FAIRCHILD
SEMICONDUCTOR®

May 2001

QFET™

FQPF50N06

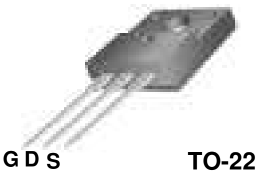
60V N-Channel MOSFET

General Description

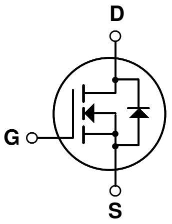
These N-Channel enhancement mode power field effect transistors are produced using Fairchild's proprietary, planar stripe, DMOS technology.
This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for low voltage applications such as automotive, DC/DC converters, and high efficiency switching for power management in portable and battery operated products.

Features

- 31A, 60V, $R_{DS(on)}$ = 0.022Ω @V_{GS} = 10 V
- Low gate charge (typical 31 nC)
- Low Crss (typical 65 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability
- 175°C maximum junction temperature rating



TO-220F
FQPF Series



Absolute Maximum Ratings T_C = 25°C unless otherwise noted

Symbol	Parameter	FQPF50N06	Units
V_{DSS}	Drain-Source Voltage	60	V
I_D	Drain Current - Continuous (T_C = 25°C)	31	A
	- Continuous (T_C = 100°C)	21.9	A
I_{DM}	Drain Current - Pulsed (Note 1)	124	A
V_{GSS}	Gate-Source Voltage	± 25	V
E_{AS}	Single Pulsed Avalanche Energy (Note 2)	495	mJ
I_{AR}	Avalanche Current (Note 1)	31	A
E_{AR}	Repetitive Avalanche Energy (Note 1)	4.7	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	7.0	V/ns
P_D	Power Dissipation (T_C = 25°C)	47	W
	- Derate above 25°C	0.31	W/°C
T_J, T_{STG}	Operating and Storage Junction Temperature Range	-55 to +175	°C
T_L	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	300	°C

Thermal Characteristics

Symbol	Parameter	Typ	Max	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	--	3.22	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	--	62.5	°C/W

Electrical Characteristics

$T_C = 25°C$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Off Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS} = 0$ V, $I_D = 250$ µA	60	--	--	V
ΔBV_{DSS} / ΔT_J	Breakdown Voltage Temperature Coefficient	$I_D = 250$ µA, Referenced to 25°C	--	0.06	--	V/°C
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 60$ V, $V_{GS} = 0$ V	--	--	1	µA
		$V_{DS} = 48$ V, $T_C = 150°C$	--	--	10	µA
I_{GSSF}	Gate-Body Leakage Current, Forward	$V_{GS} = 25$ V, $V_{DS} = 0$ V	--	--	100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	$V_{GS} = -25$ V, $V_{DS} = 0$ V	--	--	-100	nA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$, $I_D = 250$ µA	2.0	--	4.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10$ V, $I_D = 15.5$ A	--	0.018	0.022	Ω
g_{FS}	Forward Transconductance	$V_{DS} = 25$ V, $I_D = 15.5$ A (Note 4)	--	19	--	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	$V_{DS} = 25$ V, $V_{GS} = 0$ V, f = 1.0 MHz	--	1180	1540	pF
C_{oss}	Output Capacitance		--	440	580	pF
C_{rss}	Reverse Transfer Capacitance		--	65	90	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 30$ V, $I_D = 25$ A, $R_G = 25$ Ω (Note 4, 5)	--	15	40	ns
t_r	Turn-On Rise Time		--	105	220	ns
$t_{d(off)}$	Turn-Off Delay Time		--	60	130	ns
t_f	Turn-Off Fall Time		--	65	140	ns
Q_g	Total Gate Charge	$V_{DS} = 48$ V, $I_D = 50$ A, $V_{GS} = 10$ V (Note 4, 5)	--	31	41	nC
Q_{gs}	Gate-Source Charge		--	8	--	nC
Q_{gd}	Gate-Drain Charge		--	13	--	nC
Drain-Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain-Source Diode Forward Current		--	--	31	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	124	A
V_{SD}	Drain-Source Diode Forward Voltage	$V_{GS} = 0$ V, $I_S = 31$ A	--	--	1.5	V
t_{rr}	Reverse Recovery Time	$V_{GS} = 0$ V, $I_S = 50$ A, $dI_F / dt = 100$ A/µs (Note 4)	--	52	--	ns
Q_{rr}	Reverse Recovery Charge		--	75	--	nC

Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. L = 600µH, $I_{AS} = 31$A, $V_{DD} = 25$V, $R_G = 25$ Ω, Starting $T_J = 25°C$
3. $I_{SD} \leq 50$A, di/dt $\leq$ 300A/µs, $V_{DD} \leq BV_{DSS}$, Starting $T_J = 25°C$
4. Pulse Test : Pulse width $\leq$ 300µs, Duty cycle $\leq$ 2%
5. Essentially independent of operating temperature

Typical Characteristics

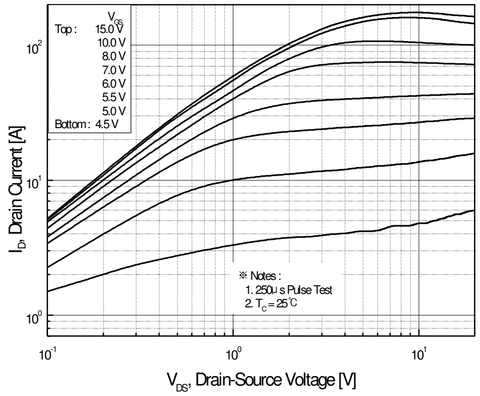


Figure 1. On-Region Characteristics

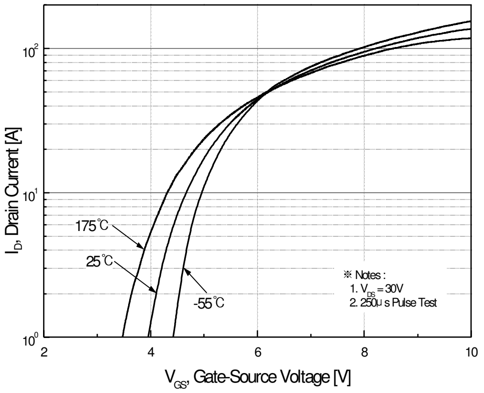


Figure 2. Transfer Characteristics

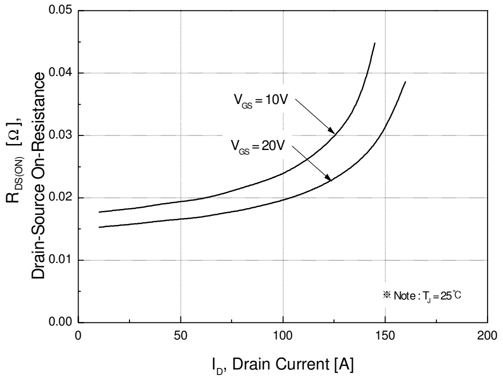


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

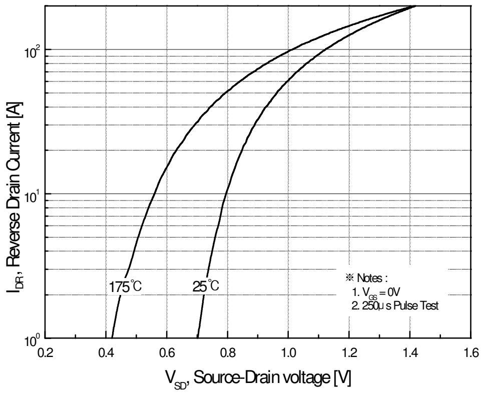


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

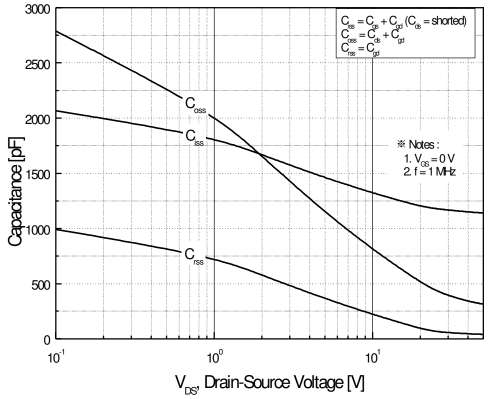


Figure 5. Capacitance Characteristics

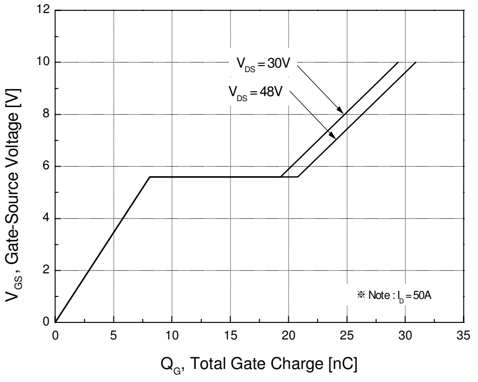


Figure 6. Gate Charge Characteristics

Typical Characteristics (Continued)

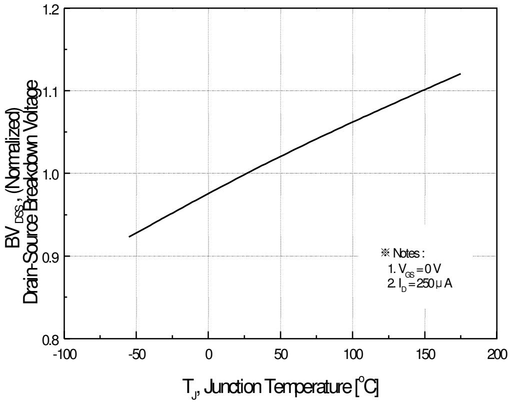


Figure 7. Breakdown Voltage Variation vs. Temperature

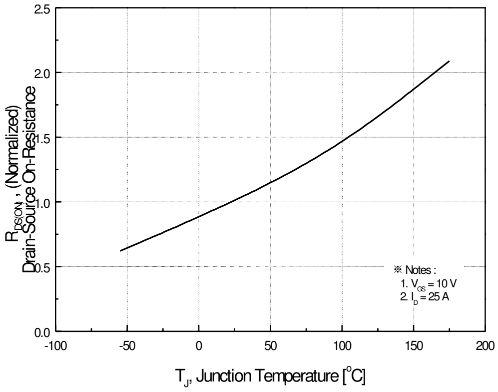


Figure 8. On-Resistance Variation vs. Temperature

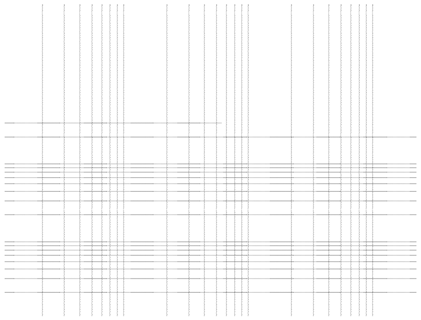


Figure 9. Maximum Safe Operating Area

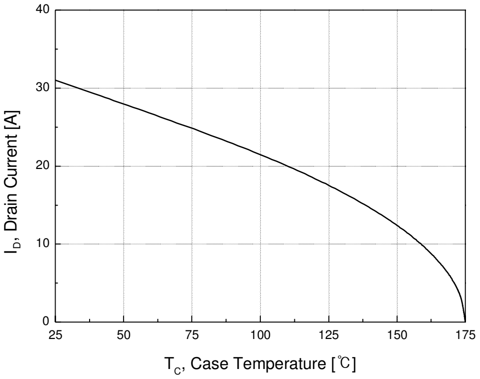


Figure 10. Maximum Drain Current vs. Case Temperature

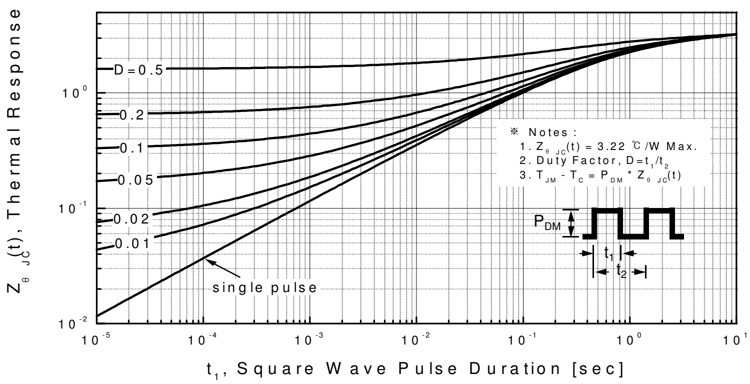
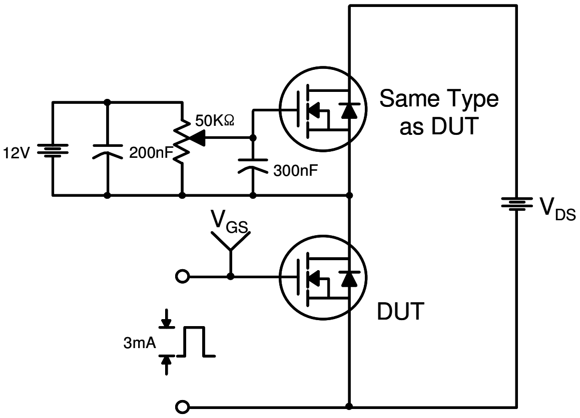
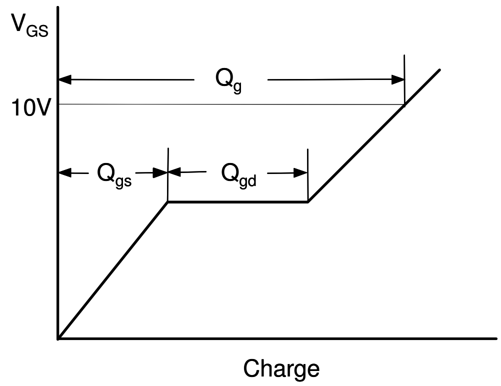


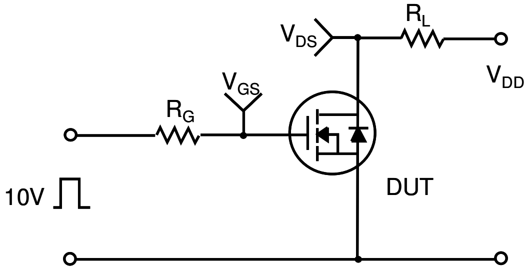
Figure 11. Transient Thermal Response Curve

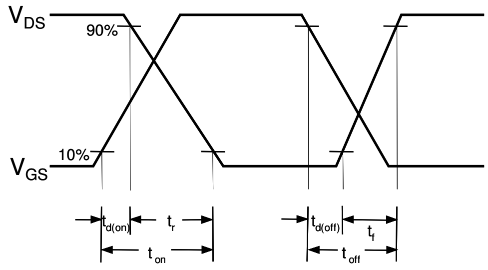
Gate Charge Test Circuit & Waveform



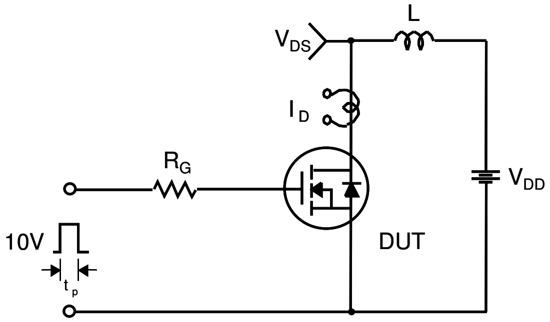


Resistive Switching Test Circuit & Waveforms

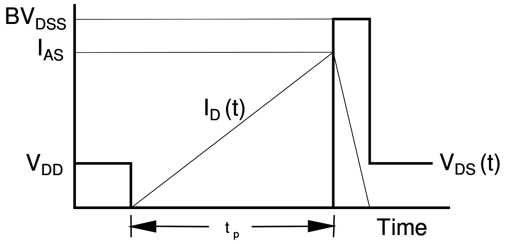




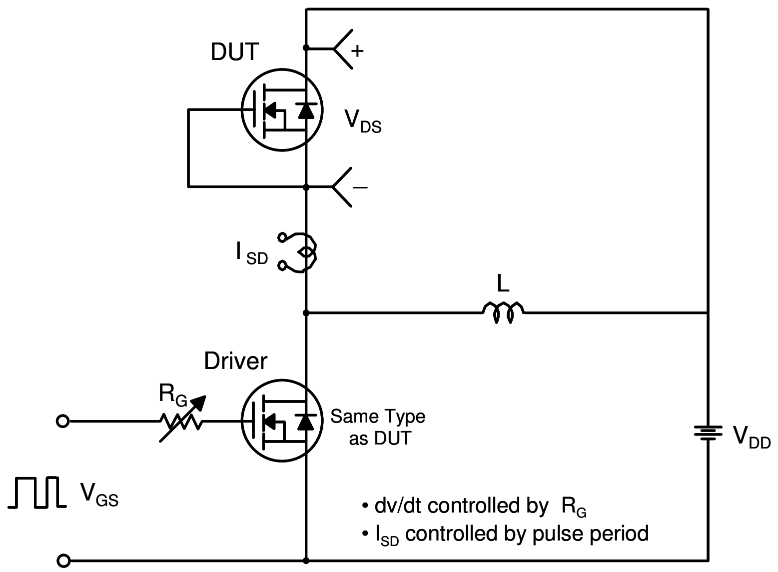
Unclamped Inductive Switching Test Circuit & Waveforms

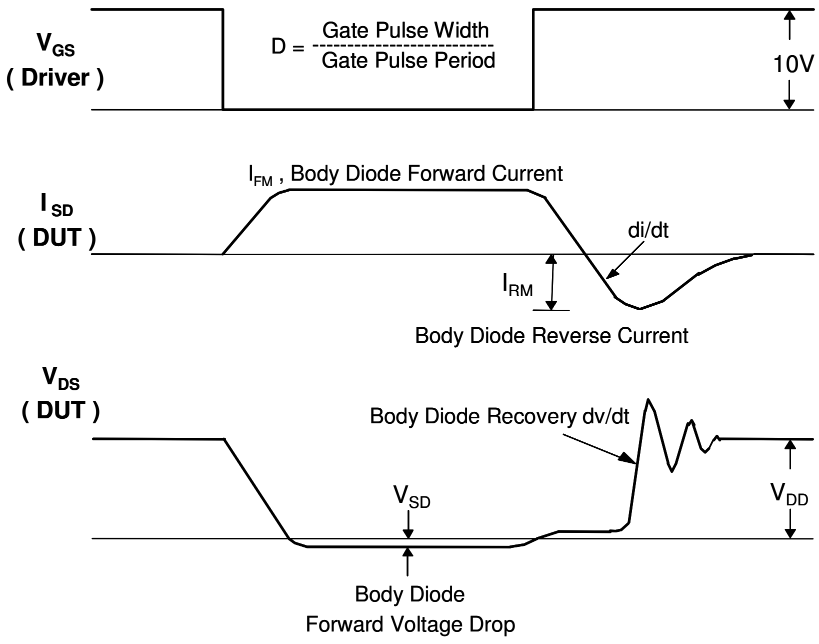


$$E_{AS} = \frac{1}{2} L I_{AS}^2 \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$



Peak Diode Recovery dv/dt Test Circuit & Waveforms





Package Dimensions

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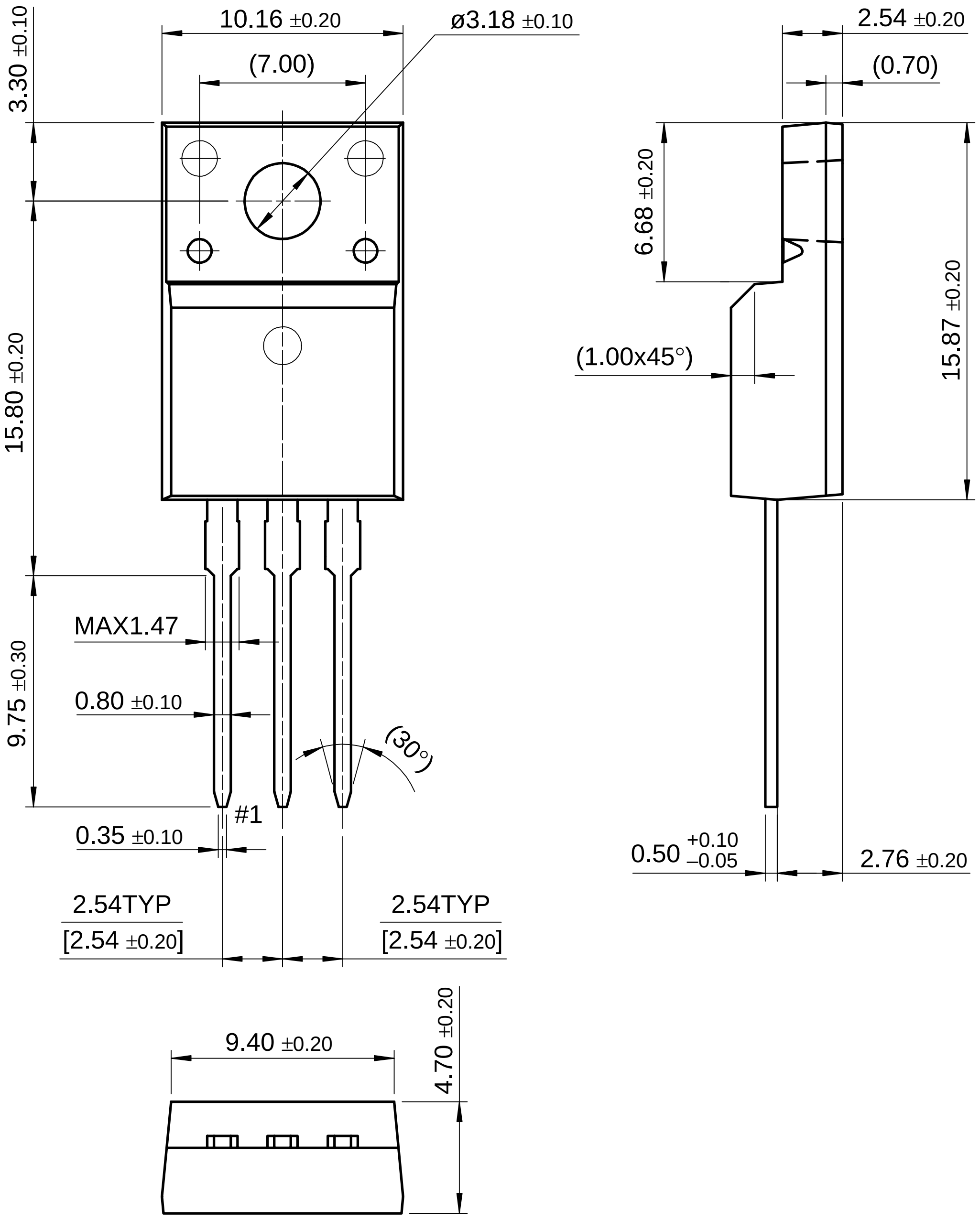

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