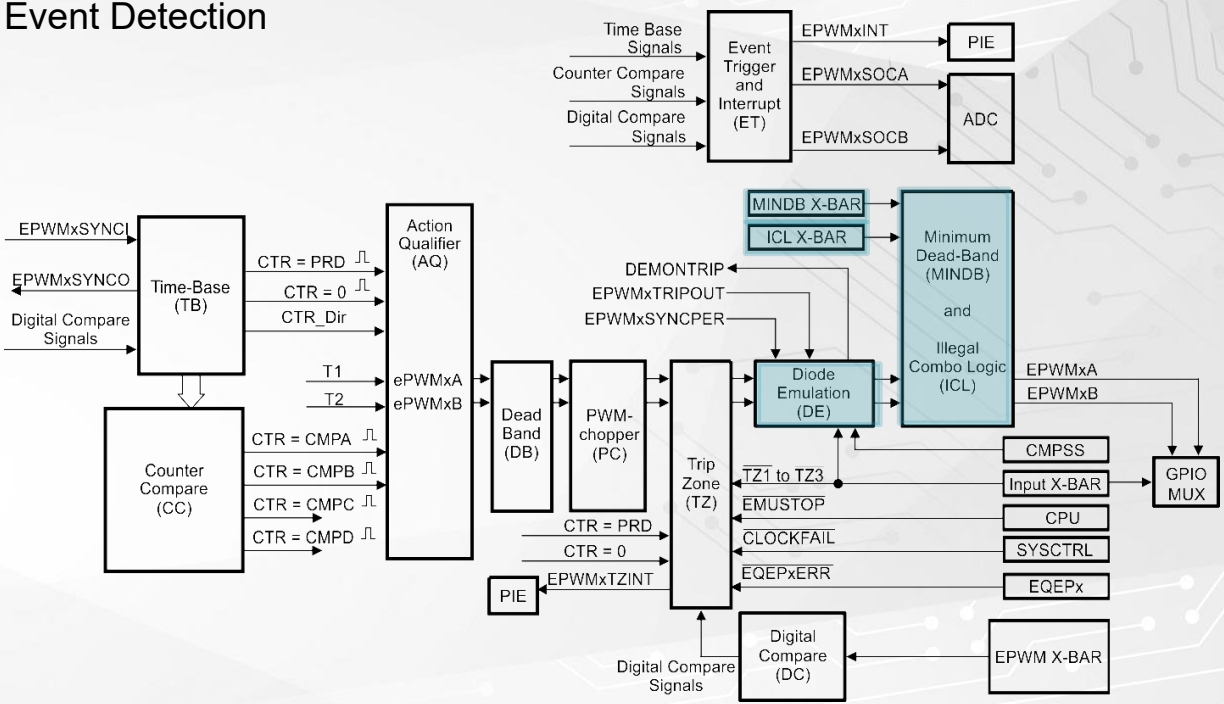
ePWM Type-5

C2000 Enhanced Pulse Width Modulator (ePWM) Series

Type-5 Feature Set

- XCMP Complex Waveform Generator Mode
- Diode Emulation Submodule
- Minimum Dead-Band & Illegal Combo Logic Submodule
- Digital Compare – Event Detection



XCMP Complex Waveform Generator Mode: Overview

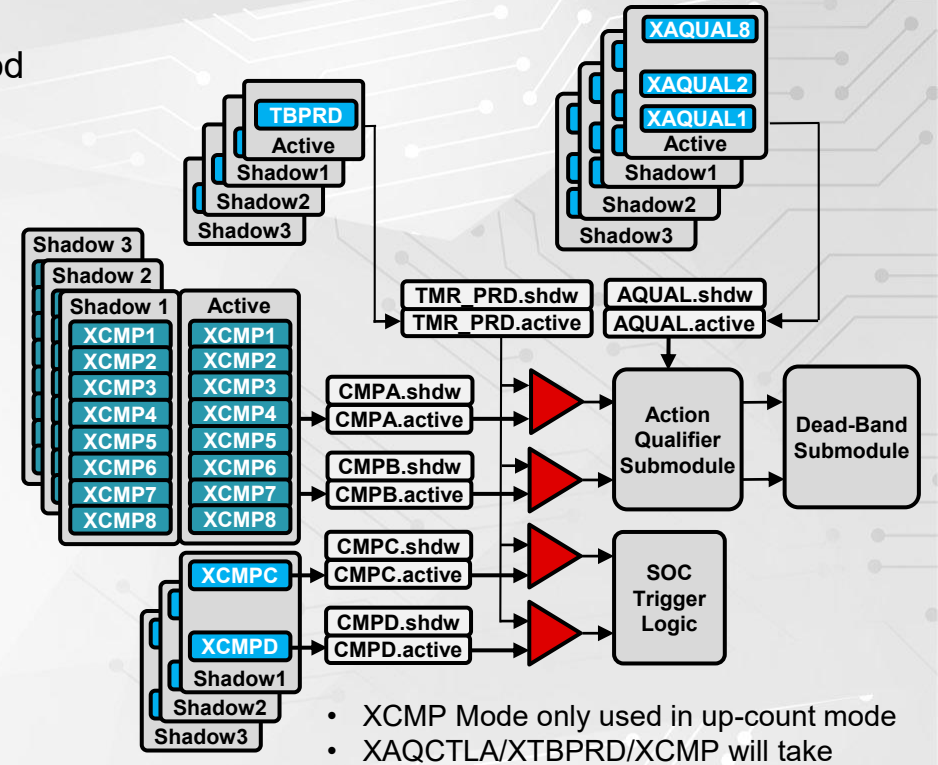
➡ Generate up to four pulses within one EPWM period

Benefits:

- ✓ Generate complex waveforms without the need of complex logic within code
- ✓ Useful for High Frequency Resonant Topologies

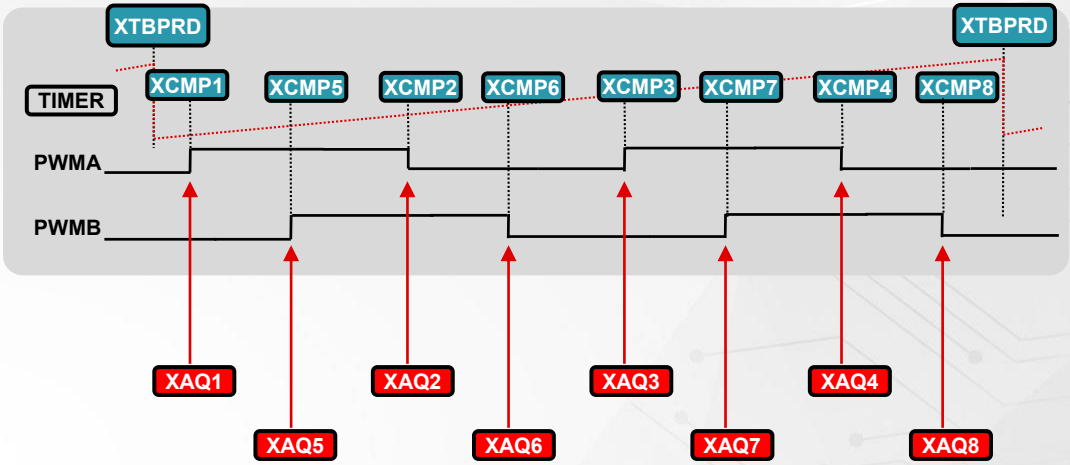
Highlights:

- 8 Comparator values (XCMP1-8)
- 3 sets of shadows for each XCMP value
  - Action qualifier event for each XCMP value, same shadow scheme
- 8 XCMP values can be allocated to CMPA or 4 to CMPA and 4 to CMPB
- XTBPRD, XCMPC, and XCMPD have 3 sets of shadows



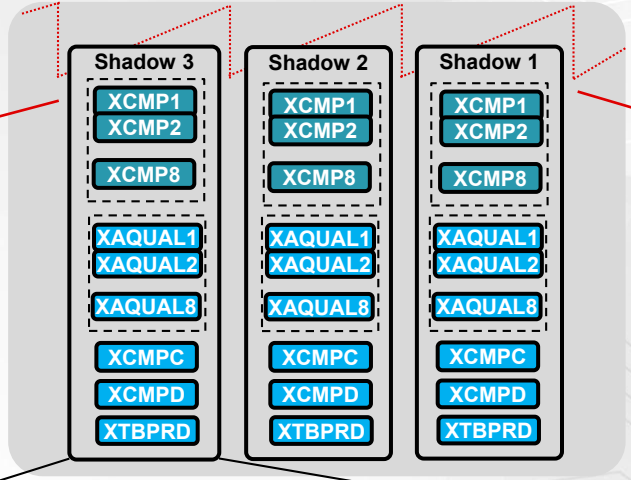
- XCMP Mode only used in up-count mode
- XAQCTLA/XTBPRD/XCMP will take affect through the AQCTLA/TBPRD/CMP registers

XCMP Complex Waveform Generator : Example



XCMP Complex Waveform Generator : Example

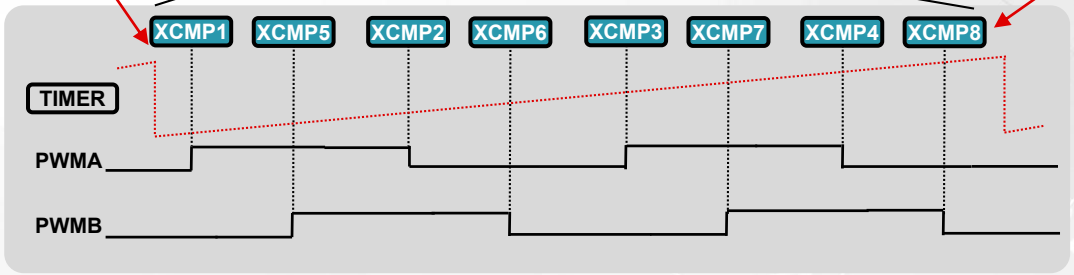
Shadow register set 3/2 can each repeat for up to a total of 8 times with different values
Shadow register set 1 cannot repeat
Ex. SHDW3, SHDW3, SHDW2, SHDW2, SHDW2, SHDW1



The number of shadow sets to use is configurable as well. (No shadow sets, one shadow set… up to 3 shadow sets)

Shadow sets get loaded when time base counter equals 0

All 8 or a subset of XCMP values can be used within one period



Diode Emulation (DE) Submodule : Overview

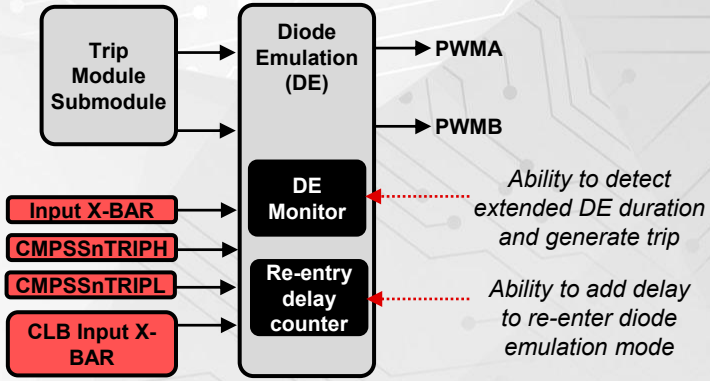
➡ Works in conjunction with CMPSS to drive outputs to trip state

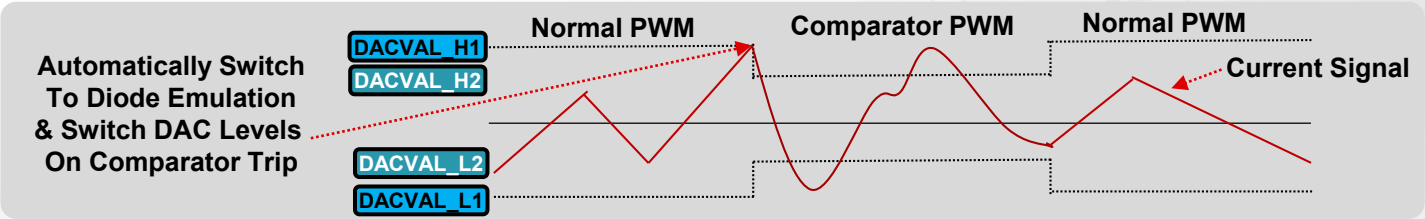
Benefits:

- ✓ Flexibility with handling digital and analog controls using the comparator submodule
- ✓ Detecting how long diode emulation mode is on

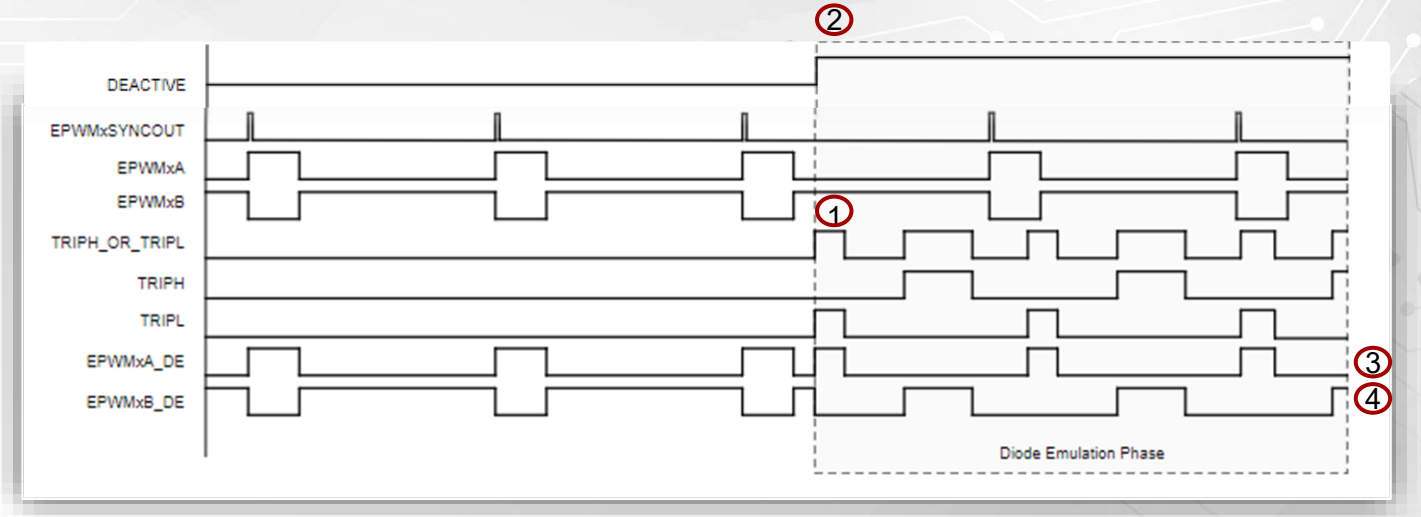
Functionality:

1. Trip Signal occurs from comparator or Input XBAR
2. Diode Emulation Mode is activated
3. Sets outputs to constant low, high, tripH, or tripL





Diode Emulation (DE) Submodule : Example



Operation:

① A trip is detected on the TRIPH_OR_TRIPL signal
② The trip detection causes diode emulation mode to take effect -> DE Mode is active
③ The output of EPWMA from the DE block is set to match the state of TripL during DE Mode
④ The output of EPWMB from the DE block is set to match the state of TripH during DE Mode

Minimum Dead-Band & Illegal Combo Logic: Overview

- Insert a configurable amount of minimum delay between EPWM modules
- Set output low or high if undesired output state across modules occurs

Benefits:

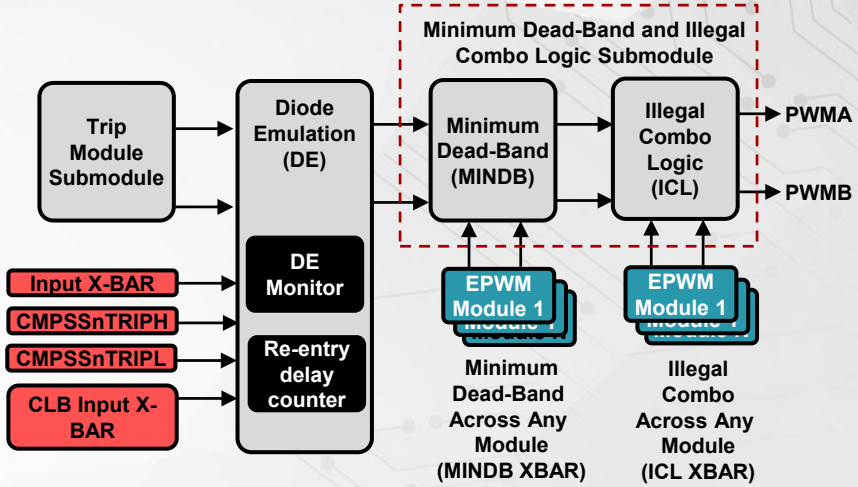
- ✓ Safety feature from power topology perspective to prevent short from supply to ground
- ✓ Prevent unwanted output combinations

Functionality (MINDB)

A blocking signal is generated to prevent both EPWM outputs switching at the same time

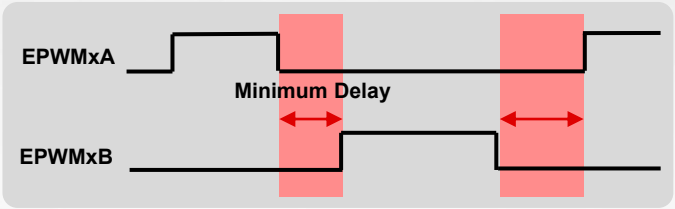
Functionality (ICL)

Logic table based on EPWM outputs is configured to setup “illegal” combos



Minimum Dead-Band & Illegal Combo Logic: Example

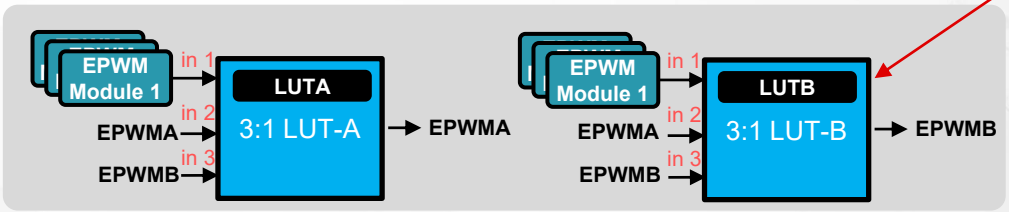
Minimum Dead-Band



Programmable delay (DelayA and Delay B in sysclk cycles) is added to ensure there is always a minimum amount of delay between outputs

Illegal Combo Logic

Based on the truth table, output of EPWMA/EPWMB are configured high or low



in 1	in 2	in 3	Output
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0

Digital Compare : Event Capture

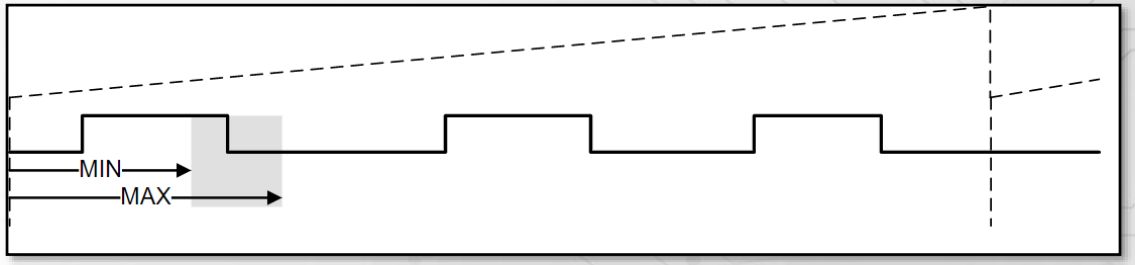
➡ Every PWM module will have this feature to detect a missing edge event in a configured time window

Benefit:

✓ Generate a trip or interrupt if edge is not detected

Functionality:

1. Define Min value
2. Define Max value
3. Select *CAPEVT* as trip or interrupt source



*Min and Max values are also shadowed (3 sets)

Other Enhancements

ePWM Submodule	Enhancement	Registers
Time-Base	Global load pulse selection for shadow to active load can occur when the time-base counter equals CMPCU, CMPCD, CMPDU, or CMPDD.	GLDCTL
Dead-Band	DBREDHR and DBFEDHR can be linked across modules.	DBFEDHR DBREDHR
Event-Trigger	Multiple events can trigger SOCA, SOCB, and INT events	ETINTMIX
Digital Compare	Pulse selection for blanking and capture alignment includes a blanking window mix selection	BLANKPULSEMIXSEL
Trip-Zone	ORed mux select of all TZ trips that can be routed to the EPWM and Output X-BARs as well as into the DE and MINDB+ICL submodules A CAPEVT signal can generate a CBC or One-shot trip event.	TZTRIPOUTSEL TZFLG

Additional ePWM Resources

- C2000 Academy with Hands-on Labs
- C2000 ePWM Developer's Guide
- TI Precision Labs: PWM Basics Overview
- TI Precision Labs: Motor Interfaces and PWM Frequencies
- ePWM Application Reports
  - Flexible PWMs Enable Multi-Axis Drives, Multi-Level Inverters
  - Using PWM Output as a Digital-to-Analog Converter
  - Using the ePWM Module for 0% - 100% Duty Cycle Control
  - Leverage New Type ePWM Features for Multiple Phase Control

Check Video Description for Additional Resources