Glossary of CMOS Logic IC

Outline:

Glossary used in datasheets (absolute max. ratings, operating ranges, electrical characteristics,
and built-in functions) for CMOS Logic ICs and one-gate logic (L-MOS) are explained.

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1. Absolute Maximum Ratings

Parameter	Symbol	Definition
Supply voltage	V_{CC} V_{EE}	The rated voltage of the power supply terminal at which an IC will not suffer breakdown, deterioration of characteristics, or reduced reliability.
Supply voltage	V_{CC} - V_{EE}	The rated voltage across the V_{CC} and V_{EE} terminals at which an IC will not suffer breakdown, deterioration of characteristics, or reduced reliability.
Input voltage	V_{IN}	The rated voltage of the input terminal at which an IC will not suffer breakdown, deterioration of characteristics, or reduced reliability.
Output voltage	V_{OUT}	The rated voltage of the output terminal at which an IC will not suffer breakdown, deterioration of characteristics, or reduced reliability.
Switch I/O voltage	$V_{I/O}$	The rated voltage across the input and output terminals at which an IC will not suffer breakdown, deterioration of characteristics, or reduced reliability.
Input diode current	I_{IK}	The rated current of the input terminal at which an IC will not suffer breakdown due to latch-up.
Output diode current	I_{OK}	The rated current of the output terminal at which an IC will not suffer breakdown due to latch-up.
Output current	I_{OUT}	The rated current that can flow through one output terminal.
Switch through current	I_T	The rated current between the input and output terminals of a switch at which an IC will not suffer breakdown, deterioration of characteristics, or reduced reliability.
VCC/ground current	I_{CC} I_{CC} / GND	The rated current between the power supply and ground terminals at which an IC will not suffer breakdown, deterioration of characteristics, or reduced reliability. As V_{CC}/ ground current includes output current, substantial V_{CC}/ ground current can flow in an IC having multiple output terminals.
Power dissipation	P_D	Power consumption that does not cause IC breakdown over the entire operating temperature range.
Storage temperature	T_{stg}	The ambient temperature range over which no deterioration of characteristics or reliability occurs when an IC is stored for a long period of time or is transported with no supply voltage present.

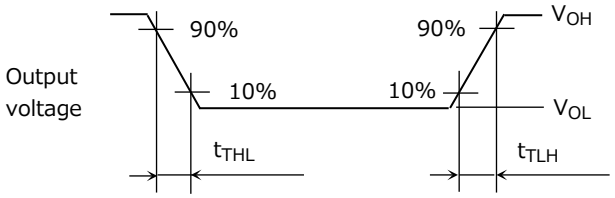
2. Operating Ranges

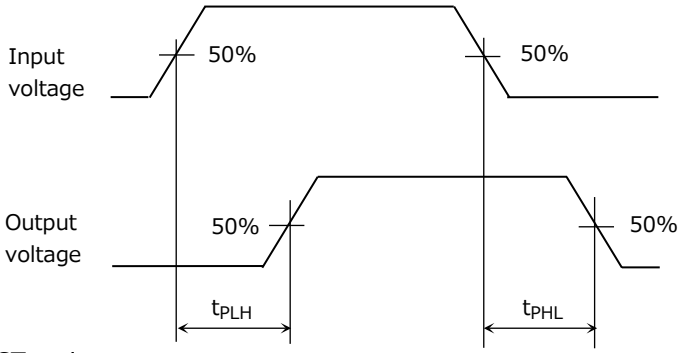
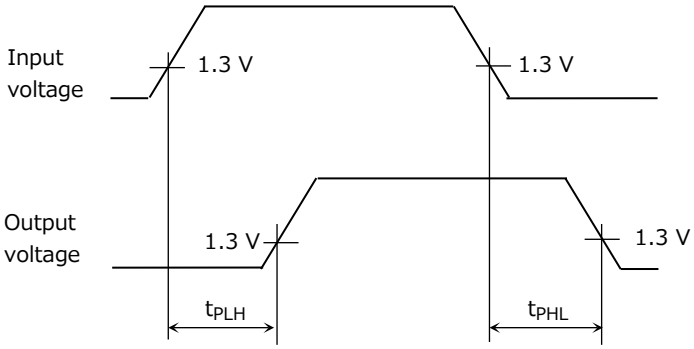
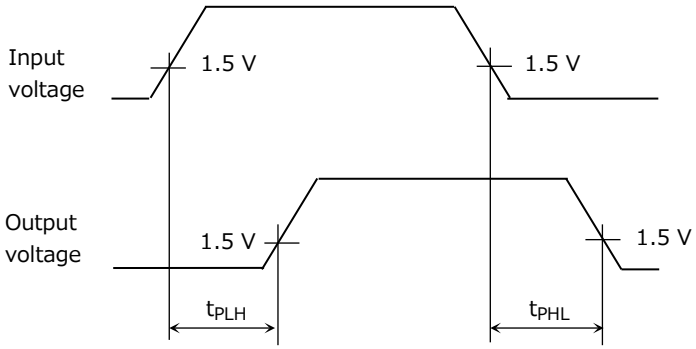
Parameter	Symbol	Definition
Supply voltage	V_{CC} V_{EE} V_{CC} - V_{EE}	The supply voltage range over which the normal operation of an IC is guaranteed.
Input voltage	V_{IN}	The input voltage range over which the normal operation and electrical characteristics of an IC are guaranteed.
Output voltage	V_{OUT}	The output voltage range over which the normal operation and electrical characteristics of an IC are guaranteed.
Switch I/O voltage	V_S $V_{I/O}$	The switch I/O voltage range over which the normal operation and electrical characteristics of an IC are guaranteed.
Output current	I_{OUT} I_{OH} , I_{OL} I_{OL}	The maximum output current at which the normal operation and electrical characteristics of an IC are guaranteed.
Input rise and fall times	t_r,t_f dt/dv	The ranges of rise and fall times of an input signal that will not cause malfunction due to oscillation of the output.
External capacitor	C_X	The external capacitance range over which the normal operation and electrical characteristics of a multivibrator IC are guaranteed.
External resistor	R_X	The external resistance range over which the normal operation and electrical characteristics of a multivibrator IC are guaranteed.
Operating temperature	T_{opr}	The operating temperature range over which the normal operation and electrical characteristics of an IC are guaranteed.

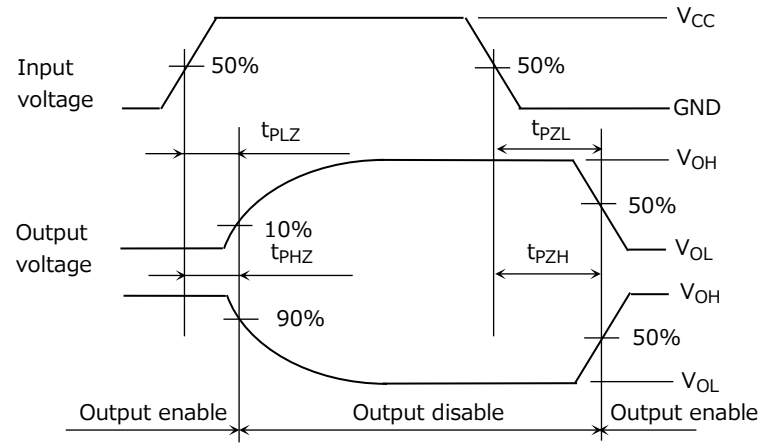
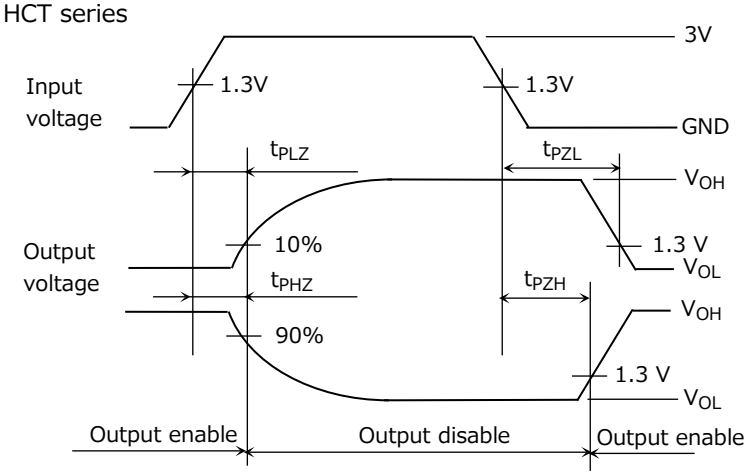
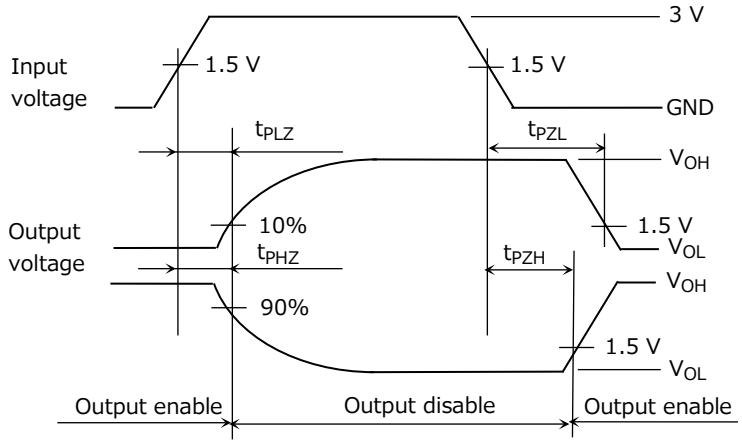
3. Electrical Characteristics

Parameter	Symbol	Definition
High-level input voltage	V_{IH}	The input voltage at which input of an IC is driven to the High level.
Low-level input voltage	V_{IL}	The input voltage at which the input of an IC is driven to the Low level.
Positive threshold voltage	V_P	The input threshold voltage at which a Schmitt-trigger input is driven to the High level.
Negative threshold voltage	V_N	The input threshold voltage at which a Schmitt-trigger input is driven to the Low level.
Hysteresis voltage	V_H	The difference between the positive and negative threshold voltages of a Schmitt trigger input.
High-level output voltage	V_{OH}	The voltage that appears at the output when either VIH or VIL is applied to each input terminal such that the output is set to the High level.
Low-level output voltage	V_{OL}	The voltage that appears at the output when either VIH or VIL is applied to each input terminal such that the output is set to the Low level.
Power-off leakage current	I_{OFF}	The leakage current that flows into an IC via input and output terminals when the power supply is off.
Input leakage current	I_{IN}	The leakage current that flows through the input terminal when a voltage is present at the input terminal of an IC.
Output off-state leakage current	I_{OZ}	The leakage current of an IC with an open-drain output that flows through the output terminal when it is in the high-impedance state.
Output leakage current (Power-off)	I_{OPD}	The leakage current that flows into an IC via the output terminals when V_{CC} is the off state (V_{CC}=0 V)
3-state output off-state leakage current	I_{OZ}	The leakage current of an IC with an open-drain or three-state output that flows through the output terminal when it is in the high-impedance state.

Parameter	Symbol	Definition
Input/output leakage current (Switch off)	I_{OFF}	The leakage current that flows through an IC from the input terminals to the output terminal when the power supply is off.
Input/output leakage current (Switch on)	$I_{I/O}$	The leakage current that flows from the input terminal to the output terminal in the switch-on and open-output states.
Control input leakage current	I_{IN}	The leakage current that flows through the control input terminal of IC when a voltage is applied to the terminal.
RX/CX terminal off-state current	I_{IN}	The current that flows through the RX/CX terminal of a multivibrator IC when a voltage is applied to the terminal.
T2 terminal input leakage current	I_{IN}	The current that flows through the T2 terminal of a multivibrator IC when a voltage is applied to the terminal.
Quiescent supply current	I_{CC}	The current that flows into an IC via the V_{CC} terminal when the V_{CC} or ground level is held constant without changing the input voltage.
	ΔI_{CC}	The current that flows into an IC via the V_{CC} terminal when V_{CC} - 0.6 V is applied to one input terminal.
	I_{CCT}	The current that flows into an IC with TTL-level input via the V_{CC} terminal when a TTL-level voltage is applied to one input terminal.
Active-state supply current (per circuit)	$I_{CC(opr)}$	The average current that flows in the no-load condition between the power supply and ground terminals due to an internal circuit operation.
On-resistance	R_{ON}	The resistance between the input and the output of an analog switch, multiplexer or demultiplexer IC in the switch-on state.
Difference of on-resistance between switches	ΔR_{ON}	The difference in on-resistance between different input-output pairs of an analog switch, multiplexer or demultiplexer IC.

Parameter	Symbol	Definition
Minimum pulse width	$t_{w(H)}$ $t_{w(L)}$	The minimum pulse width that is accepted at a clock input, etc. as a normal pulse.
Minimum setup time	t_S	The time interval during which data must be stable before the associated input (e.g., clock) changes. For example, when data is latched on the rising edge of a clock pulse, it is necessary to apply data at least t_S before the rising edge of the clock.
Minimum hold time	t_h	The time interval during which data must be stable after the active transition of the associated input (e.g., clock).
Minimum removal time	t_{rem}	The minimum time between the release of an asynchronous input (e.g., Clear, Preset) and the application of the next input (e.g., clock).
Minimum retrigger time	t_{rr}	The minimum time necessary for a multivibrator IC to accept the next trigger signal after having received one.
Output transition time	t_{TLH} t_{THL}	The rise and fall times of the output voltage. t_{TLH} is the time from 10% to 90% when the output transitions from Low to High, and t_{THL} is the time from 90% to 10% when the output transitions from High to Low. 

Parameter	Symbol	Definition
Propagation delay time	t_{PLH} t_{PHL}	The delay time between the application of an input signal and an output response. t_{PLH} is defined as the time required for an output to transition from Low to High, and t_{PHL} is defined as the time required for an output to transition from High to Low. HC / VHC series  HCT series  VHCT series 

Parameter	Symbol	Definition
Output enable time Output disable time	t_{PLZ} t_{PHZ} t_{PZL} t_{PZH}	The output enable time is defined as the delay time required for a three-state terminal to be driven High or Low after the output control terminal is set to an inactive level. The output disable time is defined as the delay time required for an output terminal to assume the high-impedance state after the output control signal is set to an active level. HC / VHC series  HCT series  VHCT series 

Parameter	Symbol	Definition
Propagation delay time	Δt_{PD}	For counters ICs, the delay time defined for an IC from when the Qn output is inverted to when the next output (Qn+1) is inverted.
Output pulse width	t_{wOUT}	For multivibrator ICs, the width of the output pulse generated when a prescribed external component is connected and a prescribed voltage is applied.
Output pulse width error between circuits (in same package)	Δt_{wOUT}	For multivibrator ICs, a difference in output pulse width between two circuits in the same package.
Output skew	tosLH tosHL tosZL	Differences in propagation delay time among output terminals when some outputs in the same package change from the Low level to the High level, from the High level to the Low level, or from the high-impedance state to the Low level.
Phase difference between input and output	$\varphi_{I/O}$	For analog switch, multiplexer and demultiplexer ICs, the delay time from the input to the output when a signal is applied to the input in the switch-on state.
Clock frequency	f	The clock frequency at which an IC operates.
Maximum clock frequency	f_{MAX}	The maximum clock frequency at which the IC operates normally.
Maximum frequency response Phase difference between input and output	$f_{MAX(I/O)}$ f_{MAX}	For analog switch, multiplexer and demultiplexer ICs, the maximum input frequency that the signal can transmit to the output in the switch-on state.
Input capacitance	C_{IN}	The capacitance between the input and ground terminals.
Control input capacitance	C_{IN}	For analog switch, multiplexer and demultiplexer ICs, the capacitance between the control input and ground terminals.
Common terminal capacitance	C_{IS}	For analog switch, multiplexer and demultiplexer ICs, the capacitance between the common and ground terminals in the off state.
Switch terminal capacitance	C_{OS}	For analog switch, multiplexer and demultiplexer ICs, the capacitance between the switch and ground terminals in the off state.

Parameter	Symbol	Definition
Feedthrough capacitance	C_{IOS}	For analog switch, multiplexer and demultiplexer ICs, the capacitance between the switch and common terminals in off state.
Bus I/O capacitance	$C_{I/O}$	The capacitance between the bus and ground terminals.
Power dissipation capacitance	C_{PD}	The equivalent internal capacitance of a device calculated by measuring the operating current in the no-load condition.
Output capacitance	C_{OUT}	The capacitance between the output and ground terminals for a three-state or open-drain output in the high-impedance state.
Sine Wave Distortion	THD	For analog switch, multiplexer and demultiplexer ICs, the distortion rate of the sine wave that is output when a sine wave is input in the on state.
Feed-through attenuation (switch off)	FTH	For analog switch, multiplexer and demultiplexer ICs, the ratio of the leakage voltage that appears at the output to the input voltage applied in the off state
Crosstalk (control input to signal output)	X_{talk}	For analog switch, multiplexer and demultiplexer ICs, the leakage voltage of a signal to the input and output that occurs when the control input changes.
Crosstalk (between any switches)	X_{talk}	For analog switch, multiplexer and demultiplexer ICs, the ratio of the voltage applied to a switch (port) in the on state to the voltage that appears at a switch (port) in the off state
Quiet output maximum dynamic VOL	V_{OLP}	The maximum peak voltage induced into an output that is fixed at the Low level when the other outputs are switching simultaneously.
Quiet output minimum dynamic VOL	V_{OLV} $\lvert V_{OLV} \rvert$	The minimum peak voltage induced into an output that is fixed at the Low level when the other outputs are switching simultaneously.
Quiet output minimum dynamic VOH	V_{OHV}	The minimum peak voltage induced into an output that is fixed at the High level when the other outputs are switching simultaneously.
Minimum high-level dynamic input voltage	V_{IHD}	High-level dynamic threshold voltage when all inputs are switching simultaneously
Maximum low-level dynamic input voltage	V_{ILD}	Low-level dynamic threshold voltage when all inputs are switching simultaneously.

4. Built-in Functions

Parameter	Definition
Input tolerant function	A function designed to prevent a current from flowing from an input to the power supply when the input voltage is higher than the power supply voltage or when V_{CC} = 0 V.
Output tolerant function	A function designed to prevent a current from flowing from an output to the power supply when the output is in the high-impedance state or when V_{CC}= 0 V.
Power-down protection	A function designed to prevent a current from flowing to the power supply terminal even if a voltage is applied to the input and output terminals when V_{CC}= 0 V.
Bus hold function	A function designed to hold the input logic level using a latch circuit even when the input terminal becomes open.

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