

**FAIRCHILD**  
SEMICONDUCTOR®

January 2002

## HGTP14N40F3VL / HGT1S14N40F3VLS

### 330mJ, 400V, N-Channel Ignition IGBT

#### General Description

This N-Channel IGBT is a MOS gated, logic level device which is intended to be used as an ignition coil driver in automotive ignition circuits. Unique features include an active voltage clamp between the drain and the gate and ESD protection for the logic level gate. Some specifications are unique to this automotive application and are intended to assure device survival in this harsh environment.

Formerly Developmental Type 49023

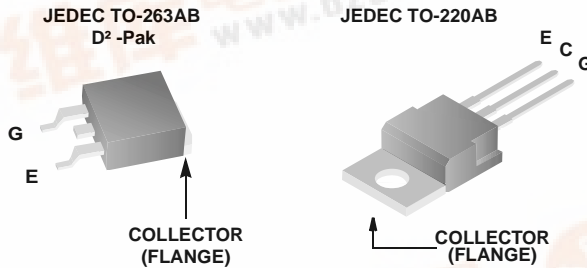
#### Applications

- Automotive Ignition Coil Driver Circuits
- Coil-On Plug Applications

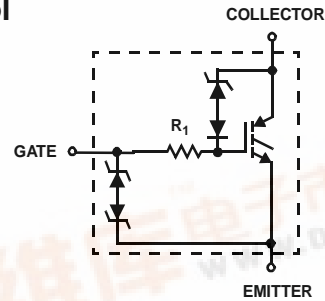
#### Features

- Logic Level Gate Drive
- Internal Voltage Clamp
- ESD Gate Protection
- Max  $T_J = 175^\circ\text{C}$
- SCIS Energy = 330mJ at  $T_J = 25^\circ\text{C}$

#### Package



#### Symbol



#### Device Maximum Ratings $T_A = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Ratings	Units
$BV_{CES}$	Collector to Emitter Breakdown Voltage ( $I_C = 1 \text{ mA}$ )	420	V
$BV_{CGR}$	Collector to Gate Breakdown Voltage ( $R_{GE} = 10\text{K}\Omega$ )	420	V
$E_{SCIS25}$	Drain to Source Avalanche Energy at $L = 2.3\text{mH}$ , $T_C = 25^\circ\text{C}$	330	mJ
$I_{C25}$	Collector Current Continuous, at $T_C = 25^\circ\text{C}$ , $V_{GE} = 4.5\text{V}$	38	A
$I_{C90}$	Collector Current Continuous, at $T_C = 90^\circ\text{C}$ , $V_{GE} = 4.5\text{V}$	35	A
$V_{GES}$	Gate to Emitter Voltage Continuous	$\pm 10$	V
$V_{GEM}$	Gate to Emitter Voltage Pulsed	$\pm 12$	V
$I_{CO}$	$L = 2.3\text{mH}$ , $T_C = 25^\circ\text{C}$	17	A
$I_{CO}$	$L = 2.3\text{mH}$ , $T_C = 150^\circ\text{C}$	12	A
$P_D$	Power Dissipation Total $T_C = 25^\circ\text{C}$	262	W
$P_D$	Power Dissipation Derating $T_C > 25^\circ\text{C}$	1.75	W/ $^\circ\text{C}$
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	-40 to 175	$^\circ\text{C}$
$T_L$	Max Lead Temp for Soldering (Leads at 1.6mm from Case for 10s)	300	$^\circ\text{C}$
$T_{pkg}$	Max Lead Temp for Soldering (Package Body for 10s)	260	$^\circ\text{C}$
ESD	Electrostatic Discharge Voltage at 100pF, 1500Ω	6	KV

## Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
14N40FVL	HGT1S14N40F3VLT	TO-263AB	24mm	24mm	800 units
14N40FVL	HGT1S14N40F3VLS	TO-263AB	Tube	N/A	50 units
14N40FVL	HGTP14N40F3VL	TO-220AB	Tube	N/A	50 units

## Electrical Characteristics $T_A = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
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### Off State Characteristics

$BV_{CES}$	Collector to Emitter Breakdown Voltage	$I_C = 10\text{mA}$ , $V_{GE} = 0$	$T_C = 150^\circ\text{C}$	345	370	415	V
			$T_C = 25^\circ\text{C}$	350	375	420	V
			$T_C = -40^\circ\text{C}$	355	380	425	V
$BV_{CE(CL)}$	Collector to Emitter Clamp Breakdown Voltage	$I_C = 10\text{A}$ , $R_G = 0$	$T_C = 150^\circ\text{C}$	350	385	430	V
$BV_{ECS}$	Emitter to Collector Breakdown Voltage	$I_C = 1\text{mA}$	$T_C = 25^\circ\text{C}$	24	-	-	V
$BV_{GES}$	Gate to Emitter Breakdown Voltage	$I_{GES} = \pm 1\text{mA}$		$\pm 12$	-	-	V
$I_{CES}$	Collector to Emitter Leakage Current	$V_{CE} = 250\text{V}$ ,	$T_C = 25^\circ\text{C}$	-	-	50	$\mu\text{A}$
			$T_C = 150^\circ\text{C}$	-	-	250	$\mu\text{A}$
$I_{GES}$	Gate to Emitter Leakage Current	$V_{GE} = \pm 10\text{V}$	$T_C = 25^\circ\text{C}$	-	-	$\pm 10$	$\mu\text{A}$
$R_1$	Series Gate Resistance			-	1000	-	$\Omega$

### On State Characteristics

$V_{CE(SAT)}$	Collector to Emitter Saturation Voltage	$I_C = 10\text{A}$ , $V_{GE} = 4.5\text{V}$	$T_C = 25^\circ\text{C}$	-	1.3	2.0	V
			$T_C = 150^\circ\text{C}$	-	1.4	2.3	V
$V_{GE(TH)}$	Gate to Emitter Threshold Voltage	$I_C = 1\text{mA}$ , $V_{CE} = V_{GE}$	$T_C = 25^\circ\text{C}$	1.0	-	2.0	V
			$T_C = 150^\circ\text{C}$	0.5	-	-	V

### Switching Characteristics

$t_{d(OFF)} + t_{r(OFF)}$	Current Turn-Off Time-Inductive Load	$I_C = 6.5\text{A}$ , $R_G = 25\Omega$ , $L = 550\mu\text{H}$ , $V_{CL} = 320\text{V}$ , $V_{GE} = 5\text{V}$ , $T_C = 25^\circ\text{C}$		-	12	16	$\mu\text{s}$
SCIS	Self Clamped Inductive Switching	$L = 2.3\text{mH}$ , $V_{GE} = 5\text{V}$ , See Fig. 1 & 2	$T_C = 25^\circ\text{C}$	17	-	-	A
			$T_C = 150^\circ\text{C}$	12	-	-	A

### Thermal Characteristics

$R_{\theta JC}$	Thermal Resistance Junction to Case		-	-	0.57	$^\circ\text{C/W}$
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Typical Performance Curves (Continued)

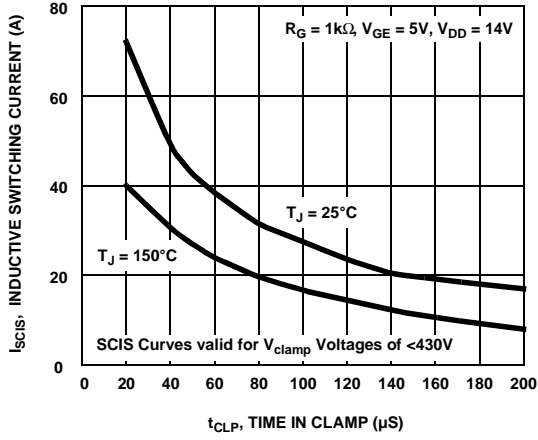


Figure 1. Self Clamped Inductive Switching Current vs Time

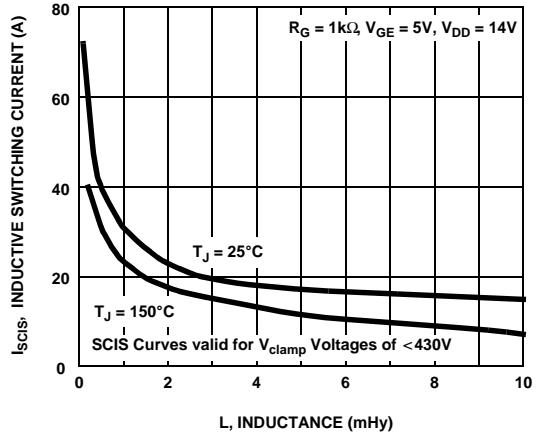


Figure 2. Self Clamped Inductive Switching Current vs Inductance

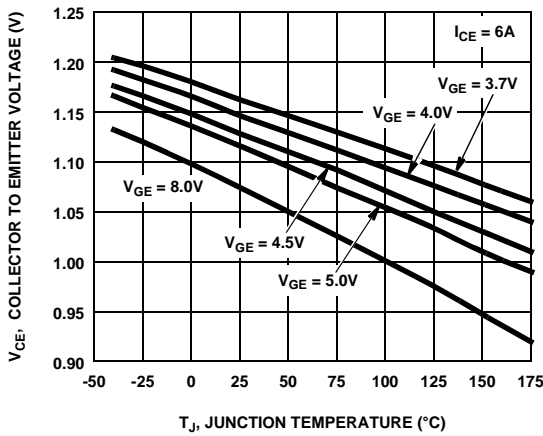


Figure 3. Collector to Emitter On-State Voltage vs Junction Temperature

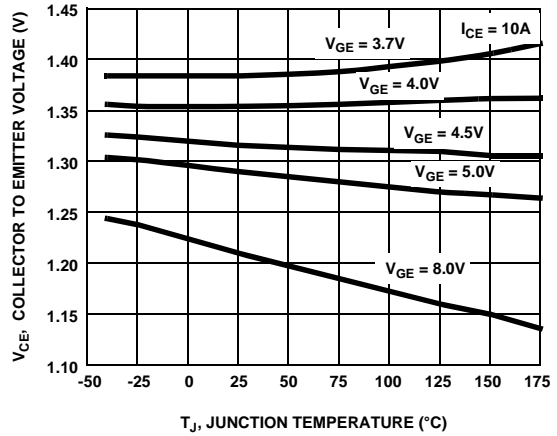


Figure 4. Collector to Emitter On-State Voltage vs Junction Temperature

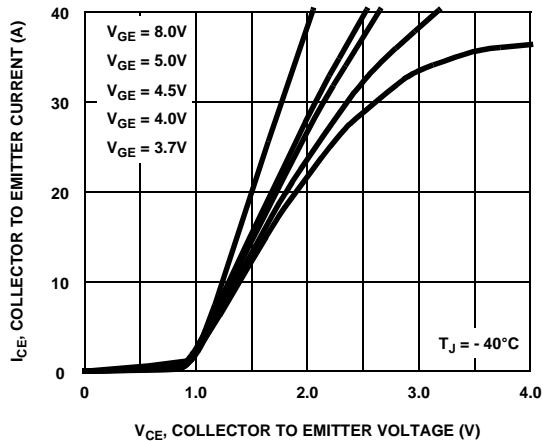


Figure 5. Collector to Emitter Current vs Collector to Emitter On-State Voltage

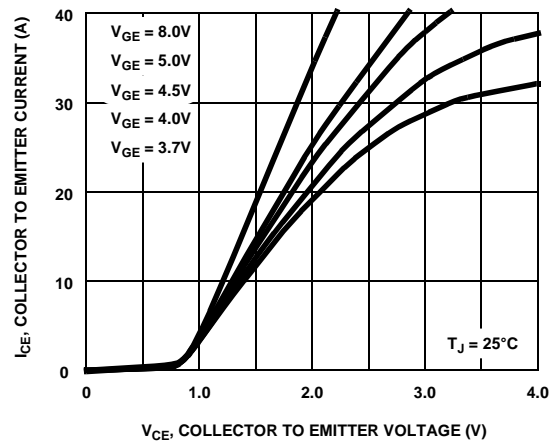


Figure 6. Collector to Emitter Current vs Collector to Emitter On-State Voltage

Typical Performance Curves (Continued)

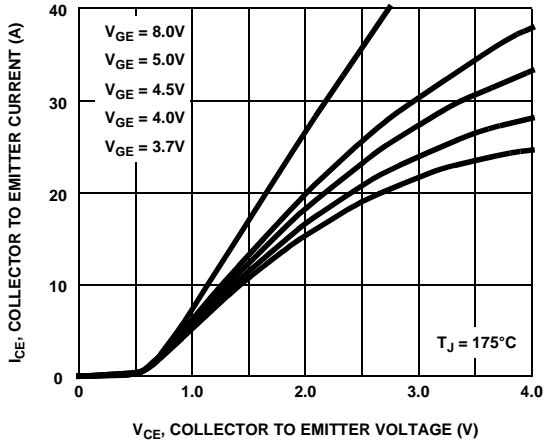


Figure 7. Collector to Emitter Current vs Collector to Emitter On-State Voltage

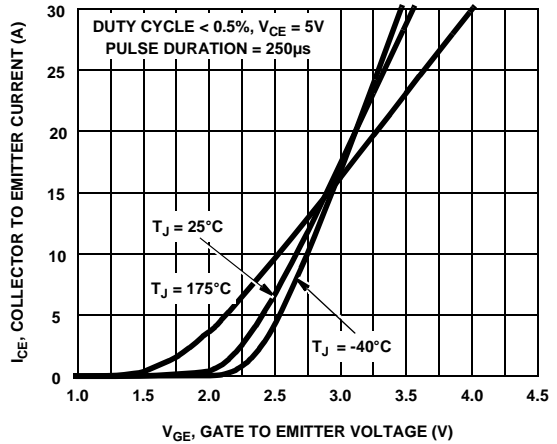


Figure 8. Transfer Characteristics

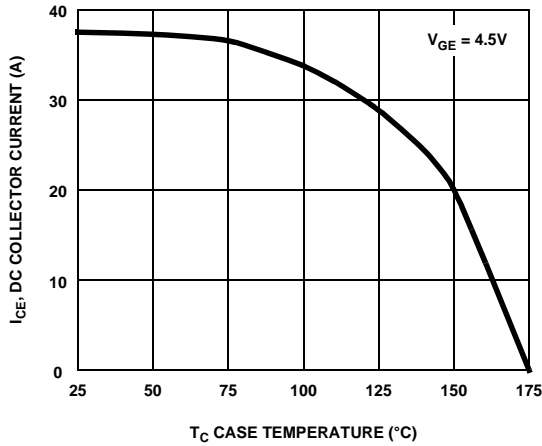


Figure 9. DC Collector Current vs Case Temperature

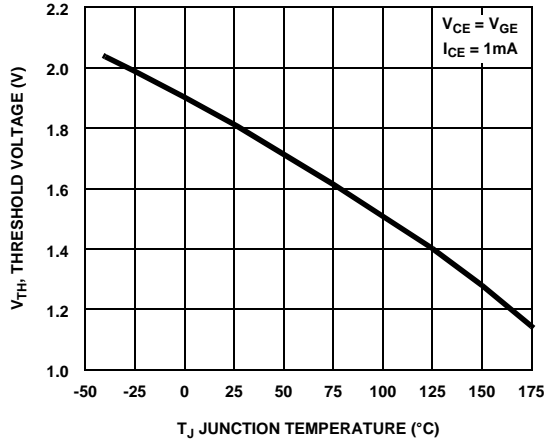


Figure 10. Threshold Voltage vs Junction Temperature

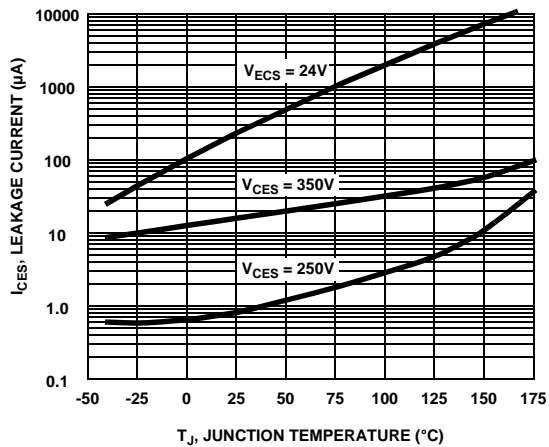


Figure 11. Leakage Current vs Junction Temperature

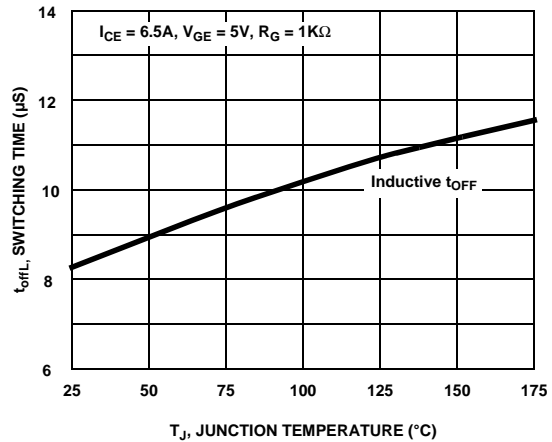


Figure 12. Switching Time vs Junction Temperature

Test Circuit and Waveforms

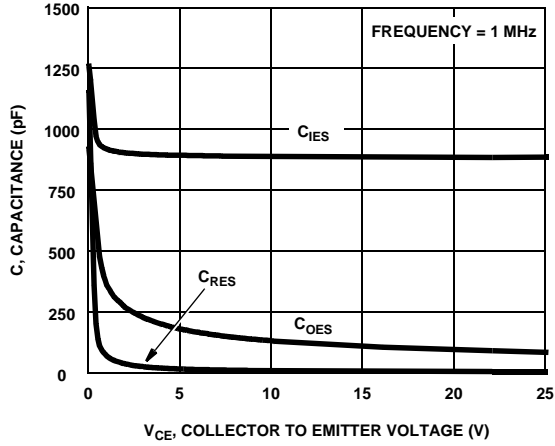


Figure 13. Capacitance vs Collector to Emitter Voltage

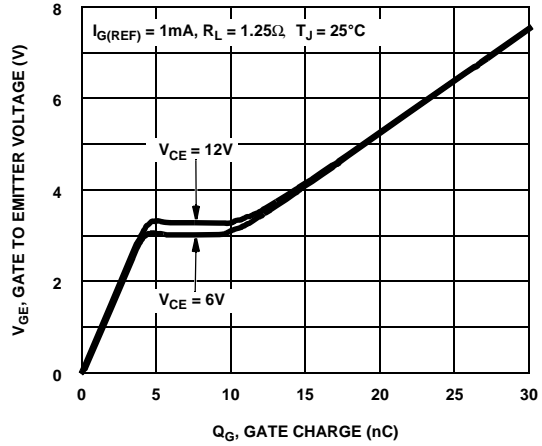


Figure 14. Gate Charge

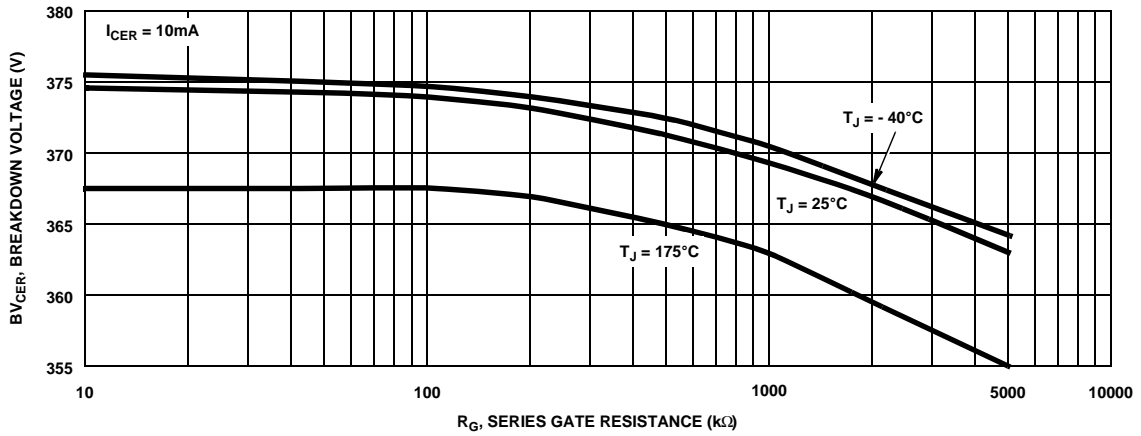


Figure 15. Breakdown Voltage vs Series Gate Resistance

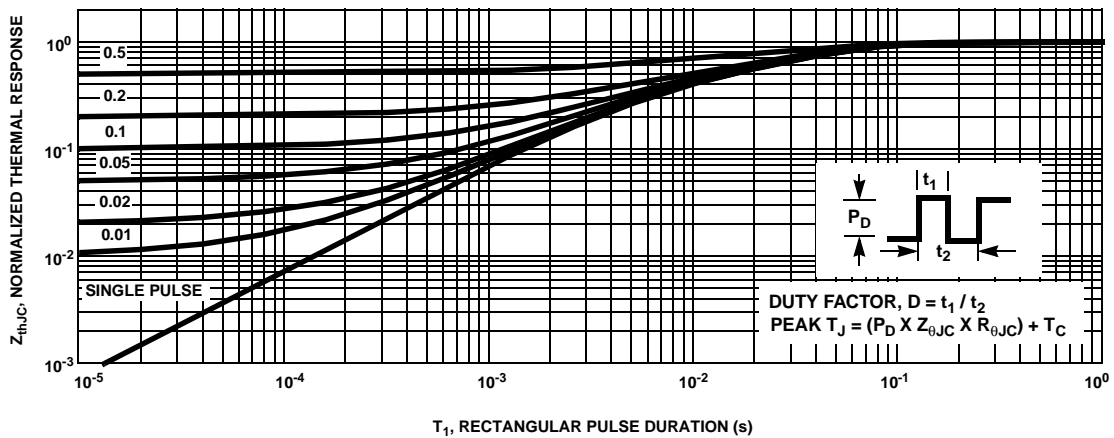


Figure 16. Normalized Transient Thermal Impedance

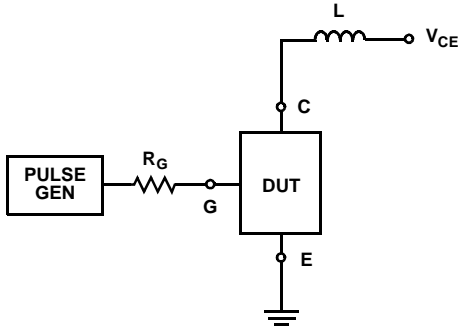


Figure 17. Inductive Switching Test Circuit

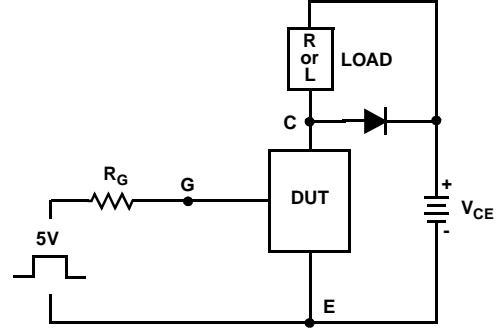


Figure 18.  $t_{ON}$  and  $t_{OFF}$  Switching Test Circuit

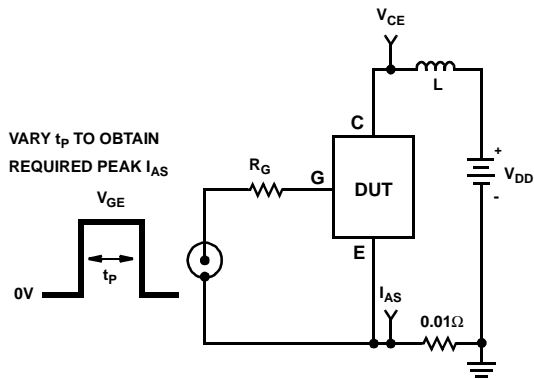


Figure 19. Unclamped Energy Test Circuit

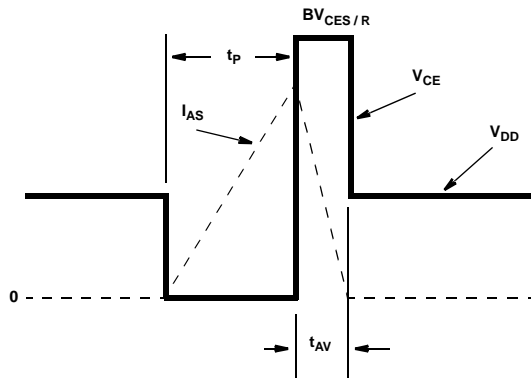


Figure 20. Unclamped Energy Waveforms

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