Fox Delta

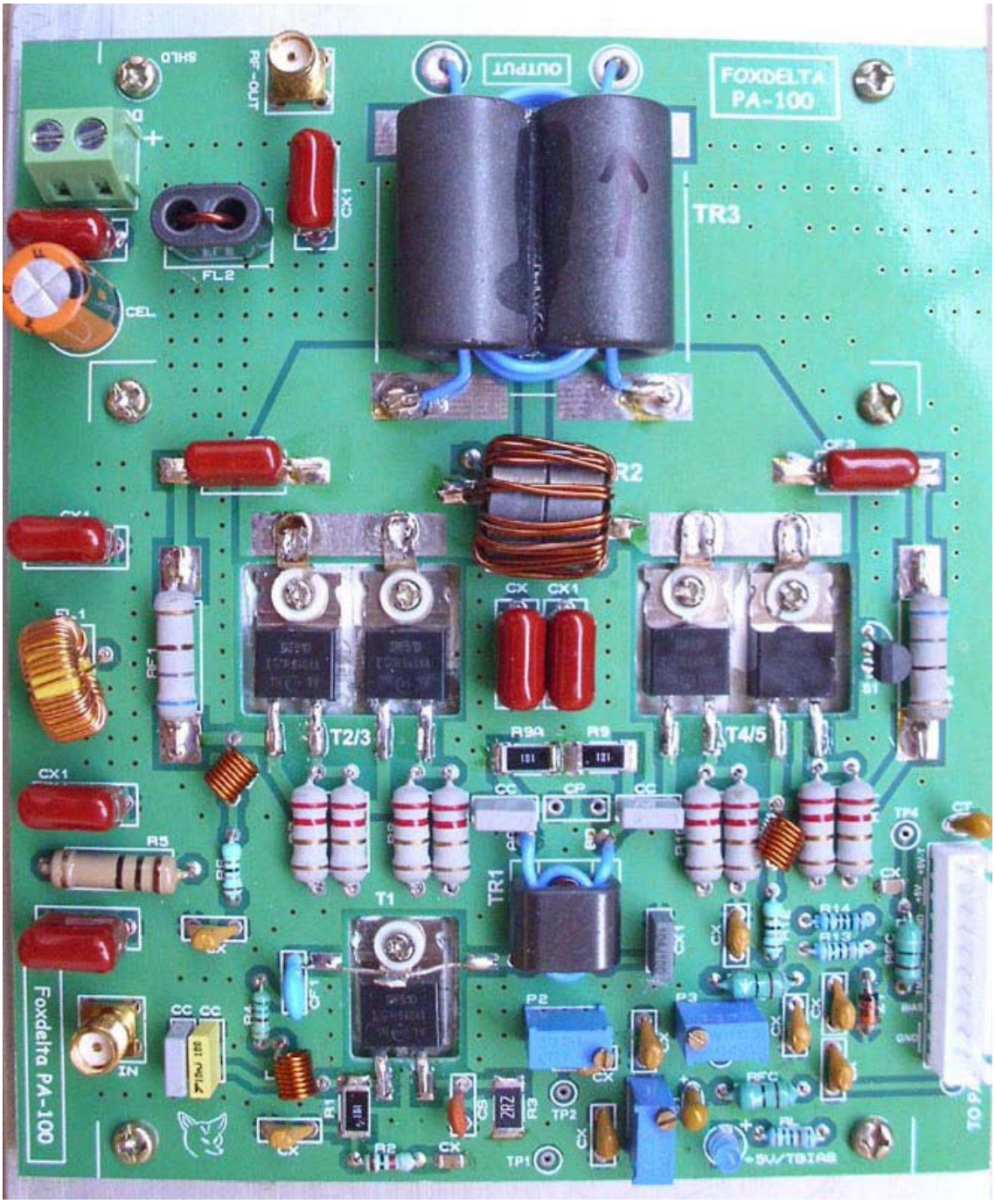
Amateur Radio Projects & Kits

PA 100

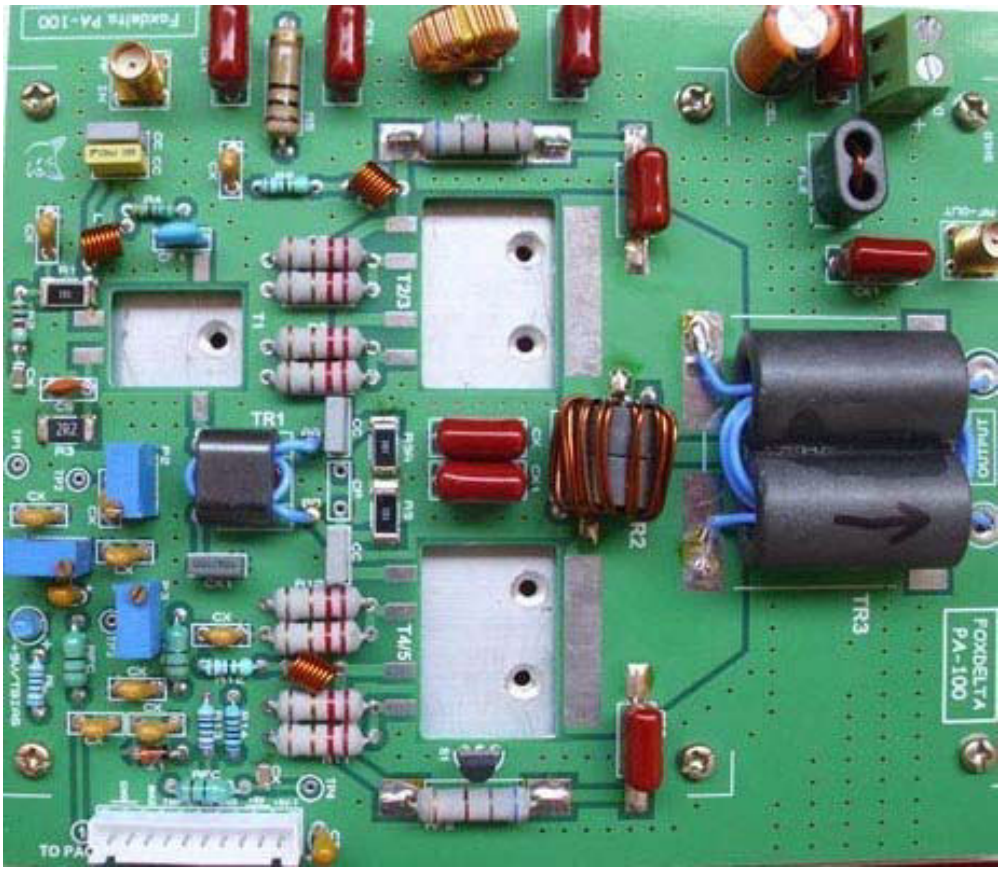
Tech Info Doc: 4 x IRF510 100W HF POWER AMPLIFIER: DC 24V to 36V

PA-100: 100W RF POWER AMPLIFIER FOR HAM RADIO DIY

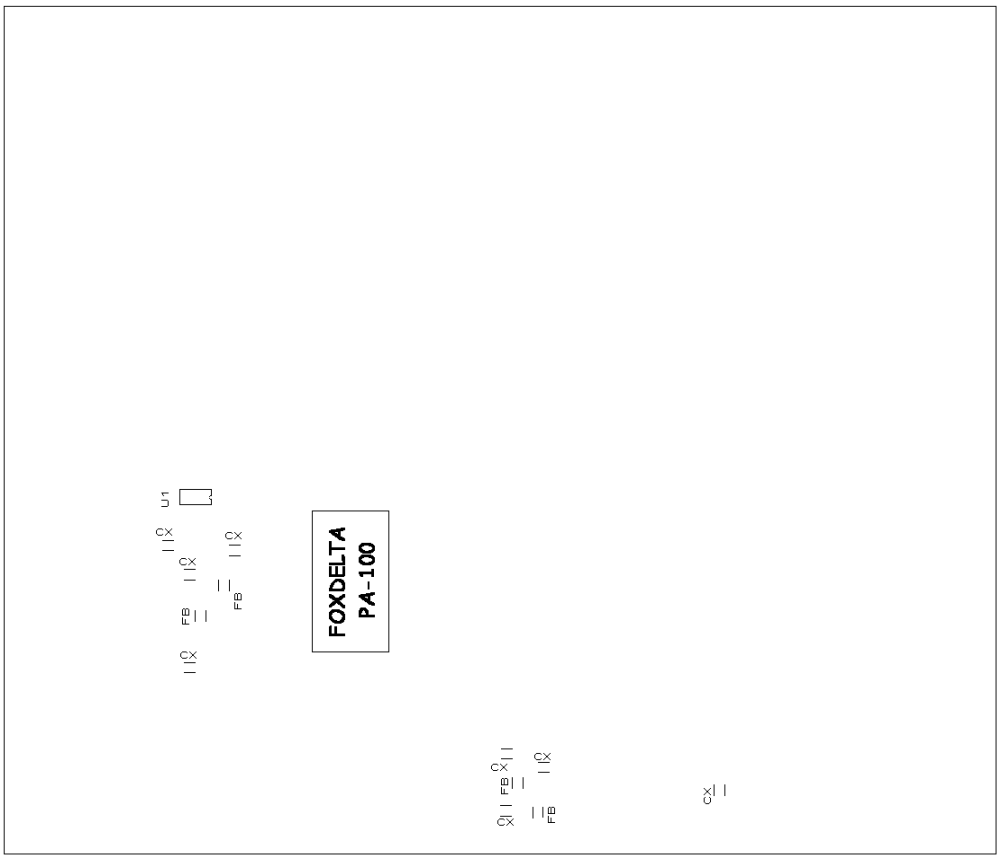
Completed board 100W Power Amplifier Board:



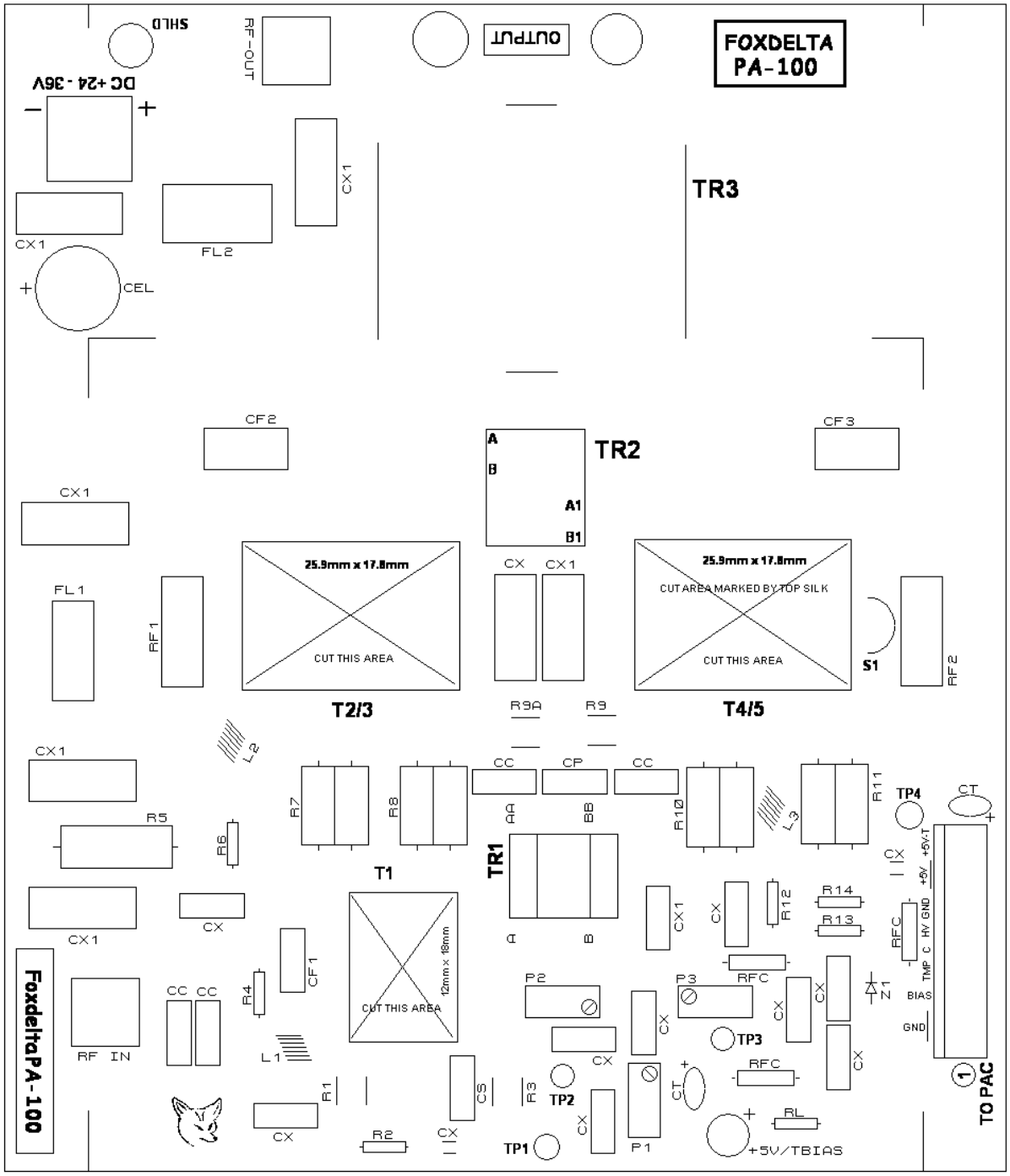
100W Power Amplifier Board without IRF FETs:



PA100 BTM SIDE SILK VIEW:



PA100 TOP SIDE SILK VIEW:



TP1 = Measure bias voltage for T1
TP2 = Measure bias voltage for T2/3
TP3 = Measure bias voltage for T4/5

PA 100 DIY KIT Parts List:

Quantity	Part ID	Details
5*	T1, 2, 3, 4, 5	IRF510 (Kits available without FETs)
1	FL1	80uH filter Toroid x 1 piece
1	FL2, TR1	Fair-rite 2843000302 x 2 pieces
1	TR3	Fair-rite 2643625102 X 2pieces
1	TR2	Fair-rite 5943001102 L 2 Stacked
2	SMA	PCB/Sreight/Female Connectors
1	Power Terminal	2PIN Screw Terminal Type 5002
1	SIL10 Male PCB	Control Connector 10-PIN Male & a 15cm long ribbon with female 10SIL
3	L1, 2, 3	7turn air inductors
3	P1, 2, 3	10K 10Turn Presets
1	PCB	PA-100 DSPTH FR4 PCB
1	Heat sink	125mm x 190mm x 10mm (Thick)
1	S1	MCP9700 Temp sensor TO92
1	U1	ACS712-12 Current Sensor
1 set	Set	Hardware for PCB to Heat sink
1 set	TR3 Wire	Teflon wire for 3:2 turns
1 set	TR2, TR2	Copper & tefoln wires
1	LED	3mm (indicates “T” +5V)

Resistors –

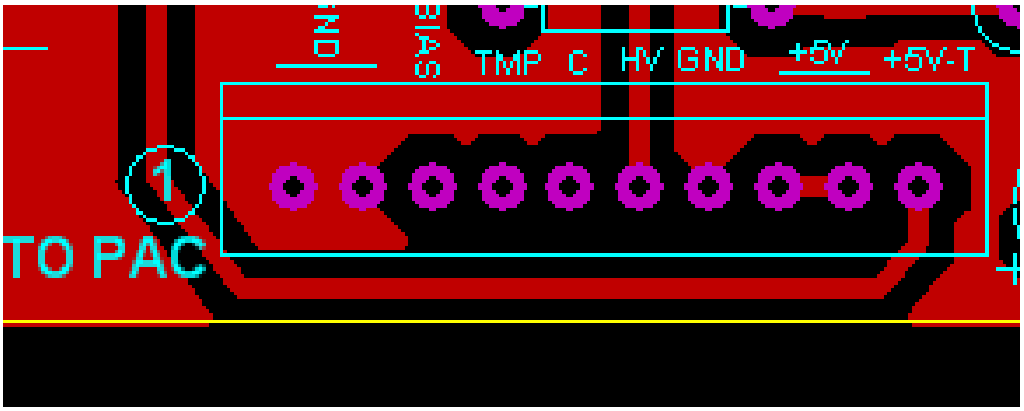
Quantity	Part ID	Details
8	R7, 8, 10, 11	2.2 ohms 2W
2	RF1, 2	680 ohms 2W
1	R5	10 Ohms 2W
1	R1	2225 100 ohms x 2 Stacked
1	R2, R13	1k 1/4w
1	R4	560 ohm 1/4w
1	R3	2225 2.2 ohms
2	R6, 12	27 ohms 1/4w
1	R14	10K 1/4w
1	RL	1K 1/4w (For LED)

Capacitors:

Quantity	Part ID	Details
7	CX1	100nf 400V
2	CF2, CF3	10nf 400V
1	CF1	10nf 400V
5	CC, CX1	100nf 100V
10	CX	100nf 50V
9	CX 1206	100nf SMT
1	CS	510pf Ceramic
4	FB 1206	Ferrite bead
1	CT	1uf Tantalum

ALL SMD parts are pre-soldered for kits

PA 100 CONTROL CONNECTOR PINOUTS:



SIL 10PIN MALE SOCKET FOR EXTERNAL CONNECTIONS		
PIN No	**Purpose**	**Use**
1	GROUND	COMMON
2	GROUND	
3	Bias Measure T4/5	Set Bias for FET: 3.5 to 3.8V: OUTPUT
4	Temp Measure	MCP9700 output chart: OUTPUT
5	PA CURRENT MEASURE	ACS712 –12A Chart: OUTPUT
6	PA HIGH VOLTAGE MEASURE	10k/1k Fix divider: OUTPUT
7	GROUND	COMMON
8	+5V INPUT	+5V to PA BOARD: INPUT
9		
10	+5V ON TX	+5V on transmit: INPUT

User to supply following essentials:

1. 24 to 36V DC Power supply: Appox 3- 5A
2. +5V to PA Board at SIL10: #9
3. +5V Transmit voltage at SIL10: #10

Must:

1. A good LPF at output of PA for band of operation
2. Ensure not to over drive PA: Max 2W input on most band
3. Ensure good fixing of FETs to heat sink using MICA insulators and thermal paste
4. TEMP, CUR, HV and BIAS Outputs are for measurement purpose
5. +5V and +5V Tx are INPUTS

73s
Dinesh Gajjar / 241024

Signature Not Verified
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Advanced Power MOSFET

IRF510A

FEATURES

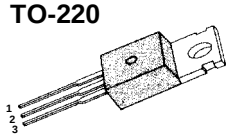
- Avalanche Rugged Technology
- Rugged Gate Oxide Technology
- Lower Input Capacitance
- Improved Gate Charge
- Extended Safe Operating Area
- 175°C Operating Temperature
- Lower Leakage Current : 10 μA (Max.) @ V_{DS} = 100V
- Lower $R_{DS(ON)}$: 0.289 Ω (Typ.)

BV_{DSS} = 100 V

$R_{DS(on)}$ = 0.4 Ω

I_D = 5.6 A

TO-220



1.Gate 2. Drain 3. Source

Absolute Maximum Ratings

Symbol	Characteristic	Value	Units
V_{DSS}	Drain-to-Source Voltage	100	V
I_D	Continuous Drain Current (T_C=25℃)	5.6	A
	Continuous Drain Current (T_C=100℃)	4	
I_{DM}	Drain Current-Pulsed (1)	20	A
V_{GS}	Gate-to-Source Voltage	±20	V
E_{AS}	Single Pulsed Avalanche Energy (2)	63	mJ
I_{AR}	Avalanche Current (1)	5.6	A
E_{AR}	Repetitive Avalanche Energy (1)	3.3	mJ
dv/dt	Peak Diode Recovery dv/dt (2)	6.5	V/ns
P_D	Total Power Dissipation (T_C=25℃)	33	W
	Linear Derating Factor	0.22	W/°C
T_J , T_{STG}	Operating Junction and Storage Temperature Range	- 55 to +175	°C
T_L	Maximum Lead Temp. for Soldering Purposes, 1/8? from case for 5-seconds	300	

Thermal Resistance

Symbol	Characteristic	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	--	4.51	°C/W
$R_{\theta CS}$	Case-to-Sink	0.5	--	
$R_{\theta JA}$	Junction-to-Ambient	--	62.5	

FAIRCHILD SEMICONDUCTOR®

Rev. B1

Electrical Characteristics (T_C=25°C unless otherwise specified)

Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Condition
BV_{DSS}	Drain-Source Breakdown Voltage	100	--	--	V	V_{GS}=0V,I_D=250μA
$\Delta BV/\Delta T_J$	Breakdown Voltage Temp. Coeff.	--	0.11	--	V/°C	I_D=250μA ***See Fig 7***
$V_{GS(th)}$	Gate Threshold Voltage	2.0	--	4.0	V	V_{DS}=5V,I_D=250μA
I_{GSS}	Gate-Source Leakage , Forward	--	--	100	nA	V_{GS}=20V
	Gate-Source Leakage , Reverse	--	--	-100		V_{GS}=-20V
I_{DSS}	Drain-to-Source Leakage Current	--	--	10	μA	V_{DS}=100V
		--	--	100		V_{DS}=80V,T_C=150°C
$R_{DS(on)}$	Static Drain-Source On-State Resistance	--	--	0.4	Ω	V_{GS}=10V,I_D=2.8A (4)
g_{fs}	Forward Transconductance	--	3.49	--	S	V_{DS}=40V,I_D=2.8A (4)
C_{iss}	Input Capacitance	--	190	240	pF	V_{GS}=0V,V_{DS}=25V,f =1MHz ***See Fig 5***
C_{oss}	Output Capacitance	--	55	65		
C_{rss}	Reverse Transfer Capacitance	--	21	25		
$t_{d(on)}$	Turn-On Delay Time	--	10	30	ns	V_{DD}=50V,I_D=5.6A, R_G=24Ω ***See Fig 13*** (4)(5)
t_r	Rise Time	--	14	40		
$t_{d(off)}$	Turn-Off Delay Time	--	28	70		
t_f	Fall Time	--	18	50		
Q_g	Total Gate Charge	--	8.5	12	nC	V_{DS}=80V,V_{GS}=10V, I_D=5.6A ***See Fig 6 & Fig 12*** (4)(5)
Q_{gs}	Gate-Source Charge	--	1.6	--		
Q_{gd}	Gate-Drain (“Miller”) Charge	--	4.1	--		

Source-Drain Diode Ratings and Characteristics

Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Condition
I_S	Continuous Source Current	--	--	5.6	A	Integral reverse pn-diode in the MOSFET
I_{SM}	Pulsed-Source Current (1)	--	--	20		
V_{SD}	Diode Forward Voltage (4)	--	--	1.5	V	T_J=25°C,I_S=5.6A,V_{GS}=0V
t_{rr}	Reverse Recovery Time	--	85	--	ns	T_J=25°C,I_F=5.6A di_F/dt=100A/μs (4)
Q_{rr}	Reverse Recovery Charge	--	0.23	--	μC	

Notes ;

(1) Repetitive Rating : Pulse Width Limited by Maximum Junction Temperature

(2) L=3mH, I_{AS}=5.6A, V_{DD}=25V, R_G=27Ω, Starting T_J=25°C

(3) $I_{SD} \leq$ 5.6A, di/dt ≤ 250A/μs, $V_{DD} \leq BV_{DSS}$, Starting T_J=25°C

(4) Pulse Test : Pulse Width = 250μs, Duty Cycle ≤ 2%

(5) Essentially Independent of Operating Temperature

Fig 1. Output Characteristics

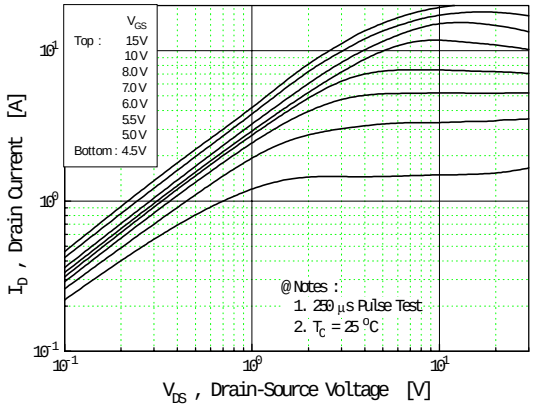


Fig 2. Transfer Characteristics

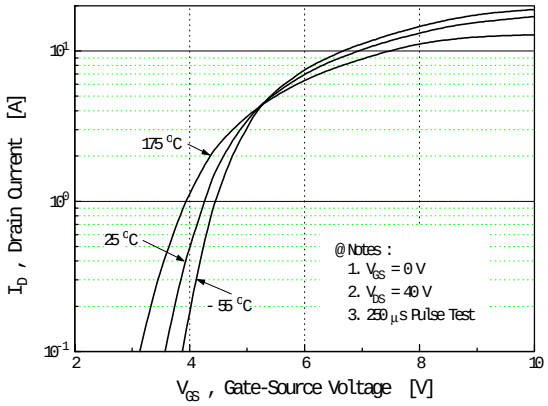


Fig 3. On-Resistance vs. Drain Current

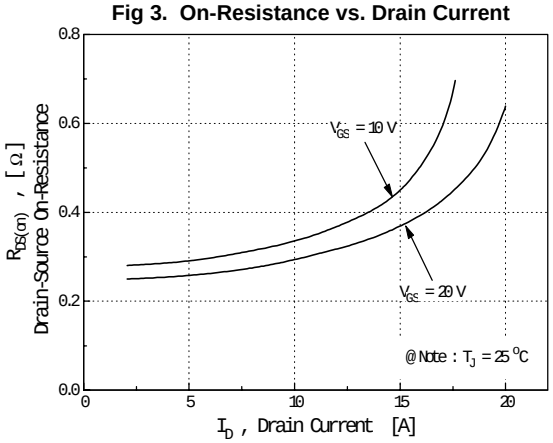


Fig 4. Source-Drain Diode Forward Voltage

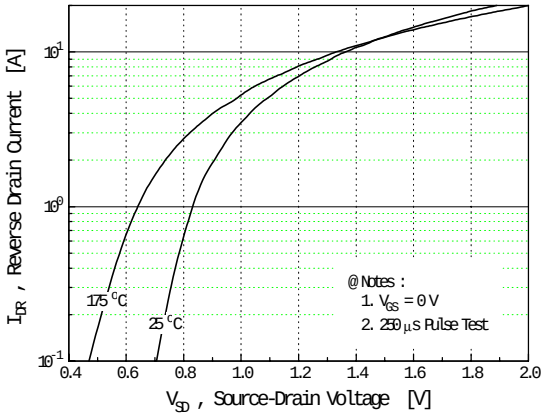


Fig 5. Capacitance vs. Drain-Source Voltage

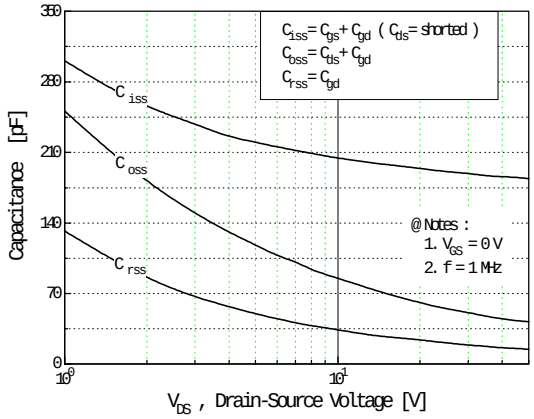


Fig 6. Gate Charge vs. Gate-Source Voltage

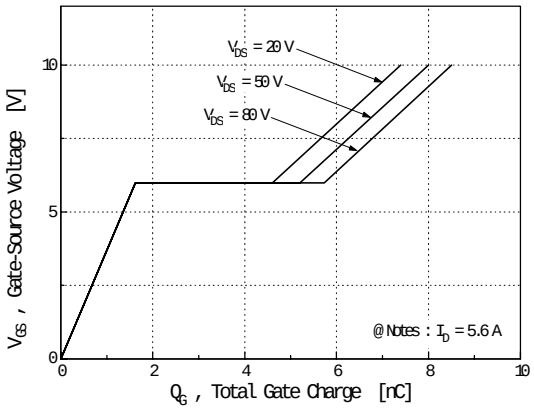


Fig 7. Breakdown Voltage vs. Temperature

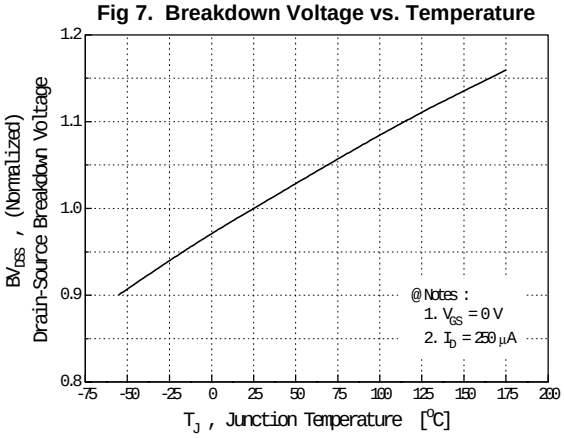


Fig 8. On-Resistance vs. Temperature

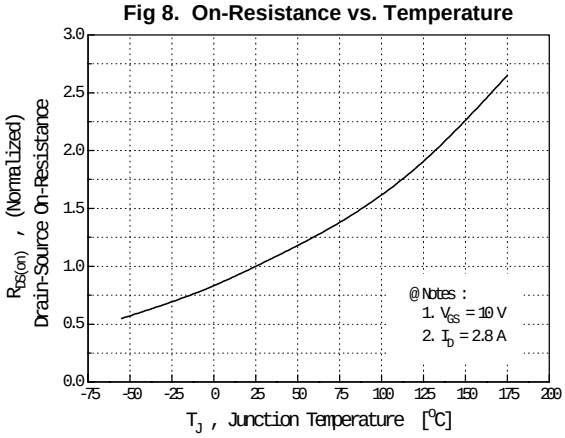


Fig 9. Max. Safe Operating Area

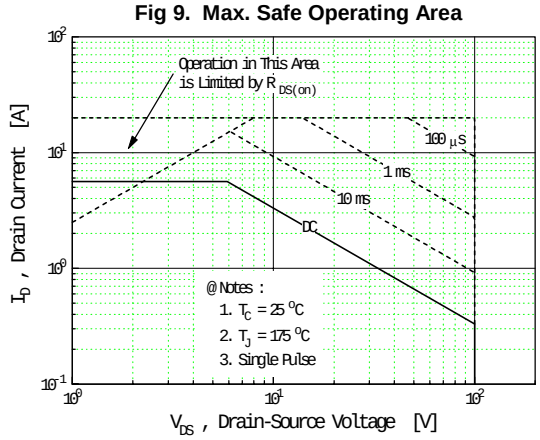


Fig 10. Max. Drain Current vs. Case Temperature

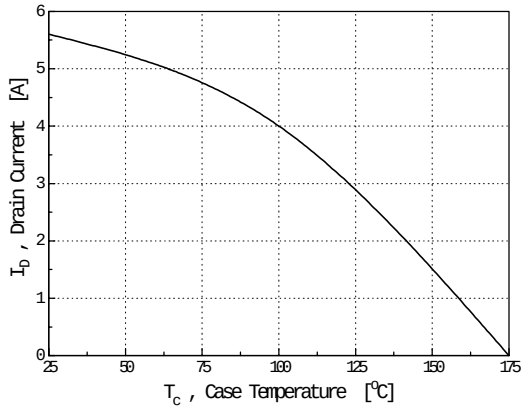


Fig 11. Thermal Response

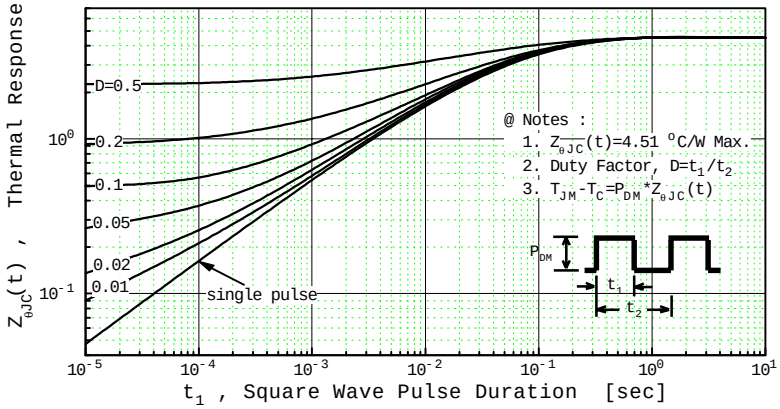


Fig 12. Gate Charge Test Circuit & Waveform

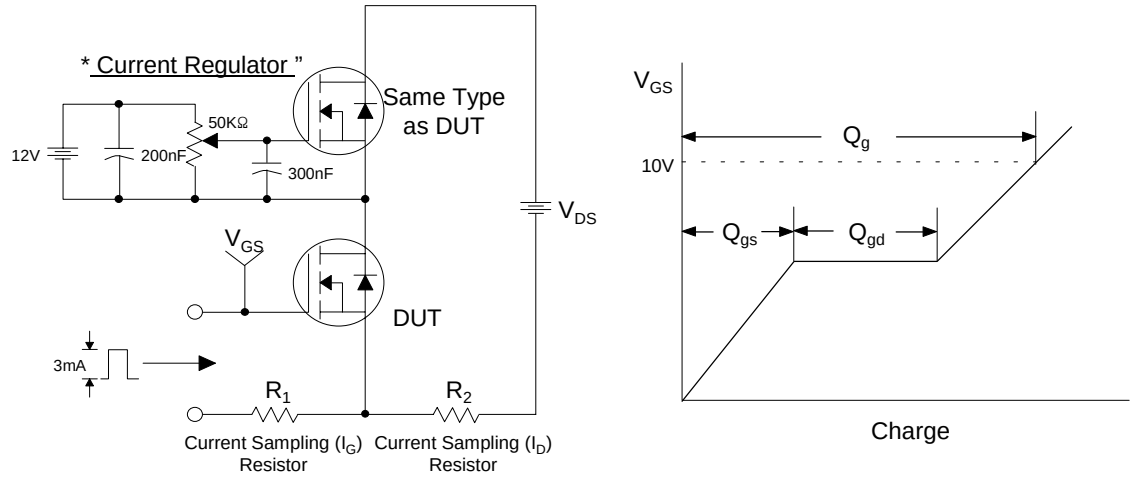


Fig 13. Resistive Switching Test Circuit & Waveforms

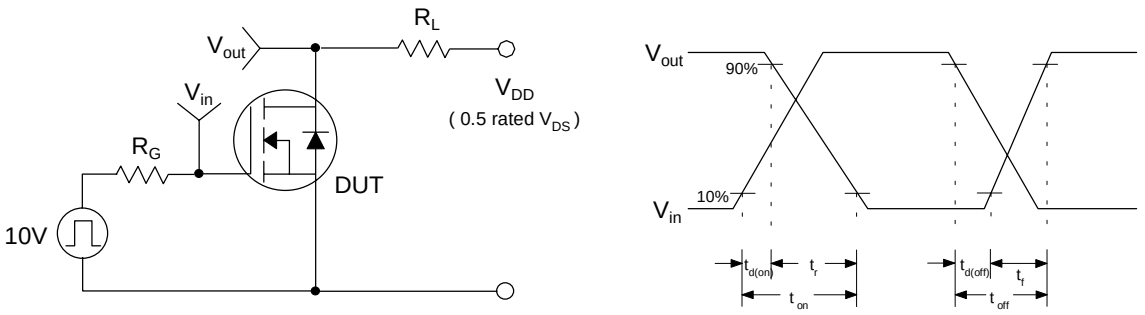


Fig 14. Unclamped Inductive Switching Test Circuit & Waveforms

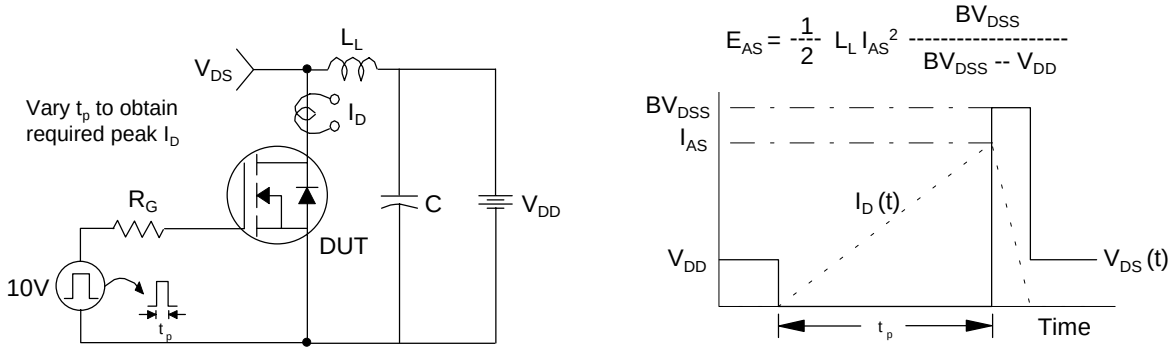
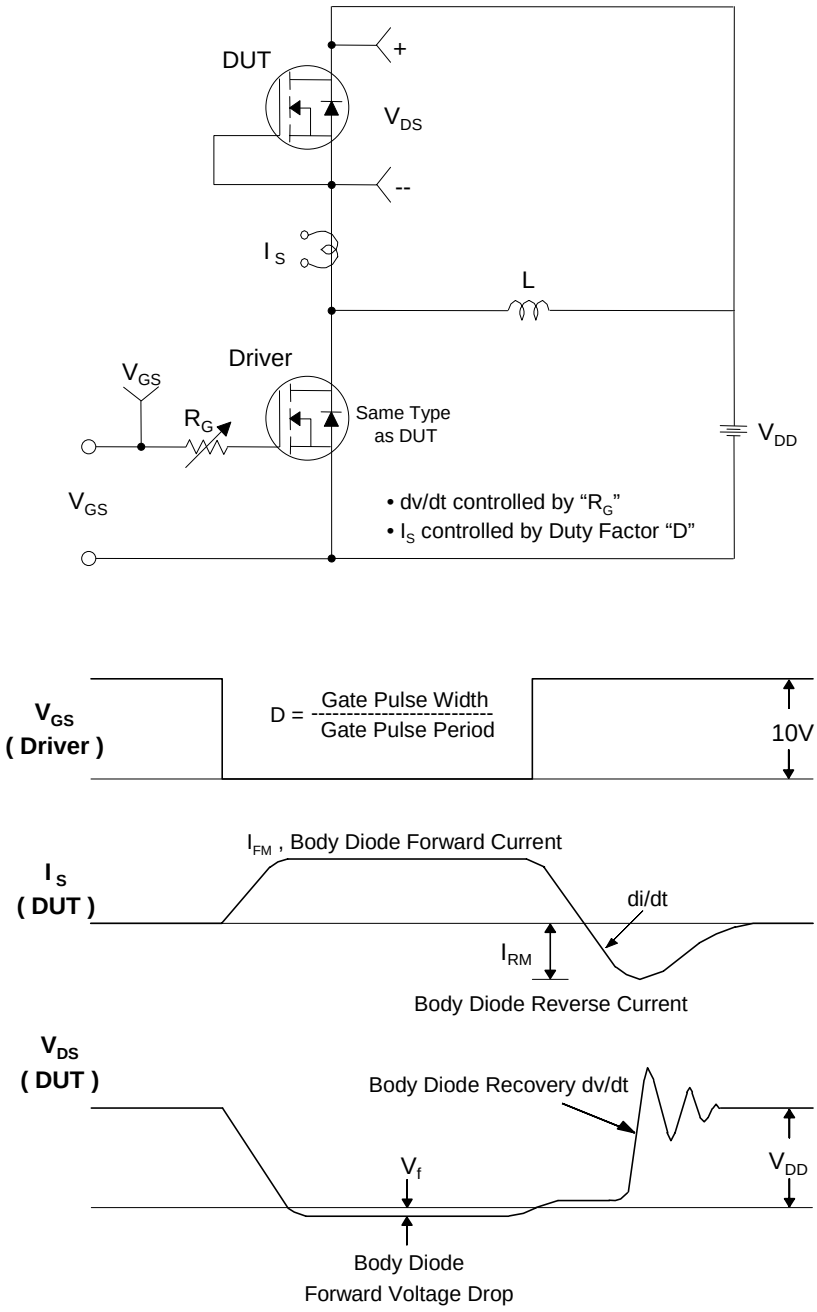


Fig 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms



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