Very High-speed CMOS logic for next-generation designs

NXP VHC/T & XC7 logic

Delivering very high speed with low power over an extended temperature range, NXP's VHC/T logic devices are drop-in replacements for competing VHC/T devices, and improve performance in a wide variety of applications. Innovative package options and competitive specifications make it easy to find the right fit.

Key features

- Low static and dynamic power consumption
- 5-volt-tolerant input within supply voltage range V_{CC} = 2.0 to 5.5 V
- Propagation delay of 5 ns at 3 V supply voltage (typ)
- TTL-compatible inputs
- Schmitt trigger action at inputs
- Extended temperature range (-40 to 125 °C) per AEC-Q100, grade 1 standard
- IBIS models are available

Key benefits

- Supports faster speeds and lower power-supply voltages
- Suitable for mixed 3.3/5 V designs
- Well-defined switching levels for reliable logic recovery
- Lower heat dissipation, suitable for battery-operated systems
- Suitable for industrial and automotive applications

Applications

- Notebook PCs
- Telecom infrastructure
- Portable devices
- Consumer electronics
- Industrial
- Automotive
- Smart metering

VHC/T & XC7 logic devices from NXP are specified over 2 to 5.5 V and are fully compatible with TTL input levels. The ability to operate at both 5 and 3.3 V makes them well suited for next-generation designs, and makes it easy to migrate existing designs to low-voltage formats. Reduced I_{CC} and I/O capacitance significantly reduce the static and dynamic power consumption. Improved package design and a high-speed CMOS process result in better noise performance, including lower EMI and cross-talk effects.

NXP VHC/T & XC7 logic has a lower C_{PD} than competing devices, so it consumes less switching power. VHC/T and XC7 logic is rated for HBM ESD protection of >2 kV per the JESD22-A114E standard.

VHC/T logic, offered as quad, hex, and octal functions, is available in standard 14-, 16-, and 20-pin SO, TSSOP packages, as well as in smaller, leadless DQFN packages.

XC7 logic is offered as single-, dual-, and triple-gate functions which are available in small, innovative 5-, 6-, and 8-pin PicoGate and leadless .5 and .35 mm pitch MicroPak packages.

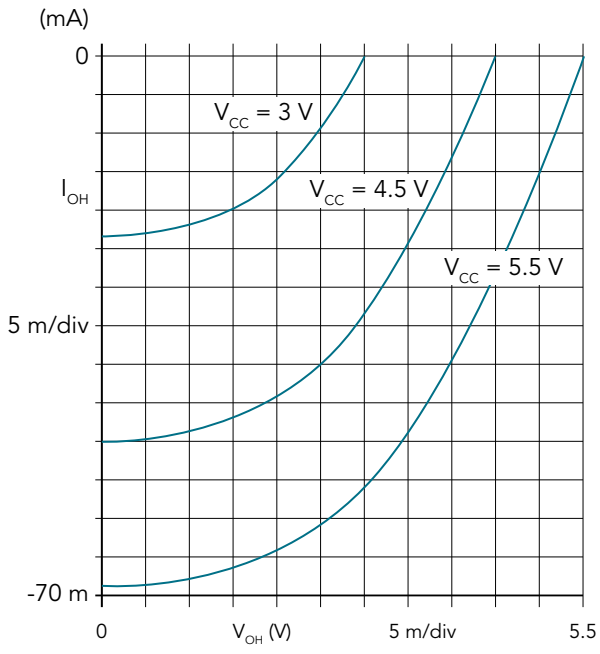
VHC/T & XC7 logic can be used as drop-in replacements for Toshiba's TC74VHC/T & TC7 families, Fairchild Semiconductor's 74VHC/T, ON Semiconductor's MC74VHC/T, and ST Microelectronics' 74VHC/T logic. VHC/T and XC7 logic is specified for an extended temperature range of -40 to 125 °C, making it suitable for use in harsh conditions, including automotive applications. The products are also automotive qualified per the AEC-Q100, grade 1 standard. NXP offers high-quality VHC/T and XC7 logic devices which enable customers to be cost competitive in their designs and minimize risk in the supply chain.

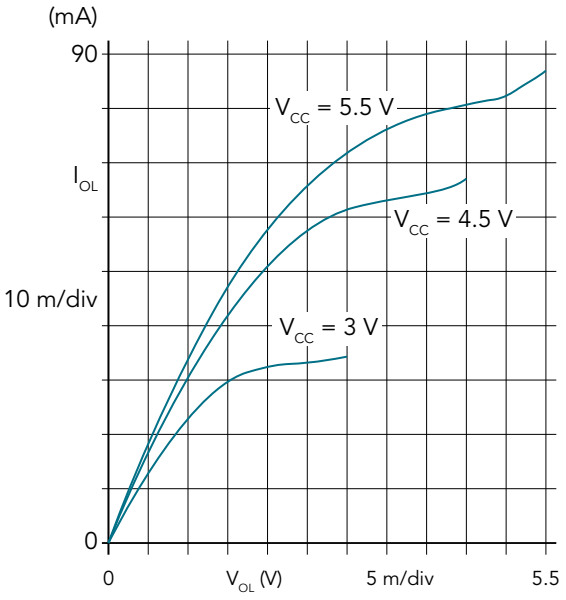
VHC/T and XC7 logic is recommended for use in a wide range of applications, including:

- Set Top Box, LCD TV
- Digital cameras, GPS navigators, electric shavers, and other consumer electronics
- Backplanes and panels for PCs, notebooks, and networking systems
- RF modems and other high-frequency systems exposed to field noise
- Portable systems such as toys, digital multimeters, power supplies, and function generators.
- Instrumentation panels for automotive, aircraft, factory sensors, etc.
- Smart Metering

Output static characteristics

The graphs show output static characteristics for the NXP 74VHC14 device at different supply voltages. The results are comparable to those of competing VHC logic devices.





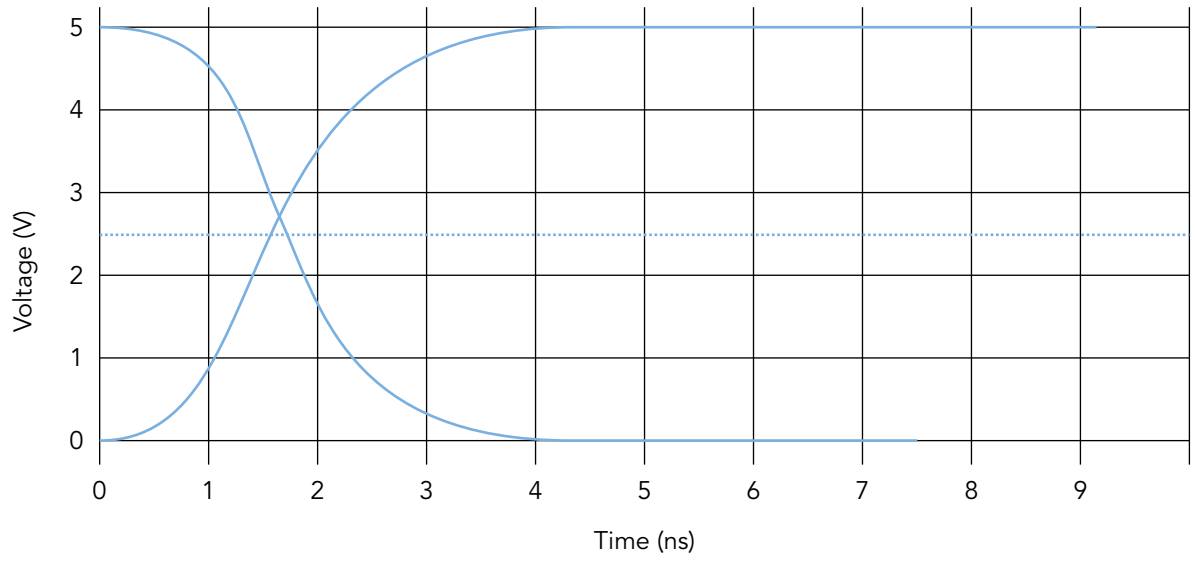
Output rise and fall times, propagation delays, and power dissipation capacitance for NXP's 74VHC14 device at different loads are measured and shown in the table below for reference. Results are comparable to competition's devices.

Bench measurements

74VHC14				
	3 V	4.5 V	5.5 V	C_l [pF]
t_r [ns]	1.2	1	1.2	0
t_f [ns]	0.9	0.8	0.9	0
t_r [ns]	3.0	3.0	2.9	15
t_f [ns]	2.1	2.1	2.0	15
t_{PHL} [ns]	4.8	3.7	3.4	15
t_{PHL} [ns]	4.8	3.7	3.4	15
C_{PD} [pF]	8.3	10.1	11.3	47.5

Output rise and fall edges when NXP VHC14 outputs have a capacitive load of 15 pF

The graph shows typical output edges for NXP's VHC14 device. Results for capacitive load of 15 pF, are similar to those of competitor's VHC devices.



NXP offers comprehensive portfolio of VHC Logic in standard and smaller, innovative leadless packages.

NXP's VHC/T & XC7 nomenclature is compared with competition's nomenclature in table below.

VHC/T & XC7 logic cross-reference

Package	NXP	Fairchild	ON	Toshiba	ST
SOIC	74VHC(T)xxxD	74VHCxxx(W)M(X)	MC74VHC(T)xxxD(W)	TC74VHC(T)xxx(A)FN/W	74VHC(T)xxxMTR
TSSOP	74VHC(T)xxxPW	74VHCxxxMTC(X)	MC74VHC(T)xxxDT	TC74VHC(T)xxx(A)FT	74VHC(T)xxxTTR
DQFN	74VHC(T)xxxBQ				
SOT353	XC7SHxxxGW		MC74VHC1GxxxDFT	TC7SHxxxFU	74V1GxxxCTR
SOT753	XC7SHxxxGV		MC74VHC1GxxxDTT	TC7SHxxxF	74V1GxxxSTR
SOT886	XC7SHxxxGM				
SOT891	XC7SHxxxGF			TC7SHxxxFS	
SOT505-2	XC7WHxxxDP			TC7WHxxxFU	74V2GxxxSTR
SOT765	XC7WHxxxDC			TC7WHxxxFK	
SOT996	XC7WHxxxGD			TC7WHxxxFK	
SOT833	XC7WHxxxGT				
SOT353	XC7SETxxxGW		MC74VHC1GTxxxDFT	TC7SETxxxFU	74V1GTxxxCTR
SOT753	XC7SETxxxGV		MC74VHC1GTxxxDTT	TC7SETxxxF	74V1GTxxxSTR
SOT886	XC7SETxxxGM				
SOT891	XC7SETxxxGF			TC7SETxxxFS	
SOT505-2	XC7WTxxxDP				
SOT765	XC7WTxxxDC				
SOT996	XC7WTxxxGD				
SOT833	XC7WTxxxGT				

Featured VHC and XC7 devices from NXP

Part number	Description	Voltage range (V)	Prop. delay (ns)*	Package type
74VHC08D	5 V quad 2-input AND gate	2.0 to 5.5	5.5	SO-14
74HC08PW				TSSOP-14
74VHC08BQ				DHVQFN-14
74VHCT244D	5 V octal buffer/line driver; non-inverting; TTL enabled (3-state)	4.5 to 5.5	5	SO-20
74VHCT244PW				TSSOP-20
74VHCT244BQ				DHVQFN-20
XC7SH125GV	5 V single buffer/line driver with active LOW output enable (3-state)	2.0 to 5.5	4.8	PicoGate-5
XC7SH125GW				PicoGate-5
XC7SH125GM				XSON-6
XC7SH125GF				XSON-6
XC7WH126DP	5 V dual bus buffer/line driver (3-state)	2.0 to 5.5	4.8	TSSOP-8
XC7WH126DC				VSSOP-8
XC7WH126GD				XSON-8
XC7SET86GV	5 V single 2-input EXCLUSIVE-OR gate; TTL enabled	4.5 to 5.5	5	PicoGate-5
XC7SET86GW				PicoGate-5
XC7SET04GV	5 V single inverter; TTL enabled	4.5 to 5.5	4.9	PicoGate-5
XC7SET04GW				PicoGate-5
XC7SH08GV	5 V single 2-input AND gate	2.0 to 5.5	4.6	PicoGate-5
XC7SH08GW				PicoGate-5
XC7WH14GT	5 V Triple Inverting Schmitt Triggers	2.0 to 5.5	4.6	XSON8
XC7WH14GD	5 V Triple Inverting Schmitt Triggers	2.0 to 5.5	4.6	XSON8U
XC7WT14GT	5 V Triple Inverting Schmitt Triggers; TTL enabled	4.5 to 5.5	5.9	XSON8
XC7WT14GD	5 V Triple Inverting Schmitt Triggers; TTL enabled	4.5 to 5.5	5.9	XSON8U

* Typical propagation delay at V_{CC} = 4.5 to 5.5 V and Cl = 50 pF

Critical parameters: NXP VHC logic versus the competition

Features	Major competitor	NXP	Comments
	VHC	VHC	
Supply voltage V_{CC}	2 to 5.5 V	2 to 5.5 V	Same
I_{CC} (max) at 25 °C	2 µA (max)	2 µA (max)	
V_{ih}	0.7 V_{CC} at V_{CC} = 3 to 5.5 V	0.7 V_{CC} at V_{CC} = 3 to 5.5 V	Same
V_{il}	0.3 V_{CC} at V_{CC} = 3 to 5.5 V	0.3 V_{CC} at V_{CC} = 3 to 5.5 V	
V_{oh}	3.94 V at I_{oh} = -8 mA and V_{CC} = 4.5 V	3.94 V at I_{oh} = -8 mA and V_{CC} = 4.5 V	Same
V_{ol}	0.36 V at I_{oh} = -8 mA and V_{CC} = 4.5 V	0.36 V at I_{oh} = -8 mA and V_{CC} = 4.5 V	
I_{in}	0.1 µA at 25 °C	0.1 µA at 25 °C	
C_{pd}	15 pF	7 pF	Lower dynamic (switching) power consumption for NXP
Prop delay (C_L = 50 pF) at 25 C V_{CC} = 3.3 to 5 V	8 ns to 12.3 ns (max)	8 ns to 12.3 ns (max)	Same
I_{IK} Input clamping diode current	-20 mA	-20 mA	Same
Input rise and fall times	0 -100 ns/V (V_{CC} = 3.3 V); 0 - 20 ns/V (V_{CC} = 5 V)	0 -100 ns/V (V_{CC} = 3.3 V); 0 - 20 ns/V (V_{CC} = 5 V)	Same
ESD (HBM)	N/A	Exceeds 2 kV	NXP tests the parts for HBM ESD per the JESD22-A114E standard. ESD rating for Toshiba's VHC logic could not be found.
RoHS compliant	Yes	Yes	Same
Dark Green (RoHS compliant + halogen and antimony free)	Yes	Yes	Same
Operating temp. range	-40 to 85 °C	-40 to 125 °C	Wider operating temperature range for NXP

7VHC

Package suffix	PW	BQ	PW	BQ	D	PW	BQ
	14 pin	14 pin	16 pin	16 pin	20 pin	20 pin	20 pin
	 SOT402-1	 SOT762-1	 SOT403-1	 SOT763-1	 SOT163-1	 SOT360-1	 SOT764-1
Width (mm)	5	3	5	3.5	10.65	6.5	4.5
Length (mm)	6.4	2.5	6.4	2.5	13	6.4	2.5
Pitch (mm)	0.65	0.5	0.65	0.5	1.27	0.65	0.5

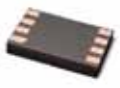
7 SH products

Package suffix	GW	GV	GM	GF
	5 pin	5 pin	6 pin	6 pin
	 SOT353-1	 SOT753	 SOT886	 SOT891
Width (mm)	2	2.9	1.45	1
Length (mm)	2.1	2.75	1	1
Pitch (mm)	0.65	0.95	0.5	0.35

7 SET products

Package suffix	GW	GV
	5 pin	5 pin
	 SOT353-1	 SOT753
Width (mm)	2.05	2.9
Length (mm)	2.125	2.75
Pitch (mm)	0.65	0.95

7WH products

Package suffix	DP	DC	GD
	8 pin	8 pin	8 pin
	 SOT505-2	 SOT765-1	 SOT996-2
Width (mm)	3	2	2
Length (mm)	4	3.1	3
Pitch (mm)	0.65	0.5	0.5

7WT

Package suffix	GT	GM
	8 pin	8 pin
	 SOT 883	 SOT902
Width (mm)	1.0	1.6
Length (mm)	1.95	1.6
Pitch (mm)	0.5	0.5

Notes

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