# NON-INTERLEAVING CASES WITH UCC28061 & UCC28063

# Light-load and High-Line Conditions

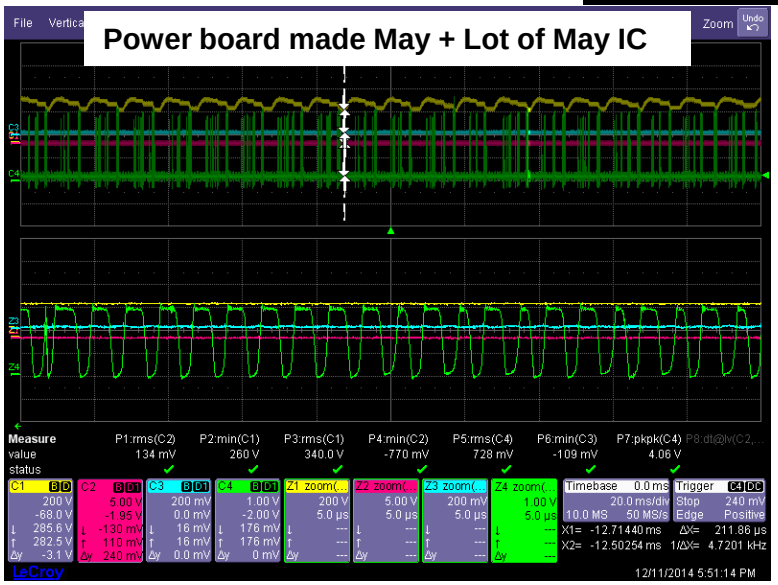
Often at high input line voltage and light output load, the PFC phases do not behave the same from one board to the next.

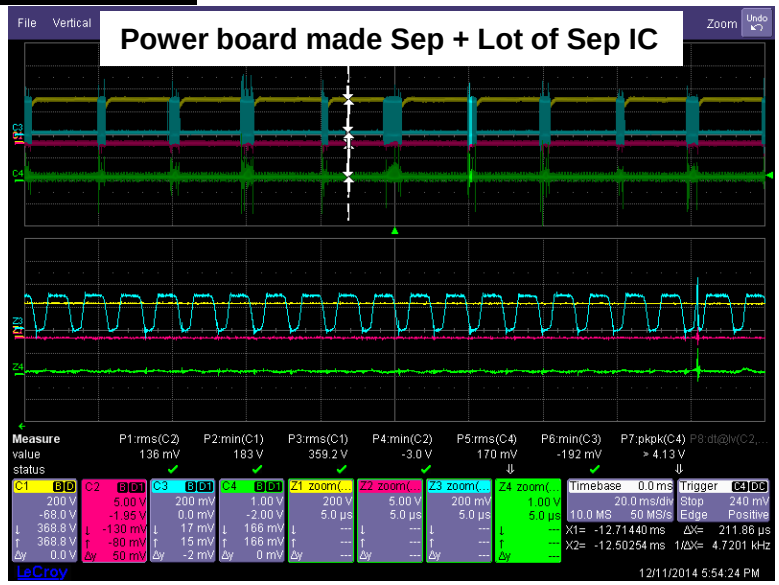
- Sometimes Phase-A and Phase-B do not operate at the same time.
- Sometimes Phase-A operates only, no Phase-B
- Sometimes Phase-B operates only, no Phase-A

This is normal operation when the COMP voltage is near 0.125V.
The following slides will explain why.

# Waveforms from board comparison

*Ch1 : Bridge Diode(+)(-)전압*
*Ch3 : PhaseA ZCDA*
*Ch4 : PhaseB ZCDB*



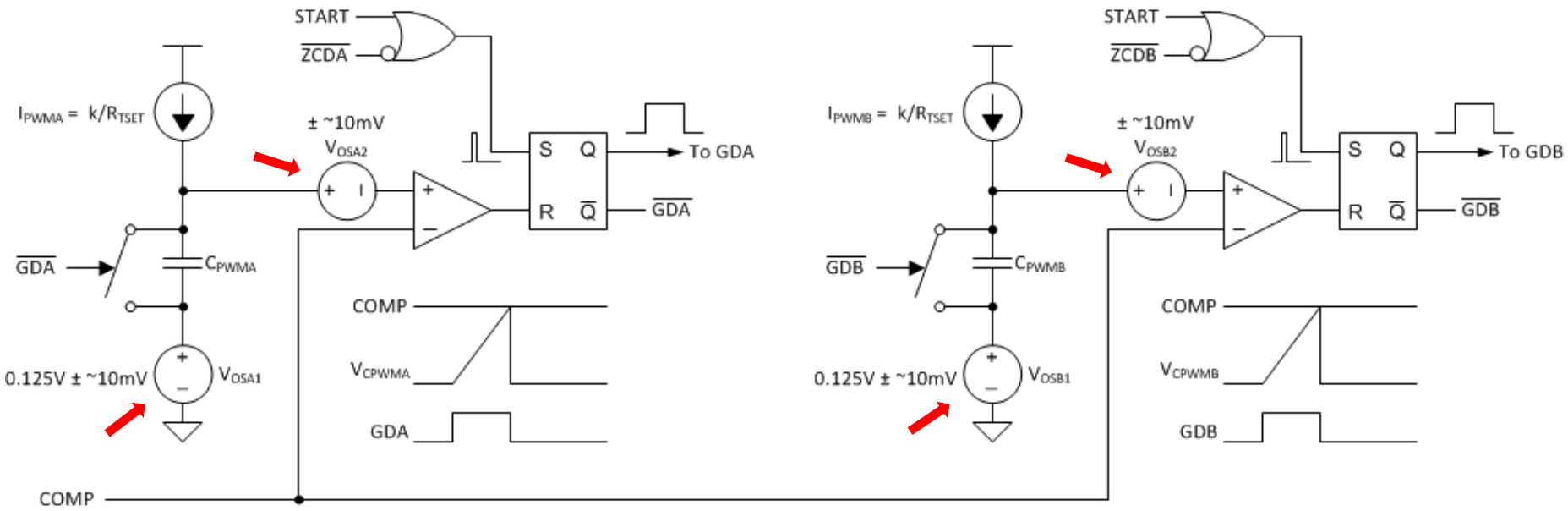




Here Phase-B (green) is switching, but no Phase-A (blue).

Here Phase-A (blue) is switching, but no Phase-B (green).

This is normal operation.

# PWM circuits for Ph-A and Ph-B

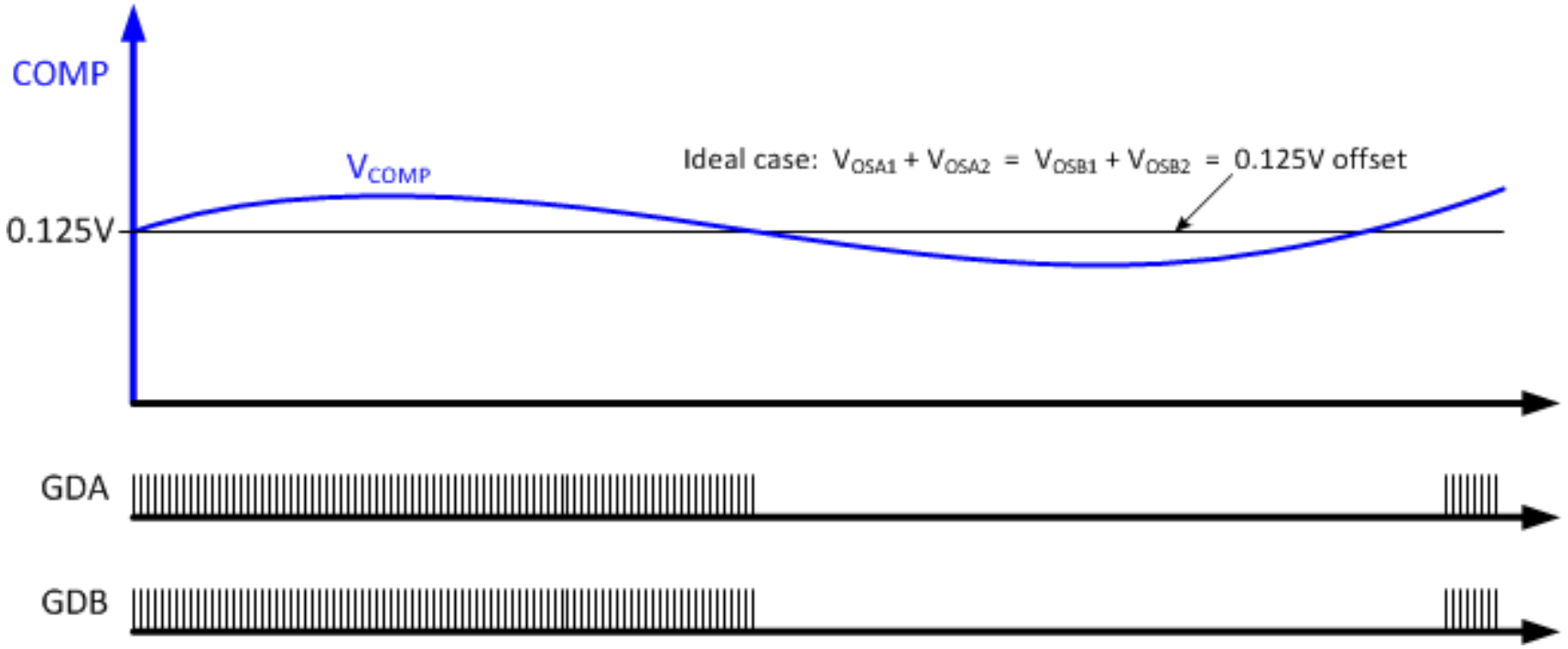



Phase-A and Phase-B have the same PWM generator circuits, but each has separate offset voltages at the ramp capacitor and the comparator.

These offset voltages can go in different directions from IC to IC.
Example:

in May IC-1, $V_{OSA2} > V_{OSB2}$, in May IC-2, $V_{OSA2} < V_{OSB2}$
in Sep IC-3, $V_{OSA2} < V_{OSB2}$ in Sep IC-4, $V_{OSA2} > V_{OSB2}$

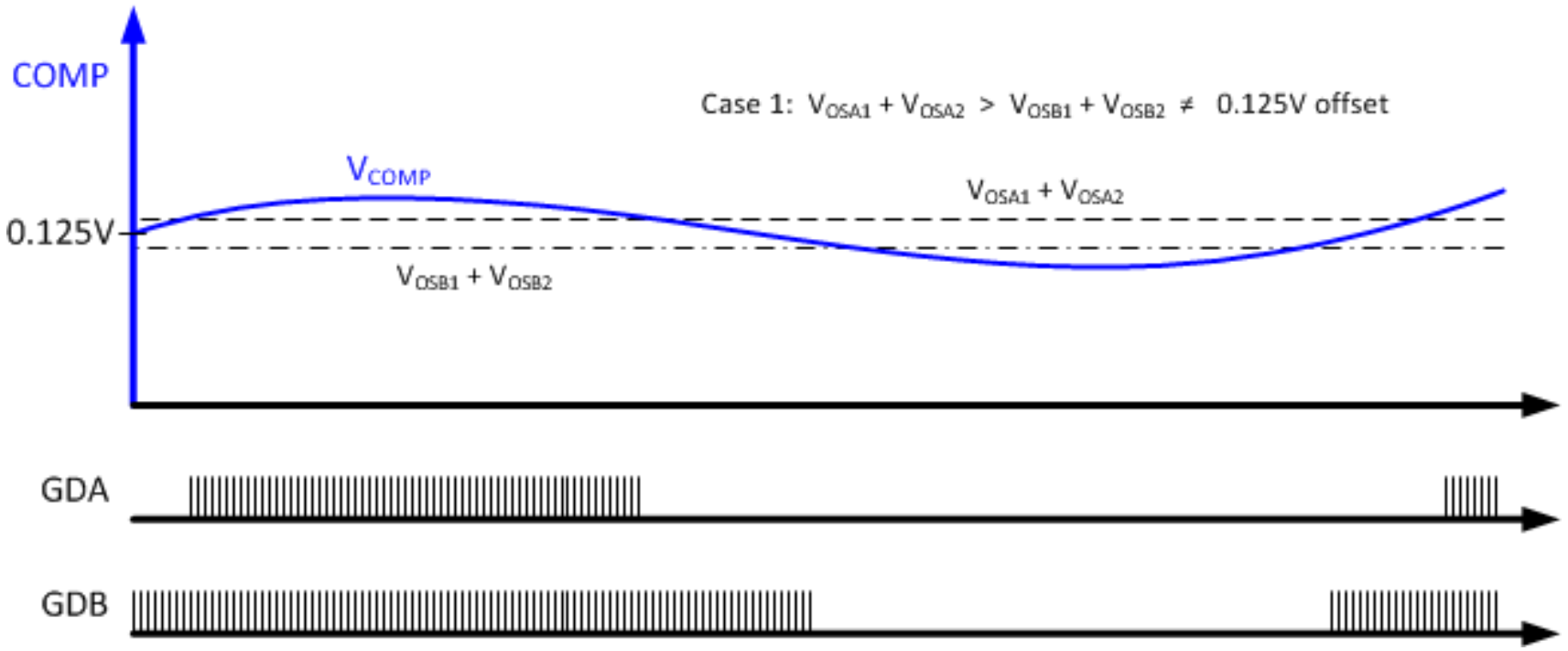
# Ideal Case with no Offset Voltages




On-time of PWM: $T_{ON} = K_T(COMP - 0.125V)$
Even at very light load, COMP has some ripple voltage on it.
At high-line, COMP is very close to the 0.125V offset.

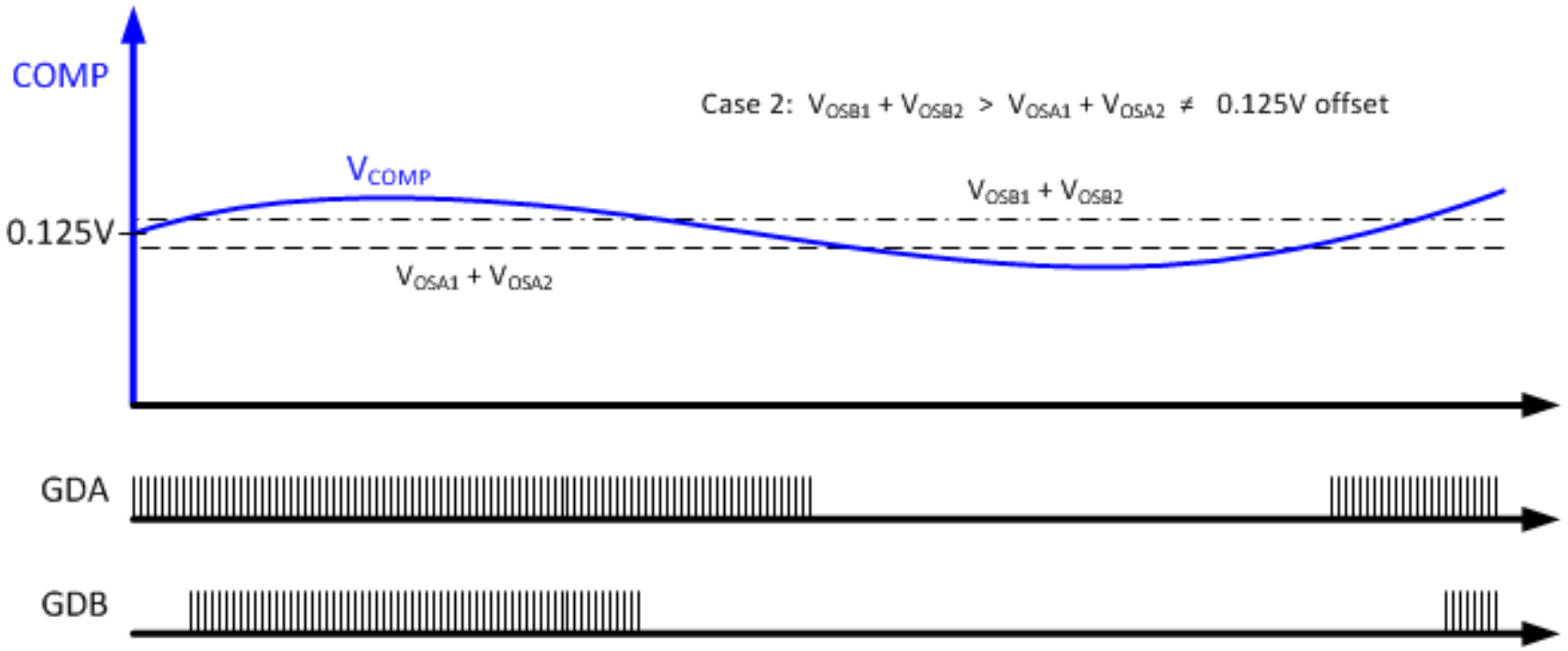
Ideal operation = Phase-A and Phase-B interleaving when COMP > 0.125V.

# Case 1 with Offset Voltages



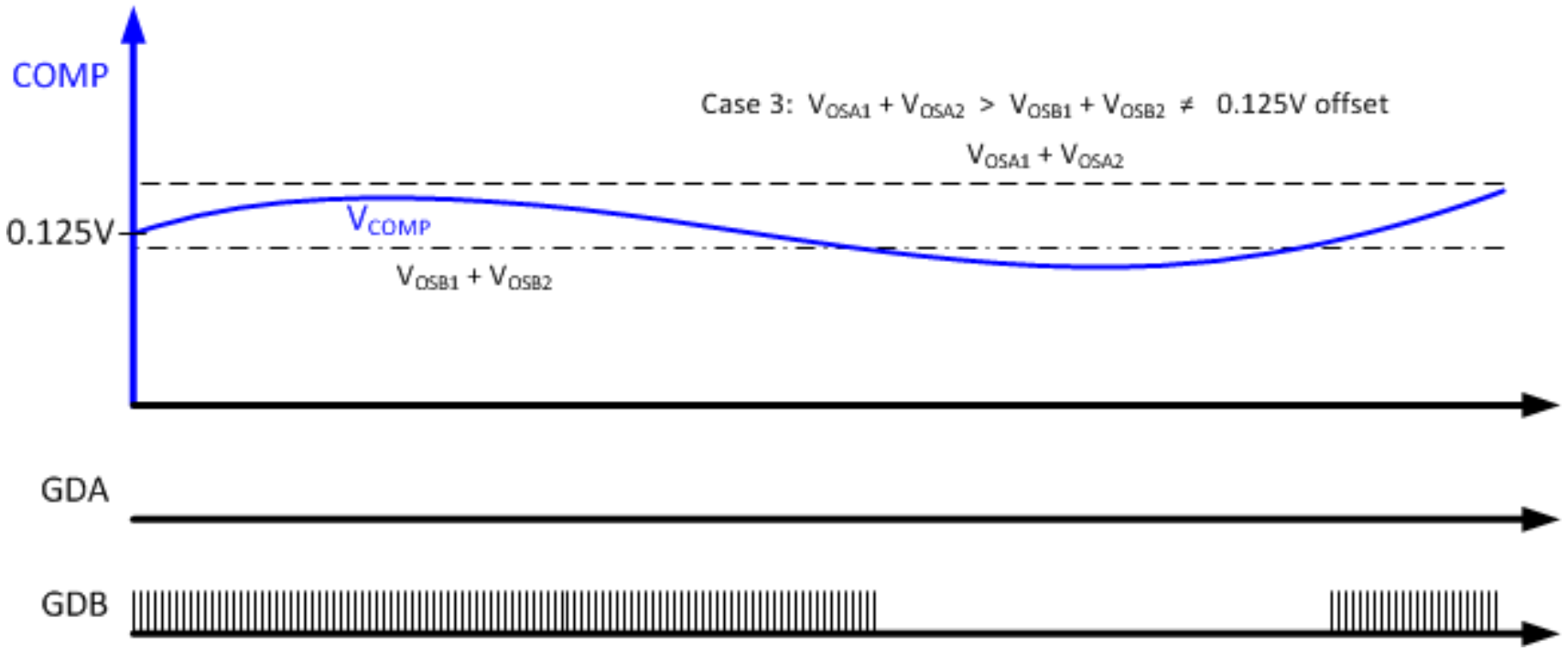

On-time of PWM: $T_{ON} = K_T(COMP - 0.125V)$
Phase-A offsets are higher than Phase-B offsets.
COMP is higher than Phase-B offsets more than Phase-A offsets,
so Phase-B switches more than Phase-A.

# Case 2 with Offset Voltages



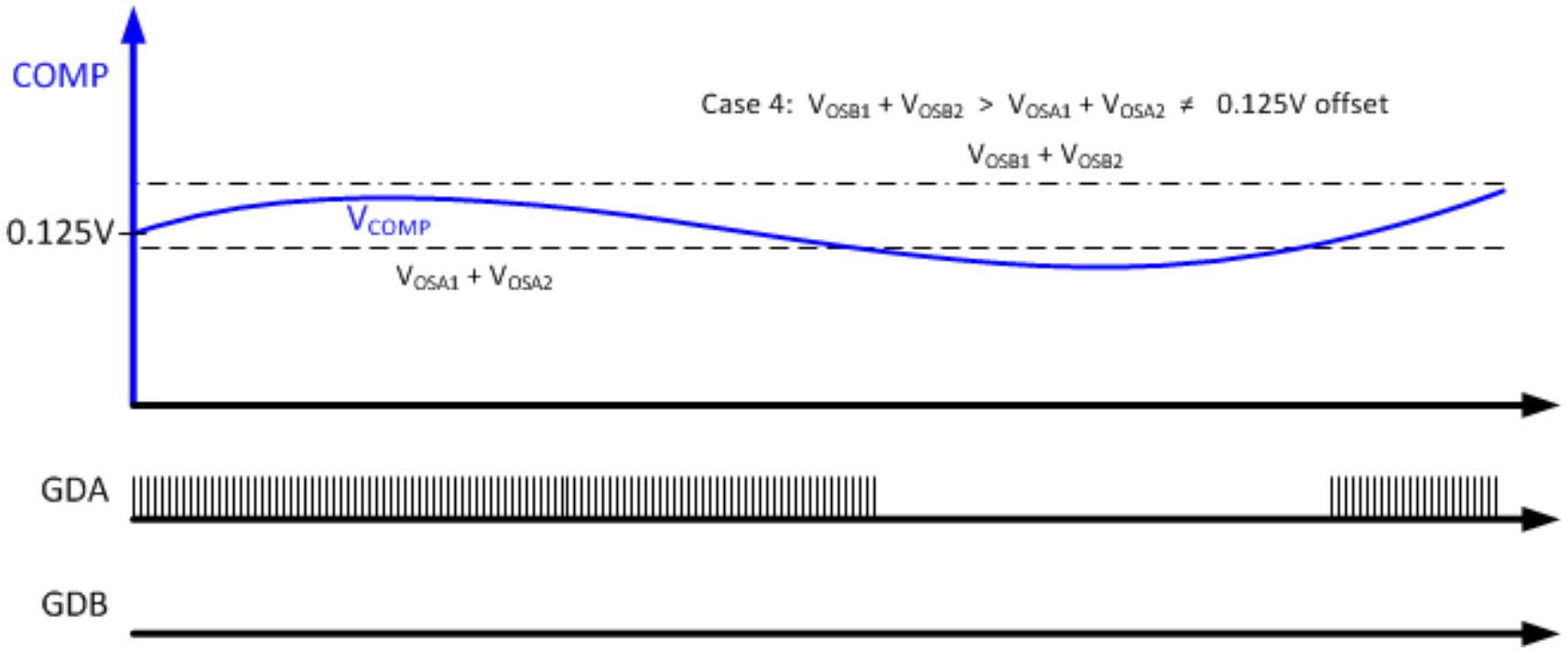

On-time of PWM: $T_{ON} = K_T(COMP - 0.125V)$
Phase-B offsets are higher than Phase-A offsets.
COMP is higher than Phase-A offsets more than Phase-B offsets,
so Phase-A switches more than Phase-B.

# Case 3 with Offset Voltages



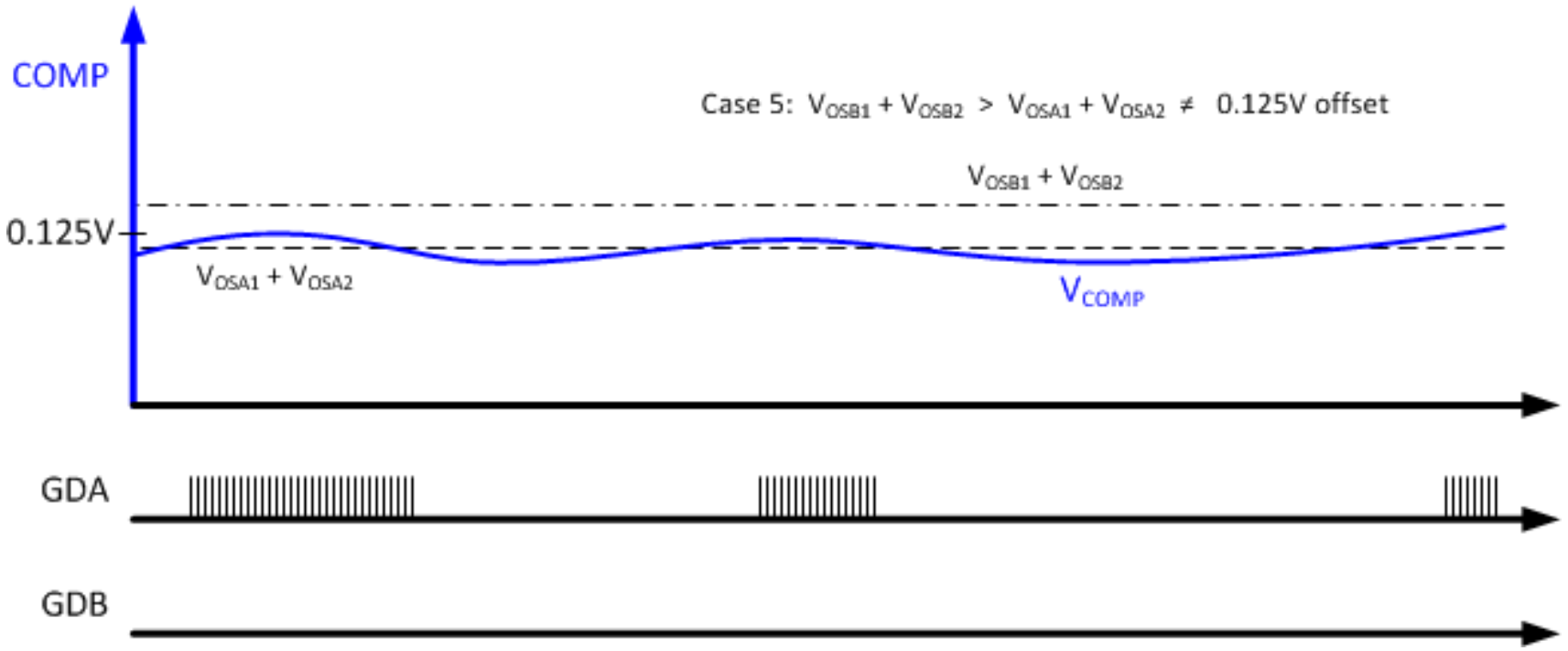

On-time of PWM: $T_{ON} = K_T(COMP - 0.125V)$
Phase-A offsets are much higher than Phase-B offsets.
COMP is higher than Phase-B offsets but always lower than Phase-A offsets, so Phase-B switches part of the time, but Phase-A does not switch.

# Case 4 with Offset Voltages




On-time of PWM: $T_{ON} = K_T(COMP - 0.125V)$
Phase-B offsets are much higher than Phase-A offsets.
COMP is higher than Phase-A offsets but always lower than Phase-B offsets, so Phase-A switches part of the time, but Phase-B does not switch.

# Case 5 with Offset Voltages




On-time of PWM: $T_{ON} = K_T(COMP - 0.125V)$
Phase-B offsets are much higher than Phase-A offsets.
COMP has irregular ripple voltage, but always lower than Phase-B offsets, so Phase-A switches part of the time, but Phase-B does not switch.

# Conclusion

- Under the conditions of high-line and light-load, it is normal that Phase-A and Phase-B may switch at different intervals, or one phase may not switch at all.
- Because the internal offset voltages have variations, the phase that is not switching may be different from part to part and board to board.
- Temperature changes may change the offset voltages and so also change the intervals when each phase is switching.