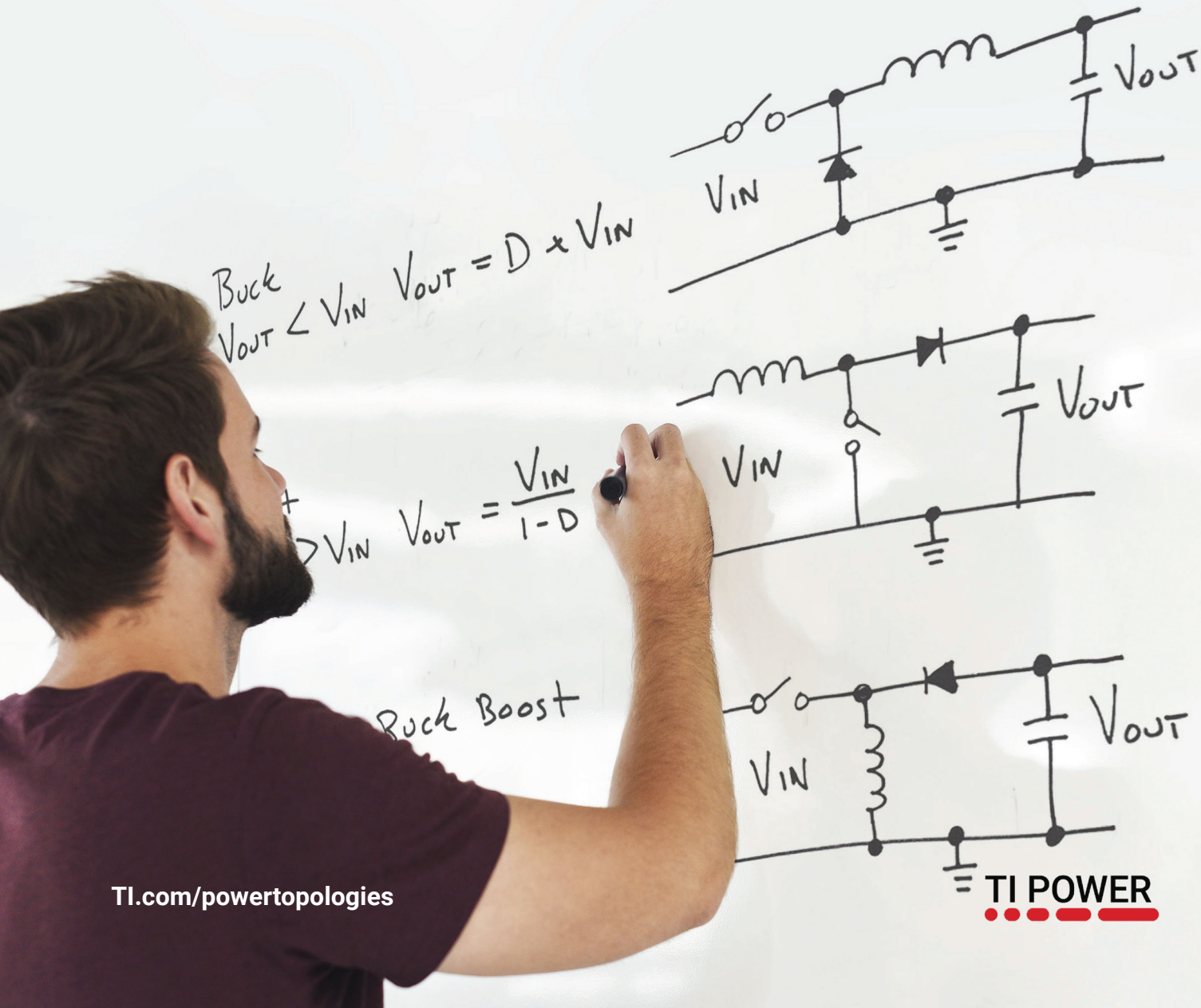
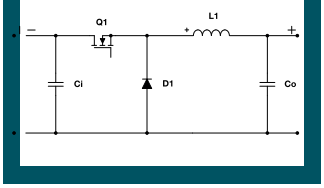
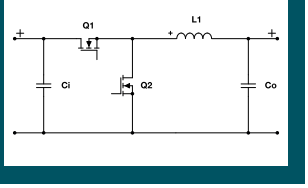
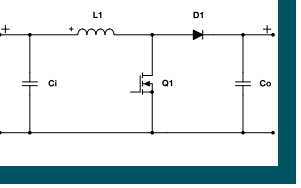
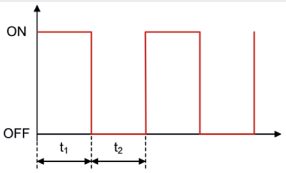
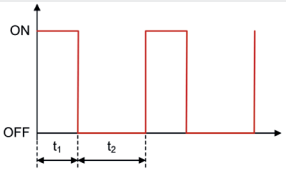
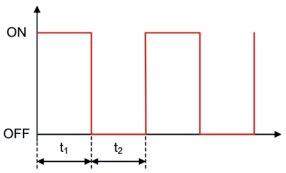
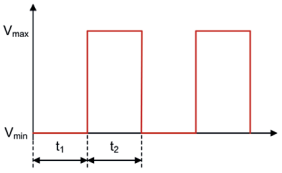
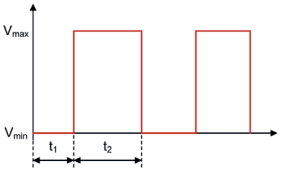
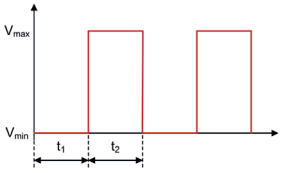
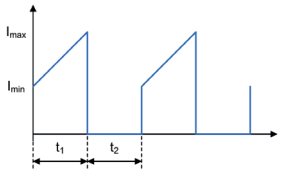
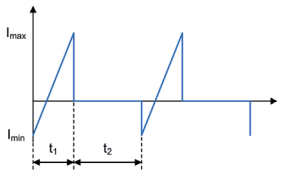
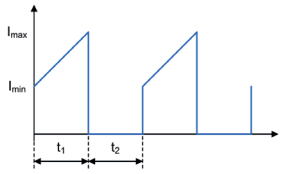
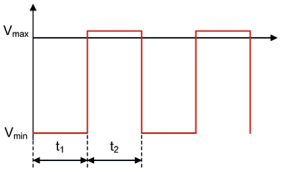
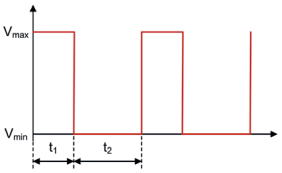
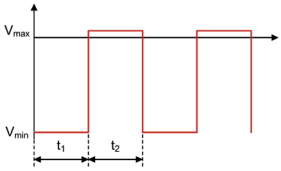
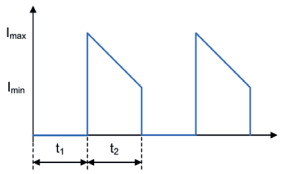
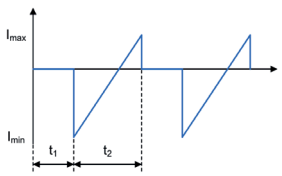
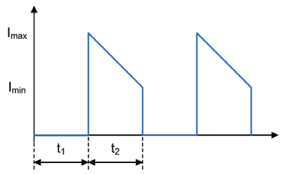
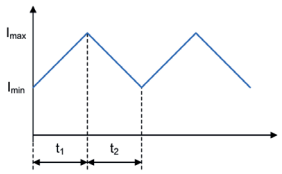
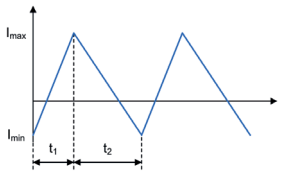
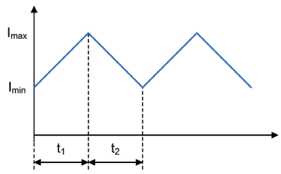
Power Topologies
Quick Reference Guide

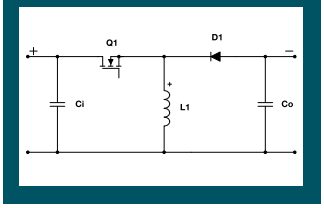
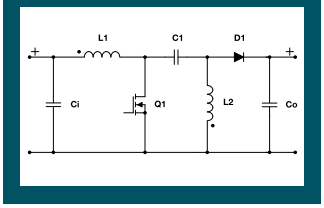
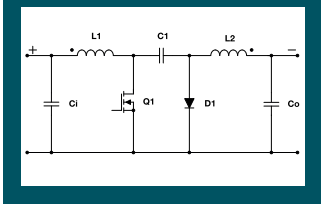
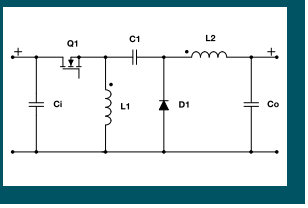
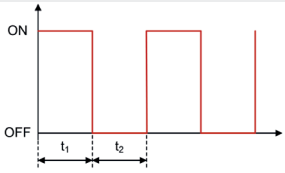
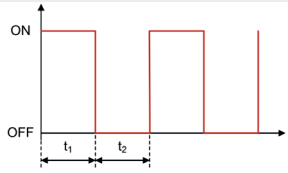
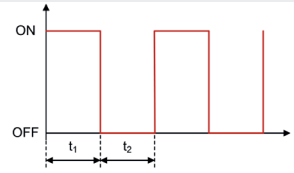
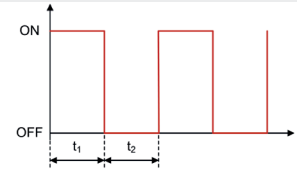
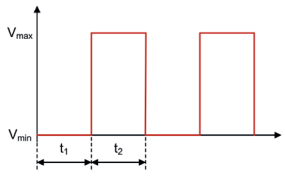
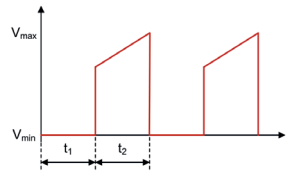
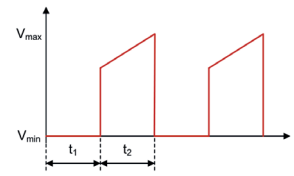
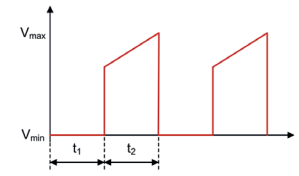
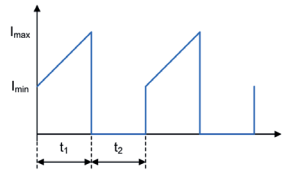
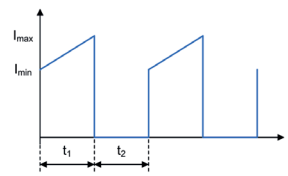
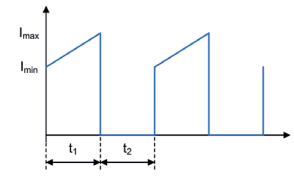
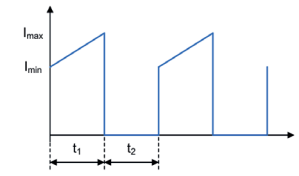
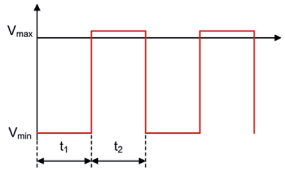
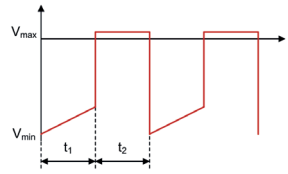
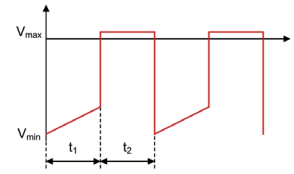
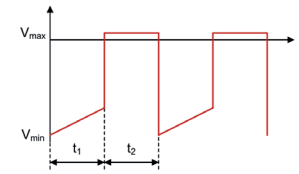
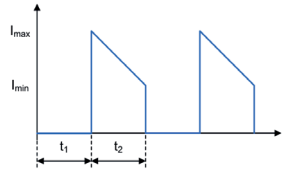
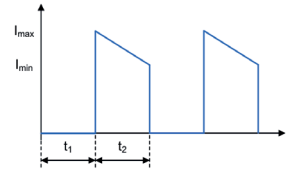
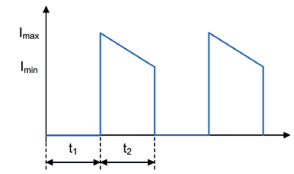
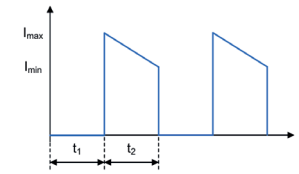
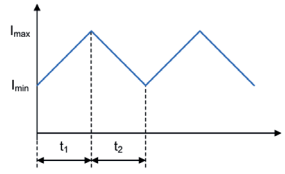
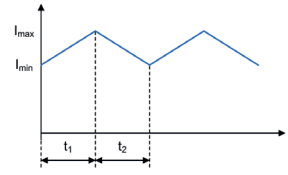
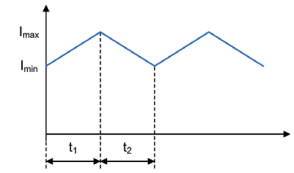
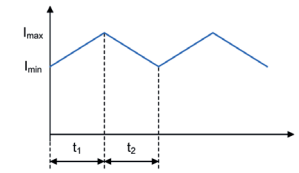
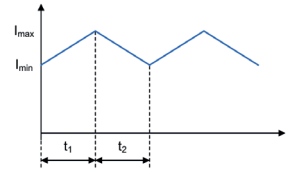
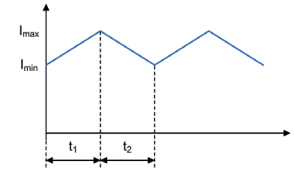
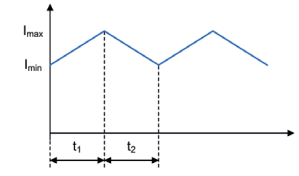
Texas Instruments

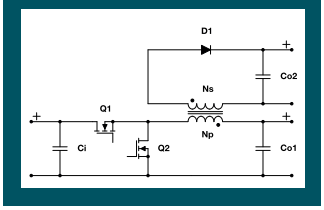
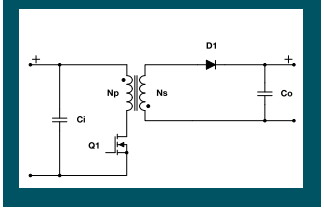
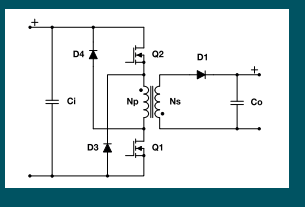
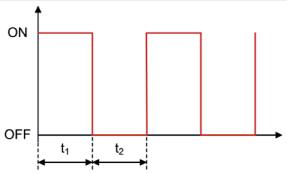
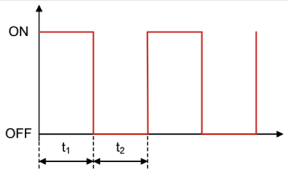
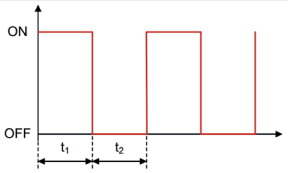
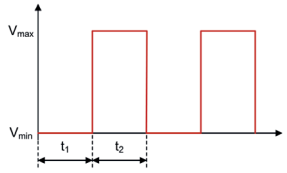
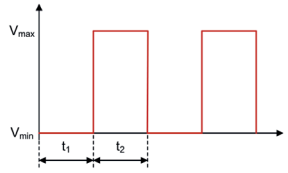
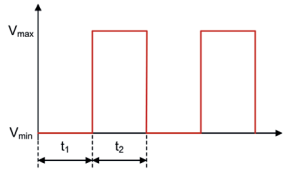
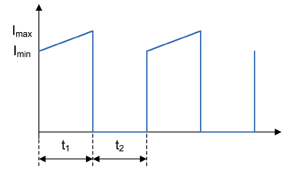
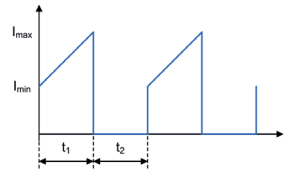
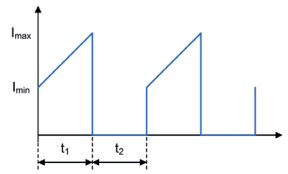
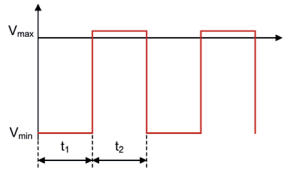
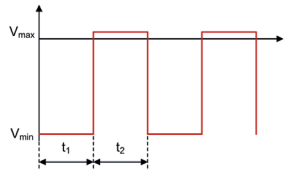
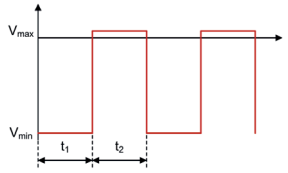
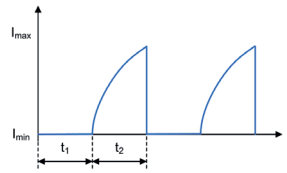
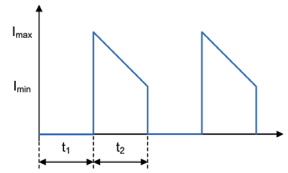
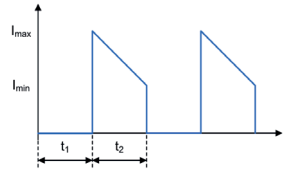
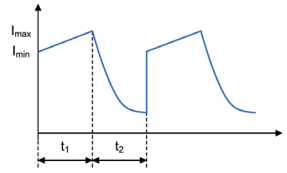
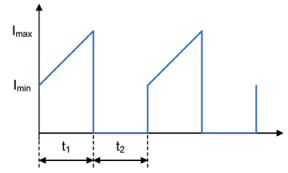
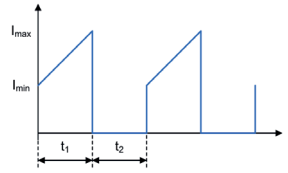
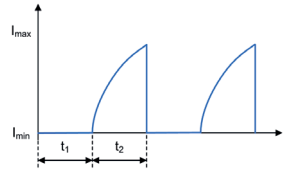
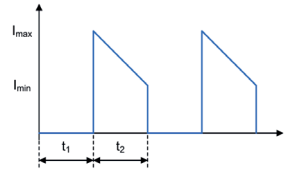
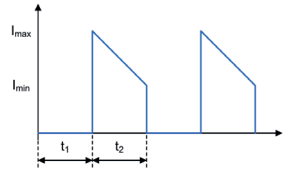


TI.com/powertopologies

TI POWER

	Buck	Synchronous Buck	Boost
			
Duty Cycle	$D = \frac{V_{out} + V_f}{V_{in} + V_f}$	$D = \frac{V_{out}}{V_{in}}$	$D = \frac{V_{out} + V_f - V_{in}}{V_{out} + V_f}$
Q1 FET Voltage	$V_{Q1} = V_{in} + V_f$	$V_{Q1} = V_{in}$	$V_{Q1} = V_{out} + V_f$
D1 Diode Voltage	$V_{D1} = V_{in}$	$V_{Q2} = V_{in}$	$V_{D1} = V_{out}$
PWM			
Q1 FET Voltage			
Q1 FET Current			
D1 Diode / Q2 FET Voltage			
D1 Diode / Q2 FET Current			
L1 Inductor Current			

	Inverting Buck-Boost	Sepic	Cuk	Zeta
				
Duty Cycle	$D = \frac{-V_{out} + V_f}{-V_{out} + V_f + V_{in}}$	$D = \frac{V_{out} + V_f}{V_{out} + V_f + V_{in}}$	$D = \frac{-V_{out} + V_f}{-V_{out} + V_f + V_{in}}$	$D = \frac{V_{out} + V_f}{V_{out} + V_f + V_{in}}$
Q1 FET Voltage	$V_{Q1} = V_{in} + V_f - V_{out}$	$V_{Q1} = V_{in} + V_{out} + V_f + \frac{V_{C1,ripple}}{2}$	$V_{Q1} = V_{in} - V_{out} + V_f + \frac{V_{C1,ripple}}{2}$	$V_{Q1} = V_{in} + V_{out} + V_f + \frac{V_{C1,ripple}}{2}$
D1 Diode Voltage	$V_{D1} = V_{in} - V_{out}$	$V_{D1} = V_{in} + V_{out} + \frac{V_{C1,ripple}}{2}$	$V_{D1} = V_{in} - V_{out} + \frac{V_{C1,ripple}}{2}$	$V_{D1} = V_{in} + V_{out} + \frac{V_{C1,ripple}}{2}$
PWM				
Q1 FET Voltage				
Q1 FET Current				
D1 Diode / Q2 FET Voltage				
D1 Diode / Q2 FET Current				
L1 Inductor Current				
L2 Inductor Current				

	Fly-Buck™	Flyback	Two Switch Flyback
			
Duty Cycle	$D = \frac{V_{out_pri}}{V_{in}}$	$D = \frac{(V_{out} + V_f) \cdot \frac{N_p}{N_s}}{V_{in} + (V_{out} + V_f) \cdot \frac{N_p}{N_s}}$	$D = \frac{(V_{out} + V_f) \cdot \frac{N_p}{N_s}}{V_{in} + (V_{out} + V_f) \cdot \frac{N_p}{N_s}}$
Q1 FET Voltage	$V_{Q1} = V_{in}$	$V_{Q1} = V_{in} + (V_{out} + V_f) \cdot \frac{N_p}{N_s}$	$V_{Q1} = \frac{V_{in} + (V_{out} + V_f) \cdot \frac{N_p}{N_s}}{2}$
D1 Diode Voltage	$V_{D1} = V_{out_sec} + (V_{in} - V_{out_pri}) \cdot \frac{N_s}{N_p}$	$V_{D1} = V_{out} + V_{in} \cdot \frac{N_s}{N_p}$	$V_{D1} = V_{out} + V_{in} \cdot \frac{N_s}{N_p}$
PWM			
Q1 FET Voltage			
Q1 FET Current			
D1 Diode Voltage			
D1 Diode Current			
Np Primary Current			
Ns Secondary Current			

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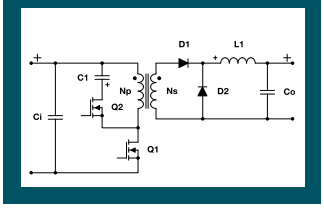
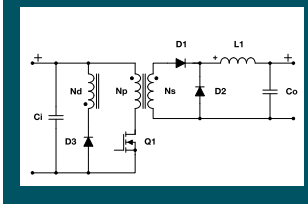
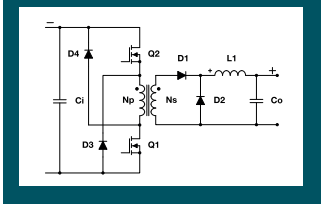
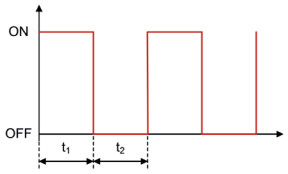
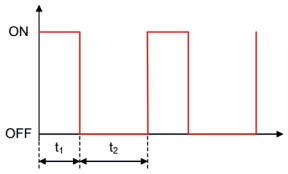
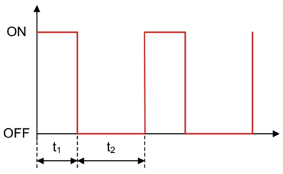
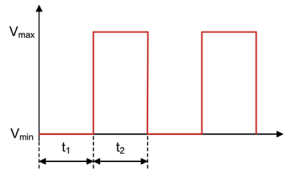
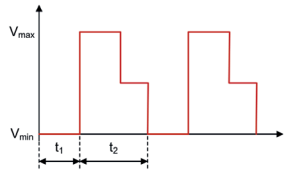
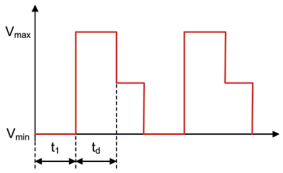
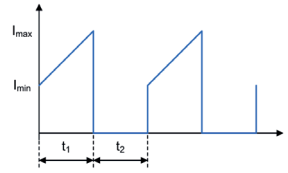
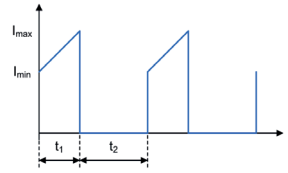
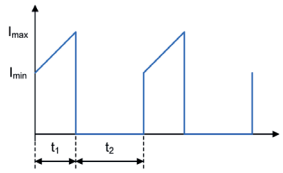
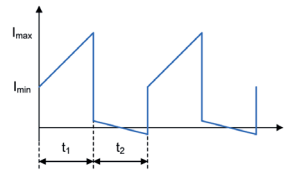
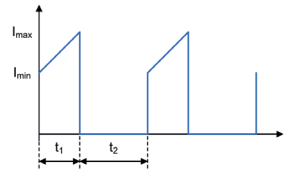
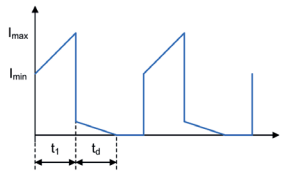
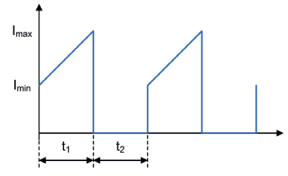
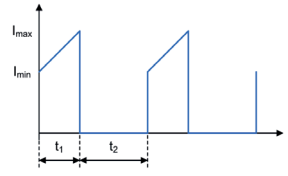
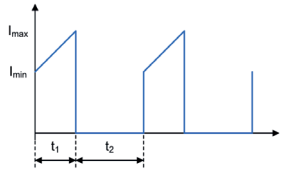
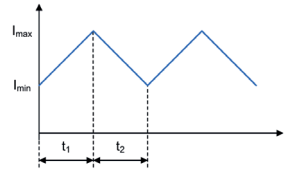
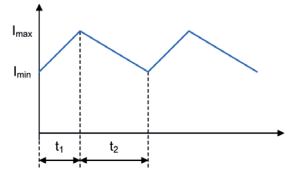
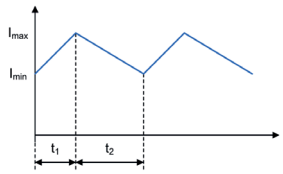
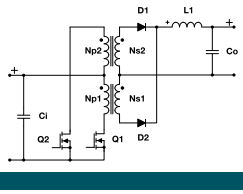
			
Duty Cycle	$D = \frac{(V_{out} + V_f)}{V_{in} \cdot \frac{N_s}{N_p}}$	$D = \frac{(V_{out} + V_f)}{V_{in} \cdot \frac{N_s}{N_p}}$	$D = \frac{(V_{out} + V_f)}{V_{in} \cdot \frac{N_s}{N_p}}$
Q1 FET Voltage	$V_{Q1} = \frac{V_{in}}{(1-D)}$	$V_{Q1} = 2 \cdot V_{in} + V_f$	$V_{Q1} = V_{in} + V_f$
D1 Diode Voltage	$V_{D1} = V_{clamp} \cdot \frac{N_s}{N_p} - V_f$	$V_{D1} = (V_{in} + V_f) \cdot \frac{N_s}{N_d} - V_f$	$V_{D1} = (V_{in} + 2 \cdot V_f) \cdot \frac{N_s}{N_p} - V_f$
D2 Diode Voltage	$V_{D2} = V_{in} \cdot \frac{N_s}{N_p} - V_f$	$V_{D2} = V_{in} \cdot \frac{N_s}{N_p} - V_f$	$V_{D2} = V_{in} \cdot \frac{N_s}{N_p} - V_f$
PWM			
Q1 FET Voltage			
Q1 FET Current			
Np Primary Current			
Ns Secondary Current			
L1 Inductor Current			

Push-Pull



Duty Cycle

$$D = \frac{1}{2} \cdot \frac{(V_{out} + V_f)}{V_{in} \cdot \frac{N_s}{N_p}}$$

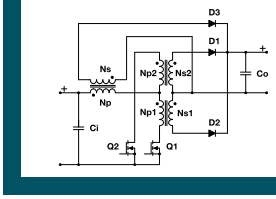
Q1 FET Voltage

$$V_{Q1} = 2 \cdot V_{in}$$

D1 Diode Voltage

$$V_{D1} = 2 \cdot V_{in} \cdot \frac{N_s}{N_p} - V_f$$

Weinberg



Duty Cycle

$$D = \frac{1}{2} \cdot \frac{V_{out} + V_f}{V_{in} \cdot \frac{N_s}{N_p}}$$

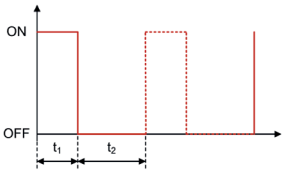
Q1 FET Voltage

$$V_{Q1} = V_{in} + 2 \cdot \frac{N_p}{N_s} \cdot (V_{out} + V_f)$$

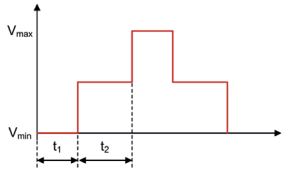
D1 Diode Voltage

$$V_{D1} = 2 \cdot (V_{out} + V_f)$$

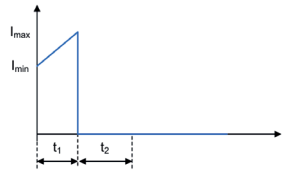
PWM



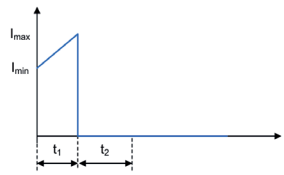
Q1 FET Voltage



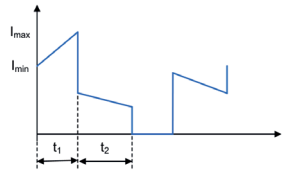
Q1 FET Current



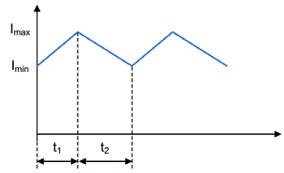
Np1 Primary Current



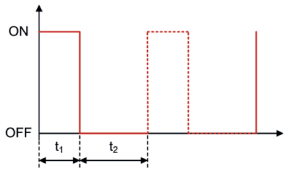
Ns2 Secondary Current



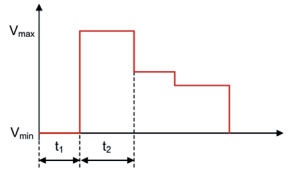
L1 Inductor Current



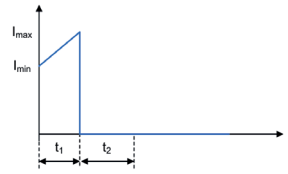
PWM



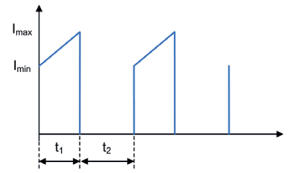
Q1 FET Voltage



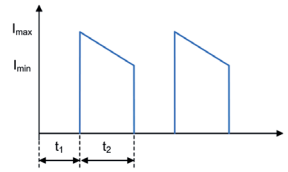
Q1 FET Current



Np Primary Current



Ns Secondary Current



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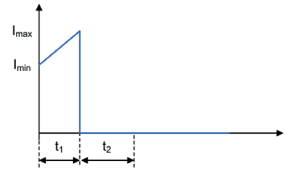

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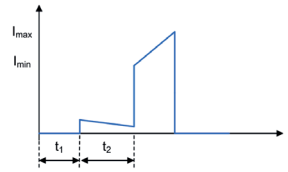
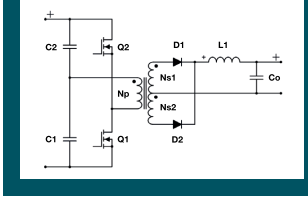
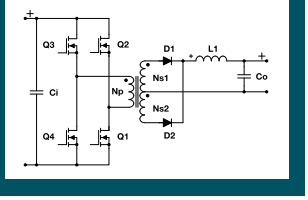
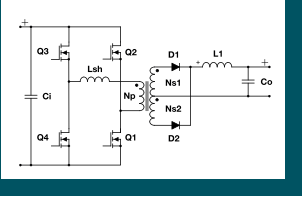
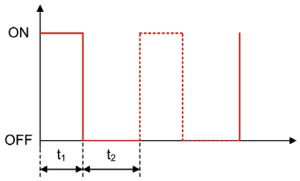
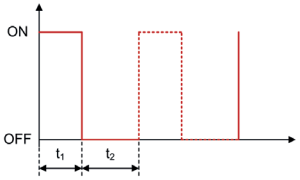
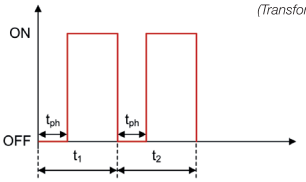
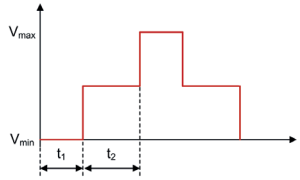
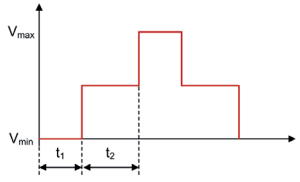
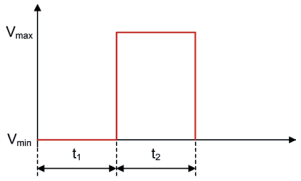
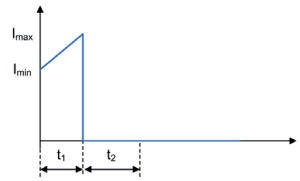
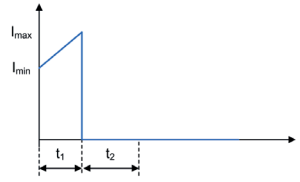
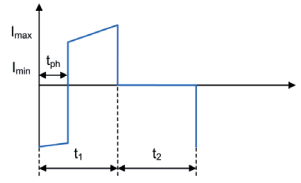
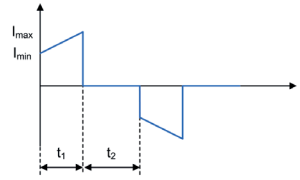
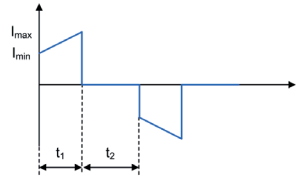
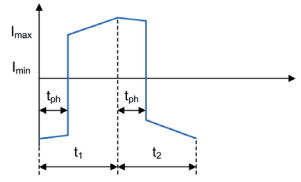
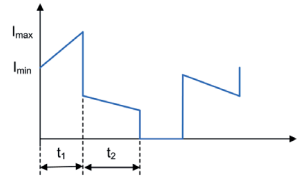
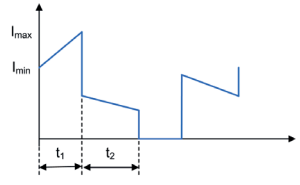
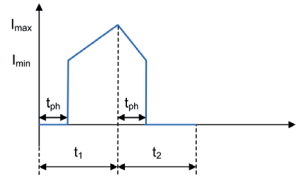
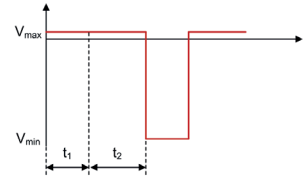
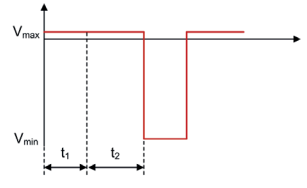
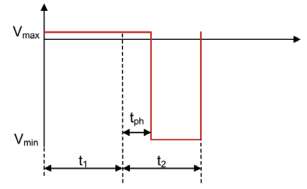
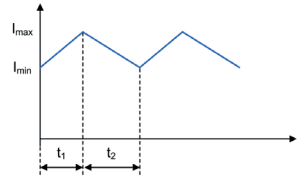
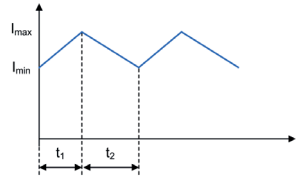
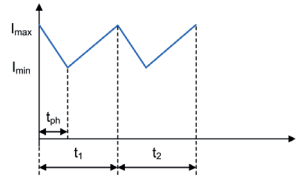
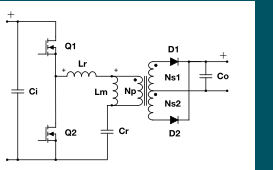
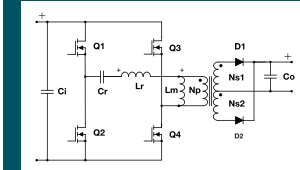
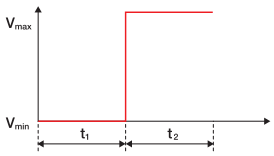
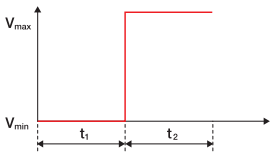
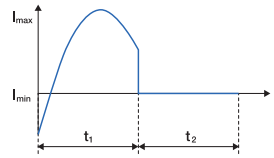
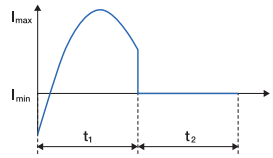
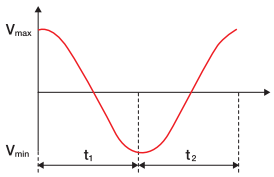
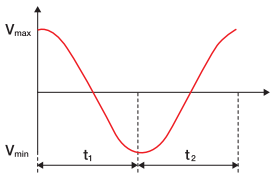
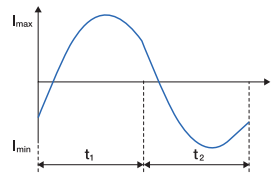
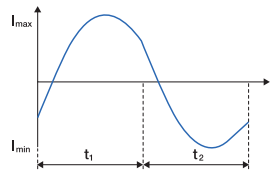
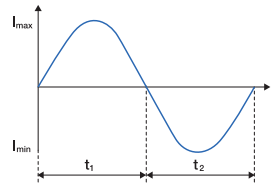
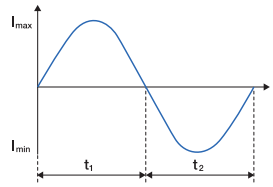
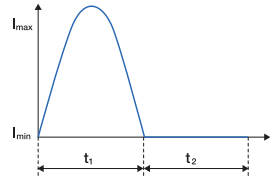
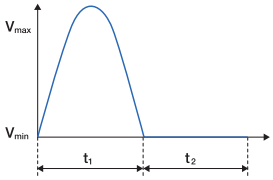
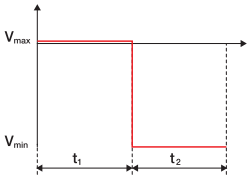
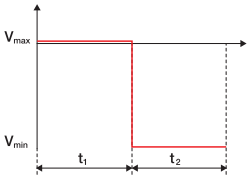


	Half-Bridge	Full-Bridge	Phase Shifted Full-Bridge
			
Duty Cycle	$D = \frac{V_{out} + V_f}{V_{in} \cdot \frac{N_s}{N_p}}$	$D = \frac{1}{2} \cdot \frac{V_{out} + V_f}{V_{in} \cdot \frac{N_s}{N_p}}$	*(Transformer)* $D = \frac{V_{out} + V_f}{\frac{V_{in} \cdot L_p}{L_p + L_{sh}} \cdot \frac{N_s}{N_p}}$
Q1 FET Voltage	$V_{Q1} = V_{in}$	$V_{Q1} = V_{in}$	$V_{Q1} = V_{in}$
D1 Diode Voltage	$V_{D1} = V_{in} \cdot \frac{N_s}{N_p} - V_f$	$V_{D1} = 2 \cdot V_{in} \cdot \frac{N_s}{N_p} - V_f$	$V_{D1} = \frac{2 \cdot V_{in} \cdot L_p}{L_p + L_s} \cdot \frac{N_s}{N_p} - V_f$
PWM			*(Transformer)* 
Q1 FET Voltage			
Q1 FET Current			
Np Primary Current			
Ns Secondary Current & D1 Diode Current			
D1 Diode Voltage			
L1 Inductor Current			

	LLC Half-Bridge	LLC Full-Bridge
		
		**Regulation through Frequency Modulation*
Duty Cycle	50%*	50%*
Q1 FET Voltage	$V_{Q1} = V_{in}$	$V_{Q1} = V_{in}$
D1 Diode Voltage	$V_{D1} = 2 \cdot V_{out} + V_f$	$V_{D1} = 2 \cdot V_{out} + V_f$
Q1 FET Voltage		
Q1 FET Current		
Lr Resonant Inductor Voltage		
Lr Resonant Inductor Current		
Np Primary Current		
Ns Secondary & D1 Diode Current		
D1 Diode Voltage		

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