

HFB1N60S

600V N-Channel MOSFET

FEATURES

- ❑ Originative New Design
- ❑ Superior Avalanche Rugged Technology
- ❑ Robust Gate Oxide Technology
- ❑ Very Low Intrinsic Capacitances
- ❑ Excellent Switching Characteristics
- ❑ Unrivalled Gate Charge : 3.0 nC (Typ.)
- ❑ Extended Safe Operating Area
- ❑ Lower $R_{DS(ON)}$: 10 Ω (Typ.) @ $V_{GS}=10V$
- ❑ 100% Avalanche Tested

$$BV_{DSS} = 600 \text{ V}$$

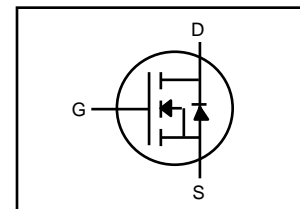
$$R_{DS(on) \text{ typ}} = 10 \ \Omega$$

$$I_D = 0.3 \text{ A}$$

TO-92



1.Gate 2. Drain 3. Source



Absolute Maximum Ratings $T_C=25^\circ\text{C}$ unless otherwise specified

Symbol	Parameter	Value	Units
V_{DSS}	Drain-Source Voltage	600	V
I_D	Drain Current – Continuous ($T_C = 25^\circ\text{C}$)	0.3	A
	Drain Current – Continuous ($T_C = 100^\circ\text{C}$)	0.18	A
I_{DM}	Drain Current – Pulsed (Note 1)	1.2	A
V_{GS}	Gate-Source Voltage	± 30	V
E_{AS}	Single Pulsed Avalanche Energy (Note 2)	33	mJ
I_{AR}	Avalanche Current (Note 1)	0.3	A
E_{AR}	Repetitive Avalanche Energy (Note 1)	0.3	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5	V/ns
P_D	Power Dissipation ($T_A = 25^\circ\text{C}$)	0.9	W
	Power Dissipation ($T_L = 25^\circ\text{C}$)	2.5	W
	- Derate above 25°C	0.02	W/ $^\circ\text{C}$
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to +150	$^\circ\text{C}$
T_L	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	300	$^\circ\text{C}$

Thermal Resistance Characteristics

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JL}$	Junction-to-Lead	--	50	$^\circ\text{C/W}$
$R_{\theta JA}$	Junction-to-Ambient	--	140	

Electrical Characteristics $T_C=25\text{ }^\circ\text{C}$ unless otherwise specified

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
On Characteristics						
V_{GS}	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$	2.0	--	4.0	V
$R_{DS(ON)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\ \text{V}, I_D = 0.15\ \text{A}$	--	10	12	Ω

Off Characteristics

BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS} = 0\ \text{V}, I_D = 250\ \mu\text{A}$	600	--	--	V
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$, Referenced to $25\text{ }^\circ\text{C}$	--	0.6	--	$\text{V}/^\circ\text{C}$
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 600\ \text{V}, V_{GS} = 0\ \text{V}$	--	--	50	μA
		$V_{DS} = 480\ \text{V}, T_C = 125\text{ }^\circ\text{C}$	--	--	250	μA
I_{GSSF}	Gate-Body Leakage Current, Forward	$V_{GS} = 30\ \text{V}, V_{DS} = 0\ \text{V}$	--	--	100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	$V_{GS} = -30\ \text{V}, V_{DS} = 0\ \text{V}$	--	--	-100	nA

Dynamic Characteristics

C_{iss}	Input Capacitance	$V_{DS} = 25\ \text{V}, V_{GS} = 0\ \text{V},$ $f = 1.0\ \text{MHz}$	--	130	170	pF
C_{oss}	Output Capacitance		--	22	29	pF
C_{rss}	Reverse Transfer Capacitance		--	5.0	6.5	pF

Switching Characteristics

$t_{d(on)}$	Turn-On Time	$V_{DS} = 300\ \text{V}, I_D = 1.0\ \text{A},$ $R_G = 25\ \Omega$ (Note 4,5)	--	7	24	ns
t_r	Turn-On Rise Time		--	21	52	ns
$t_{d(off)}$	Turn-Off Delay Time		--	13	36	ns
t_f	Turn-Off Fall Time		--	27	64	ns
Q_g	Total Gate Charge	$V_{DS} = 480\ \text{V}, I_D = 1.0\ \text{A},$ $V_{GS} = 10\ \text{V}$ (Note 4,5)	--	3.0	4.0	nC
Q_{gs}	Gate-Source Charge		--	0.5	--	nC
Q_{gd}	Gate-Drain Charge		--	1.3	--	nC

Source-Drain Diode Maximum Ratings and Characteristics

I_S	Continuous Source-Drain Diode Forward Current	--	--	0.3	A	
I_{SM}	Pulsed Source-Drain Diode Forward Current	--	--	1.2		
V_{SD}	Source-Drain Diode Forward Voltage	$I_S = 0.3\ \text{A}, V_{GS} = 0\ \text{V}$	--	--	1.4	V
t_{rr}	Reverse Recovery Time	$I_S = 1.0\ \text{A}, V_{GS} = 0\ \text{V}$ $di_F/dt = 100\ \text{A}/\mu\text{s}$ (Note 4)	--	190	--	ns
Q_{rr}	Reverse Recovery Charge		--	0.53	--	μC

Notes ;

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. $L=59\text{mH}, I_{AS}=1.0\text{A}, V_{DD}=50\text{V}, R_G=25\Omega$, Starting $T_J=25\text{ }^\circ\text{C}$
3. $I_{SD}\leq 0.3\text{A}, di/dt\leq 200\text{A}/\mu\text{s}, V_{DD}\leq BV_{DSS}$, Starting $T_J=25\text{ }^\circ\text{C}$
4. Pulse Test : Pulse Width $\leq 300\mu\text{s}$, Duty Cycle $\leq 2\%$
5. Essentially Independent of Operating Temperature

Typical Characteristics

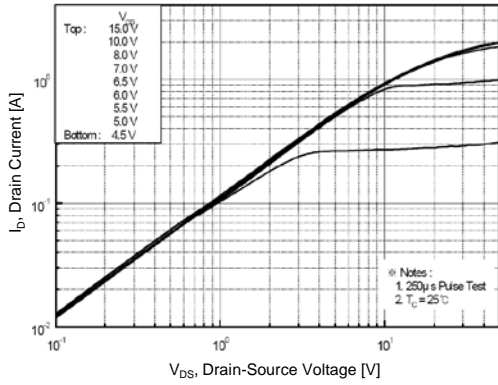


Figure 1. On Region Characteristics

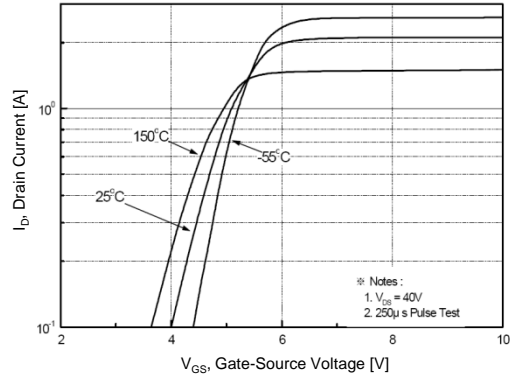


Figure 2. Transfer Characteristics

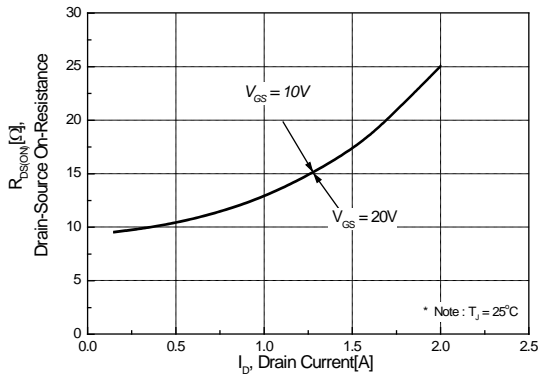


Figure 3. On Resistance Variation vs Drain Current and Gate Voltage

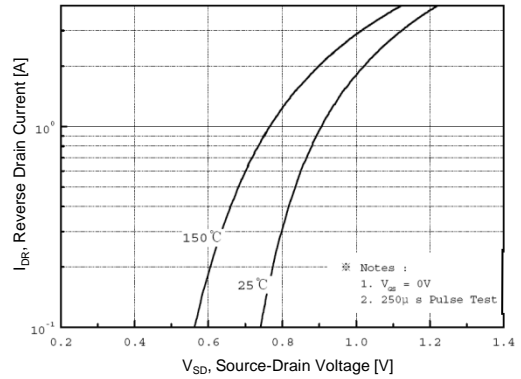


Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature

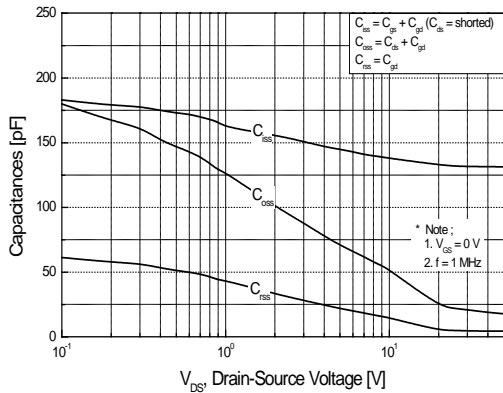


Figure 5. Capacitance Characteristics

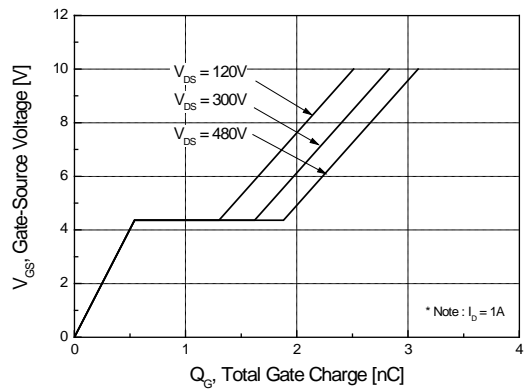


Figure 6. Gate Charge Characteristics

Typical Characteristics (continued)

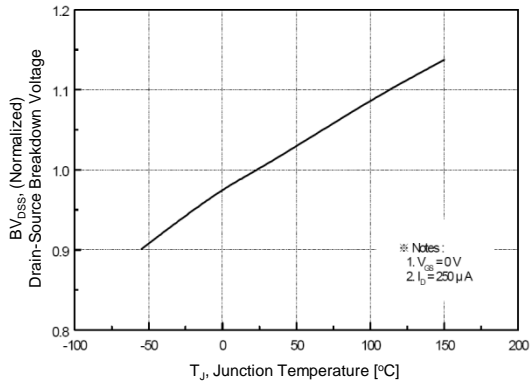


Figure 7. Breakdown Voltage Variation vs Temperature

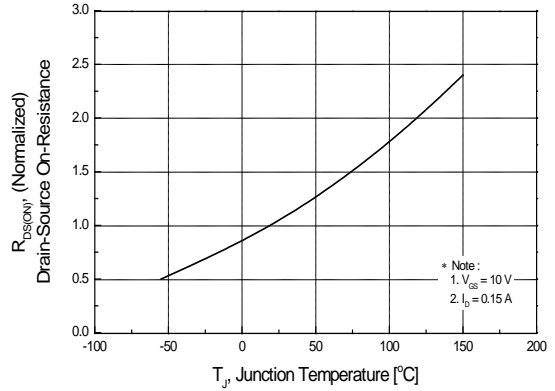


Figure 8. On-Resistance Variation vs Temperature

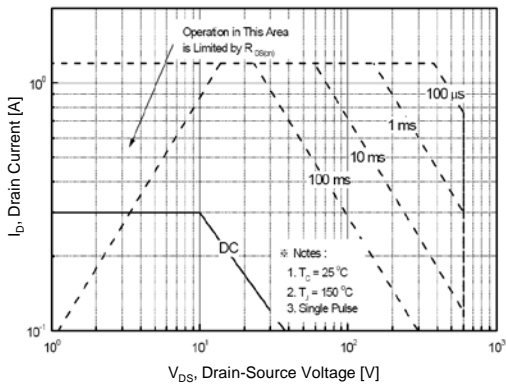


Figure 9. Maximum Safe Operating Area

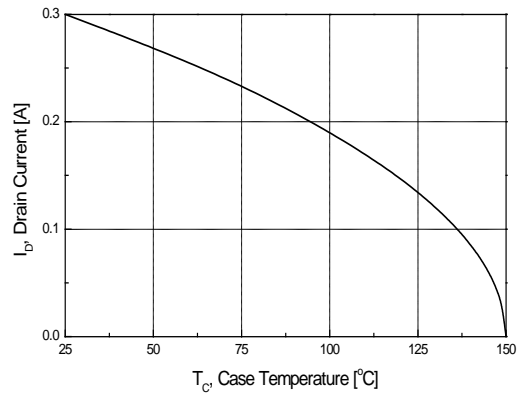


Figure 10. Maximum Drain Current vs Case Temperature

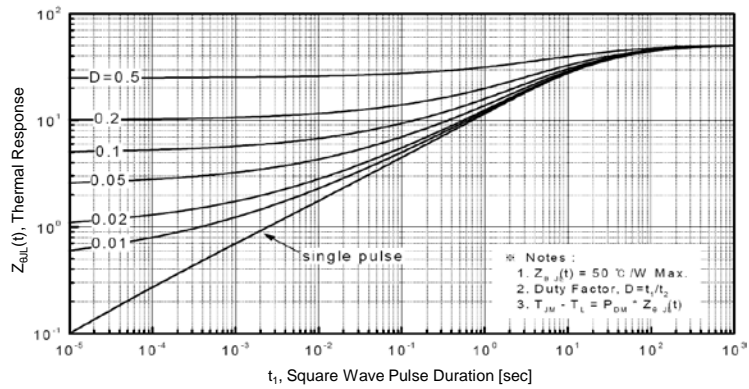


Figure 11. Transient Thermal Response Curve

Fig 12. Gate Charge Test Circuit & Waveform

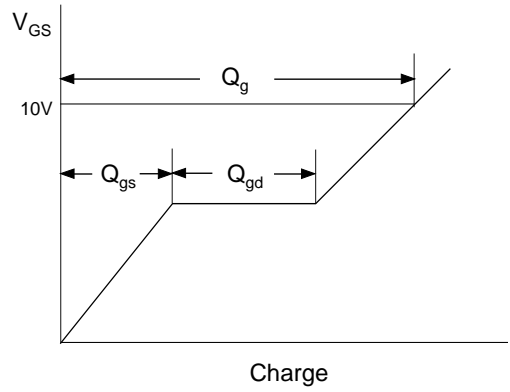
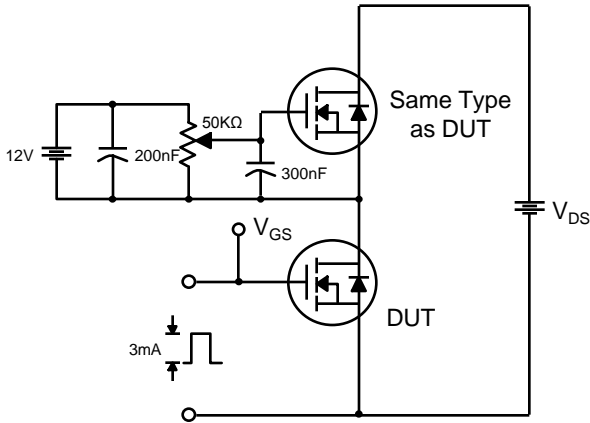


Fig 13. Resistive Switching Test Circuit & Waveforms

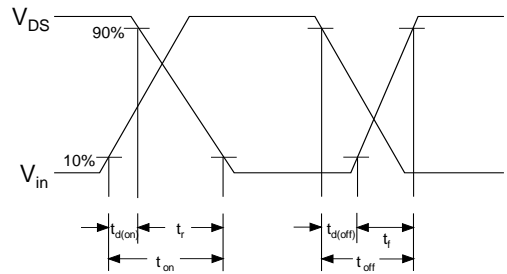
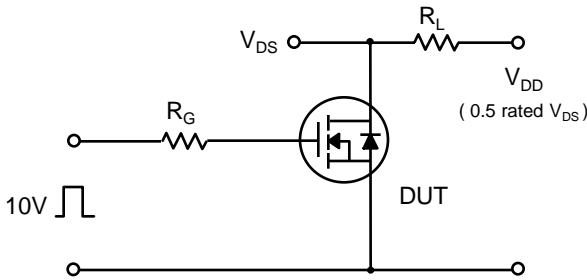


Fig 14. Unclamped Inductive Switching Test Circuit & Waveforms

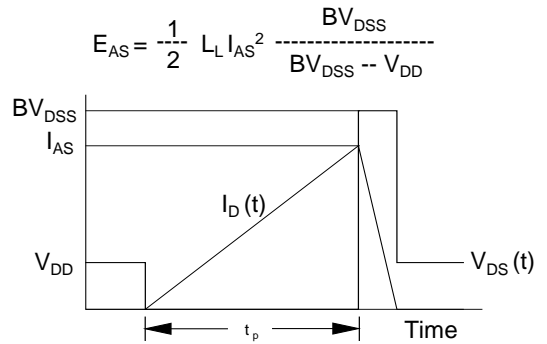
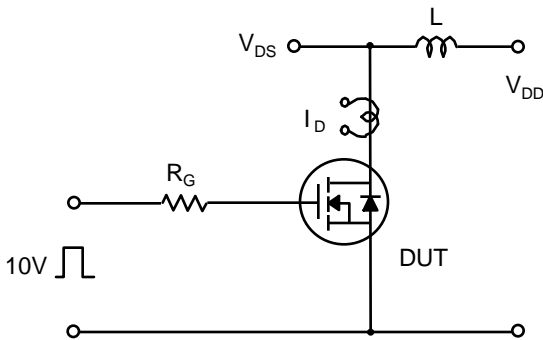
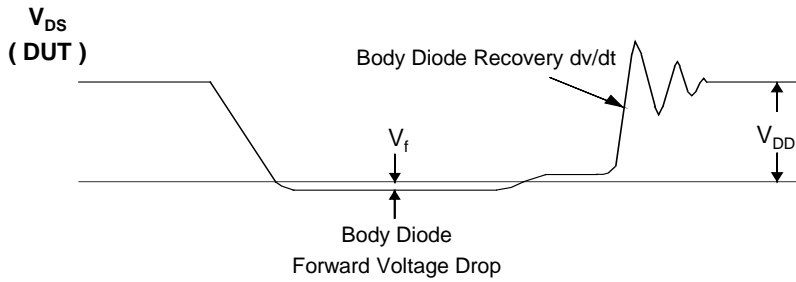
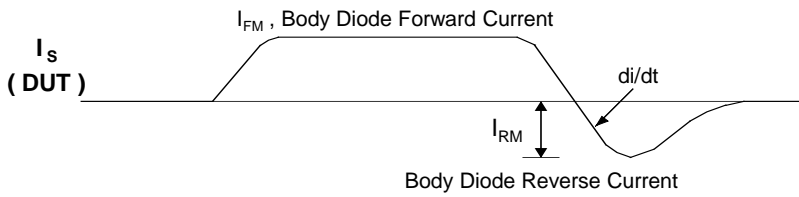
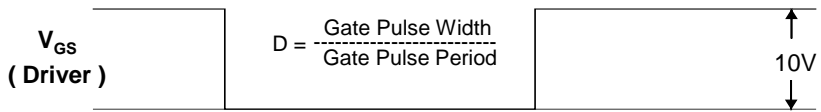
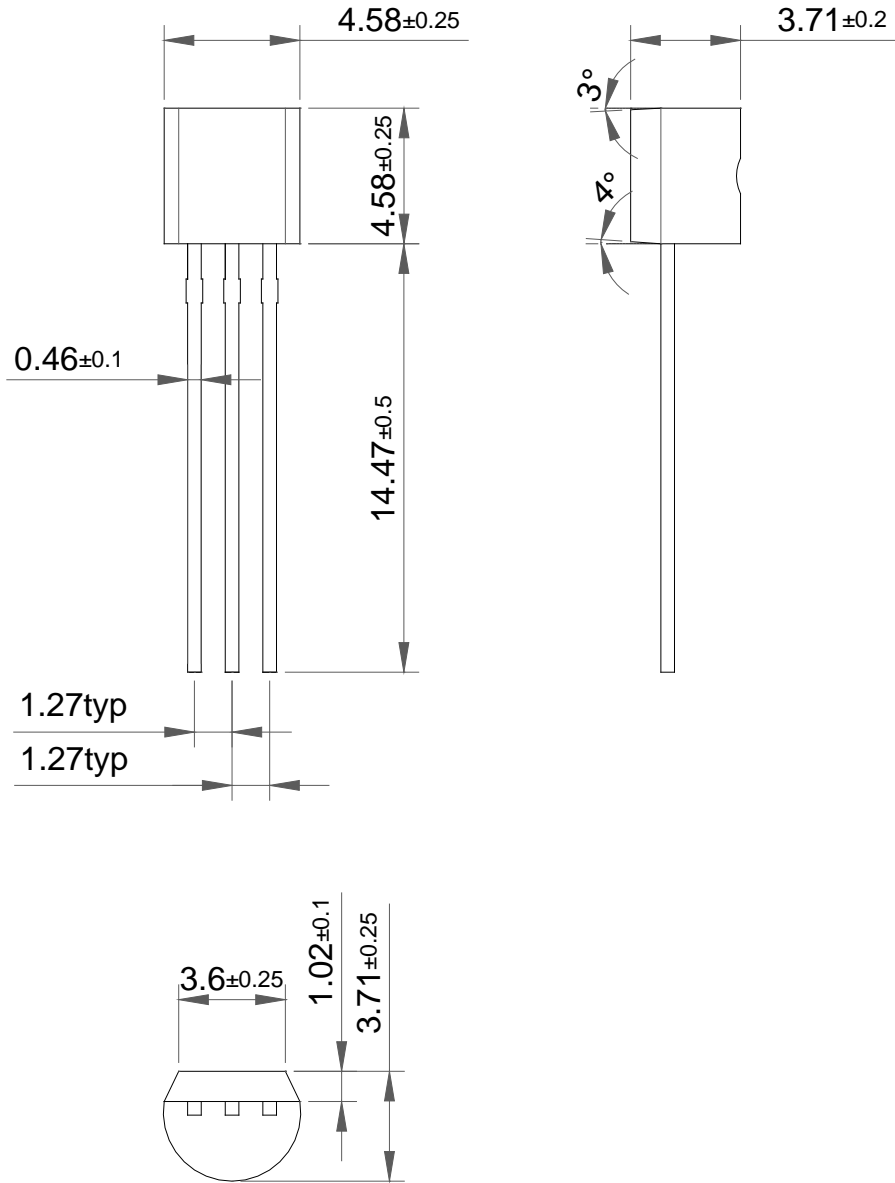


Fig 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms

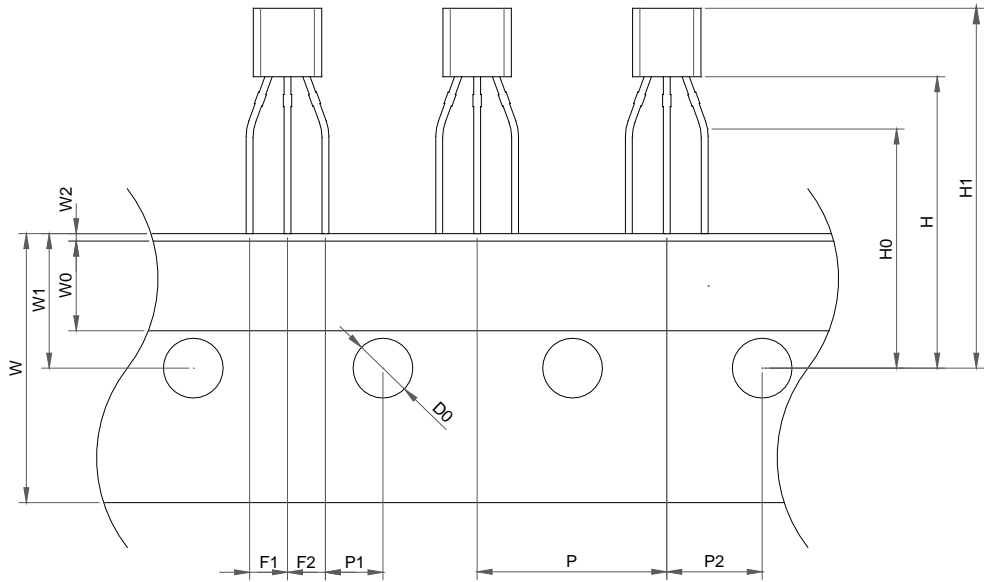


Package Dimension

TO-92



TO-92 TAPING



Item	Symbol	Dimension [mm]	
		Reference	Tolerance
Component pitch	P	12.7	±0.5
Side lead to center of feed hole	P1	3.85	±0.5
Center lead to center of feed hole	P2	6.35	±0.5
Lead pitch	F1,F2	2.5	+0.2/-0.1
Carrier Tape width	W	18.0	+1.0/-0.5
Adhesive tape width	W0	6.0	±0.5
Tape feed hole location	W1	9.0	±0.5
Adhesive tape position	W2	1.0 MAX	
Center of feed hole to bottom of component	H	19.5	±1
Center of feed hole to lead form	H0	16.0	±0.5
Component height	H1	27.0 max	
Tape feed hole diameter	D0	4.0	±0.2