NX5DV713E

Dual supply 1-of-2 VGA switch

Rev. 1 — 24 November 2011 Product data sheet

1. General description

The NX5DV713E is a dual supply 1-to-2 VGA switch. It integrates high-bandwidth SPDT switches with level-translating buffers and level translating switches to provide switching of input RGB, H-sync, V-sync and DDC signals to either of two output channels.

The NX5DV713E is characterized for operation from −40 °C to +85 °C.

2. Features and benefits

- RGB switches:
  - Low ON resistance (4 Ω typical)
  - Low ON capacitance (12 pF typical)
  - Low output skew (50 ps)
- Low power consumption (< 2 μA)
- Level translation of sync and DDC signals
- Over-voltage tolerant inputs
- ESD protection:
  - HBM JESD22-A114F Class 3A exceeds 4 kV
  - MM JESD22-A115-A exceeds 200 V
  - CDM JESD22-C101D exceeds 1000 V
  - IEC61000-4-2 contact discharge exceeds 4 kV for I/Os
- Specified from −40 °C to +85 °C

3. Applications

- Notebook Computers
- Docking stations
- Digital projectors
- Computer monitors
- Servers
- Storage

4. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
NX5DV713EHF	−40 °C to +85 °C	HWQFN32	plastic thermal enhanced very very thin quad flat package; no leads; 32 terminals; body 3 × 6 × 0.75 mm	SOT1180-1

5. Functional diagram

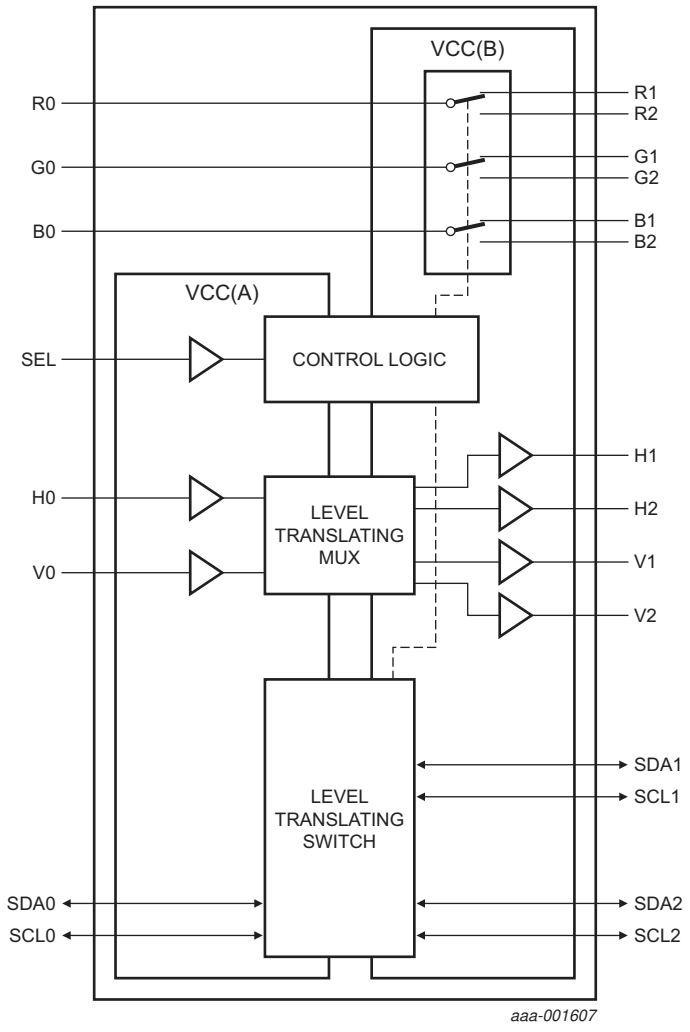
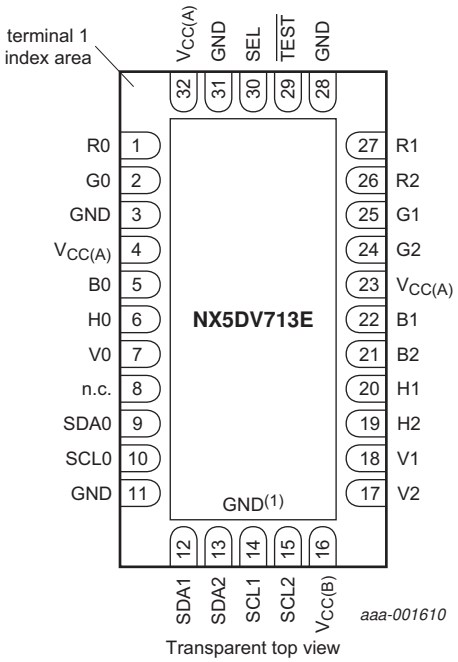


Fig 1. Logic symbol

6. Pinning information

6.1 Pinning



Transparent top view

(1) This is not a supply pin, the substrate is attached to this pad using conductive die attach material. There is no electrical or mechanical requirement to solder this pad however if it is soldered the solder land should remain floating or be connected to GND.

Fig 2. Pin configuration SOT1180-1 (HWQFN32)

6.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
R0, G0, B0	1, 2, 5	RGB input or output
GND	3, 11, 28, 31	ground (0 V)
$V_{CC(A)}$	4, 23, 32	supply voltage A
H0	6	horizontal sync input
V0	7	vertical sync input
n.c.	8	not connected
SDA0	9	SDA0 input or output
SCL0	10	SCL0 input or output
SDA1, SDA2	12, 13	SDAn input or output
SCL1, SCL2	14, 15	SCLn input or output
$V_{CC(B)}$	16	supply voltage B
V1, V2	18, 17	vertical sync output
H1, H2	20, 19	horizontal sync output

Table 2. Pin description *...continued*

Symbol	Pin	Description
R1, G1, B1, R2, G2, B2	27, 25, 22, 26, 24, 21	RGB input or output
$\overline{TEST}$[1]	29	test pin (active LOW)
SEL	30	select input

[1] Test pin used to enable test mode. For normal usage, this pin must be connected to $V_{CC(A)}$.

7. Functional description

The NX5DV713E integrates high-bandwidth SPDT switches, level-translating buffers and level translating SPDT switches to provide a complete solution for 1-to-2 switching of VGA signals. An select input (SEL) is used to determine which output is selected.

7.1 RGB switches

The NX5DV713E provides three identical single pole double throw high-bandwidth switches to route standard VGA RGB signals (see Table 3).

Table 3. Function table RGB

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

Input	Switch
SEL	
L	R0 to R1; G0 to G1; B0 to B1
H	R0 to R2; G0 to G2; B0 to B2

7.2 H-Sync/V-Sync level translator

The horizontal and vertical synchronization buffers have inputs (H0, V0) referenced to $V_{CC(A)}$ and outputs (H1, V1 and H2,V2) that are referenced to $V_{CC(B)}$. This allows level translation of synchronization signals from as low as 2.0 V up to 5.5 V and supports low-voltage CMOS or TTL-compatible graphics controllers meeting the VESA specification for output drive of ±8 mA.

Table 4. Function table HV

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

Input	Switch
SEL	
L	H1 = H0; V1 = V0; H2, V2 = Z
H	H2 = H0; V2 = V0; H1, V1 = Z

7.3 Display-Data Channel Multiplexer

The NX5DV713E provides two identical SPDT active-level translating switches to route DDC signals (See Table 5). The switch outputs are limited to a diode drop less than the voltage applied on $V_{CC(A)}$. To provide VESA I^2C-compatible signals 3.3 V should be applied to $V_{CC(A)}$. If voltage translation is not required $V_{CC(A)}$ should be connected to $V_{CC(B)}$.

Table 5. Function table DDC

H = HIGH voltage level; L = LOW voltage level; Z = high-impedance OFF-state.

Input	Switch
SEL	
L	SDA0 to SDA1, SCL0 to SCL1
H	SDA0 to SDA2, SCL0 to SCL2

8. Limiting values

Table 6. 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
$V_{CC(A)}$	supply voltage A			−0.5	+6	V
$V_{CC(B)}$	supply voltage B			−0.5	+6	V
V_I	input voltage		[1]	−0.5	+6	V
V_{SW}	switch voltage		[1]	−0.5	+6	V
I_{IK}	input clamping current	$V_I < -0.5$ V		−50	-	mA
I_{SK}	switch clamping current	$V_I < -0.5$ V		−50	-	mA
I_{OK}	output clamping current	$V_O < 0$ V		−50	-	mA
I_O	output current	$V_O = 0$ V to $V_{CC(B)}$		-	±50	mA
I_{CC}	supply current	$I_{CC(A)}$ or $I_{CC(B)}$		-	100	mA
I_{GND}	ground current			−100	-	mA
I_{SW}	switch current	$V_{SW} > -0.5$ V or $V_{SW} < 6$ V; source or sink current		-	±30	mA
		$V_{SW} > -0.5$ V or $V_{SW} < 6$ V; pulsed at 1 ms duration, < 10 % duty cycle; peak current		-	±90	mA
T_{stg}	storage temperature			−65	+150	°C
P_{tot}	total power dissipation	$T_{amb} = -40$ °C to +85 °C	[2]	-	250	mW

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

[2] For HWQFN32 package: above 137 °C the value of P_{tot} derates linearly with 20.5 mW/K.

9. Recommended operating conditions

Table 7. Recommended operating conditions

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$V_{CC(A)}$	supply voltage A			2	3.3	5.5	V
$V_{CC(B)}$	supply voltage B			4.5	5.0	5.5	V
T_{amb}	ambient temperature	operating in free-air		−40	+25	+85	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC(A)}$ = 2.3 V to 2.7 V	[1]	-	20	-	ns/V
		$V_{CC(A)}$ = 3 V to 3.6 V	[1]	-	10	-	ns/V
		$V_{CC(A)}$ = 4.5 V to 5.5 V	[1]	-	5	-	ns/V

[1] Applies to control signal levels.

10. Static characteristics

Table 8. Static characteristics

$V_{CC(B)}$ = 4.5 V to 5.5 V; $V_{CC(A)}$ = 2 V to 5.5 V, unless otherwise specified; Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions		T_{amb} = −40 °C to +85 °C			Unit
				Min	Typ[1]	Max	
General							
$I_{CC(A)}$	supply current A	$V_{CC(A)}$ = 3.3 V; for H1, H2, V1, V2: I_O = 0 A		-	-	2.0	μA
$I_{CC(B)}$	supply current B	$V_{CC(B)}$ = 5.0 V; for H1, H2, V1, V2: I_O = 0 A		-	-	2.0	μA
HV buffer							
V_{IH}	HIGH-level input voltage	$V_{CC(A)}$ = 3 V to 3.6 V		2	-	-	V
V_{IL}	LOW-level input voltage	$V_{CC(A)}$ = 3 V to 3.6 V		-	-	0.8	V
V_H	hysteresis voltage			-	50	-	mV
I_I	input leakage current	$V_{CC(B)}$ = $V_{CC(A)}$ = 5.5 V; V_I = GND to $V_{CC(A)}$		-	-	±1	μA
V_{OH}	HIGH-level output voltage	I_O = −8 mA		$V_{CC(B)}$ − 0.5	-	-	V
V_{OL}	LOW-level output voltage	I_O = 8 mA		-	-	0.5	V
I_{OFF}	power-off leakage current	V_I or V_O = 0 V to 5.5 V; $V_{CC(B)}$ = 0 V; $V_{CC(A)}$ = 0 V to 5.5 V		-	-	±1	μA
RGB switches							
$I_{S(OFF)}$	OFF-state leakage current	$V_{CC(B)}$ = 5.5 V; V_I = 0.3 V or 5.5 V; V_O = 0 V to $V_{CC(B)}$; See Figure 3		-	-	±1	μA
$I_{S(ON)}$	ON-state leakage current	$V_{CC(B)}$ = 5.5 V; V_I = 0.3 V or 5.5 V; V_O = 0 V to $V_{CC(B)}$; See Figure 4		-	-	±1	μA
R_{ON}	ON resistance	V_I = 0.7 V; I_{SW} = −10 mA; See Figure 5 and Figure 6	[4]	-	4	-	Ω
ΔR_{ON}	ON resistance mismatch between channels	V_I = GND to 0.7 V; I_{SW} = −10 mA	[2]	-	0.5	-	Ω
$R_{ON(flat)}$	ON resistance (flatness)	V_I = GND to 0.7 V; I_{SW} = −10 mA	[3]	-	0.5	-	Ω
$C_{S(OFF)}$	OFF-state capacitance			-	4.5	-	pF
$C_{S(ON)}$	ON-state capacitance			-	12	-	pF

Table 8. Static characteristics *...continued*

$V_{CC(B)}$ = 4.5 V to 5.5 V; $V_{CC(A)}$ = 2 V to 5.5 V, unless otherwise specified; Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions		T_{amb} = –40 °C to +85 °C			Unit
				Min	Typ[1]	Max	
SDAn, SCLn							
$I_{S(OFF)}$	OFF-state leakage current	$V_{CC(B)}$ = 5.5 V; $V_{CC(A)}$ = 3.6 V; SCL0, SDA0, SCL1, SCL2, SDA1, SDA2 = $V_{CC(A)}$ or GND; V_O = 0 V to $V_{CC(B)}$; See Figure 3	[5]	-	-	±1	μA
R_{ON}	ON resistance	$V_{CC(A)}$ = 2 V; V_I = 0.4 V; I_{SW} = ±2 mA; See Figure 5 and Figure 7		-	9	-	Ω
$C_{S(ON)}$	ON-state capacitance			-	15	-	pF
Control Logic (SEL)							
V_{IH}	HIGH-level input voltage	$V_{CC(A)}$ = 2.3 V to 2.7 V		1.7	-		V
		$V_{CC(A)}$ = 3.0 V to 3.6 V		2.0	-		V
		$V_{CC(A)}$ = 4.5 V to 5.5 V		$0.7V_{CC(A)}$	-		V
V_{IL}	LOW-level input voltage	$V_{CC(A)}$ = 2.3 V to 2.7 V		-	-	0.7	V
		$V_{CC(A)}$ = 3.0 V to 3.6 V		-	-	0.8	V
		$V_{CC(A)}$ = 4.5 V to 5.5 V		-	-	$0.3V_{CC(A)}$	V
V_H	hysteresis voltage			-	50	-	mV
I_I	input leakage current	$V_{CC(A)}$ = 5.5 V; V_I = GND to $V_{CC(A)}$		-	-	±1	μA

[1] All typical values are measured at $V_{CC(B)}$ = 5 V, $V_{CC(A)}$ = 3.3 V and T_{amb} = 25 °C unless otherwise specified.

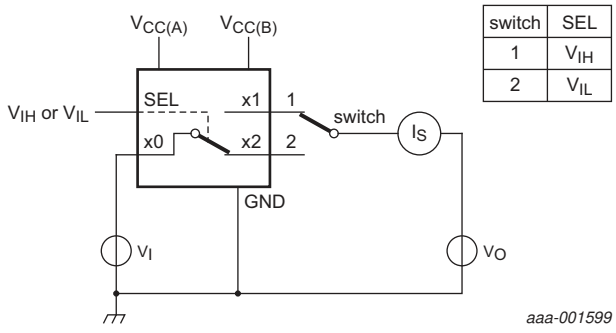
[2] Measured at identical V_{CC}, temperature and input voltage.

[3] Flatness is defined as the difference between the maximum and minimum value of ON resistance measured at identical V_{CC} and temperature.

[4] Guarantees the LOW level.

[5] Guarantees the HIGH level.

10.1 Test circuits and waveforms



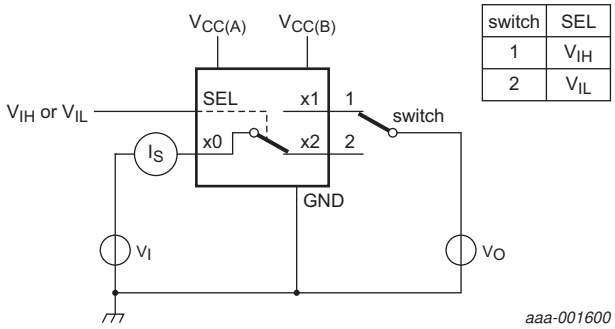
switch	SEL
1	V_{IH}
2	V_{IL}

x0 refers to R0, G0, B0, SCL0 or SDA0

x1 refers to R1, G1, B1, SCL1 or SDA1

x2 refers to R2, G2, B2, SCL2 or SDA2

Fig 3. Test circuit for measuring OFF-state leakage current



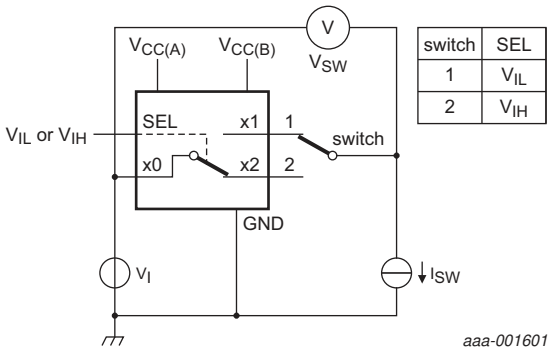
switch	SEL
1	V_{IH}
2	V_{IL}

x0 refers to R0, G0, B0, SCL0 or SDA0

x1 refers to R1, G1, B1, SCL1 or SDA1

x2 refers to R2, G2, B2, SCL2 or SDA2

Fig 4. Test circuit for measuring ON-state leakage current



switch	SEL
1	V_{IL}
2	V_{IH}

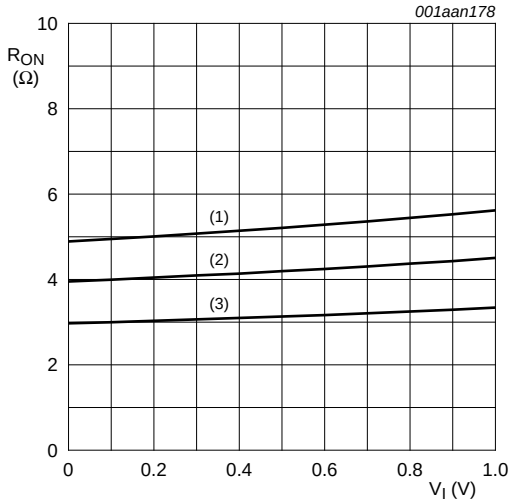
x0 refers to R0, G0, B0, SCL0 or SDA0

x1 refers to R1, G1, B1, SCL1 or SDA1

x2 refers to R2, G2, B2, SCL2 or SDA2

$R_{ON} = V_{SW} / I_{SW}$.

Fig 5. Test circuit for measuring ON resistance

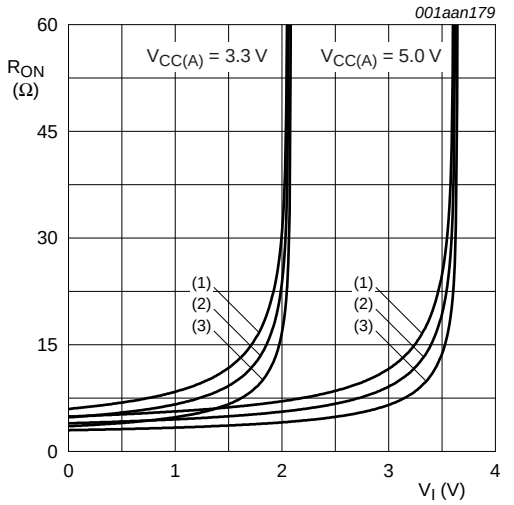


(1) T_{amb} = 85 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = −40 °C

Fig 6. ON resistance as a function of input voltage (RGB switches)



(1) T_{amb} = 85 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = −40 °C

Fig 7. ON resistance as a function of input voltage (DDC switches)

11. Dynamic characteristics

Table 9. Dynamic characteristics

At recommended operating conditions; Voltages are referenced to GND (ground = 0 V; $V_{CC(B)}$ = 4.5 V to 5.5 V; $V_{CC(A)}$ = 2 V to 5.5 V.

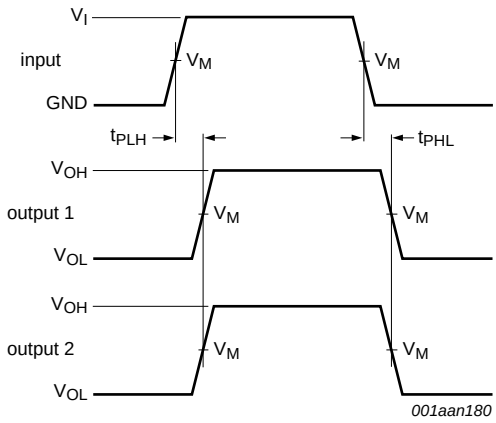
Symbol	Parameter	Conditions		T_{amb} = –40 °C to +85 °C			Unit
				Min	Typ[1]	Max	
t_{pd}	propagation delay	H0 to H1, H2 and V0 to V1, V2; See Figure 8 and Figure 9	[2]	-	3	-	ns
t_{en}	enable time	SEL to all outputs; See Figure 9, Figure 10 and Figure 11		-	15	-	ns
t_{dis}	disable time	SEL to all outputs; See Figure 9, Figure 10 and Figure 11		-	5	-	ns
t_{b-m}	break-before-make time	See Figure 9, Figure 10 and Figure 12		-	10	-	ns
$t_{sk(o)}$	output skew time	Skew between any Rn, Gn and Bn ports; see Figure 8	[3]	-	50	-	ps

[1] All typical values are measured at $V_{CC(B)}$ = 5 V; $V_{CC(A)}$ = 3.3 V; T_{amb} = 25 °C.

[2] t_{pd} is the same as t_{PLH} and t_{PHL}.

[3] Guaranteed by design.

11.1 Test circuits and waveforms



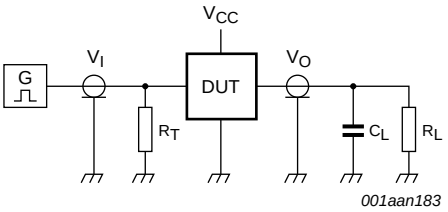
Measurement points are given in Table 10.

$t_{sk(o)} = |t_{PLH1} - t_{PLH2}|$

Fig 8. Propagation delay and output skew times

Table 10. Measurement points

Input		Output	
V_M	V_I	V_X	V_M
$0.5V_{CC(A)}$	GND to $V_{CC(A)}$	$0.9V_{OH}$	$0.5V_{CC(B)}$



Test data is given in Table 11.

Definitions:

DUT = Device Under Test.

R_T = Termination resistance should be equal to output impedance Z_o of the pulse generator.

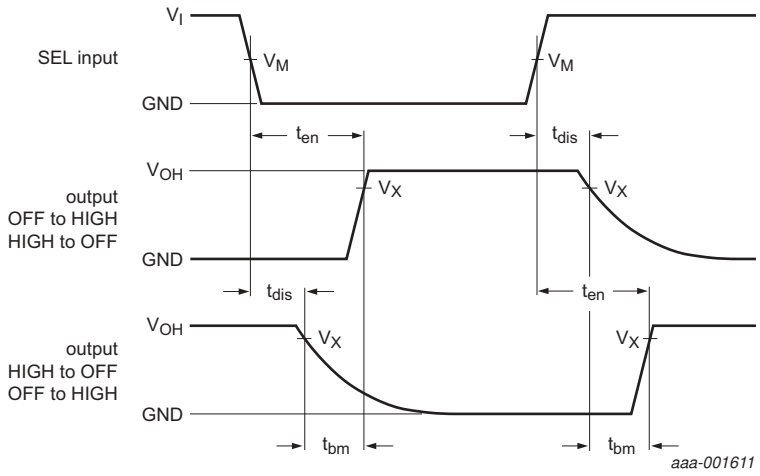
C_L = Load capacitance including test jig and probe.

R_L = Load resistance.

Fig 9. Test circuit for measuring propagation delay times, enable and disable times (SEL to H1, H2, V1, V2), break-before-make times (H1 to H2, V1 to V2)

Table 11. Test data

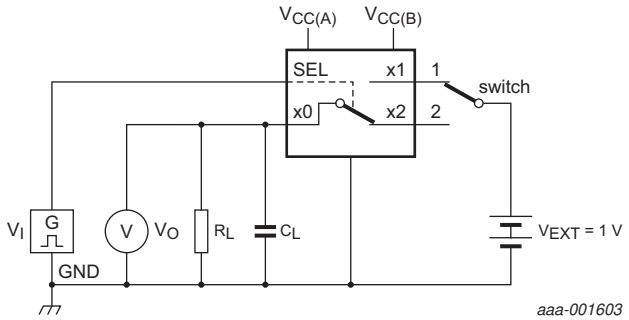
Input	Load	
t_r, t_f	C_L	R_L
≤ 2.5 ns	10 pF	1 kΩ



Measurement points are given in Table 10.

Logic level: V_{OH} is typical output voltage level that occurs with the output load.

Fig 10. Enable and disable times (all outputs) and break-before-make times



Test data is given in Table 12.

x0 refers to R0, G0, B0, SCL0, SDA0

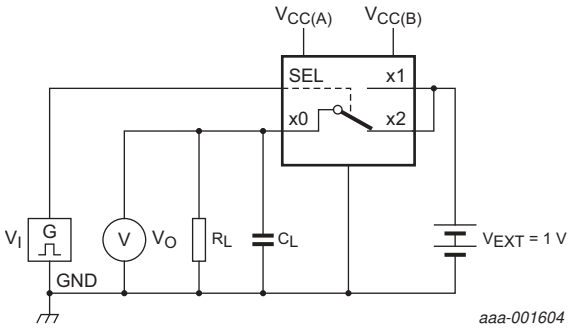
x1 refers to R1, G1, B1, SCL1, SDA1

x2 refers to R2, G2, B2, SCL2, SDA2

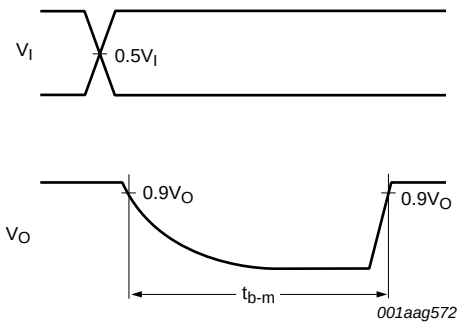
Fig 11. Test circuit for measuring enable and disable times (SEL to Rn, Gn, Bn, SDAn, SCLn)

Table 12. Test data

Input		Load	
t_r, t_f	V_I	C_L	R_L
≤ 2.5 ns	GND to $V_{CC(A)}$	10 pF	100 Ω



a. Test circuit



b. Input and output measurement points

Test data is given in Table 12.

x0 refers to R0, G0, B0, SCL0, SDA0

x1 refers to R1, G1, B1, SCL1, SDA1

x2 refers to R2, G2, B2, SCL2, SDA2

Fig 12. Test circuit for measuring break-before-make time (R1 to R2, G1 to G2, B1 to B2, SCL1 to SCL2, SDA1 to SDA2)

12. Additional dynamic characteristics

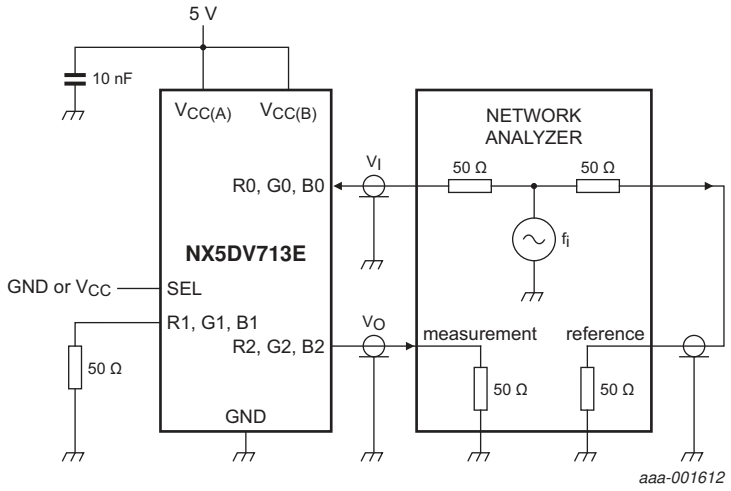
Table 13. Additional dynamic characteristics

$V_{CC(B)}$ = 5.0 V ± 10 %, $V_{CC(A)}$ = 2 V to 5.5 V, unless otherwise specified; Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions		T_{amb} = –40 °C to +85 °C			Unit
				Min	Typ	Max	
$f_{(-3dB)}$	–3 dB frequency response	R_L = 50 Ω; see Figure 13	[1]	-	600	-	MHz
α_{ins}	Insertion loss	f_i = 1 MHz; $R_L = R_S$ =50 Ω; see Figure 13		-	0.6	-	dB
Xtalk	crosstalk	between switches; f_i = 50 MHz; R_L = 50 Ω; see Figure 13	[1]	-	–50	-	dB

[1] f_i is biased at $0.5V_{CC}$.

12.1 Test circuits



Insertion loss is measured between R0 and R1 or R2 on each switch; crosstalk is measured from one channel to the other channel.

Fig 13. Test circuit for measuring crosstalk and insertion loss

13. Application information

The NX5DV713E provides the level shifting necessary to drive two standard VGA ports from a graphic controller as low as 2.2 V. Internal buffers drive the HSYNC and VSYNC signals to VGA standard TTL levels. The DDC multiplexer provides level shifting by clamping signals to a diode drop less than $V_{CC(A)}$ (See Figure 14). Connect $V_{CC(A)}$ to 3.3 V for normal operation, or to $V_{CC(B)}$ to disable voltage clamping for DDC signals

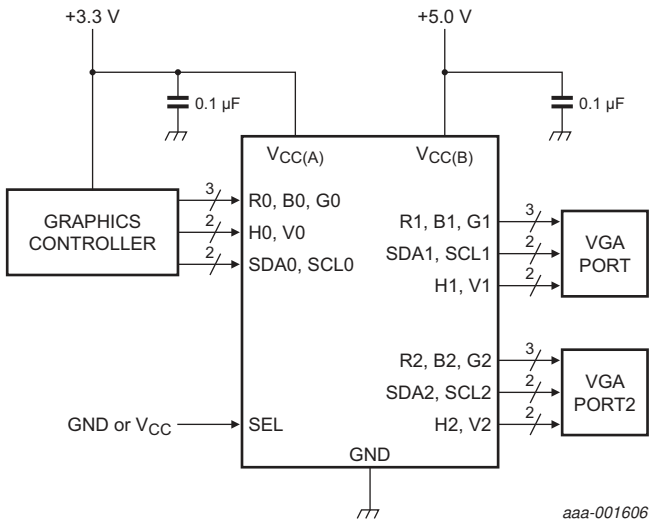
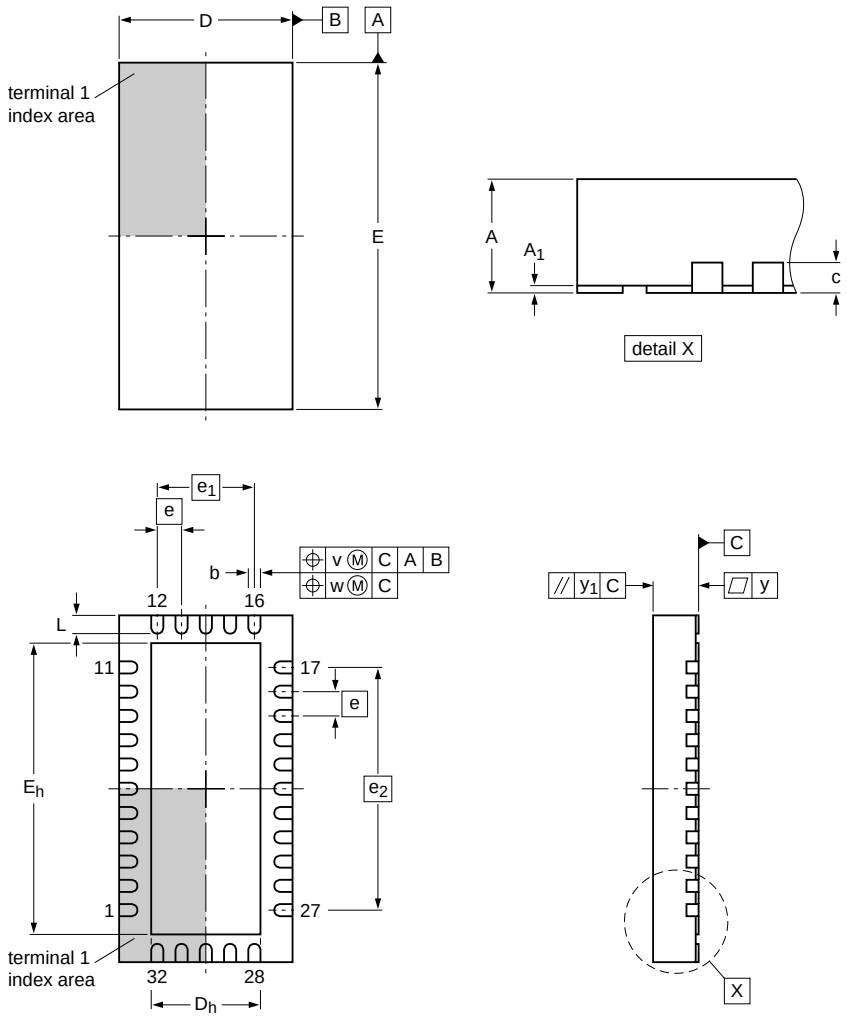


Fig 14. Typical operating circuit

14. Package outline

HWQFN32: plastic thermal enhanced very very thin quad flat package; no leads; 32 terminals; 3 x 6 x 0.75 mm **SOT1180-1**



Dimensions

Unit		$A^{(1)}$	A_1	b	c	$D^{(1)}$	D_h	$E^{(1)}$	E_h	e	e_1	e_2	L	v	w	y	y_1
	max	0.80	0.05	0.25		3.1	1.9	6.1	4.9				0.4				
mm	nom	0.75	0.02	0.20	0.2	3.0	1.8	6.0	4.8	0.4	1.6	4	0.3	0.07	0.05	0.08	0.1
	min	0.70	0.00	0.15		2.9	1.7	5.9	4.7				0.2				

Note
1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

sot1180-1_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1180-1	- - -	- - -	- - -			~~10-07-02~~ 10-08-05

Fig 15. Package outline SOT1180-1 (HWQFN32)

15. Abbreviations

Table 14. Abbreviations

Acronym	Description
CDM	Charged Device Model
DDC	Display Data Channel
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model
RGB	Red Green Blue
SPDT	Single-Pole Double-Throw
TTL	Transistor-Transistor Logic
VESA	Video Electronics Standards Association

16. Revision history

Table 15. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
NX5DV713E v.1	20111124	Product data sheet	-	-

17. Legal information

17.1 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.

[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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