2-channel analog multiplexer/demultiplexer Rev. 3 — 17 August 2018

**Product data sheet** 

### 1. General description

The 74LVC1G53-Q100 is a low-power, low-voltage, high-speed, Si-gate CMOS device.

The 74LVC1G53-Q100 provides one analog multiplexer/demultiplexer with a digital select input (S), two independent inputs/outputs (Y0 and Y1), a common input/output (Z) and an active LOW enable input ( $\overline{E}$ ). When pin  $\overline{E}$  is HIGH, the switch is turned off.

Schmitt-trigger action at the select and enable inputs makes the circuit tolerant to slower input rise and fall times across the entire  $V_{CC}$  range from 1.65 V to 5.5 V.

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 1) and is suitable for use in automotive applications.

### 2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
   Specified from -40 °C to +85 °C and from -40 °C to +125 °C
- Wide supply voltage range from 1.65 V to 5.5 V
- Very low ON resistance:
  - 7.5  $\Omega$  (typical) at V<sub>CC</sub> = 2.7 V
  - 6.5 Ω (typical) at V<sub>CC</sub> = 3.3 V
  - 6  $\Omega$  (typical) at V<sub>CC</sub> = 5 V
- Switch current capability of 32 mA
- High noise immunity
- CMOS low power consumption
- TTL interface compatibility at 3.3 V
- Latch-up performance meets requirements of JESD 78 Class I
- ESD protection:
  - MIL-STD-883, method 3015 exceeds 2000 V
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V (C = 200 pF, R = 0 Ω)

### 3. Ordering information

#### Table 1. Ordering information

Type number	Package						
	Temperature range Name Description						
74LVC1G53DP-Q100	-40 °C to +125 °C		plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm	SOT505-2			
74LVC1G53DC-Q100	-40 °C to +125 °C	VSSOP8	plastic very thin shrink small outline package; 8 leads; body width 2.3 mm	SOT765-1			

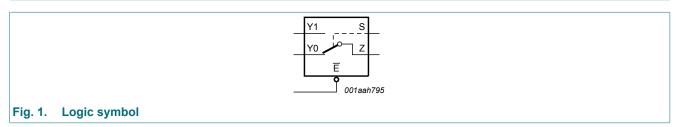
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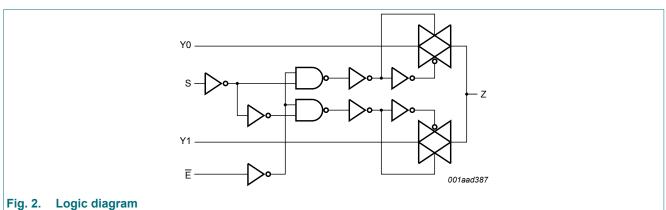
### 4. Marking

Table 2. Marking codes					
Type number     Marking code[1]					
74LVC1G53DC-Q100	V53				
74LVC1G53DP-Q100	V53				

[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

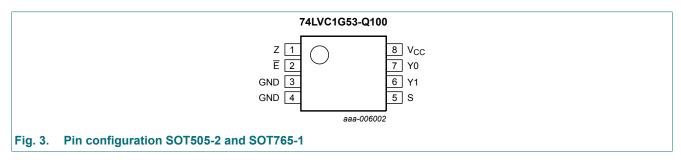
### 5. Functional diagram





# 6. Pinning information

### 6.1. Pinning



### 6.2. Pin description

Table 3. Pin description		
Symbol	Pin	Description
Z	1	common output or input
Ē	2	enable input (active LOW)
GND	3	ground (0 V)
GND	4	ground (0 V)
S	5	select input
Y1	6	independent input or output
Y0	7	independent input or output
V <sub>CC</sub>	8	supply voltage

### 7. Functional description

#### Table 4. Function table

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

Input	Channel on	
S	E	
L	L	Y0 to Z or Z to Y0
Н	L	Y1 to Z or Z to Y1
X	Н	Z (switch off)

# 8. 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 <sub>CC</sub>	supply voltage			-0.5	+6.5	V
VI	input voltage		[1]	-0.5	+6.5	V
I <sub>IK</sub>	input clamping current	$V_{\rm I}$ < -0.5 V or $V_{\rm I}$ > $V_{\rm CC}$ + 0.5 V		-50	-	mA
I <sub>SK</sub>	switch clamping current	$V_{\rm I}$ < -0.5 V or $V_{\rm I}$ > $V_{\rm CC}$ + 0.5 V		-	±50	mA
V <sub>SW</sub>	switch voltage	enable and disable mode	[2]	-0.5	V <sub>CC</sub> + 0.5	V
I <sub>SW</sub>	switch current	$V_{SW}$ > -0.5 V or $V_{SW}$ < $V_{CC}$ + 0.5 V		-	±50	mA
I <sub>CC</sub>	supply current			-	100	mA
I <sub>GND</sub>	ground current			-100	-	mA
T <sub>stg</sub>	storage temperature			-65	+150	°C
P <sub>tot</sub>	total power dissipation	$T_{amb}$ = -40 °C to +125 °C	[3]	-	250	mW

[1] The minimum input voltage rating may be exceeded if the input current rating is observed.

[2] The minimum and maximum switch voltage ratings may be exceeded if the switch clamping current rating is observed.

[3] For TSSOP8 packages: above 55 °C the value of P<sub>tot</sub> derates linearly with 2.5 mW/K.

For VSSOP8 packages: above 110 °C the value of P<sub>tot</sub> derates linearly with 8.0 mW/K.

## 9. Recommended operating conditions

Symbol	Parameter	Conditions		Min	Мах	Unit
V <sub>CC</sub>	supply voltage			1.65	5.5	V
VI	input voltage			0	5.5	V
V <sub>SW</sub>	switch voltage	enable and disable mode	[1]	0	V <sub>CC</sub>	V
T <sub>amb</sub>	ambient temperature			-40	+125	°C
Δt/ΔV	input transition rise and fall rate	V <sub>CC</sub> = 1.65 V to 2.7 V	[2]	-	20	ns/V
		V <sub>CC</sub> = 2.7 V to 5.5 V	[2]	-	10	ns/V

[1] To avoid sinking GND current from terminal Z when switch current flows in terminal Yn, the voltage drop across the bidirectional switch must not exceed 0.4 V. If the switch current flows into terminal Z, no GND current will flow from terminal Yn. In this case, there is no limit for the voltage drop across the switch.

[2] Applies to control signal levels.

## **10. Static characteristics**

#### Table 7. Static characteristics

At recommended operating conditions; voltages are referenced to GND (ground 0 V).

Symbol	Parameter	Conditions		T <sub>amb</sub> =	-40 °C to	+85 °C	T <sub>an</sub> -40 °C to	<sub>nb</sub> = ) +125 °C	Unit
				Min	Тур [1]	Max	Min	Max	
V <sub>IH</sub>	HIGH-level input	V <sub>CC</sub> = 1.65 V to 1.95 V		$0.65V_{CC}$	-	-	0.65V <sub>CC</sub>	-	V
	voltage	$V_{CC}$ = 2.3 V to 2.7 V		1.7	-	-	1.7	-	V
		V <sub>CC</sub> = 3 V to 3.6 V		2.0	-	-	2.0	-	V
		$V_{CC}$ = 4.5 V to 5.5 V		$0.7V_{CC}$	-	-	0.7V <sub>CC</sub>	-	V
V <sub>IL</sub>	LOW-level input	V <sub>CC</sub> = 1.65 V to 1.95 V		-	-	0.35V <sub>CC</sub>	-	0.35V <sub>CC</sub>	V
	voltage	V <sub>CC</sub> = 2.3 V to 2.7 V		-	-	0.7	-	0.7	V
		V <sub>CC</sub> = 3 V to 3.6 V		-	-	0.8	-	0.8	V
		V <sub>CC</sub> = 4.5 V to 5.5 V		-	-	0.3V <sub>CC</sub>	-	0.3V <sub>CC</sub>	V
I <sub>I</sub>	input leakage current	pin S and pin Ē; V <sub>I</sub> = 5.5 V or GND; V <sub>CC</sub> = 0 V to 5.5 V	[2]	-	±0.1	±1	-	±1	μA
I <sub>S(OFF)</sub>	OFF-state leakage current	V <sub>CC</sub> = 5.5 V; see <u>Fig. 4</u>	[2]	-	±0.1	±0.2	-	±0.5	μA
I <sub>S(ON)</sub>	ON-state leakage current	V <sub>CC</sub> = 5.5 V; see <u>Fig. 5</u>	[2]	-	±0.1	±1	-	±2	μA
I <sub>CC</sub>	supply current	$V_{I} = 5.5 V \text{ or GND};$ $V_{SW} = GND \text{ or } V_{CC};$ $V_{CC} = 1.65 V \text{ to } 5.5 V$	[2]	-	0.1	4	-	4	μA
ΔI <sub>CC</sub>	additional supply current	pin S and pin $\overline{E}$ ; V <sub>I</sub> = V <sub>CC</sub> - 0.6 V; V <sub>SW</sub> = GND or V <sub>CC</sub> ; V <sub>CC</sub> = 5.5 V	[2]	-	5	500	-	500	μA

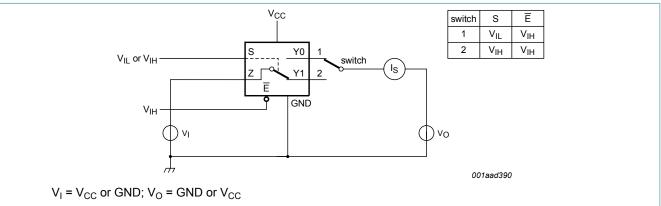
#### 2-channel analog multiplexer/demultiplexer

Symbol	Parameter	Conditions	T <sub>amb</sub> =	-40 °C to	+85 °C		amb = Un to +125 °C		
			Min	Тур [1]	Max	Min	Max		
CI	input capacitance		-	2.5	-	-	-	pF	
C <sub>S(OFF)</sub>	OFF-state capacitance		-	6.0	-	-	-	pF	
C <sub>S(ON)</sub>	ON-state capacitance		-	18	-	-	-	pF	

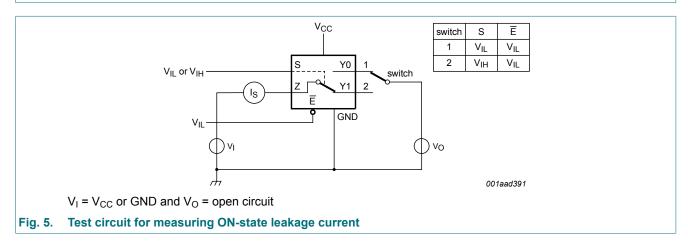
[1] Typical values are measured at  $T_{amb}$  = 25 °C.

[2] These typical values are measured at  $V_{CC}$  = 3.3 V.

### 10.1. Test circuits



#### Fig. 4. Test circuit for measuring OFF-state leakage current



### 10.2. ON resistance

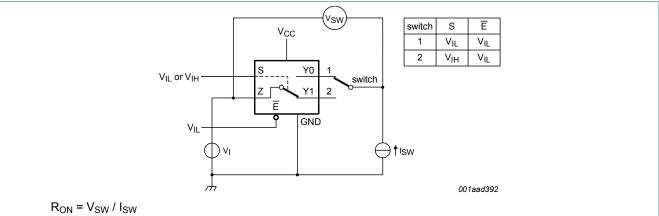
#### Table 8. ON resistance

At recommended operating conditions; voltages are referenced to GND (ground 0 V); for graphs see Fig. 7 to Fig. 12.

Symbol	Parameter	Conditions	-40 °	°C to +8	5 °C	-40 °C to	+125 °C	Unit
			Min	Typ[1]	Max	Min	Мах	-
R <sub>ON(peak)</sub>	ON resistance (peak)	$V_1$ = GND to $V_{CC}$ ; see <u>Fig. 6</u>						
		$I_{SW}$ = 4 mA; $V_{CC}$ = 1.65 V to 1.95 V	-	34.0	130	-	195	Ω
		$I_{SW}$ = 8 mA; $V_{CC}$ = 2.3 V to 2.7 V	-	12.0	30	-	45	Ω
		I <sub>SW</sub> = 12 mA; V <sub>CC</sub> = 2.7 V	-	10.4	25	-	38	Ω
		I <sub>SW</sub> = 24 mA; V <sub>CC</sub> = 3 V to 3.6 V	-	7.8	20	-	30	Ω
		$I_{SW}$ = 32 mA; $V_{CC}$ = 4.5 V to 5.5 V	-	6.2	15	-	23	Ω
R <sub>ON(rail)</sub>	ON resistance (rail)	V <sub>I</sub> = GND; see <u>Fig. 6</u>						
		$I_{SW}$ = 4 mA; $V_{CC}$ = 1.65 V to 1.95 V	-	8.2	18	-	27	Ω
		$I_{SW}$ = 8 mA; $V_{CC}$ = 2.3 V to 2.7 V	-	7.1	16	-	24	Ω
		I <sub>SW</sub> = 12 mA; V <sub>CC</sub> = 2.7 V	-	6.9	14	-	21	Ω
		I <sub>SW</sub> = 24 mA; V <sub>CC</sub> = 3 V to 3.6 V	-	6.5	12	-	18	Ω
		$I_{SW}$ = 32 mA; $V_{CC}$ = 4.5 V to 5.5 V	-	5.8	10	-	15	Ω
		$V_{I} = V_{CC}$ ; see <u>Fig. 6</u>						
		$I_{SW}$ = 4 mA; $V_{CC}$ = 1.65 V to 1.95 V	-	10.4	30	-	45	Ω
		$I_{SW}$ = 8 mA; $V_{CC}$ = 2.3 V to 2.7 V	-	7.6	20	-	30	Ω
		I <sub>SW</sub> = 12 mA; V <sub>CC</sub> = 2.7 V	-	7.0	18	-	27	Ω
		I <sub>SW</sub> = 24 mA; V <sub>CC</sub> = 3 V to 3.6 V	-	6.1	15	-	23	Ω
		$I_{SW}$ = 32 mA; $V_{CC}$ = 4.5 V to 5.5 V	-	4.9	10	-	15	Ω
R <sub>ON(flat)</sub>	ON resistance	$V_{I} = GND \text{ to } V_{CC}$ [2]						
	(flatness)	$I_{SW}$ = 4 mA; $V_{CC}$ = 1.65 V to 1.95 V	-	26.0	-	-	-	Ω
		$I_{SW}$ = 8 mA; $V_{CC}$ = 2.3 V to 2.7 V	-	5.0	-	-	-	Ω
		I <sub>SW</sub> = 12 mA; V <sub>CC</sub> = 2.7 V	-	3.5	-	-	-	Ω
		I <sub>SW</sub> = 24 mA; V <sub>CC</sub> = 3 V to 3.6 V	-	2.0	-	-	-	Ω
		$I_{SW}$ = 32 mA; $V_{CC}$ = 4.5 V to 5.5 V	-	1.5	-	-	-	Ω

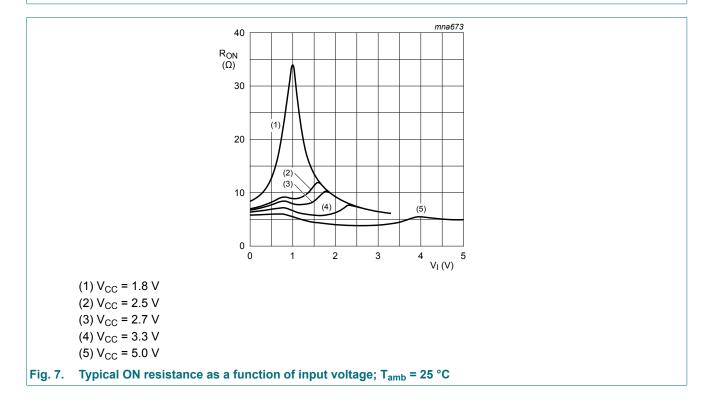
[1] Typical values are measured at T<sub>amb</sub> = 25 °C and nominal V<sub>CC</sub>.

[2] Flatness is defined as the difference between the maximum and minimum value of ON resistance measured at identical V<sub>CC</sub> and temperature.

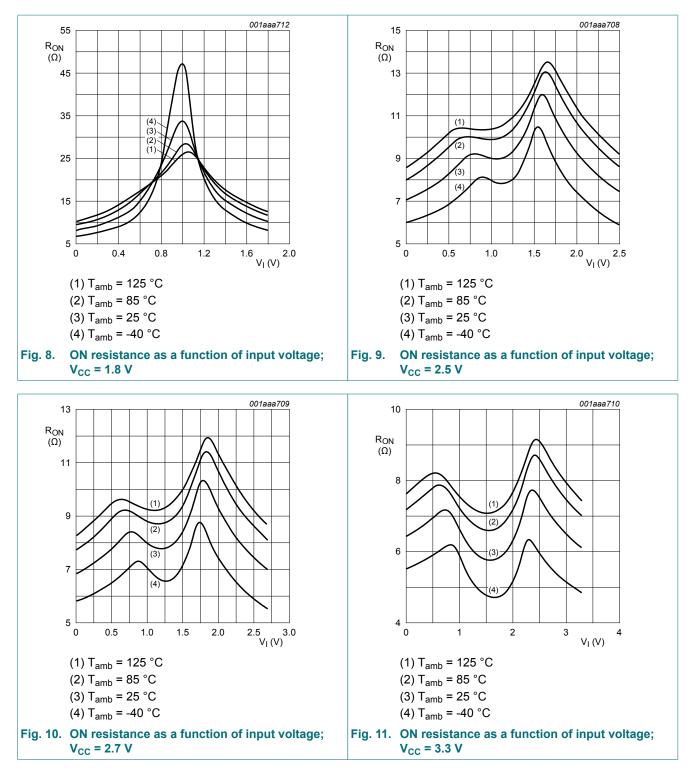


### 10.3. ON resistance test circuit and graphs

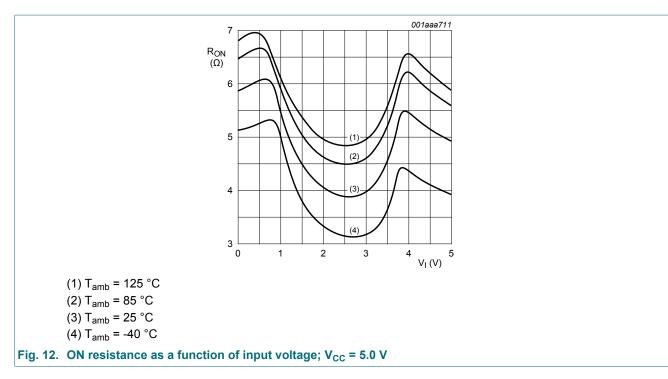
### Fig. 6. Test circuit for measuring ON resistance



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#### 2-channel analog multiplexer/demultiplexer



# **11. Dynamic characteristics**

#### Table 9. Dynamic characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 15.

Symbol	Parameter	Conditions	-4	0 °C to +85	°C	-40 °C to	o +125 °C	Unit
		-	Min	Typ[1]	Мах	Min	Max	
t <sub>pd</sub>	propagation	Z to Yn or Yn to Z; see Fig. 13 [2] [3]						
	delay	V <sub>CC</sub> = 1.65 V to 1.95 V	-	-	2	-	2.5	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	-	1.2	-	1.5	ns
		V <sub>CC</sub> = 2.7 V	-	-	1.0	-	1.25	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	-	-	0.8	-	1.0	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V	-	-	0.6	-	0.8	ns
t <sub>en</sub>	enable time	S to Z or Yn; see Fig. 14 [2]						
		V <sub>CC</sub> = 1.65 V to 1.95 V	2.6	6.7	10.3	2.6	12.9	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.9	4.1	6.4	1.9	8.0	ns
		V <sub>CC</sub> = 2.7 V	1.9	4.0	5.5	1.8	7.0	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.8	3.4	5.0	1.8	6.3	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V	1.3	2.6	3.8	1.3	4.8	ns
		E to Z or Yn; see Fig. 14 [2]						
		V <sub>CC</sub> = 1.65 V to 1.95 V	1.9	4.0	7.3	1.9	9.2	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.4	2.5	4.4	1.4	5.5	ns
		V <sub>CC</sub> = 2.7 V	1.1	2.6	3.9	1.1	4.9	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.2	2.2	3.8	1.2	4.8	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V	1.0	1.7	2.6	1.0	3.3	ns

#### 2-channel analog multiplexer/demultiplexer

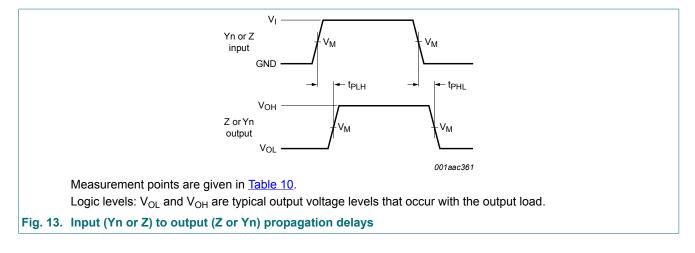
Symbol	Parameter	Conditions	-4	0 °C to +85	°C	-40 °C to	o +125 ℃	Unit
		-	Min	Typ[1]	Max	Min	Max	
t <sub>dis</sub>	disable time	S to Z or Yn; see Fig. 14 [2]						
		V <sub>CC</sub> = 1.65 V to 1.95 V	2.1	6.8	10.0	2.1	12.5	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.4	3.7	6.1	1.4	7.7	ns
		V <sub>CC</sub> = 2.7 V	1.4	4.9	6.2	1.4	7.8	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.1	4.0	5.4	1.1	6.8	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V	1.0	2.9	3.8	1.0	4.8	ns
		Ē to Z or Yn; see <u>Fig. 14</u> [2]						
		V <sub>CC</sub> = 1.65 V to 1.95 V	2.3	5.6	8.6	2.3	11.0	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.2	3.2	4.8	1.2	6.0	ns
		V <sub>CC</sub> = 2.7 V	1.4	4.0	5.2	1.4	6.5	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	2.0	3.7	5.0	2.0	6.3	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V	1.3	2.9	3.8	1.3	4.8	ns

Typical values are measured at T<sub>amb</sub> = 25 °C and nominal V<sub>CC</sub>. [1]

[2]

 $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ ;  $t_{en}$  is the same as  $t_{PZH}$  and  $t_{PZL}$ ;  $t_{dis}$  is the same as  $t_{PLZ}$  and  $t_{PHZ}$ Propagation delay is the calculated RC time constant of the typical ON resistance of the switch and the specified capacitance when [3] driven by an ideal voltage source (zero output impedance).

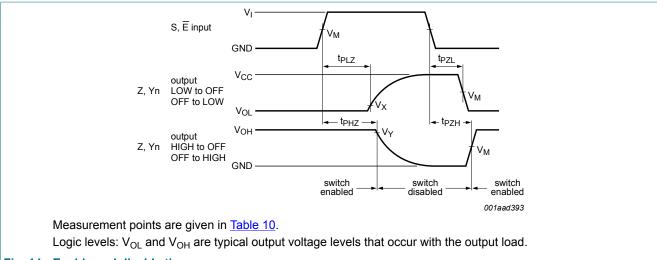
### 11.1. Waveforms and test circuits



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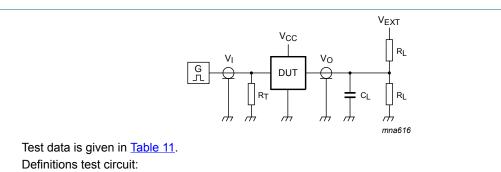
#### 2-channel analog multiplexer/demultiplexer



#### Fig. 14. Enable and disable times

#### Table 10. Measurement points

Supply voltage	Input	Output					
V <sub>cc</sub>	V <sub>M</sub>	V <sub>M</sub>	V <sub>X</sub>	V <sub>Y</sub>			
1.65 V to 2.7 V	0.5 x V <sub>CC</sub>	0.5 x V <sub>CC</sub>	V <sub>OL</sub> + 0.15 V	V <sub>OH</sub> - 0.15 V			
2.7 V to 5.5 V	0.5 x V <sub>CC</sub>	0.5 x V <sub>CC</sub>	V <sub>OL</sub> + 0.3 V	V <sub>OH</sub> - 0.3 V			



 $R_T$  = Termination resistance (should be equal to output impedance  $Z_0$  of the pulse generator).

 $C_L$  = Load capacitance (including jig and probe capacitance).

- R<sub>L</sub> = Load resistance.
- V<sub>EXT</sub> = External voltage for measuring switching times.

#### Fig. 15. Test circuit for measuring switching times

#### Table 11. Test data

Supply voltage	Input	Input		Load		V <sub>EXT</sub>		
V <sub>cc</sub>	VI	t <sub>r</sub> , t <sub>f</sub>	CL	RL	t <sub>PLH</sub> , t <sub>PHL</sub>	t <sub>PZH</sub> , t <sub>PHZ</sub>	t <sub>PZL</sub> , t <sub>PLZ</sub>	
1.65 V to 1.95 V	V <sub>CC</sub>	≤ 2.0 ns	30 pF	1 kΩ	open	GND	$2 \times V_{CC}$	
2.3 V to 2.7 V	V <sub>CC</sub>	≤ 2.0 ns	30 pF	500 Ω	open	GND	$2 \times V_{CC}$	
2.7 V	V <sub>CC</sub>	≤ 2.5 ns	50 pF	500 Ω	open	GND	$2 \times V_{CC}$	
3 V to 3.6 V	V <sub>CC</sub>	≤ 2.5 ns	50 pF	500 Ω	open	GND	$2 \times V_{CC}$	
4.5 V to 5.5 V	V <sub>CC</sub>	≤ 2.5 ns	50 pF	500 Ω	open	GND	$2 \times V_{CC}$	

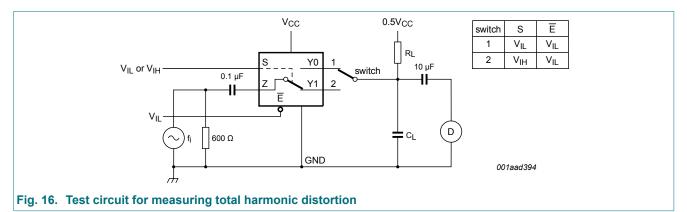
### **11.2.** Additional dynamic characteristics

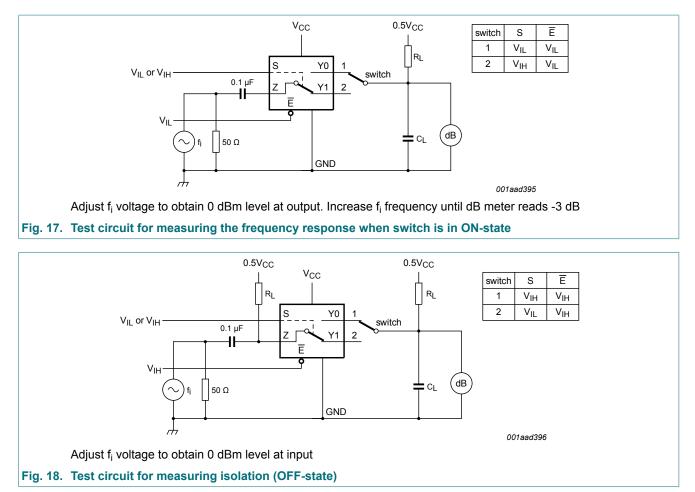
#### Table 12. Additional dynamic characteristics

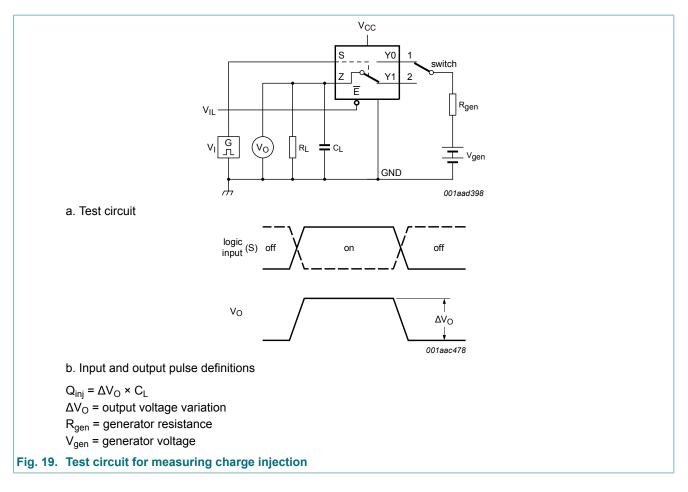
At recommended operating conditions; voltages are referenced to GND (ground = 0 V); T<sub>amb</sub> = 25 °C.

Symbol	Parameter	Conditions	Min	Тур	Max	Unit
THD total harmonic dis	total harmonic distortion	$f_i$ = 600 Hz to 20 kHz; R <sub>L</sub> = 600 Ω; C <sub>L</sub> = 50 pF; V <sub>I</sub> = 0.5 V (p-p); see Fig. 16				
		V <sub>CC</sub> = 1.65 V	-	0.260	-	%
		V <sub>CC</sub> = 2.3 V	-	0.078	-	%
		V <sub>CC</sub> = 3.0 V	-	0.078	-	%
		V <sub>CC</sub> = 4.5 V	-	0.078	-	%
f <sub>(-3dB)</sub> -3 d	-3 dB frequency response	$R_L$ = 50 Ω; $C_L$ = 5 pF; see <u>Fig. 17</u>				
		V <sub>CC</sub> = 1.65 V	-	200	-	MHz
		V <sub>CC</sub> = 2.3 V	-	300	-	MHz
		V <sub>CC</sub> = 3.0 V	-	300	-	MHz
		V <sub>CC</sub> = 4.5 V	-	300	-	MHz
α <sub>iso</sub> iso	isolation (OFF-state)	$R_L$ = 50 Ω; $C_L$ = 5 pF; $f_i$ = 10 MHz; see <u>Fig. 18</u>				
		V <sub>CC</sub> = 1.65 V	-	-42	-	dB
		V <sub>CC</sub> = 2.3 V	-	-42	-	dB
		V <sub>CC</sub> = 3.0 V	-	-40	-	dB
		V <sub>CC</sub> = 4.5 V	-	-40	-	dB
Q <sub>inj</sub>	charge injection	C <sub>L</sub> = 0.1 nF; V <sub>gen</sub> = 0 V; R <sub>gen</sub> = 0 Ω; f <sub>i</sub> = 1 MHz; R <sub>L</sub> = 1 MΩ; see <u>Fig. 19</u>				
		V <sub>CC</sub> = 1.8 V	-	3.3	-	рС
		V <sub>CC</sub> = 2.5 V	-	4.1	-	рС
		V <sub>CC</sub> = 3.3 V	-	5.0	-	рС
		V <sub>CC</sub> = 4.5 V	-	6.4	-	pC
		V <sub>CC</sub> = 5.5 V	-	7.5	-	рС

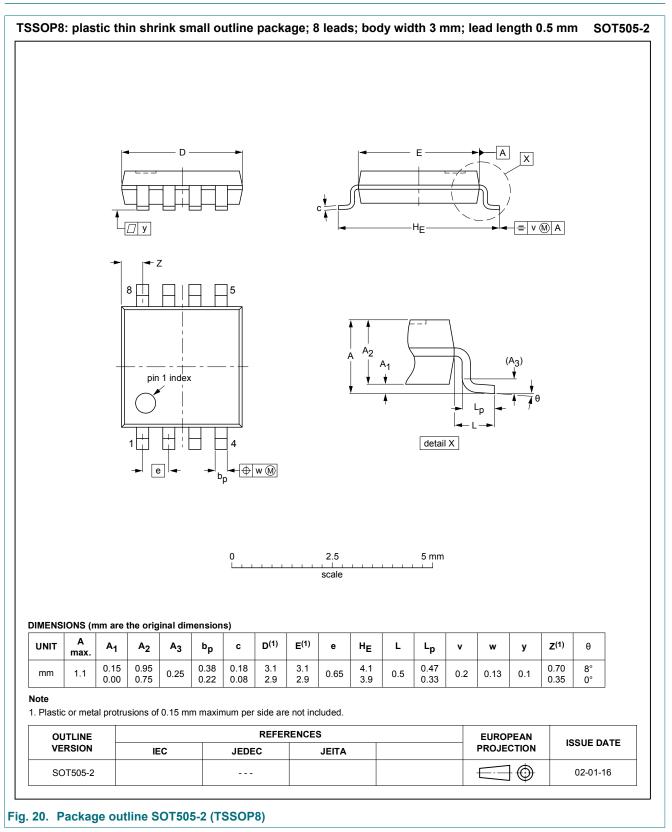
### 11.3. Test circuits

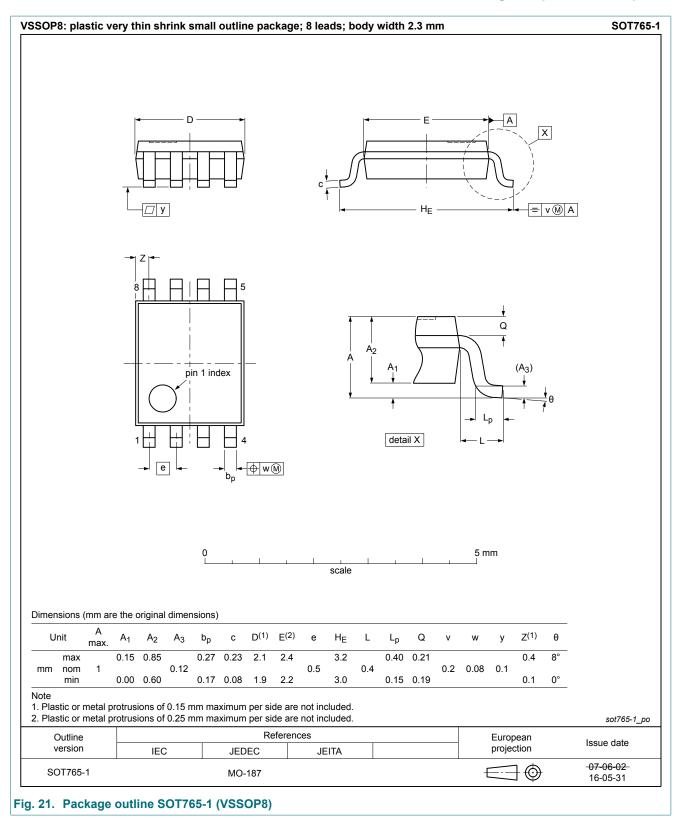






### 12. Package outline





# 13. Abbreviations

Table 13. Abbreviations				
Acronym	Description			
CMOS	Complementary Metal-Oxide Semiconductor			
DUT	Device Under Test			
ESD	ElectroStatic Discharge			
НВМ	Human Body Model			
MIL	Military			
ММ	Machine Model			
TTL	Transistor-Transistor Logic			

### 14. Revision history

#### Table 14. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes		
74LVC1G53_Q100 v.3	20180817	Product data sheet	-	74LVC1G53_Q100 v.2		
Modifications:	<ul> <li>The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> </ul>					
74LVC1G53_Q100 v.2	20161209	Product data sheet	-	74LVC1G53_Q100 v.1		
Modifications:	• <u>Table 7</u> : The maximum limits for leakage current and supply current have changed.					
74LVC1G53_Q100 v.1	20130129	Product data sheet	-	-		

# 15. Legal information

#### **Data sheet status**

Document status [1][2]	Product status [3]	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.

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

- [2] The term 'short data sheet' is explained in section "Definitions".
- [3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the internet at <u>https://www.nexperia.com</u>.

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#### 2-channel analog multiplexer/demultiplexer

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