

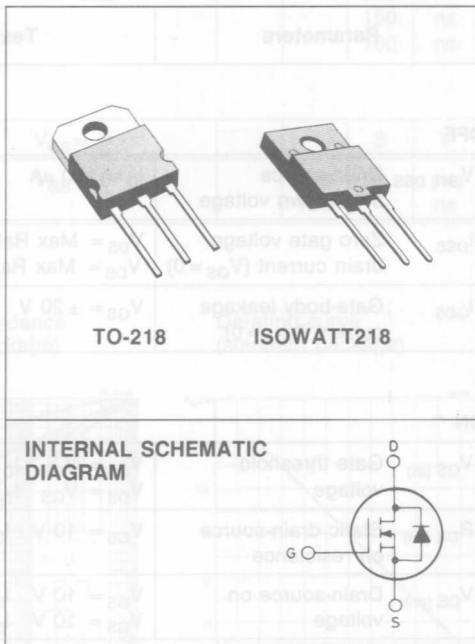
## N - CHANNEL ENHANCEMENT MODE POWER MOS TRANSISTORS

TYPE	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>
MTH40N06	60 V	0.028 Ω	40 A
MTH40N06FI	60 V	0.028 Ω	26 A

- VERY LOW ON-LOSSES
- RATED FOR UNCLAMPED INDUCTIVE SWITCHING (ENERGY TEST) ♦
- LOW DRIVE ENERGY FOR EASY DRIVE
- HIGH TRANSCONDUCTANCE/C<sub>rSS</sub> RATIO

### AUTOMOTIVE POWER APPLICATIONS

N-channel enhancement mode POWER MOS field effect transistors. Easy drive and very fast switching times make these POWER MOS transistors ideal for high speed switching circuit in applications such as power actuator driving, motor drive including brushless motors, hydraulic actuators and many other uses in automotive applications. They also find use in DC/DC converters and uninterruptible power supplies.



### ABSOLUTE MAXIMUM RATINGS

		TO-218 ISOWATT218		MTH40N06 MTH40N06FI		
V <sub>DS</sub>	Drain-source voltage (V <sub>GS</sub> = 0)			60	V	
V <sub>DGR</sub>	Drain-gate voltage (R <sub>GS</sub> = 1 MΩ)			60	V	
V <sub>GS</sub>	Gate-source voltage			±20	V	
I <sub>DM</sub>	Drain current (pulsed)			140	A	
				<b>TO-218</b>	<b>ISOWATT218</b>	
I <sub>D</sub> ■	Drain current (cont.) T <sub>c</sub> = 20°C			40	26	A
P <sub>tot</sub> ■	Total dissipation at T <sub>c</sub> < 25°C			150	65	W
	Derating factor			1.2	0.52	W/°C
T <sub>stg</sub>	Storage temperature			-65 to 150		°C
T <sub>j</sub>	Max. operating junction temperature			150		°C

■ See note on ISOWATT218 in this datasheet

♦ Introduced in 1988 week 44

## THERMAL DATA ■

TO-218 | ISOWATT218

$R_{thj-case}$	Thermal resistance junction-case	max	0.83	1.92	°C/W
$T_1$	Maximum lead temperature for soldering purpose	max	275		°C

ELECTRICAL CHARACTERISTICS ( $T_{case} = 25^\circ\text{C}$  unless otherwise specified)

Parameters	Test Conditions	Min.	Typ.	Max.	Unit
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## OFF

$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 100 \mu\text{A}$	$V_{GS} = 0$	60		V
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = \text{Max Rating} \times 0.85$ $V_{DS} = \text{Max Rating} \times 0.85$	$T_c = 100^\circ\text{C}$		250 1000	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20 \text{ V}$			$\pm 100$	nA

## ON \*

$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ $V_{DS} = V_{GS}$	$I_D = 1 \text{ mA}$ $I_D = 1 \text{ mA}$	2 1.5	4.5 4	V V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10 \text{ V}$	$I_D = 20 \text{ A}$		0.028	$\Omega$
$V_{DS(on)}$	Drain-source on voltage	$V_{GS} = 10 \text{ V}$ $V_{GS} = 10 \text{ V}$	$I_D = 40 \text{ A}$ $I_D = 20 \text{ A}$		1.4 1.12	V V

## ENERGY TEST

$I_{UIS}$	Unclamped inductive switching current (single pulse)	$V_{DD} = 30 \text{ V}$ starting $T_j = 25^\circ\text{C}$	$L = 100 \mu\text{H}$	40		A
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## DYNAMIC

$g_{fs}^*$	Forward transconductance	$V_{DS} = 15 \text{ V}$	$I_D = 20 \text{ A}$	10		mho
$C_{iss}$	Input capacitance	$V_{DS} = 25 \text{ V}$ $V_{GS} = 0$	$f = 1 \text{ MHz}$		5000	pF
$C_{oss}$	Output capacitance				2500	pF
$C_{rss}$	Reverse transfer capacitance				1000	pF
$Q_g$	Total gate charge	$V_{DS} = 50 \text{ V}$ $V_{GS} = 10 \text{ V}$	$I_D = 40 \text{ A}$		120	nC

ELECTRICAL CHARACTERISTICS (Continued)

Parameters	Test Conditions	Min.	Typ.	Max.	Unit
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SWITCHING

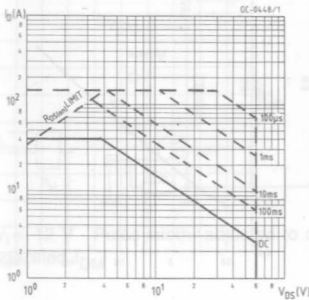
$t_{d(on)}$	Turn-on time	$V_{DD} = 25\text{ V}$ $R_{gen} = 50\ \Omega$	$I_D = 20\text{ A}$		50	ns
$t_r$	Rise time				300	ns
$t_{d(off)}$	Turn-off delay time				150	ns
$t_f$	Fall time				100	ns

SOURCE DRAIN DIODE

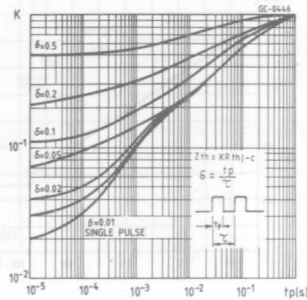
$V_{SD}$	Forward on voltage	$I_{SD} = 40\text{ A}$	$V_{GS} = 0$		3	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 40\text{ A}$	$V_{GS} = 0$		200	ns
$t_{on}$	Forward turn-on time				150	ns

- \* Pulsed: Pulse duration  $\leq 300\ \mu\text{s}$ , duty cycle  $\leq 2\%$
- See note on ISOWATT218 in this datasheet

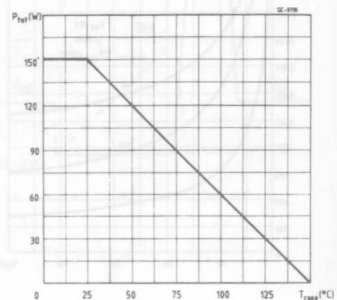
Safe operating areas (standard package)



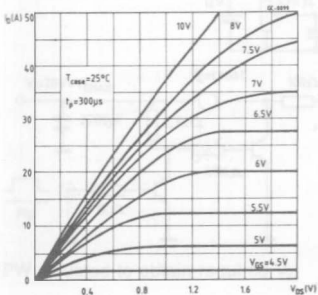
Thermal impedance (standard package)



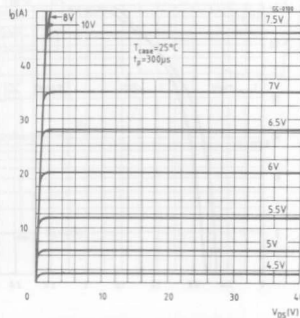
Derating curve (standard package)



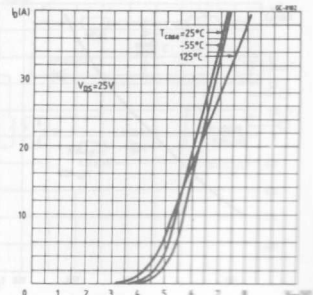
Output characteristics



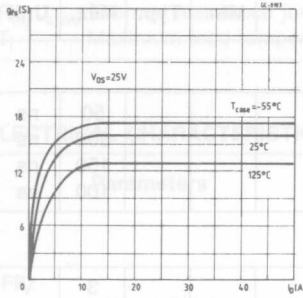
Output characteristics



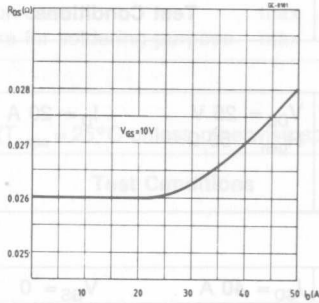
Transfer characteristics



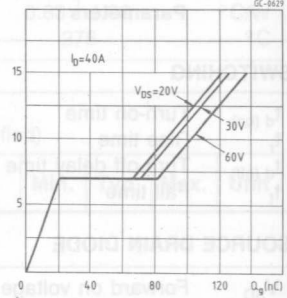
Transconductance



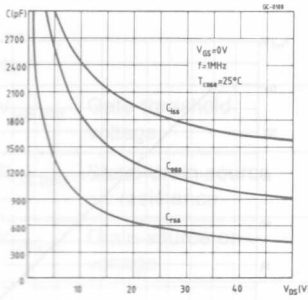
Static drain-source on resistance



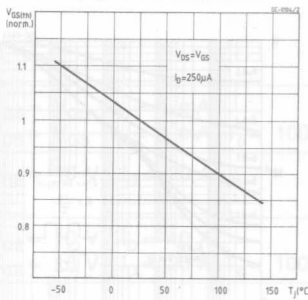
Gate charge vs gate-source voltage



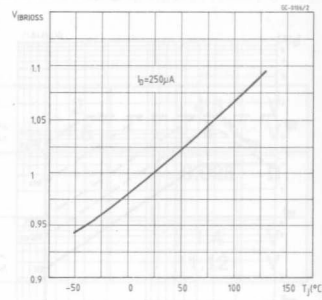
Capacitance variation



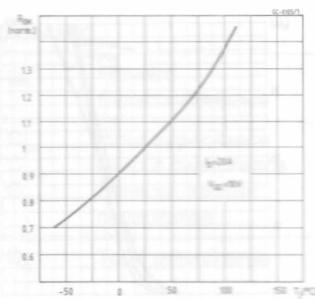
Normalized gate threshold voltage vs temperature



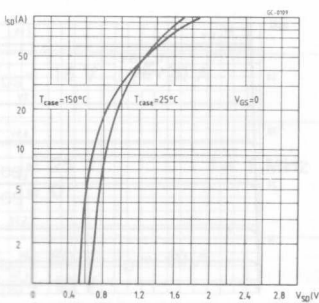
Normalized breakdown voltage vs temperature



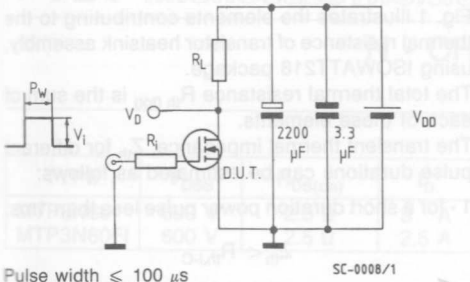
Normalized on resistance vs temperature



Source-drain diode forward characteristics

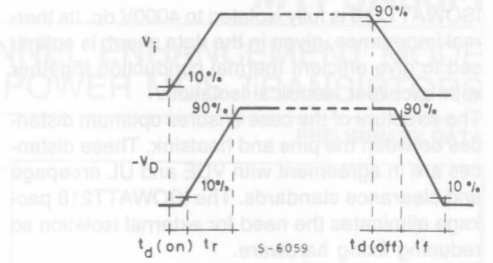


Switching times test circuit for resistive load

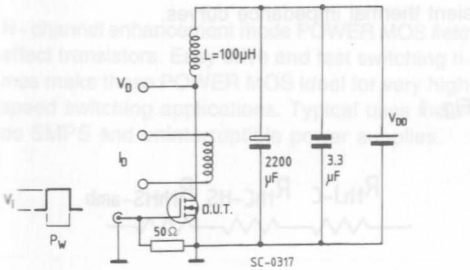


Pulse width  $\leq 100 \mu\text{s}$   
Duty cycle  $\leq 2\%$

Switching time waveforms for resistive load

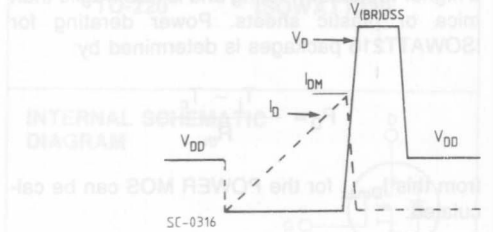


Unclamped inductive load test circuit

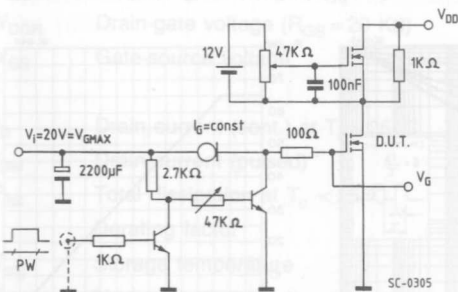


$V_i = 12 \text{ V}$  - Pulse width: adjusted to obtain specified  $I_{DM}$

Unclamped inductive waveforms

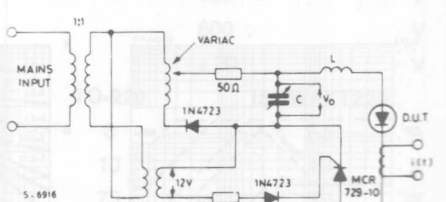


Gate charge test circuit



PW adjusted to obtain required  $V_G$

Body-drain diode  $t_{rr}$  measurement  
Jedec test circuit



**ISOWATT218 PACKAGE CHARACTERISTICS AND APPLICATION.**

ISOWATT218 is fully isolated to 4000V dc. Its thermal impedance, given in the data sheet, is optimized to give efficient thermal conduction together with excellent electrical isolation.

The structure of the case ensures optimum distances between the pins and heatsink. These distances are in agreement with VDE and UL creepage and clearance standards. The ISOWATT218 package eliminates the need for external isolation so reducing fixing hardware.

The package is supplied with leads longer than the standard TO-218 to allow easy mounting on pcbs. Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance

ISOWATT218 thermal performance is better than that of the standard part, mounted with a 0.1mm mica washer. The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets. Power derating for ISOWATT218 packages is determined by:

$$P_D = \frac{T_j - T_c}{R_{th}}$$

from this  $I_{Dmax}$  for the POWER MOS can be calculated:

$$I_{Dmax} \leq \sqrt{\frac{P_D}{R_{DS(on)} \text{ (at } 150^\circ\text{C)}}}$$

**THERMAL IMPEDANCE OF ISOWATT218 PACKAGE**

Fig. 1 illustrates the elements contributing to the thermal resistance of transistor heatsink assembly, using ISOWATT218 package.

The total thermal resistance  $R_{th (tot)}$  is the sum of each of these elements.

The transient thermal impedance,  $Z_{th}$  for different pulse durations can be estimated as follows:

- 1 - for a short duration power pulse less than 1ms;

$$Z_{th} < R_{thJ-C}$$

- 2 - for an intermediate power pulse of 5ms to 50ms;

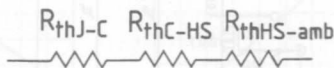
$$Z_{th} = R_{thJ-C}$$

- 3 - for long power pulses of the order of 500ms or greater:

$$Z_{th} = R_{thJ-C} + R_{thC-HS} + R_{thHS-amb}$$

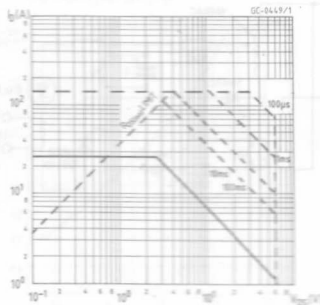
It is often possible to discern these areas on transient thermal impedance curves.

Fig. 1

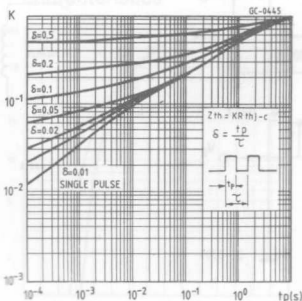


**ISOWATT DATA**

**Safe operating areas**



**Thermal impedance**



**Derating curve**

