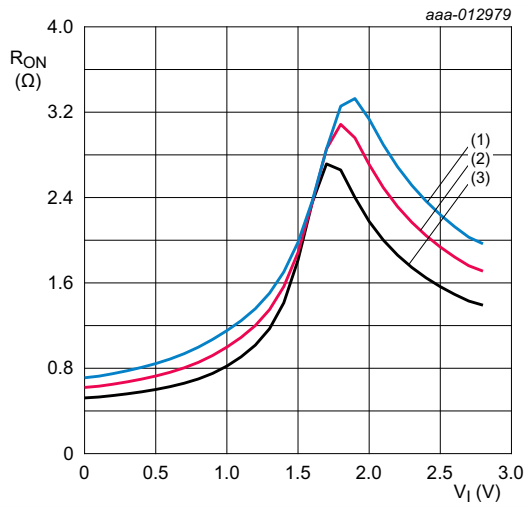
Fig 7. Test circuit for measuring ON resistance



aaa-012978

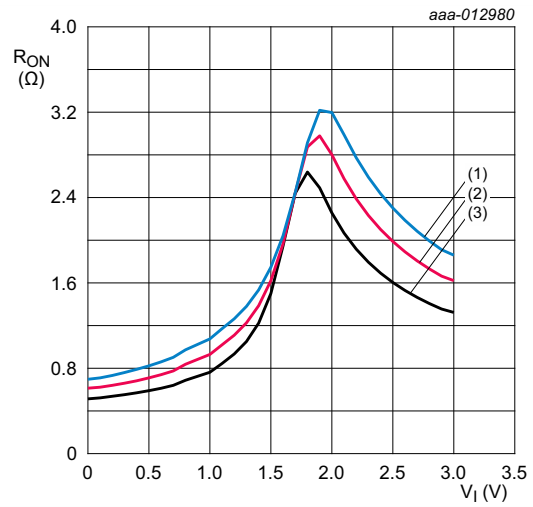
- (1)  $T_{amb} = 85\text{ °C}$
- (2)  $T_{amb} = 25\text{ °C}$
- (3)  $T_{amb} = -40\text{ °C}$

Fig 8. ON resistance versus VCC



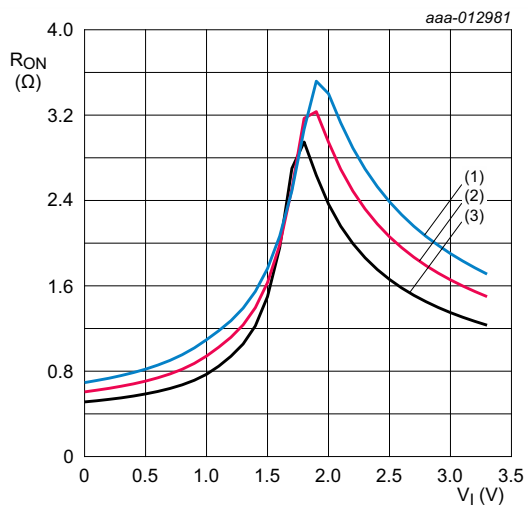
- (1)  $T_{amb} = 85$  °C
- (2)  $T_{amb} = 25$  °C
- (3)  $T_{amb} = -40$  °C

Fig 9. ON resistance as a function of  $V_{I(MIC)}$ ;  $V_{CC} = 2.8$  V



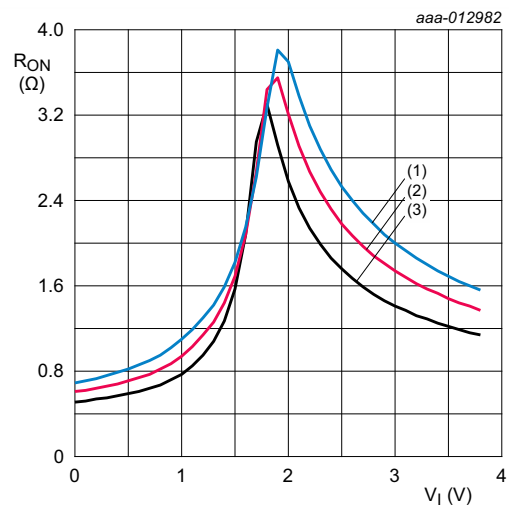
- (1)  $T_{amb} = 85$  °C
- (2)  $T_{amb} = 25$  °C
- (3)  $T_{amb} = -40$  °C

Fig 10. ON resistance as a function of  $V_{I(MIC)}$ ;  $V_{CC} = 3.0$  V



- (1)  $T_{amb} = 85$  °C
- (2)  $T_{amb} = 25$  °C
- (3)  $T_{amb} = -40$  °C

Fig 11. ON resistance as a function of  $V_{I(MIC)}$ ;  $V_{CC} = 3.3$  V



- (1)  $T_{amb} = 85$  °C
- (2)  $T_{amb} = 25$  °C
- (3)  $T_{amb} = -40$  °C

Fig 12. ON resistance as a function of  $V_{I(MIC)}$ ;  $V_{CC} = 3.8$  V

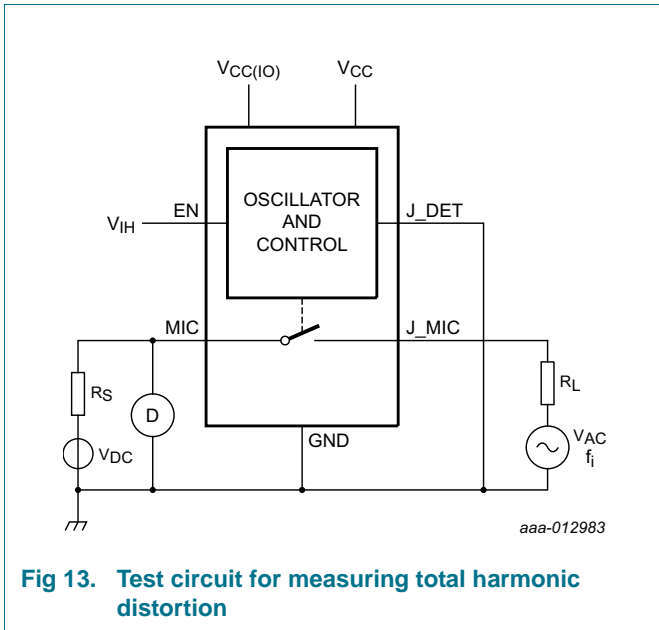


Fig 13. Test circuit for measuring total harmonic distortion

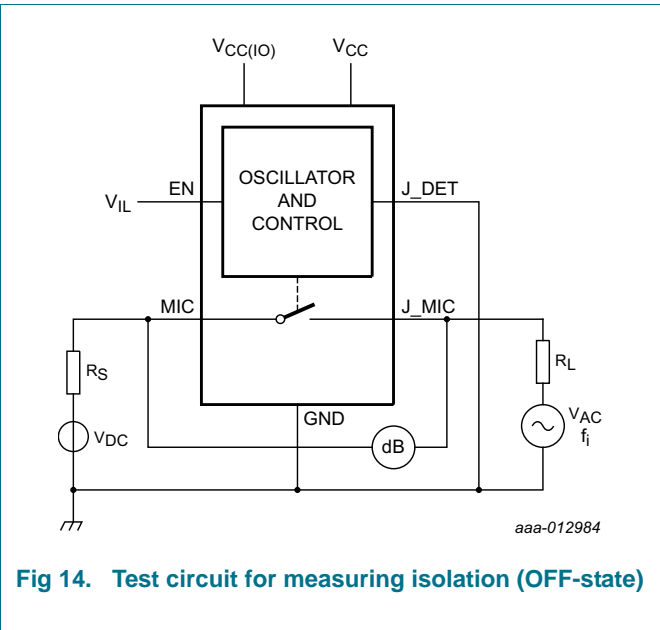


Fig 14. Test circuit for measuring isolation (OFF-state)

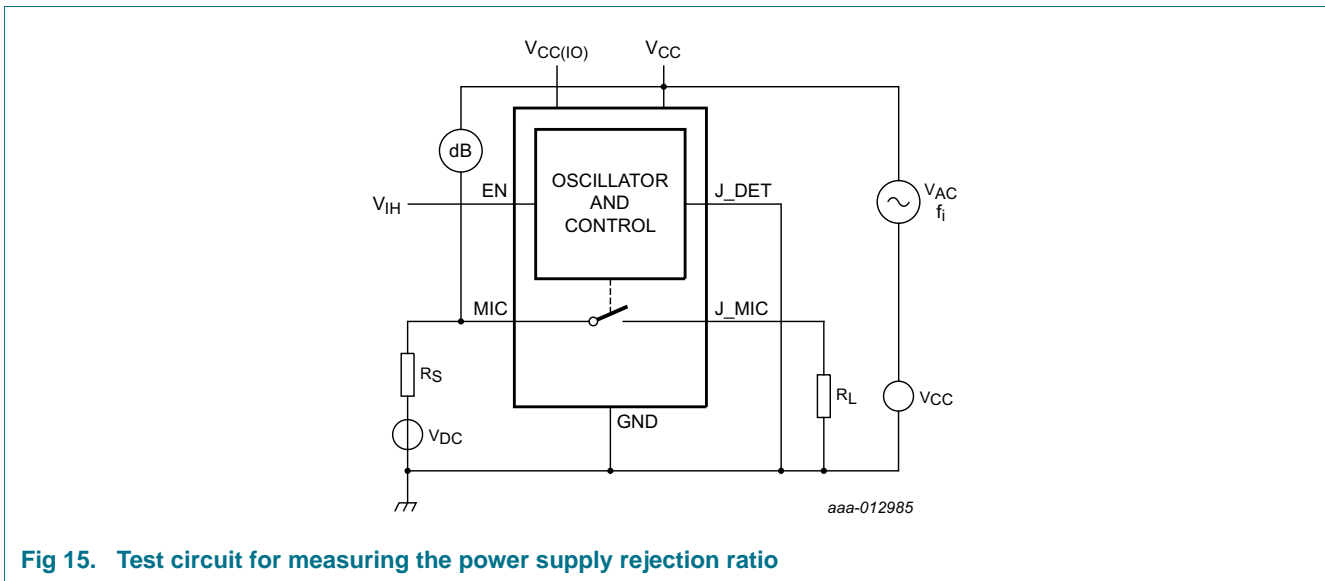


Fig 15. Test circuit for measuring the power supply rejection ratio

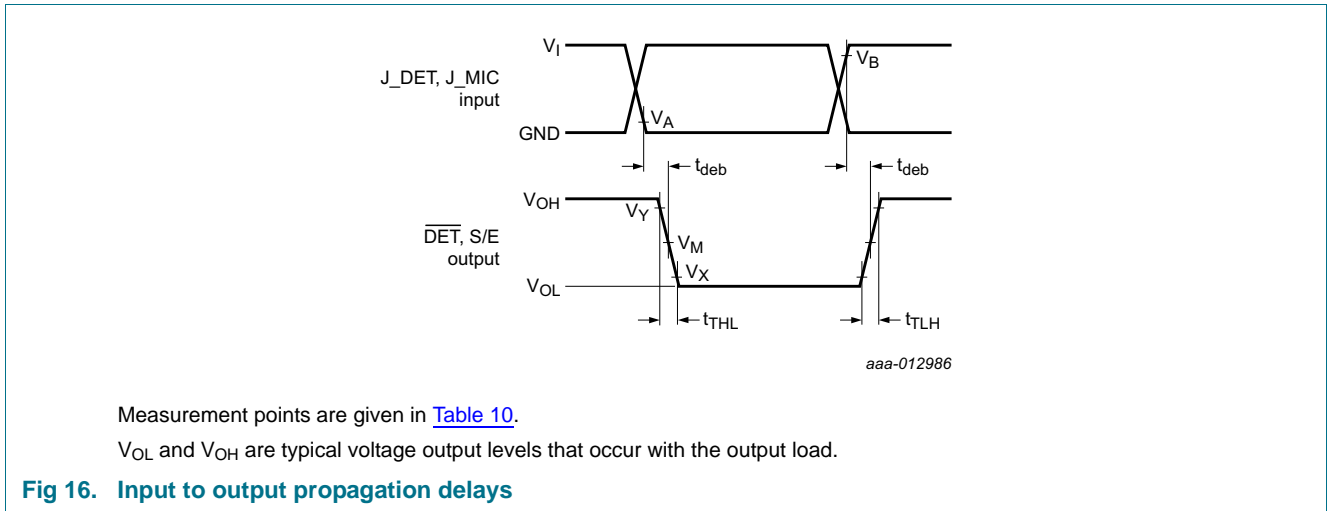
## 14. Dynamic characteristics

**Table 9. Dynamic characteristics**

At recommended operating conditions; unless otherwise specified typical values are measured with  $V_{CC} = 3.6\text{ V}$  and  $V_{CC(IO)} = 1.8\text{ V}$ ; voltages are referenced to GND (ground = 0 V); see [Figure 19](#).

Symbol	Parameter	Conditions	$T_{amb} = 25\text{ }^{\circ}\text{C}$			$T_{amb} = -40\text{ }^{\circ}\text{C to } +85\text{ }^{\circ}\text{C}$		Unit
			Min	Typ	Max	Min	Max	
$t_{TLH}$	LOW to HIGH output transition time	$\overline{\text{DET}}$ ; S/E; $C_L = 5\text{ pF}$ ; see <a href="#">Figure 16</a> and <a href="#">Figure 19</a>	-	5	-	-	-	ns
$t_{THL}$	HIGH to LOW output transition time	$\overline{\text{DET}}$ ; S/E; $C_L = 5\text{ pF}$ ; see <a href="#">Figure 16</a> and <a href="#">Figure 19</a>	-	2	-	-	-	ns
$t_{deb}$	debounce time	see <a href="#">Figure 16</a> and <a href="#">Figure 19</a>						
		Detect to Plug-in	-	80	-	-	100	ms
		Plug-in to Sleep	-	40	-	-	-	ms
	Active to or from J_MIC Pressed	-	30	-	-	-	ms	
$t_{en}$	enable time	EN to J_MIC; $V_{I(MIC)} = V_{CC}$ ; see <a href="#">Figure 17</a> and <a href="#">Figure 20</a>	-	15	-	-	-	$\mu\text{s}$
$t_{dis}$	disable time	$V_{I(MIC)} = V_{CC}$ ;						
		EN to J_MIC; see <a href="#">Figure 17</a> and <a href="#">Figure 20</a>	-	15	-	-	-	$\mu\text{s}$
		J_DET to J_MIC; see <a href="#">Figure 18</a>	-	15	-	-	-	$\mu\text{s}$

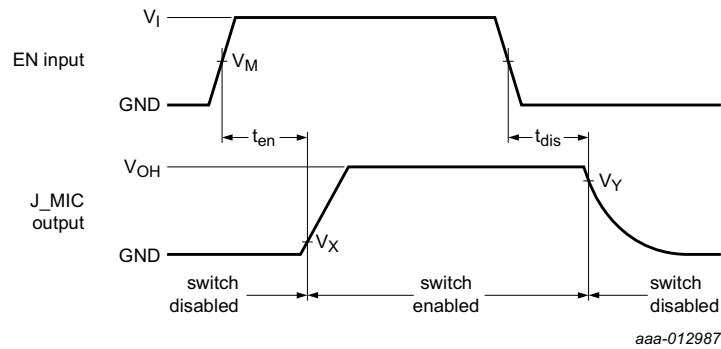
### 14.1 Waveform and test circuits



**Table 10. Measurement points**

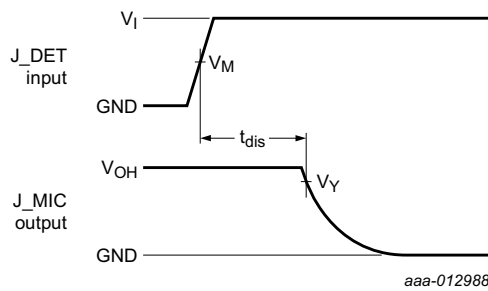
Supply voltage		Input J_DET		Input J_MIC		Output DET, S/E		
$V_{CC}$	$V_{CC(IO)}$	$V_A$	$V_B$	$V_A$	$V_B$	$V_M$	$V_X$	$V_Y$
3.6 V	1.8 V	0.05 V	1.44 V	0.7 V	0.85 V	$0.5V_{CC(IO)}$	$0.2V_{CC(IO)}$	$0.8V_{CC(IO)}$

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Measurement points are given in [Table 11](#).  
 Logic level:  $V_{OH}$  is the typical output voltage that occurs with the output load.

**Fig 17. Enable and disable times (EN to J\_MIC)**



Measurement points are given in [Table 11](#).  
 Logic level:  $V_{OH}$  is the typical output voltage that occurs with the output load.

**Fig 18. Enable and disable times (J\_DET to J\_MIC)**

**Table 11. Measurement points**

Supply Voltage		Input J_DET	Input EN	Output J_MIC	
$V_{CC}$	$V_{CC(10)}$	$V_M$	$V_M$	$V_X$	$V_Y$
3.6 V	1.8 V	1.44 V	$0.5V_{CC(10)}$	$0.1V_{CC}$	$0.9V_{CC}$

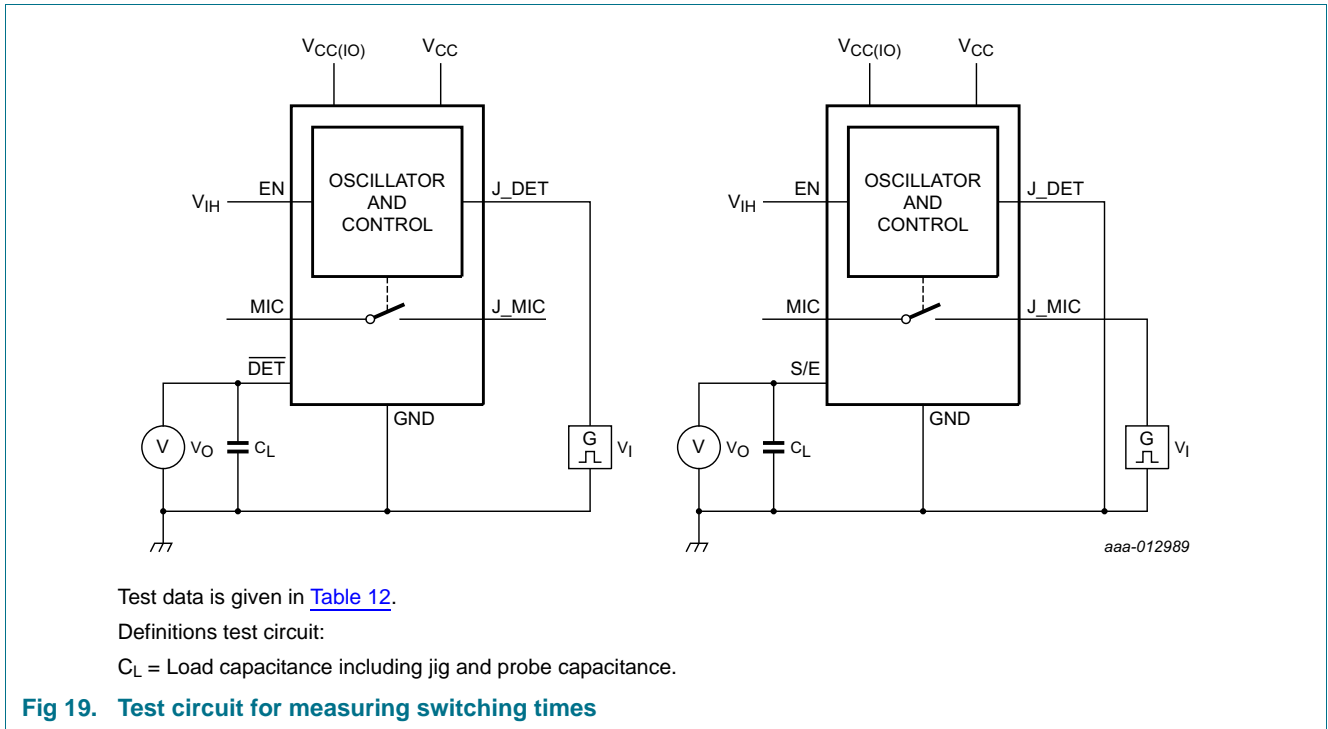


Table 12. Test data

Supply voltage		Input		Load
$V_{CC}$	$V_{CC(10)}$	$V_I$	$t_r, t_f$	$C_L$
2.4 V to 5.25 V	1.6 V to $V_{CC}$	$V_{CC}$	$\leq 2.5$ ns	5 pF

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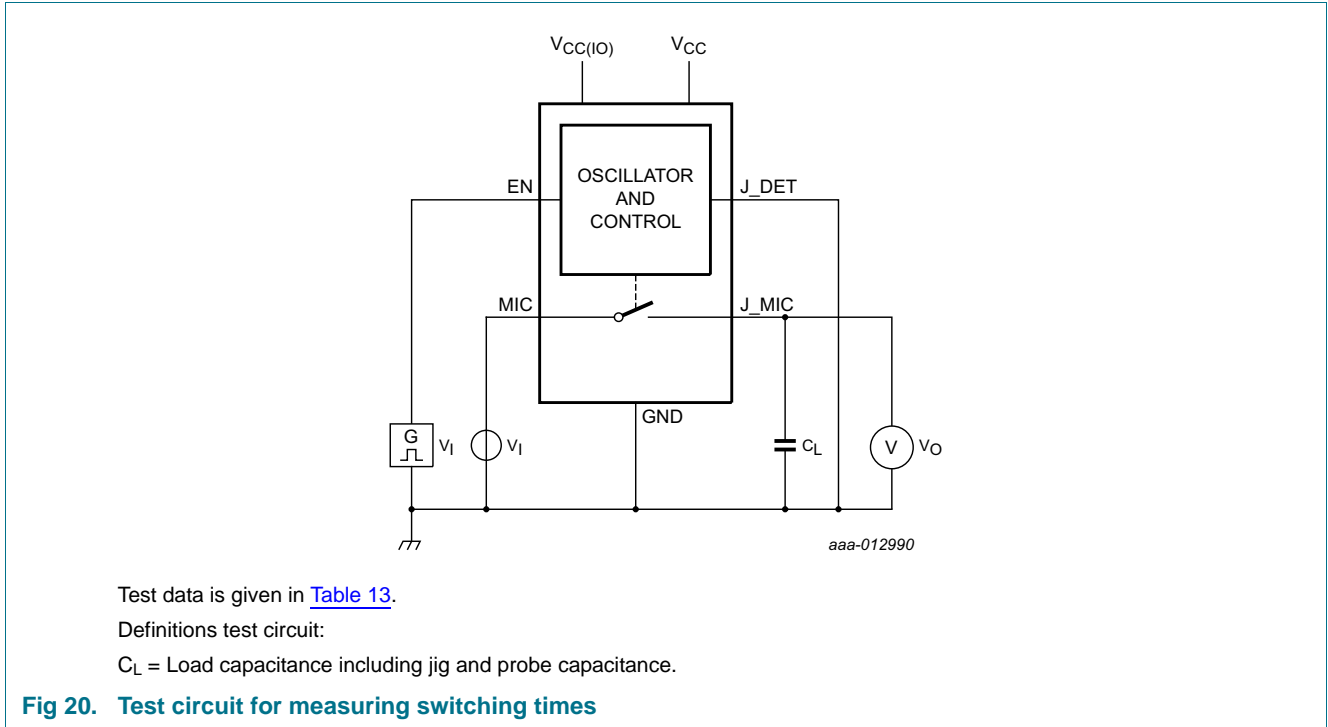


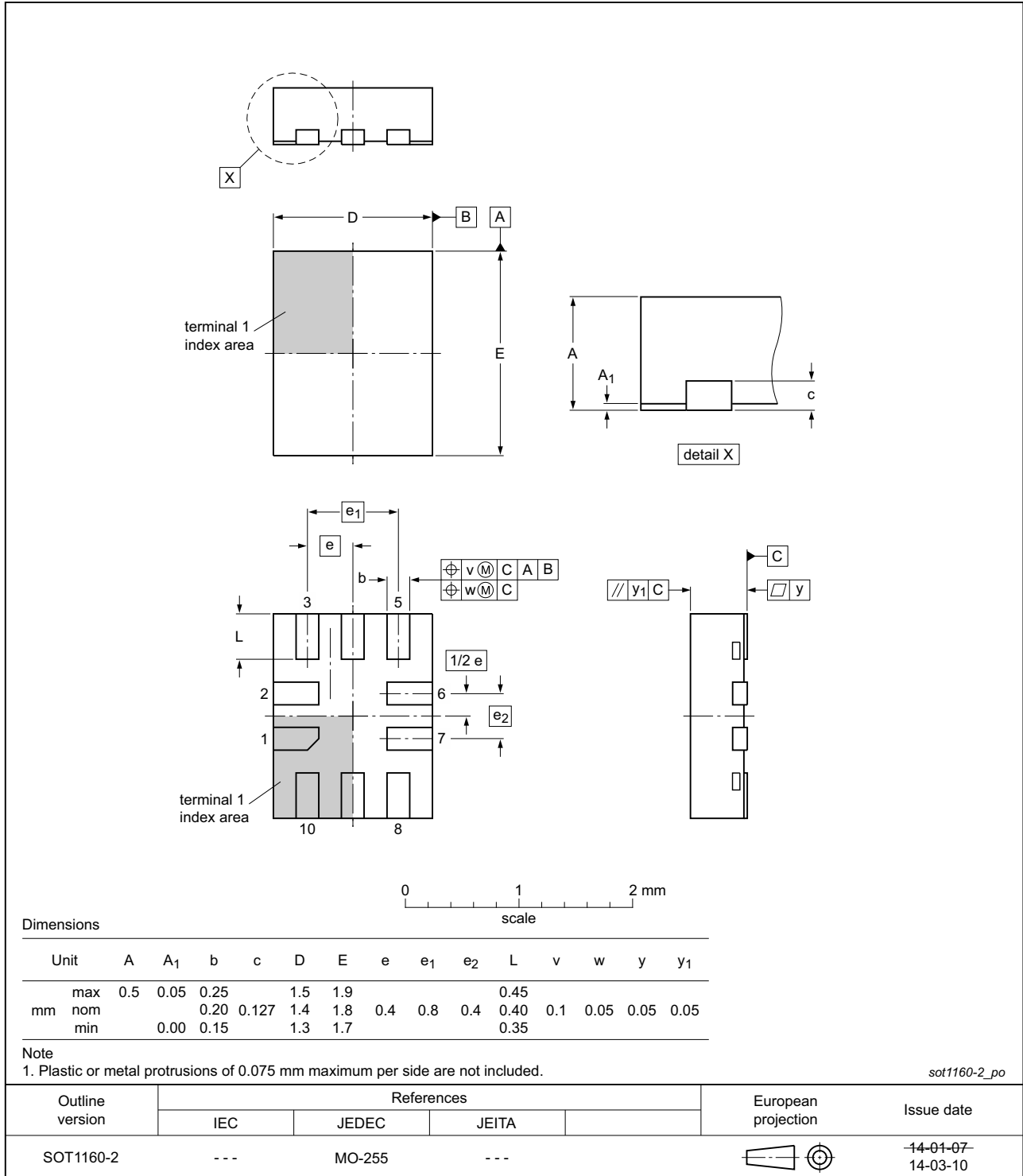
Table 13. Test data

Supply voltage		Input			Load
$V_{CC}$	$V_{CC(10)}$	$V_{I(EN)}$	$V_{I(J\_MIC)}$	$t_r, t_f$	$C_L$
2.4 V to 5.25 V	1.6 V to $V_{CC}$	$V_{CC(10)}$	$V_{CC}$	$\leq 2.5$ ns	5 pF

**15. Package outline**

**XQFN10: plastic, extremely thin quad flat package; no leads; 10 terminals; body 1.8 x 1.4 x 0.5 mm**

**SOT1160-2**



**Fig 21. Package outline XQFN10 (SOT1160-2) package**

## 16. Abbreviations

Table 14. Abbreviations

Acronym	Description
CDM	Charged Device Model
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MOSFET	Metal-Oxide Semiconductor Field Effect Transistor
THD	Total Harmonic Distortion

## 17. Revision history

Table 15. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
NCX8193 v.2	20141121	Product data sheet	-	NCX8193 v.1
Modifications:	• Added application			
NCX8193 v.1	20140709	Product data sheet	-	-

## 18. Legal information

### 18.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

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