

## Power MOS Field-Effect Transistors

### N-Channel Enhancement-Mode Power Field-Effect Transistors

45 A, 50 V - 60 V

$r_{DS(on)} = 0.040 \Omega$

**Features:**

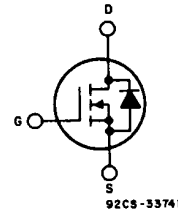
- SOA is power-dissipation limited
- Nanosecond switching speeds
- Linear transfer characteristics
- High input impedance
- Majority carrier device
- High-current, low-inductance package

The RFH45N05 and RFH45N06\* are n-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The RFH-types are supplied in the JEDEC TO-218AC plastic package.

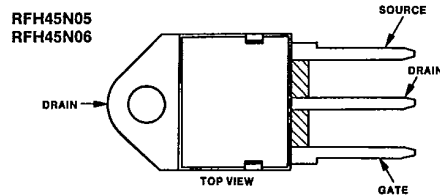
\*The RFH45N05 and RFH45N06 types were formerly RCA developmental numbers TA9480A and TA9480B respectively.

TERMINAL DIAGRAM



N-CHANNEL ENHANCEMENT MODE

TERMINAL DESIGNATIONS



JEDEC TO-218AC

**MAXIMUM RATINGS, Absolute-Maximum Values ( $T_C = 25^\circ C$ ):**

	RFH45N05	RFH45N06		
DRAIN-SOURCE VOLTAGE .....	$V_{DS}$	50	60	V
DRAIN-GATE VOLTAGE, $R_{\theta Jc} = 1 M\Omega$ .....	$V_{DG}$	50	60	V
GATE-SOURCE VOLTAGE .....	$V_{GS}$	$\pm 20$		V
DRAIN CURRENT, RMS Continuous .....	$I_D$	45		A
Pulsed .....	$I_{DM}$	100		A
POWER DISSIPATION @ $T_C = 25^\circ C$ .....	$P_T$	150		W
Derate above $T_C = 25^\circ C$ .....		1.2		W/ $^\circ C$
OPERATING AND STORAGE TEMPERATURE .....	$T_J, T_{stg}$	-55 to +150		$^\circ C$

RFH45N05, RFH45N06

ELECTRICAL CHARACTERISTICS, at Case Temperature (T<sub>c</sub>) = 25° C unless otherwise specified.

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS				UNITS
			RFH45N05		RFH45N06		
			Min.	Max.	Min.	Max.	
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	I <sub>D</sub> = 1 mA V <sub>GS</sub> = 0	50	—	60	—	V
Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>GS</sub> = V <sub>DS</sub> I <sub>D</sub> = 1 mA	2	4	2	4	V
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = 40 V	—	1	—	—	μA
		V <sub>DS</sub> = 50 V	—	—	—	1	
		T <sub>c</sub> = 125° C V <sub>DS</sub> = 40 V V <sub>DS</sub> = 50 V	—	50	—	—	
Gate-Source Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> = ± 20 V V <sub>DS</sub> = 0	—	100	—	100	nA
Drain-Source On Voltage	V <sub>DS(on)</sub> <sup>a</sup>	I <sub>D</sub> = 22.5 A V <sub>GS</sub> = 10 V	—	0.9	—	0.9	V
		I <sub>D</sub> = 45 A V <sub>GS</sub> = 10 V	—	3.6	—	3.6	
Static Drain-Source On Resistance	r <sub>DS(on)</sub> <sup>a</sup>	I <sub>D</sub> = 22.5 A V <sub>GS</sub> = 10 V	—	.04	—	.04	Ω
Forward Transconductance	g <sub>fs</sub> <sup>a</sup>	V <sub>DS</sub> = 10 V I <sub>D</sub> = 22.5 A	10	—	10	—	mho
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> = 25 V	—	3000	—	3000	pF
Output Capacitance	C <sub>oss</sub>	V <sub>GS</sub> = 0 V	—	1800	—	1800	
Reverse Transfer Capacitance	C <sub>rss</sub>	f = 1MHz	—	750	—	750	
Turn-On Delay Time	t <sub>d(on)</sub>	V <sub>DS</sub> = 30 V	40(typ)	80	40(typ)	80	ns
Rise Time	t <sub>r</sub>	I <sub>D</sub> = 22.5 A	310(typ)	475	310(typ)	475	
Turn-Off Delay Time	t <sub>d(off)</sub>	R <sub>θon</sub> = R <sub>θs</sub> = 50Ω	220(typ)	350	220(typ)	350	
Fall Time	t <sub>f</sub>	V <sub>GS</sub> = 10 V	240(typ)	375	240(typ)	375	
Thermal Resistance Junction-to-Case	R <sub>θJC</sub>	RFH45N05, RFH45N06 Series	—	0.83	—	0.83	° C/W

<sup>a</sup>Pulsed: Pulse duration = 300 μs max., duty cycle = 2%.

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS				UNITS
			RFH45N05		RFH45N06		
			Min.	Max.	Min.	Max.	
Diode Forward Voltage	V <sub>SD</sub> <sup>*</sup>	I <sub>SD</sub> = 22.5A	—	1.4	—	1.4	V
Reverse Recovery Time	t <sub>rr</sub>	I <sub>F</sub> = 4A, dI <sub>F</sub> /dt = 100 A/μs	150 (typ.)		150 (typ.)		ns

<sup>\*</sup> Pulse Test: Width ≤ 300 μs, Duty cycle ≤ 2%.

Standard Power MOSFETs

RFH45N05, RFH45N06

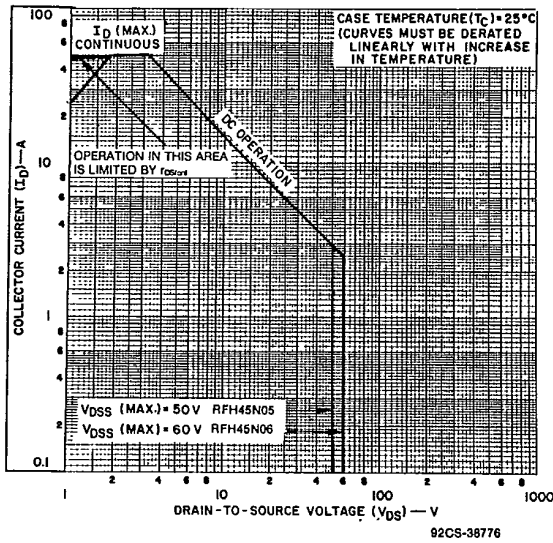


Fig. 1 - Maximum safe operating areas for all types.

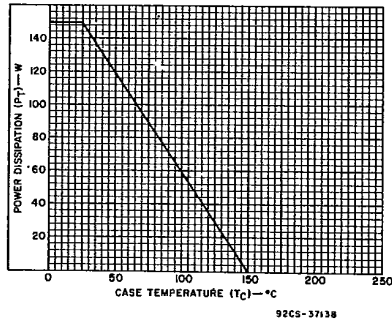


Fig. 2 - Power vs. temperature derating curve for all types.

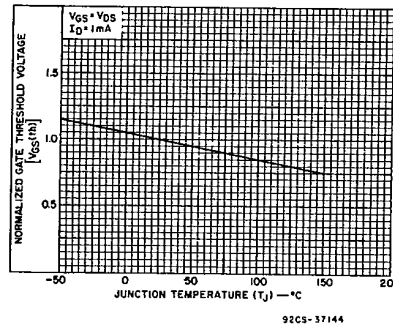


Fig. 3 - Typical normalized gate threshold voltage as a function of junction temperature for all types.

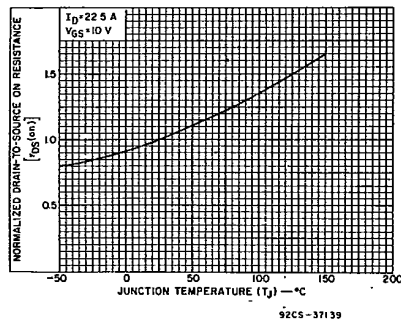


Fig. 4 - Normalized drain-to-source on resistance to junction temperature for all types.

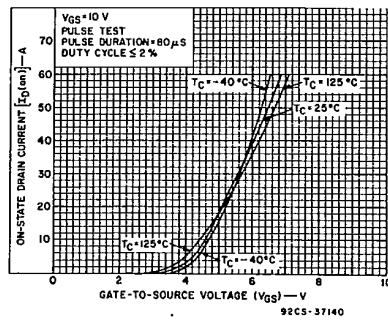


Fig. 5 - Typical transfer characteristics for all types.

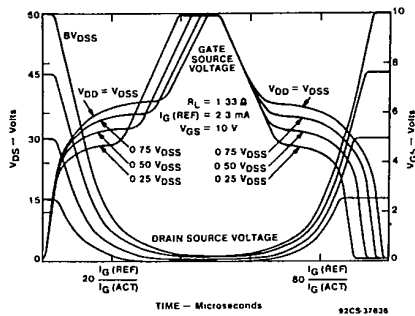


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

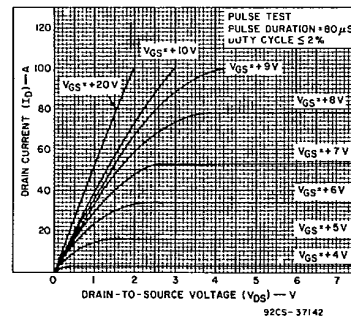


Fig. 7 - Typical saturation characteristics for all types.

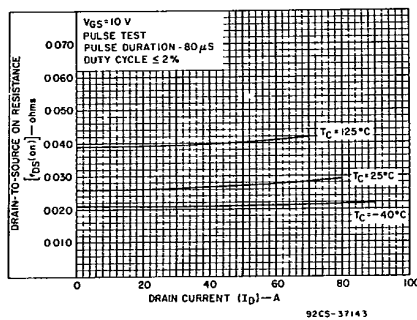


Fig. 8 - Typical drain-to-source on resistance as a function of drain current for all types.

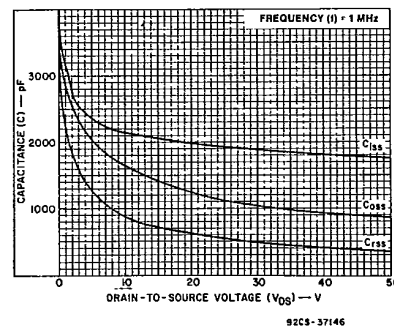


Fig. 9 - Capacitance as a function of drain-to-source voltage for all types.

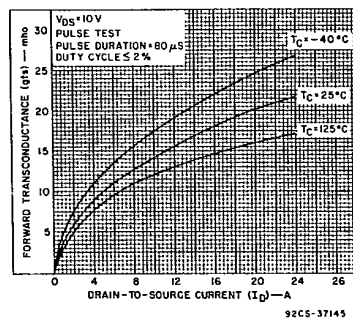


Fig. 10 - Typical forward transconductance as a function of drain current for all types.

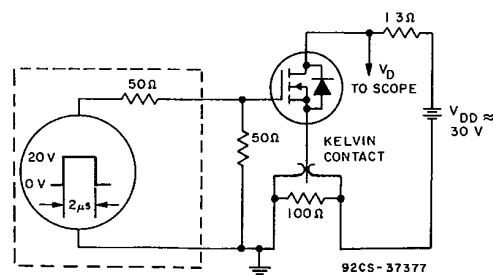


Fig. 11 - Switching Time Test Circuit.

**RFK45N05, RFK45N06**

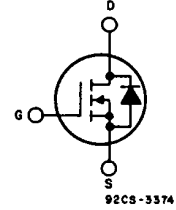
File Number **1498**

**N-Channel Enhancement-Mode Power Field-Effect Transistors**

45 A, 50 V - 60 V  
 $r_{DS(on)} = 0.040 \Omega$

**Features:**

- SOA is power-dissipation limited
- Nanosecond switching speeds
- Linear transfer characteristics
- High input impedance
- Majority carrier device



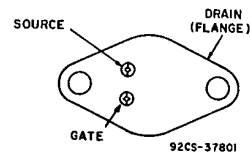
**N-CHANNEL ENHANCEMENT MODE**

The RFK45N05 and RFK45N06\* are n-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The RFK-types are supplied in the JEDEC TO-204AE steel package.

\*The RFK45N05 and RFK45N06 types were formerly RCA developmental numbers TA9388A and TA9388B, respectively.

**TERMINAL DESIGNATIONS**



**JEDEC TO-204AE**

**MAXIMUM RATINGS, Absolute-Maximum Values ( $T_C=25^\circ C$ ):**

	<b>RFK45N05</b>		<b>RFK45N06</b>	
DRAIN-SOURCE VOLTAGE .....	50		60	V
DRAIN-GATE VOLTAGE, $R_{GS}=1 M\Omega$ .....	50		60	V
GATE-SOURCE VOLTAGE .....		$\pm 20$		V
DRAIN CURRENT, RMS Continuous .....		45		A
Pulsed .....		100		A
POWER DISSIPATION @ $T_C=25^\circ C$ .....		150		W
Derate above $T_C=25^\circ C$ .....		1.2		W/ $^\circ C$
OPERATING AND STORAGE TEMPERATURE .....		-55 to +150		$^\circ C$

## RFK45N05, RFK45N06

ELECTRICAL CHARACTERISTICS, At Case Temperature ( $T_c$ )=25°C unless otherwise specified.

CHARACTERISTICS	SYMBOL	TEST CONDITIONS	LIMITS				UNITS
			RFK45N05		RFK45N06		
			MIN.	MAX.	MIN.	MAX.	
Drain-Source Breakdown Voltage	$BV_{DSS}$	$I_D=1\text{ mA}$ $V_{GS}=0$	50	—	60	—	V
Gate Threshold Voltage	$V_{GS(th)}$	$V_{GS}=V_{DS}$ $I_D=1\text{ mA}$	2	4	2	4	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS}=40\text{ V}$ $V_{GS}=50\text{ V}$	—	1	—	—	$\mu\text{A}$
		$T_C=125^\circ\text{C}$ $V_{DS}=40\text{ V}$ $V_{GS}=50\text{ V}$	—	50	—	50	
Gate-Source Leakage Current	$I_{GSS}$	$V_{GS}=\pm 20\text{ V}$ $V_{DS}=0$	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS(on)}^*$	$I_D=22.5\text{ A}$ $V_{GS}=10\text{ V}$	—	0.9	—	0.9	V
		$I_D=45\text{ A}$ $V_{GS}=10\text{ V}$	—	3.6	—	3.6	
Static Drain-Source On Resistance	$r_{DS(on)}^*$	$I_D=22.5\text{ A}$ $V_{GS}=10\text{ V}$	—	.04	—	.04	$\Omega$
Forward Transconductance	$g_{fs}^*$	$V_{DS}=10\text{ V}$ $I_D=22.5\text{ A}$	10	—	10	—	mho
Input Capacitance	$C_{iss}$	$V_{DS}=25\text{ V}$ $V_{GS}=0\text{ V}$	—	3000	—	3000	pF
Output Capacitance	$C_{oss}$	$f = 1\text{ MHz}$	—	1800	—	1800	
Reverse Transfer Capacitance	$C_{rss}$		—	750	—	750	
Turn-On Delay Time	$t_d(on)$	$V_{DD} = 30\text{ V}$ $I_D=22.5\text{ A}$	40(typ)	80	40(typ)	80	ns
Rise Time	$t_r$		310(typ)	475	310(typ)	475	
Turn-Off Delay Time	$t_d(off)$	$R_{\theta en}=R_{\theta gs}=50\ \Omega$ $V_{GS}=10\text{ V}$	220(typ)	350	220(typ)	350	
Fall Time	$t_f$		240(typ)	375	240(typ)	375	
Thermal Resistance Junction-to-Case	$R_{\theta JC}$	RFK45N05, RFK45N06 Series	—	0.83	—	0.83	$^\circ\text{C/W}$

\*Pulsed: Pulse duration = 300  $\mu\text{s}$  max., duty cycle = 2%.

## SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS				UNITS
			RFK45N05		RFK45N06		
			Min.	Max.	Min.	Max.	
Diode Forward Voltage	$V_{SD}$	$I_{SD} = 22.5\text{ A}$	—	1.4	—	1.4	V
Reverse Recovery Time	$t_{rr}$	$I_F = 4\text{ A}$ $dI_F/dt = 100\text{ A}/\mu\text{s}$	150(typ.)		150(typ.)		ns

\*Pulse Test: Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

Standard Power MOSFETs

RFK45N05, RFK45N06

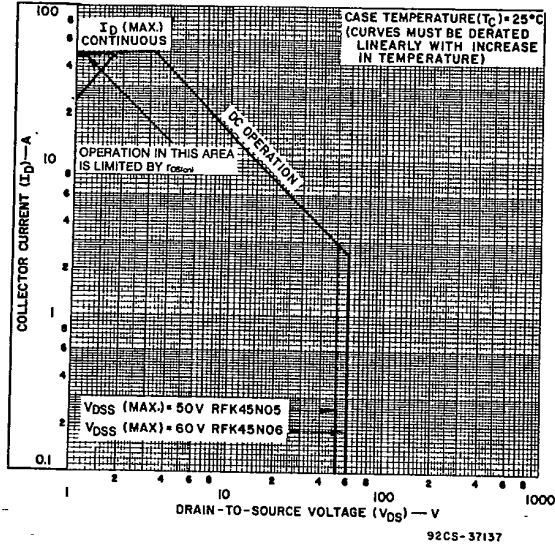


Fig. 1 — Maximum safe operating areas for all types.

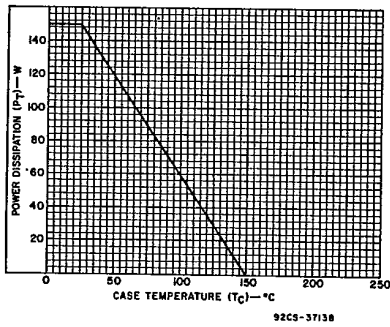


Fig. 2 — Power vs. temperature derating curve for all types.

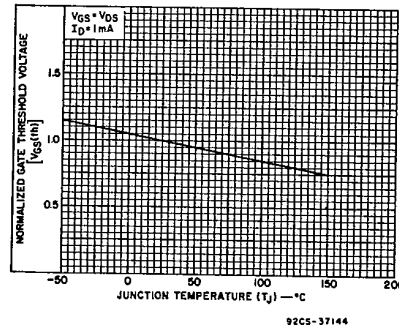


Fig. 3 — Typical normalized gate threshold voltage as a function of junction temperature for all types.

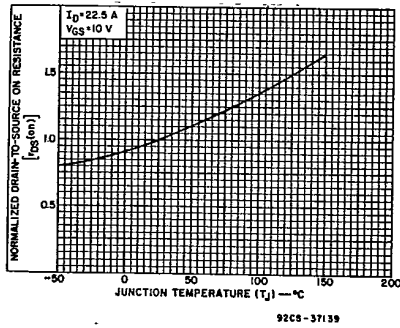


Fig. 4 — Normalized drain-to-source on resistance to junction temperature for all types.

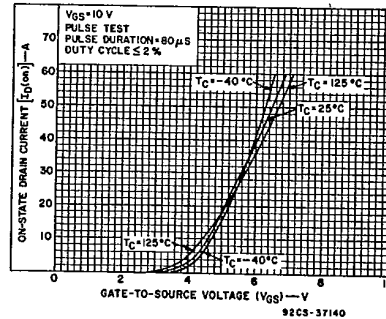


Fig. 5 — Typical transfer characteristics for all types.

RFK45N05, RFK45N06

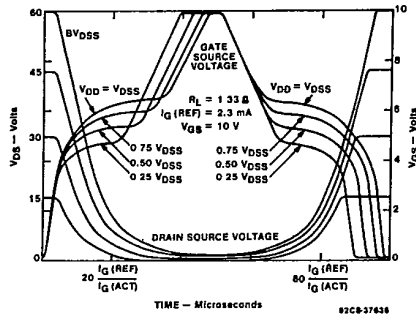


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

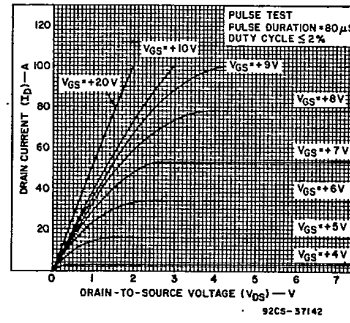


Fig. 7 - Typical saturation characteristics for all types.

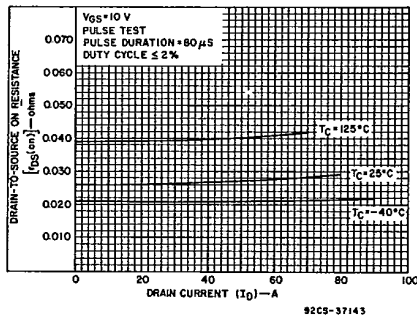


Fig. 8 - Typical drain-to-source on resistance as a function of drain current for all types.

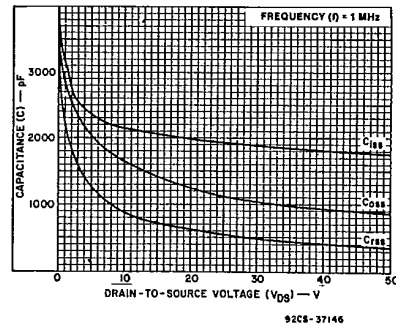


Fig. 9 - Capacitance as a function of drain-to-source voltage for all types.

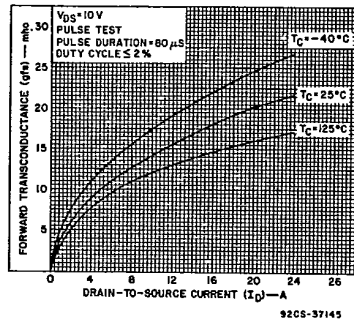


Fig. 10 - Typical forward transconductance as a function of drain current for all types.

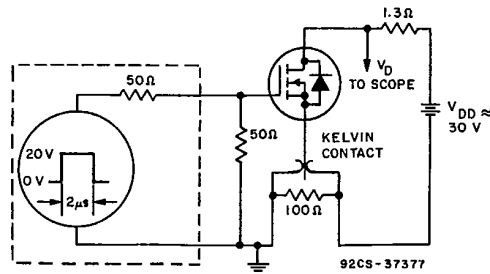


Fig. 11 - Switching Time Test Circuit.