

Introduction

This application note describes the requirements for a differential interface being referenced to the V_{IH} (Input High Voltage) of an input signal.

Advantages of a Differential Interface

- It offers a wide range of input signaling standards and works with a wide range of input offset voltage.
- Greater immunity to common mode noise. Has tolerance to ground offsets or noise.
- Suitability for use with a low voltage application.
- Less power and substrate noise during signal transition. Current switching much less than single ended interface.
- Reduced EMI due to the cancellation in differential traces.

Requirements of Differential Interface

The input requirement for a differential interface is different from the requirement for a single ended interface. In a single ended interface such as LVCMOS, LVTTTL, single-ended HSTL or single-ended PECL/ECL, the V_{OH} and V_{OL} must meet the V_{IH} and V_{IL} requirements of the receivers. In the differential interface, such as LVPECL, HSTL, HCSL, CML, LVDS, or SSTL, the V_{IH} and V_{IL} are no longer referenced. The input parameters V_{PP} and V_{CMR} are now the requirements. Only V_{SWING} and the V_{OH} of the incoming signal are required to meet both V_{PP} and V_{CMR} .

$$V_{PP} < V_{SWING} < V_{PP_MAX}$$

$$V_{CMR_MIN} < V_{OH} < V_{CMR_MAX}$$

V_{PP} = Input peak-to-peak voltage requirement

V_{CMR} = Input Common Mode Range Voltage requirement

V_{SWING} = Driver output swing

V_{OH} = Driver output logic high

Figure 1 shows the relationship between V_{SWING} , V_{OH} and V_{PP} , V_{CMR} . The following conditions must be met for a valid input signal: V_{SWING} must be within the required range of the specified V_{PP} and the V_{OH} must be within the V_{CMR} range.

Figure 1. Relationship between Interface Parameters

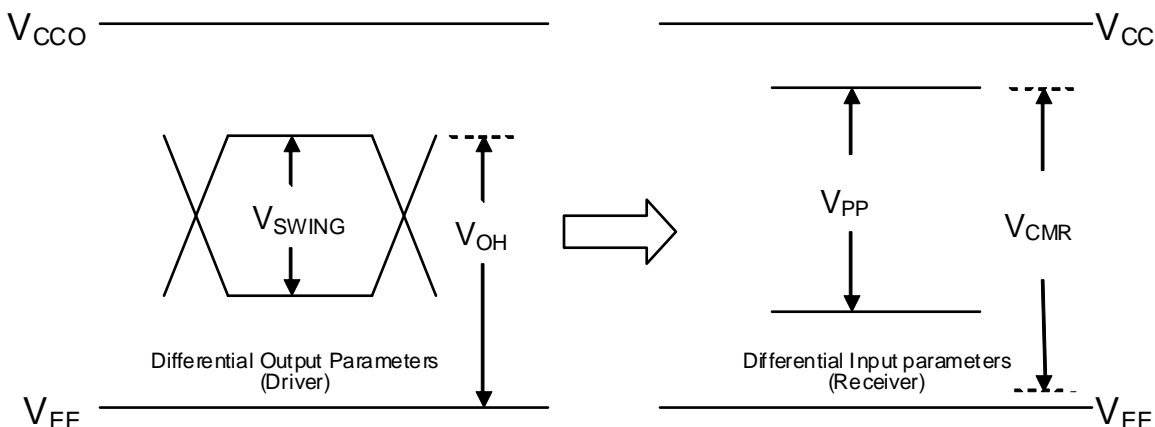


Figure 2. Typical Datasheet for VCMR and VPP

Symbol	Parameter	Minimum	Typical	Maximum	Units
V_{PP}	Peak-to-Peak Input Voltage	0.15		1.3	V
V_{CMR}	Common Mode Input Voltage	$V_{EE} + 0.5$		$V_{CC} - 0.85$	V

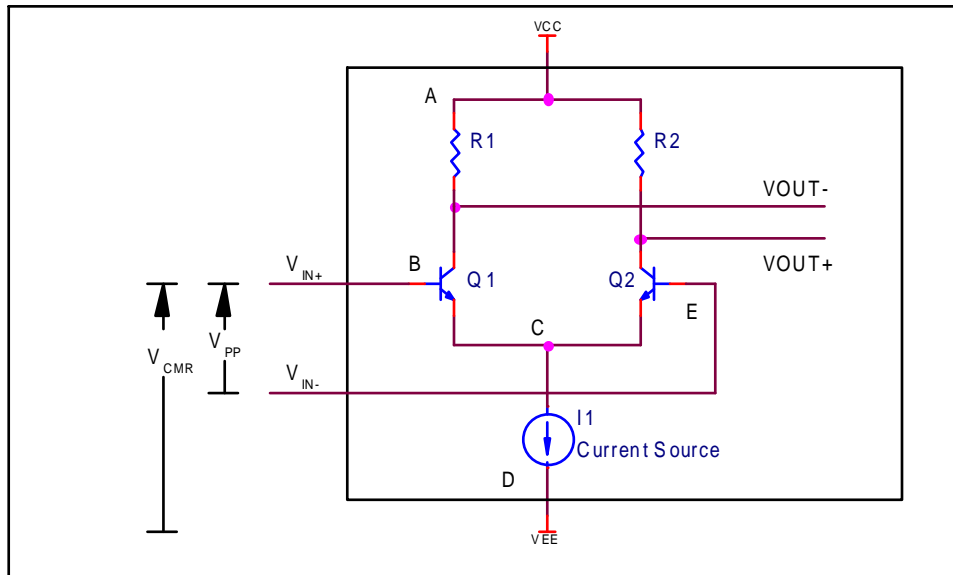
Example

Figure 2 shows a typical datasheet specification for both V_{PP} and V_{CMR} . As an example, let's use an input driver with an amplitude (V_{SWING}) of 200mV and a V_{OH} level at 2V. Will this work? First, the V_{SWING} should be verified that it is within the V_{PP} specification. Yes, 200mV falls between 0.15V and 1.3V. Second, the V_{OH} of the signal must fall within the V_{CMR} range. Assuming the V_{CC} is 3.3V and V_{EE} is 0V, the V_{CMR} range will be 0.5V and 2.45V. Again, 2V fall within the V_{CMR} range. Both of the conditions are met. This is a valid input. Though not specified, it is not recommended that the V_{IL} goes below V_{EE} . This could happen with the V_{PP} at 1.3V and the V_{IH} at $V_{EE}+0.5$. That would put the V_{IL} at 800mV below V_{EE} .

Limitations of VCMR and VPP

This section will describe the limitation of both V_{CMR} and v from a circuit perspective. When V_{CMR} is referenced to V_{IH} , the analysis is purely DC. Some inputs also reference V_{CMR} to the input signals cross-point. This would be a similar except it would be an AC analysis.

Figure 3. Simplified Typical Differential Input Interface Circuit



For the following analysis, refer to Figure 3. In determining V_{PP} , both $V_{PP(min)}$ and $V_{PP(max)}$ specification must be examined. For both cases, V_{IN+} is greater than V_{IN-} , where V_{IN+} is a logic high and V_{IN-} is a logic low.

- $V_{PP(min)}$ is determined by the minimum voltage difference required to correctly operate the differential amplifier by keeping the Q1 transistor on and Q2 off.
- $V_{PP(max)}$ is determined by the maximum voltage swing allowable which will not forward bias either Q1 or Q2.

Similar to V_{PP} , both $V_{CMR(max)}$ and $V_{CMR(min)}$ must be examined.

- $V_{CMR(min)}$ is determined by the minimum V_{CD} required to keep the constant current source I1 function properly.
- $V_{CMR(max)}$ is determined by the minimum V_{AB} required to prevent the forward biasing of Q1.

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