

We strongly recommended that level shifters be used on all power domain interfaces where an up shift is required, since this prevents crowbar currents and improves edge rates and therefore timing.

In general, we recommend that level shifters be used on all power domain interfaces where a down shift is required. It is safe to overdrive the input in the lower voltage domain. However, the timing characteristics of the destination cell will assume a correctly driven input signal operating at the same voltages the output driver of the cell. There will be an error in calculating the delay if a level shifter is not used.

Thus, we recommend **-rule both**.

The placement of the level shifters is important. The output driver for a level shifter requires more supply current than the input stage. For this reason, we recommend placing the level shifter in the destination domain – the domain that the level shifter output drives. This assures a high quality power connection to the output stage of the level shifter cell.

There are two ways to do this with the **set\_level\_shifter** command. We can say:

**applies\_to inputs**  
**-location self**

Or we can say:

**applies\_to outputs**  
**-location fanout**

There is no general, ironclad rule to prescribe the difference in voltage levels above which level shifters are required. This decision is technology and library dependent.

In certain cases, when the voltage difference between the two power domains is less than the threshold voltage then level shifters are not strictly required. However, when making this decision, the tolerance of the power supplies should be considered. It may be the case that when both power domains are being powered by ideal supplies that the voltage difference is tolerable, however when worst case variation between the power supplies is considered, the difference may be too great and level shifting required.

Using the default **-threshold** of 0V is a safe initial value. If timing across critical interfaces becomes a problem, we can revisit this issue and specify a different value.

In any case, we do need to specify unambiguously which power domains are at what voltage level, so the tools know where to insert level shifters. The UPF power state



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