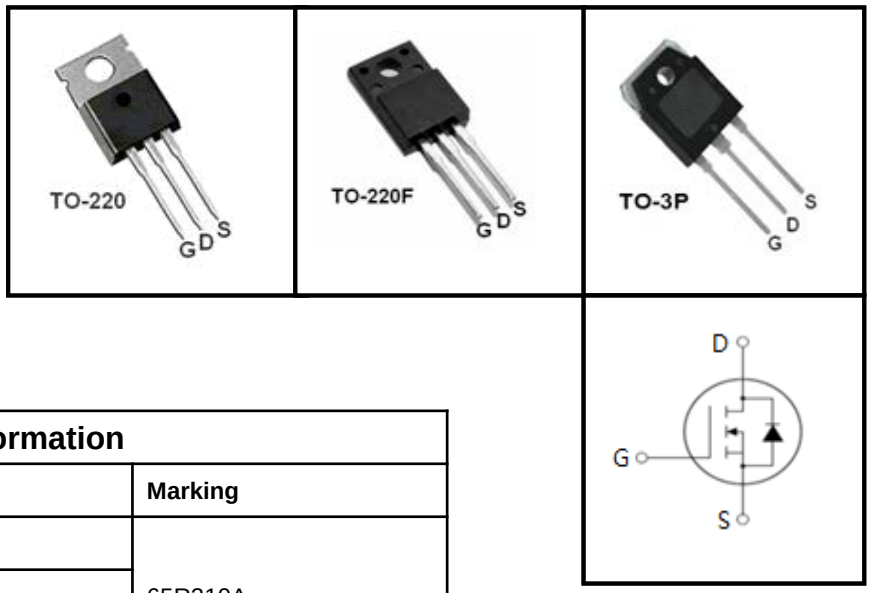
650V Super-Junction Power MOSFET

FEATURES

- Very low FOM $R_{DS(on)} \times Q_g$
- 100% avalanche tested
- RoHS compliant



APPLICATIONS

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply (UPS)
- Power Factor Correction (PFC)

Device Marking and Package Information

Device	Package	Marking
TPP65R210A	TO-220	65R210A
TPA65R210A	TO-220F	
TPV65R210A	TO-3P	

Absolute Maximum Ratings T_C = 25ºC, unless otherwise noted

Parameter	Symbol	Value			Unit
		TO-220	TO-3P	TO-220F	
Drain-Source Voltage (V_{GS} = 0V)	V_{DSS}	650			V
Continuous Drain Current	I_D	20			A
Pulsed Drain Current (note1)	I_{DM}	60			A
Gate-Source Voltage	V_{GSS}	±30			V
Single Pulse Avalanche Energy (note2)	E_{AS}	500			mJ
Avalanche Current (note1)	I_{AR}	10			A
Repetitive Avalanche Energy (note1)	E_{AR}	1			mJ
Power Dissipation (T_C = 25ºC)	P_D	208		34.5	W
Operating Junction and Storage Temperature Range	T_J, T_{stg}	-55~+150			ºC

Thermal Resistance

Parameter	Symbol	Value			Unit
		TO-220	TO-3P	TO-220F	
Thermal Resistance, Junction-to-Case	R_{thJC}	0.6		3.6	ºC/W
Thermal Resistance, Junction-to-Ambient	R_{thJA}	62		80	

Specifications T_J = 25ºC, unless otherwise noted						
Parameter	**Symbol**	**Test Conditions**	**Value**			**Unit**
			Min.	**Typ.**	**Max.**	
Static						
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	V_{GS} = 0V, I_D = 250μA	650	--	--	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 650V, V_{GS} = 0V, T_J = 25ºC	--	--	1	μA
		V_{DS} = 650V, V_{GS} = 0V, T_J = 150ºC	--	--	100	
Gate-Source Leakage	I_{GSS}	V_{GS} = ±30V	--	--	±100	nA
Gate-Source Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 250μA	2.5	--	4.0	V
Drain-Source On-Resistance (Note3)	$R_{DS(on)}$	V_{GS} = 10V, I_D = 10A	--	0.19	0.21	Ω
Forward Transconductance (Note3)	g_{fs}	V_{DS} = 10V, I_D = 10A	--	18.8	--	S
Dynamic						
Input Capacitance	C_{iss}	V_{GS} = 0V, V_{DS} = 50V, f = 1.0MHz	--	2140	--	pF
Output Capacitance	C_{oss}		--	300	--	
Reverse Transfer Capacitance	C_{rss}		--	18	--	
Total Gate Charge	Q_g	V_{DD} = 480V, I_D = 20A, V_{GS} = 10V	--	54	--	nC
Gate-Source Charge	Q_{gs}		--	10	--	
Gate-Drain Charge	Q_{gd}		--	20	--	
Turn-on Delay Time	$t_{d(on)}$	V_{DD} = 400V, I_D = 20A, R_G = 25Ω	--	48	104	ns
Turn-on Rise Time	t_r		--	108	220	
Turn-off Delay Time	$t_{d(off)}$		--	176	360	
Turn-off Fall Time	t_f		--	50	108	
Drain-Source Body Diode Characteristics						
Continuous Body Diode Current	I_S	T_C = 25ºC	--	--	20	A
Pulsed Diode Forward Current	I_{SM}		--	--	60	
Body Diode Voltage	V_{SD}	T_J = 25ºC, I_{SD} = 20A, V_{GS} = 0V	--	0.95	1.2	V
Reverse Recovery Time	t_{rr}	V_R = 480V, I_F = I_S, di_F/dt = 100A/μs	--	440	--	ns
Reverse Recovery Charge	Q_{rr}		--	5	--	μC
Peak Reverse Recovery Current	I_{rrm}		--	24	--	A

Notes

1. Repetitive Rating: Pulse Width limited by maximum junction temperature
2. I_{AS} = 10A, V_{DD} = 50V, R_G = 25Ω, Starting T_J = 25°C
3. Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 1%

Typical Characteristics T_J = 25ºC, unless otherwise noted

Figure 1. Output Characteristics

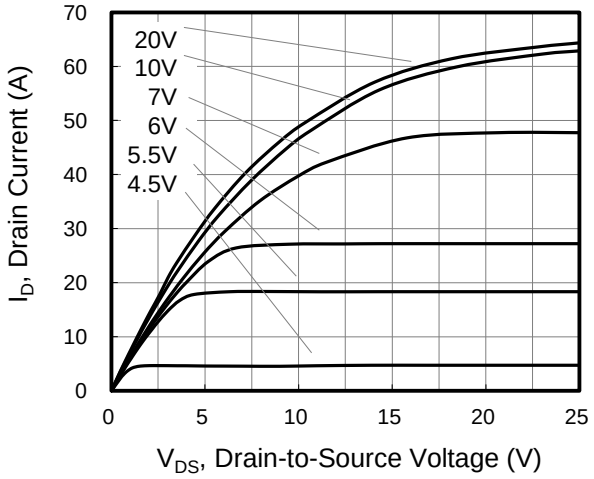


Figure 2. Transfer Characteristics

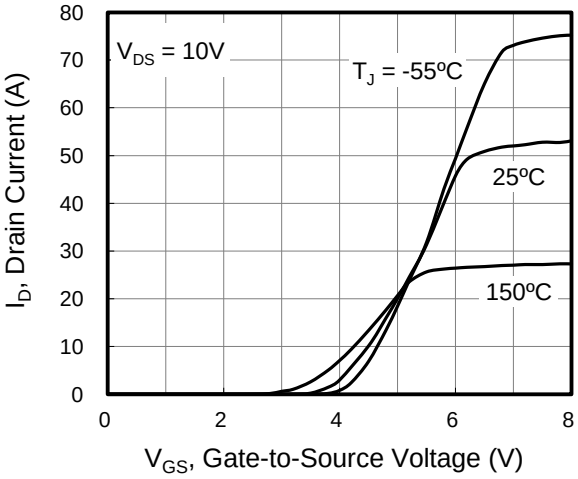


Figure 3. On-Resistance vs. Drain Current

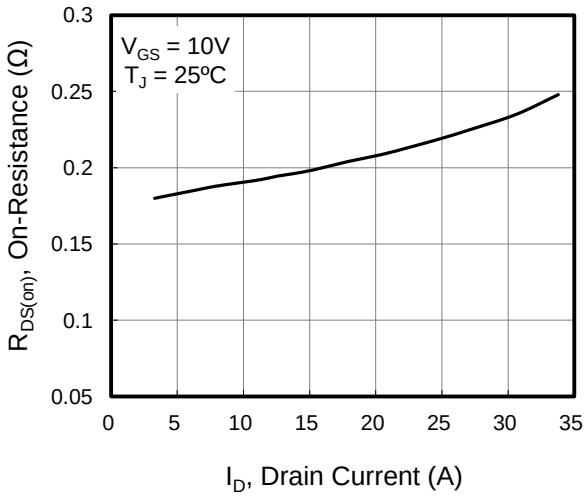


Figure 4. Capacitance

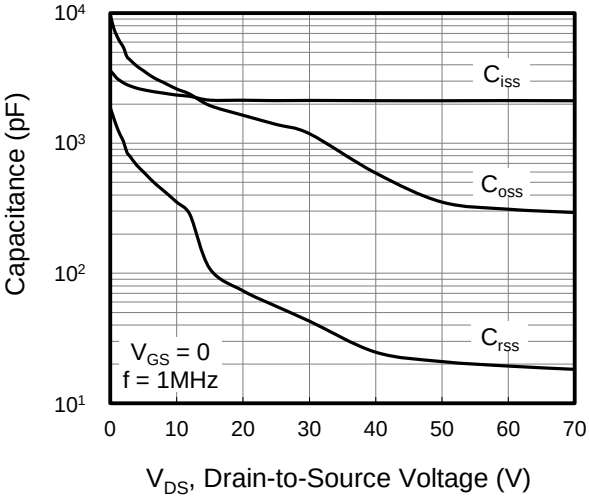


Figure 5. Gate Charge

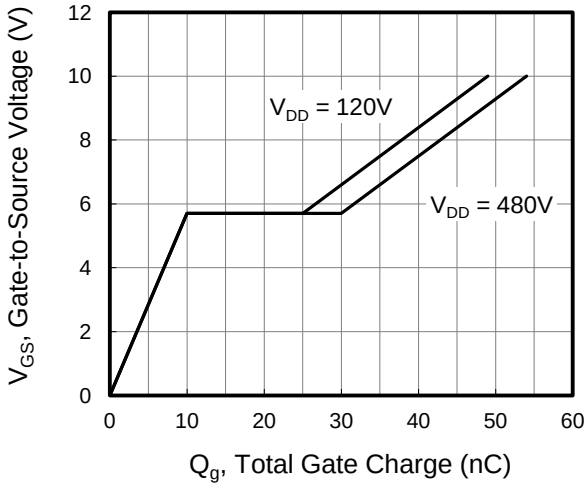
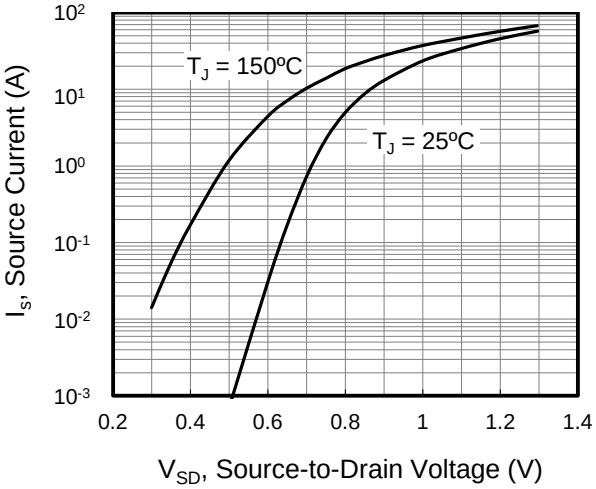


Figure 6. Body Diode Forward Voltage



Typical Characteristics T_J = 25ºC, unless otherwise noted

Figure 7. On-Resistance vs. Junction Temperature

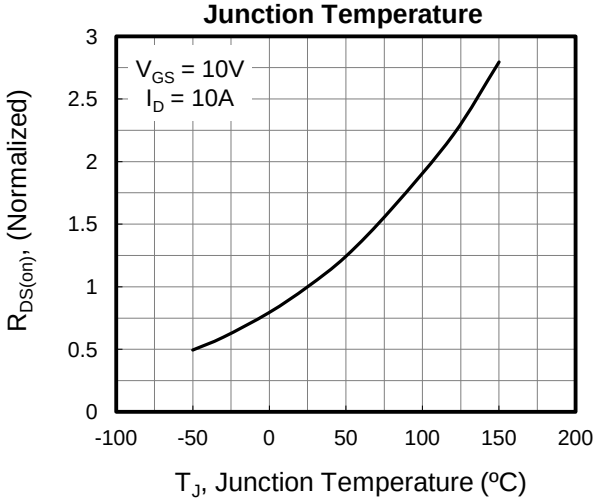


Figure 8. Threshold Voltage vs. Junction Temperature

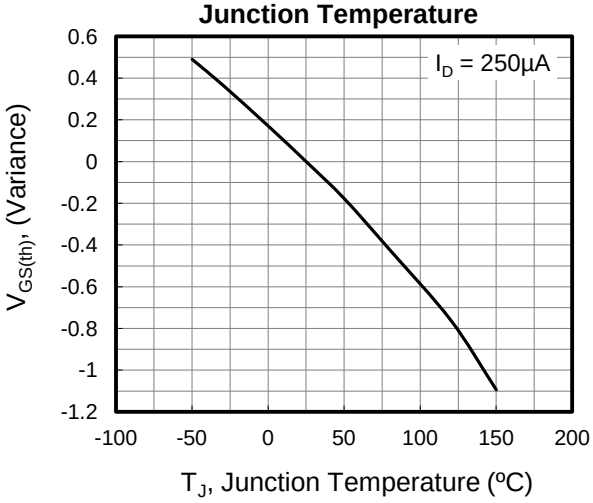


Figure 9. Transient Thermal Impedance TO-220/TO-3P

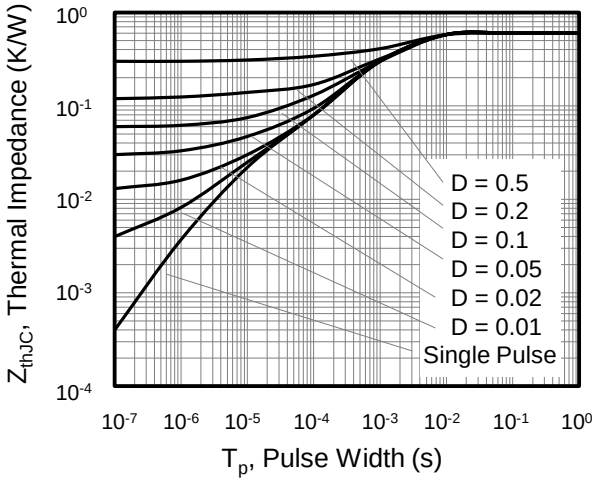


Figure 10. Transient Thermal Impedance TO-220F

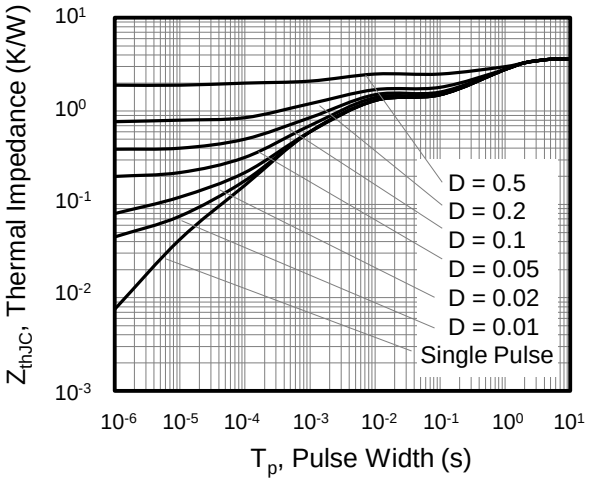


Figure 11. Safe Operating Area TO-220/TO-3P

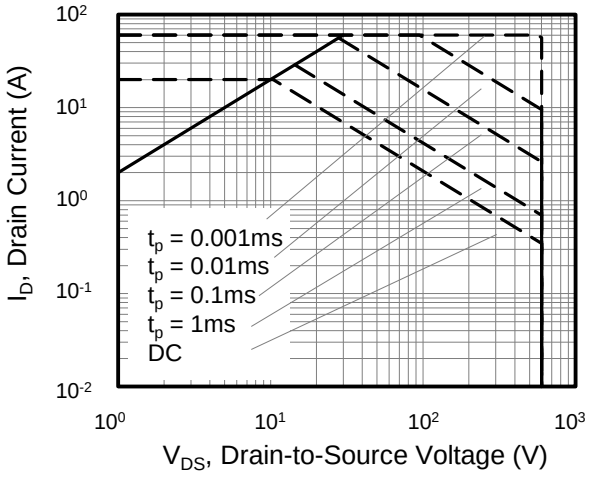


Figure 12. Safe Operating Area TO-220F

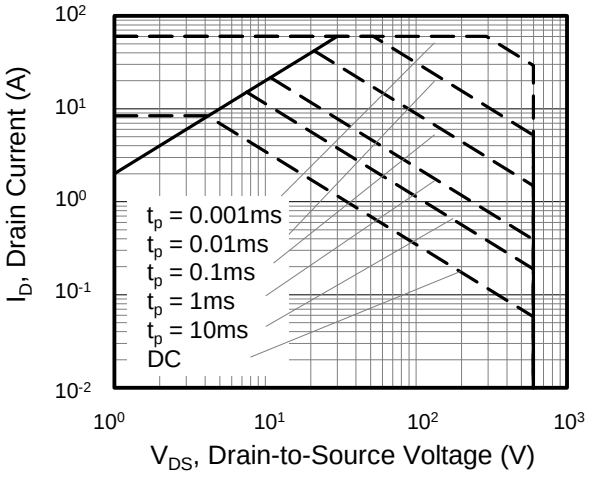


Figure A：Gate Charge Test Circuit and Waveform

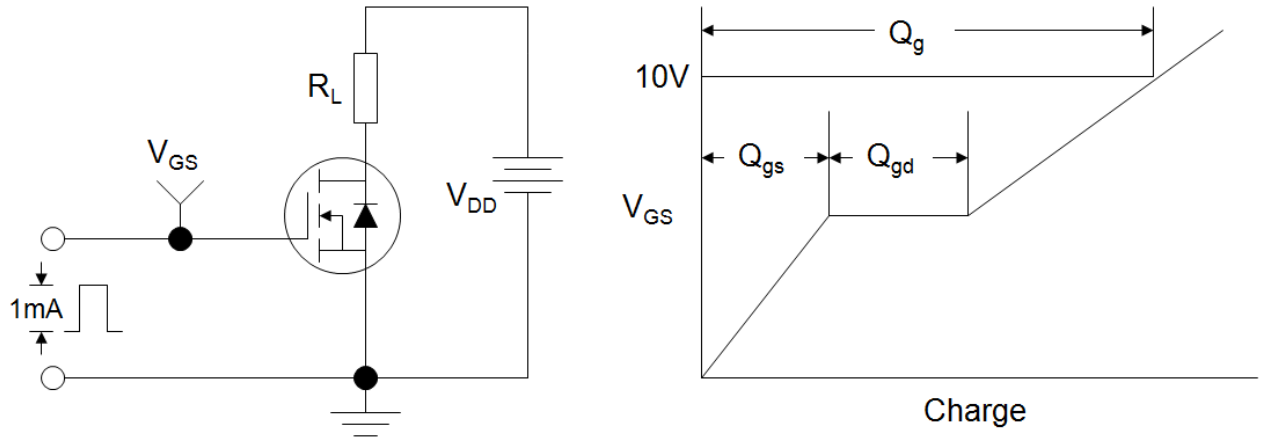


Figure B：Resistive Switching Test Circuit and Waveform

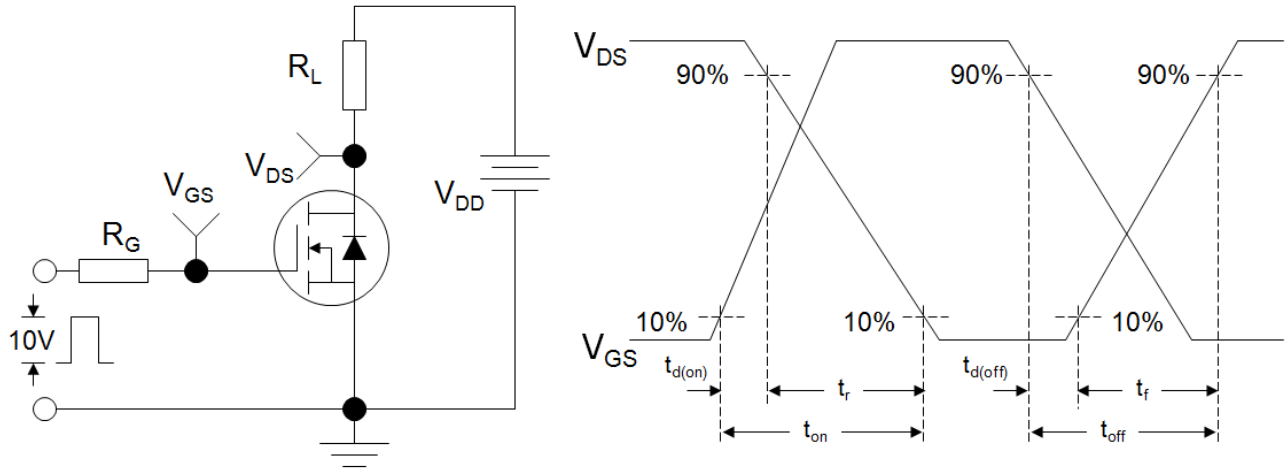
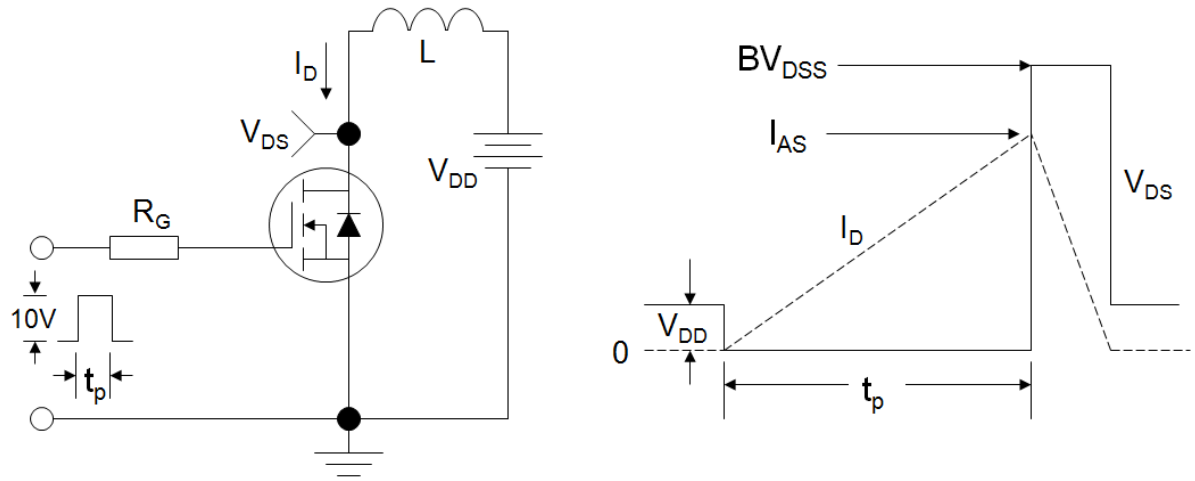
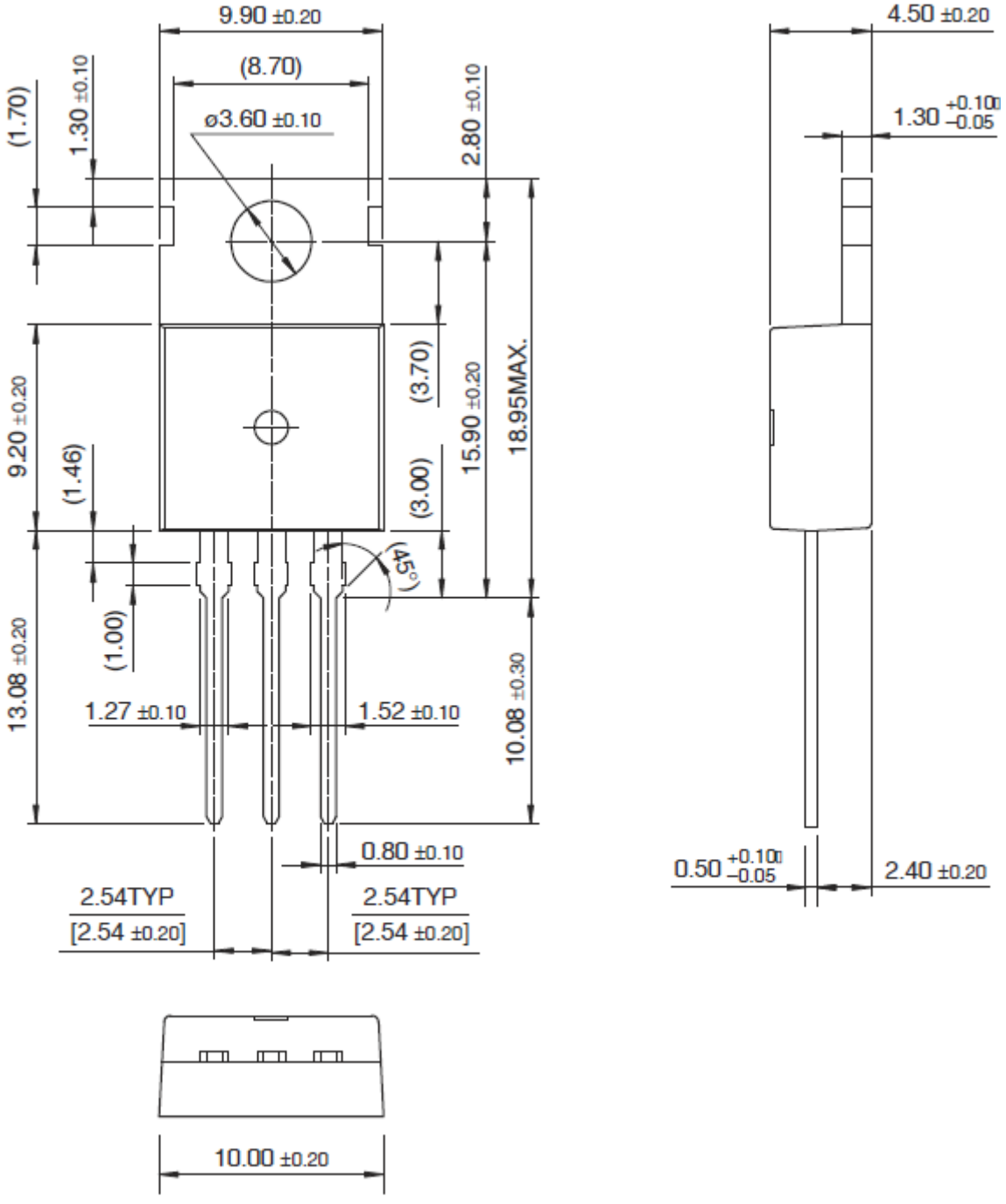


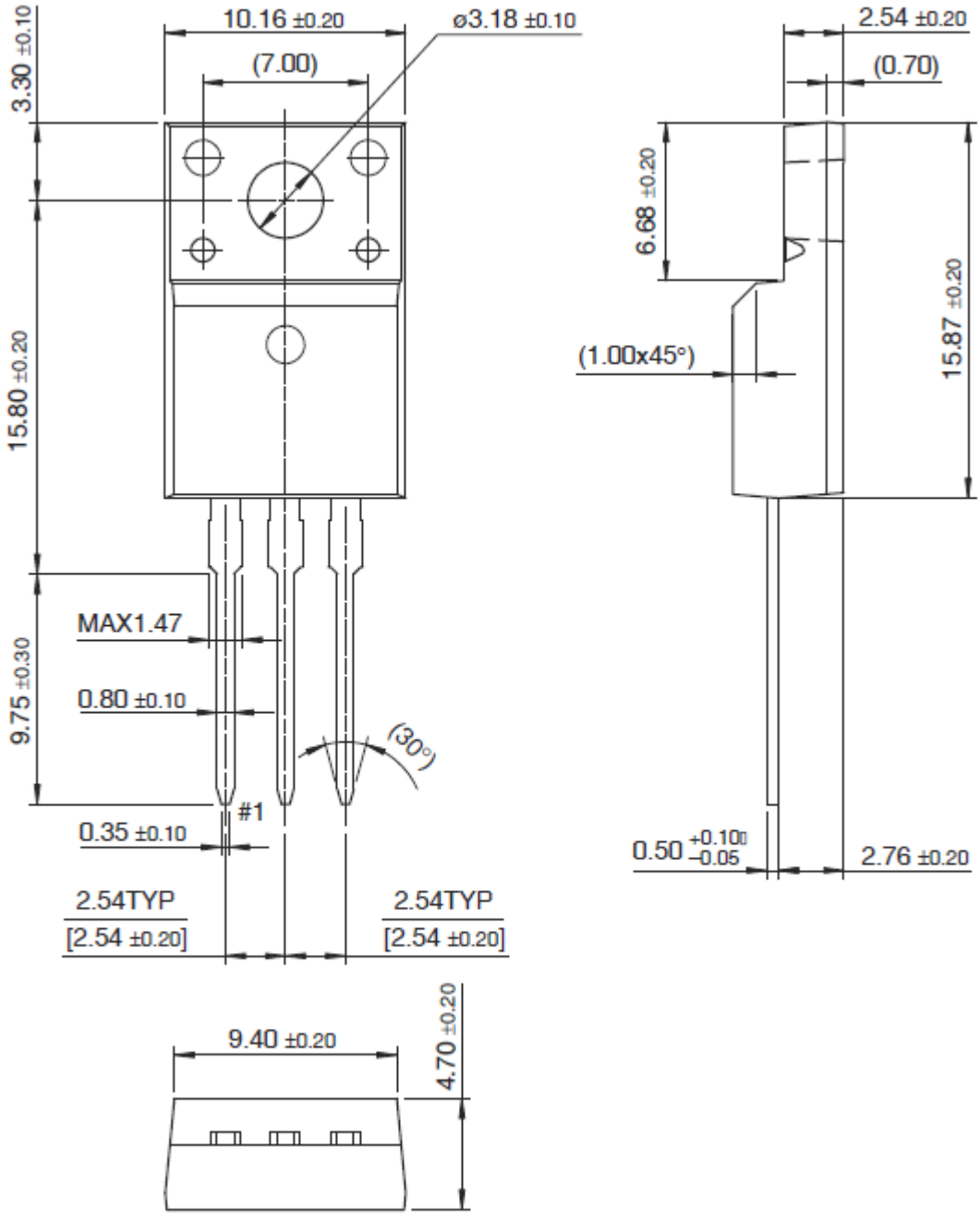
Figure C：Unclamped Inductive Switching Test Circuit and Waveform



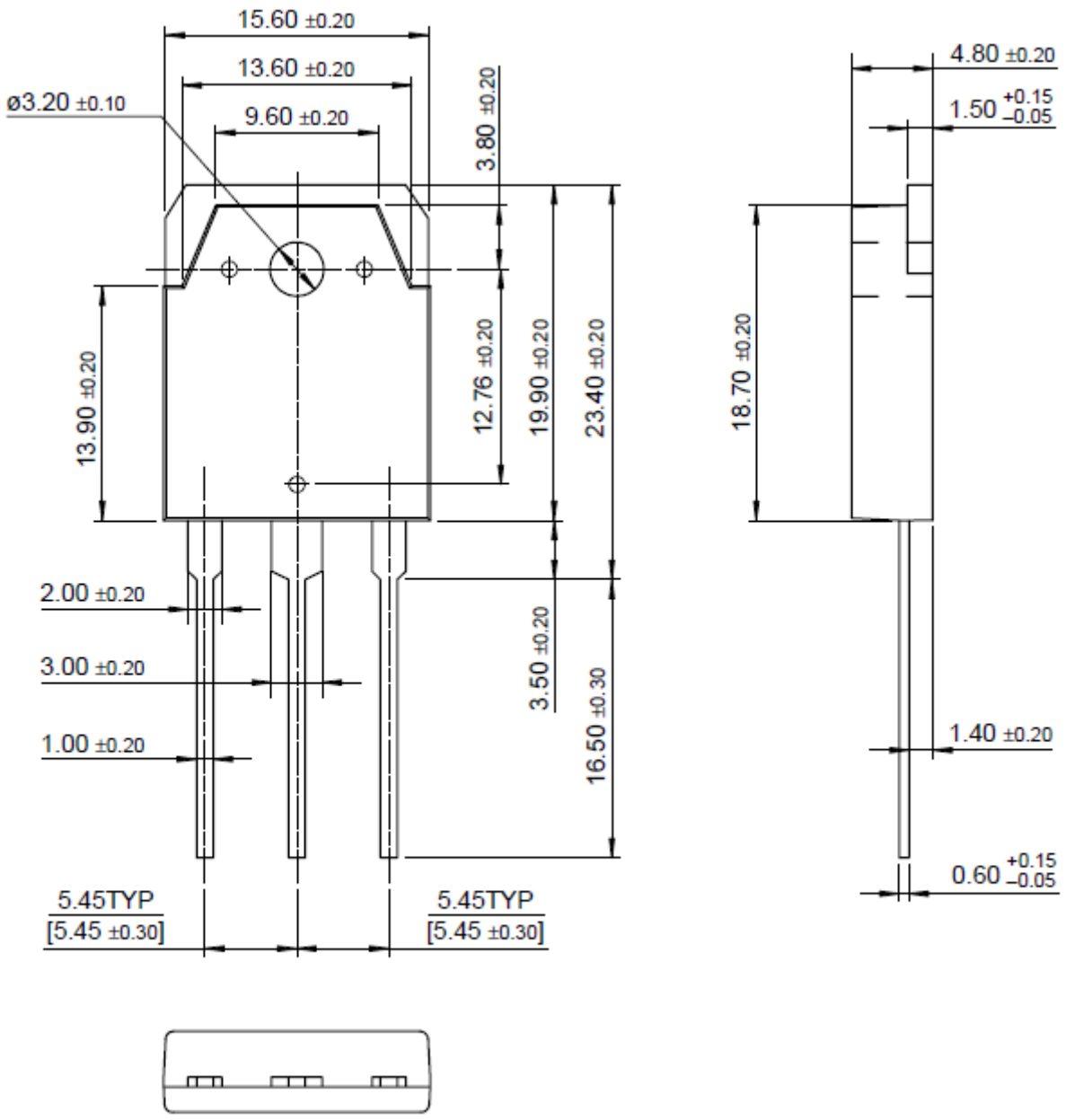
TO-220


9.90 ±0.20
(8.70)
ø3.60 ±0.10
(1.70)
1.30 ±0.10
2.80 ±0.10
4.50 ±0.20
1.30 +0.10 −0.05
9.20 ±0.20
(1.46)
(3.70)
15.90 ±0.20
18.95MAX.
(3.00)
(45°)
(1.00)
13.08 ±0.20
1.27 ±0.10
1.52 ±0.10
10.08 ±0.30
0.80 ±0.10
2.54TYP
[2.54 ±0.20]
2.54TYP
[2.54 ±0.20]
0.50 +0.10 −0.05
2.40 ±0.20
10.00 ±0.20

TO-220F


10.16 ±0.20
ø3.18 ±0.10
(7.00)
3.30 ±0.10
15.80 ±0.20
MAX1.47
0.80 ±0.10
9.75 ±0.30
(30°)
#1
0.35 ±0.10
2.54TYP
[2.54 ±0.20]
2.54TYP
[2.54 ±0.20]
9.40 ±0.20
4.70 ±0.20
2.54 ±0.20
(0.70)
6.68 ±0.20
15.87 ±0.20
(1.00x45°)
0.50 +0.100 −0.05
2.76 ±0.20

TO-3P


15.60 ±0.20
13.60 ±0.20
9.60 ±0.20
ø3.20 ±0.10
3.80 ±0.20
13.90 ±0.20
12.76 ±0.20
19.90 ±0.20
23.40 ±0.20
2.00 ±0.20
3.00 ±0.20
1.00 ±0.20
3.50 ±0.20
16.50 ±0.30
5.45TYP
[5.45 ±0.30]
5.45TYP
[5.45 ±0.30]
4.80 ±0.20
1.50 +0.15 −0.05
18.70 ±0.20
1.40 ±0.20
0.60 +0.15 −0.05

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