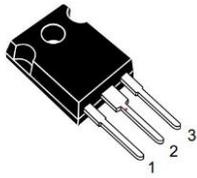


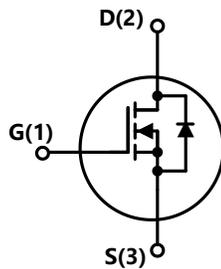
## N-channel 650V 34mΩ (Typ) Power MOSFET

### FEATURES

- 650V break down voltage
- Ultra-low  $R_{DS-ON}$  & FOM
- Fast switching on/off
- Ultra-fast body diode integrated



TO-247



### APPLICATIONS

- Server power
- Telecom power
- EV charger
- Motor driver

### ORDERING INFORMATION

TYPE	MARKING	PACKAGE
IPW65R041CFD	65R041	TO-247

### KEY PERFORMANCE PARAMETERS

PARAMETER	VALUE	UNIT
$V_{DS}$ @ $T_{j\_max}$	700	V
$R_{DS-ON}$ max @ $V_{GS}=10V$	40	mΩ
$Q_g$ (Typ)	130	nC
$I_{D-pulse}$	216	A
$E_{oss@400V}$	18	μJ
Body diode recovery time	170	ns

## SPECIFICATIONS

### ABSOLUTE MAXIMUM RATINGS

$T_J=25^{\circ}\text{C}$  operating free-air temperature unless otherwise noted

SYMBOL	PARAMETER	TEST CONDITION	VALUE	UNIT
$V_{DS}$	Drain-source voltage		650	V
$I_D$	Continuous drain current	$T_C=25^{\circ}\text{C}$	54	A
		$T_C=100^{\circ}\text{C}$	34	
$I_{D\text{-pulse}}$	Pulsed drain current		216	A
$V_{GS}$	Gate-source voltage		$\pm 30$	V
$E_{AS}$	Single pulsed avalanche energy	$I_D=6\text{A}, V_{DD}=50\text{V}$	200	mJ
$E_{AR}$	Repetitive avalanche energy	$I_D=6\text{A}, V_{DD}=50\text{V}$	1	mJ
$I_{AS}$	Single pulsed avalanche current		6	A
$P_D$	Power dissipation		450	W
dv/dt	MOSFET dv/dt ruggedness	$V_{DS}=0\sim 400\text{V}$	60	V/ns
$I_S$	Continuous diode forward current		54	A
$I_{S\text{-pulse}}$	Diode pulsed current		216	A
dv/dt	Reverse diode dv/dt	$V_{DS}=0\sim 400\text{V}, I_{SD}<25\text{A}$	50	V/ns
$T_{stg}$	Storage temperature		-55 ~ 150	$^{\circ}\text{C}$

### THERMAL INFORMATION

SYMBOL	PARAMETER	VALUE	UNIT
$R_{\theta JC \text{ max.}}$	Max. Thermal resistance, junction - case	0.54	$^{\circ}\text{C}/\text{W}$
$R_{\theta JA \text{ max.}}$	Max. Thermal resistance, junction - ambient	62	$^{\circ}\text{C}/\text{W}$
$T_{sold}$	Soldering temperature	260	$^{\circ}\text{C}$

### ELECTRICAL CHARACTERISTICS

$T_J=25^{\circ}\text{C}$  operating free-air temperature unless otherwise noted

SYMBOL	PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT
<b>STATIC CHARACTERISTICS</b>						
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS}=0\text{V}, I_D=10\text{mA}$	650			V
		$V_{GS}=0\text{V}, I_D=10\text{mA}, T_J=150^{\circ}\text{C}$	700			

SYMBOL	PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT
$V_{(GS)th}$	Gate threshold voltage	$V_{DS}=V_{GS}, I_D=1mA$	3.4	4	4.6	V
$R_{DS-ON}$	Drain-source on state resistance	$V_{GS}=10V, I_D=25A$		34	40	mΩ
		$V_{GS}=10V, I_D=25A,$ $T_j=125^{\circ}C$		74		
$I_{GSS}$	Gate-source leakage current	$V_{GS}=30V, V_{DS}=0V$			100	nA
$I_{DSS}$	Drain-source leakage current	$V_{GS}=0V, V_{DS}=650V$			1	uA
		$V_{GS}=0V, V_{DS}=650V,$ $T_j=125^{\circ}C$			500	
<b>DYNAMIC CHARACTERISTICS</b>						
$C_{iss}$	Input capacitance	$V_{GS}=0V$		6300		pF
$C_{oss}$	Output capacitance	$V_{DS}=400V, f=250KHz$		95		pF
$C_{rss}$	Reverse transfer capacitance			4		pF
$C_{o(er)}$	Effective output capacitance, energy related	$V_{GS} = 0V, V_{DS} = 0V\sim 400V$		225		pF
$C_{o(tr)}$	Effective output capacitance, time related			2435		pF
$t_{d(on)}$	Turn-on delay time	$V_{GS}=14V, V_{DS}=400V,$ $R_G=3\Omega$		50		ns
$t_r$	Rise time			11		ns
$t_{d(off)}$	Turn-off delay time			110		ns
$t_f$	Fall time			6		ns
<b>GATE CHARGE CHARACTERISTICS</b>						
$Q_g$	Gate charge total	$V_{DS}=400V, I_D=25A$ $V_{GS}=0\sim 10V$		130		nC
$Q_{gd}$	Gate to drain charge			48		nC
$Q_{gs}$	Gate to source charge			38		nC
$V_{plateau}$	Gate plateau voltage			6.2		V
<b>BODY DIODE CHARACTERISTICS</b>						
$V_{SD}$	Diode forward voltage	$V_{GS}=0V, I_F=25A, T_j=25^{\circ}C$			1.3	V
$t_{rr}$	Reverse recovery time	$V_{DS}=400V, I_F=25A$		170		ns
$Q_{rr}$	Reverse recovery charge			1.2		μC

SYMBOL	PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT
$I_{rr}$	Peak reverse recovery current	$di_F/dt = 100A/\mu s$		14.2		A

## Electrical Characteristic Diagram

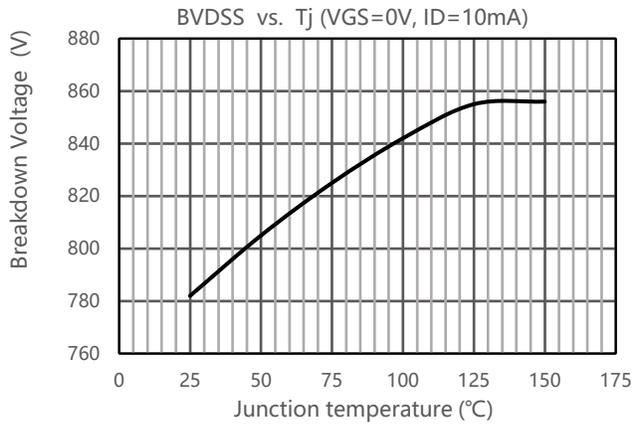


Figure 1. Drain-source Breakdown Voltage

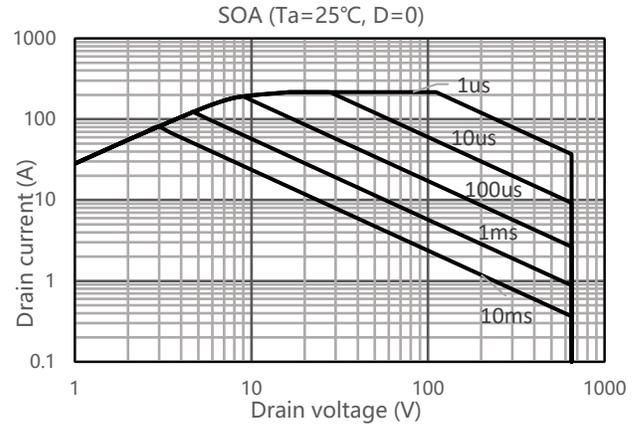


Figure 2. Safety Operating Area

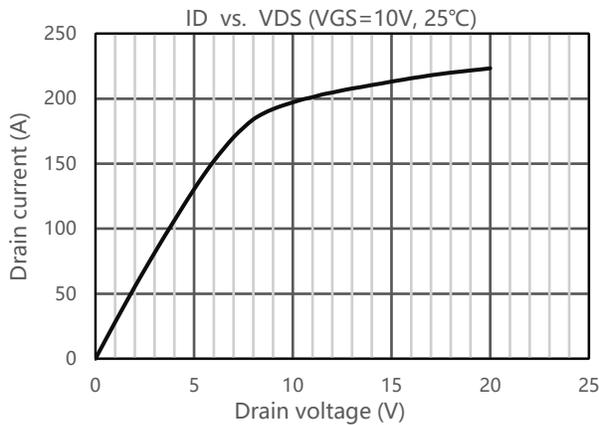


Figure 3. Typ. Output Characteristics

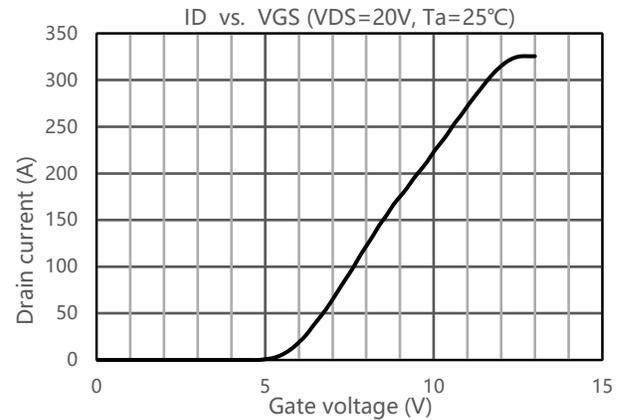


Figure 4. Typ. Transfer Characteristics

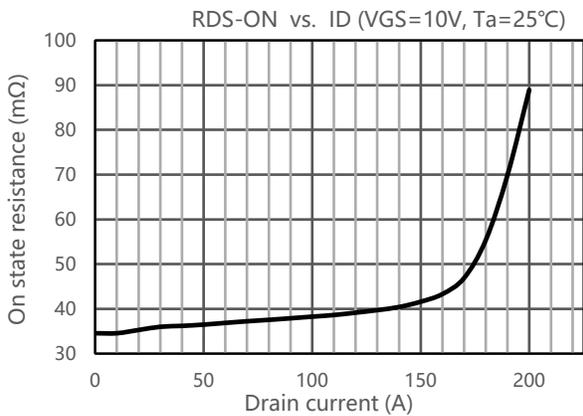


Figure 5. Typ. Drain Source On-state Resistance

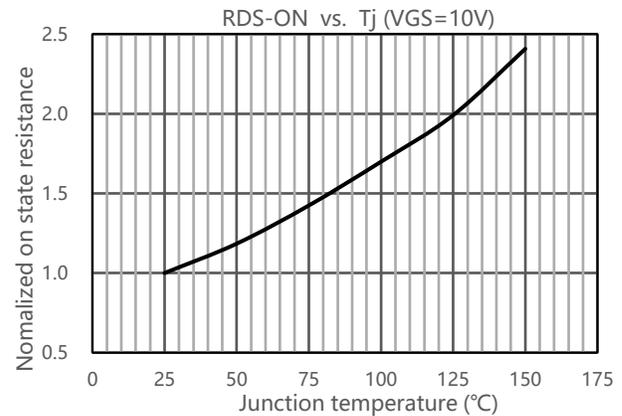
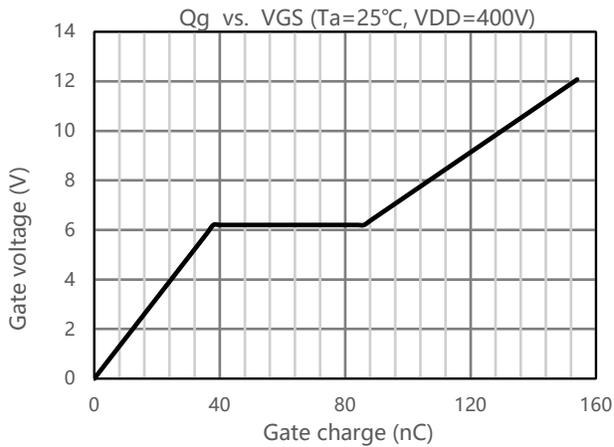
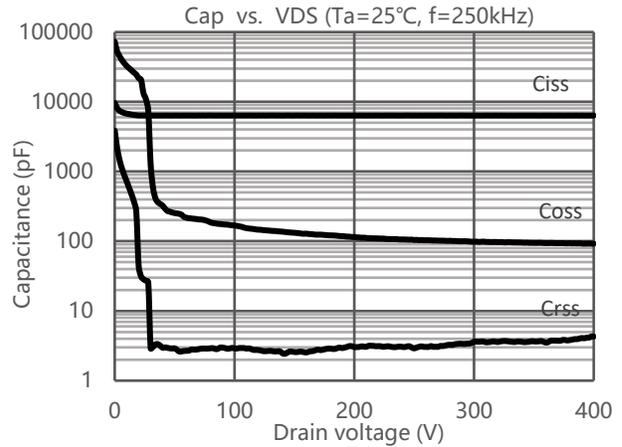


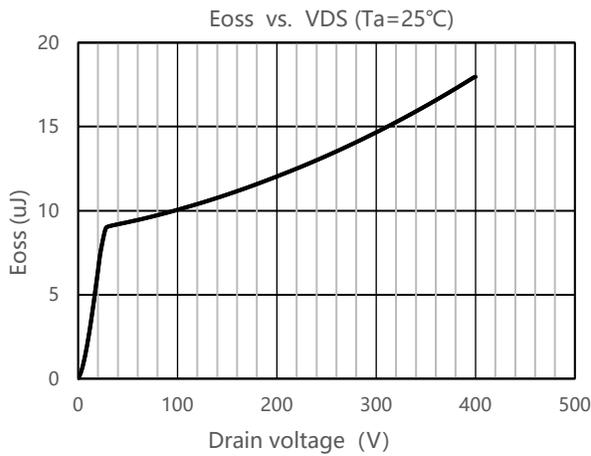
Figure 6.  $R_{DS-ON}$  vs.  $T_j$



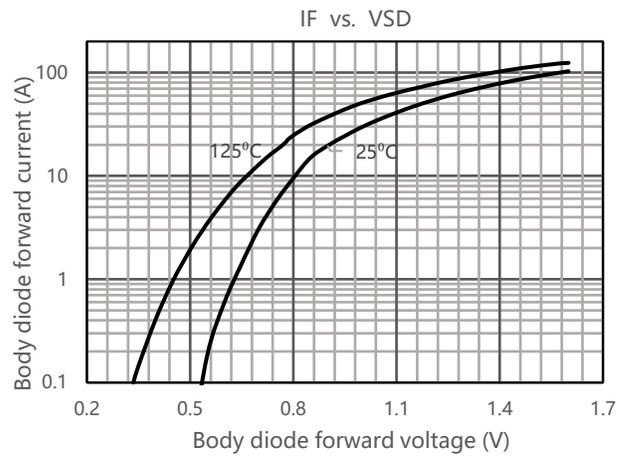
**Figure 7. Typ. Gate Charge**



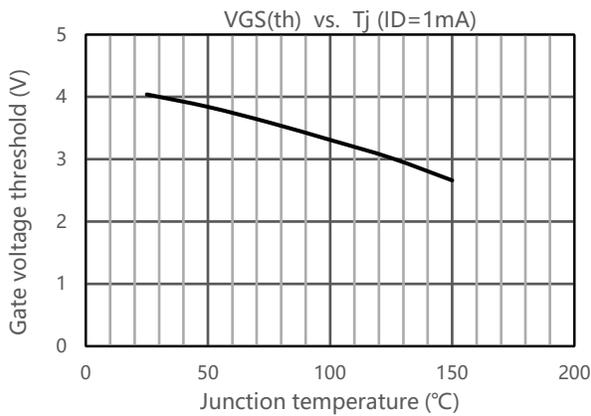
**Figure 8. Typ. Capacitance**



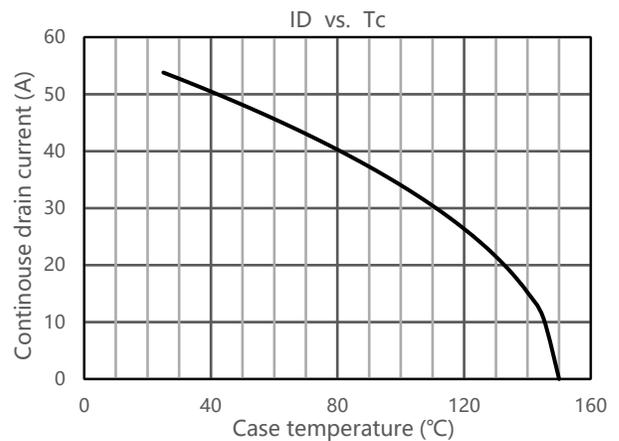
**Figure 9. Typ. Coss Stored Energy**



**Figure 10. Body diode forward characteristics**



**Figure 11. Threshold Voltage vs. Tj**



**Figure 12. Maximum drain current vs. Case temperature**

### Test Circuit

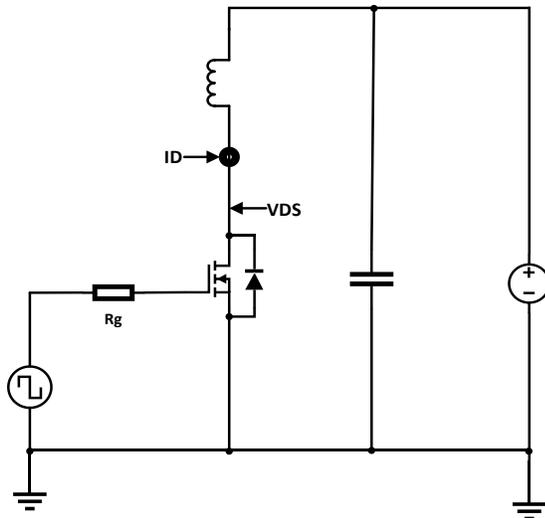
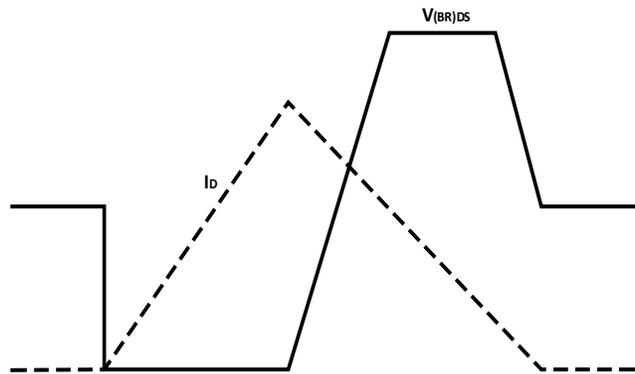


Figure 13. Unclamped inductive switching test circuit



Waveform 1. Unclamped inductive switching waveform

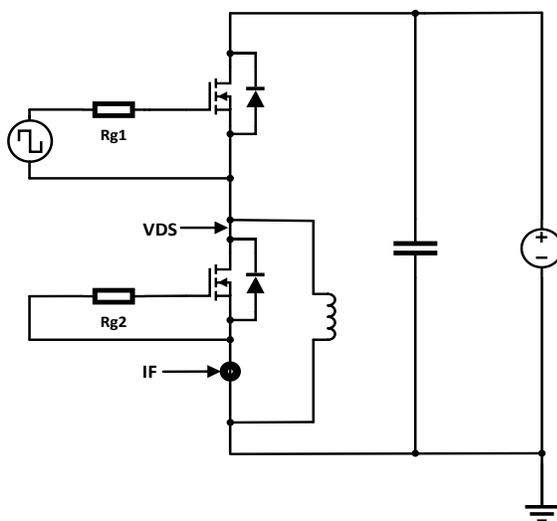
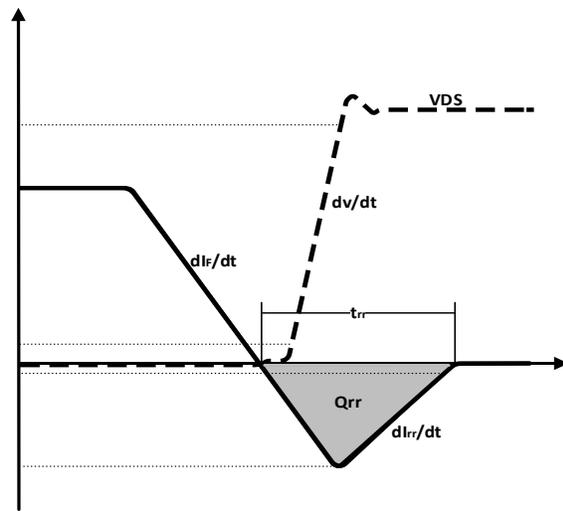


Figure 14. Body diode characteristics test circuit



Waveform 2. Body diode characteristics waveform

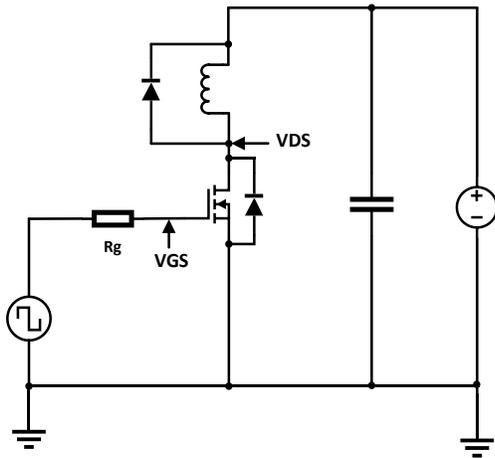
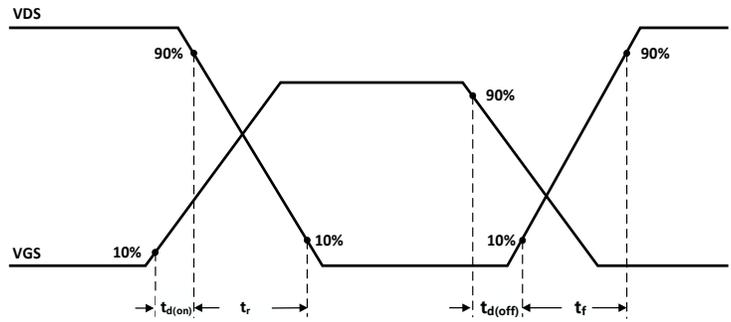


Figure 15. Switching time test circuit



Waveform 3. Switching time waveform

