SGS-THOMSON MICROELECTRONICS

MTH40N06
MTH40N06FI

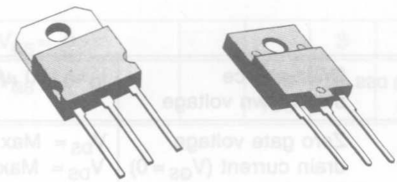
N - CHANNEL ENHANCEMENT MODE POWER MOS TRANSISTORS

TYPE	V_{DSS}	$R_{DS(on)}$	I_D
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_{rss} RATIO

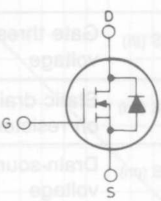
AUTOMOTIVE POWER APPLICATIONS

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.



TO-218 ISOWATT218

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

		TO-218 / ISOWATT218	MTH40N06 / MTH40N06FI	
V_{DS}	Drain-source voltage ($V_{GS}=0$)		60	V
V_{DGR}	Drain-gate voltage ($R_{GS}=$ 1 MΩ)		60	V
V_{GS}	Gate-source voltage		±20	V
I_{DM}	Drain current (pulsed)		140	A
		TO-218	**ISOWATT218**	
I_D ■	Drain current (cont.) $T_c=$ 20°C	40	26	A
P_{tot} ■	Total dissipation at $T_c<25°C$	150	65	W
■	Derating factor	1.2	0.52	W/°C
T_{stg}	Storage temperature		−65 to 150	°C
T_j	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_l	Maximum lead temperature for soldering purpose	max	275		°C

ELECTRICAL CHARACTERISTICS ($T_{case} = 25°C$ unless otherwise specified)

Symbol	Parameters	Test Conditions	Min.	Typ.	Max.	Unit

OFF

Symbol	Parameters	Test Conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 100\ \mu A$ $V_{GS} = 0$	60			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	V_{DS} = Max Rating × 0.85 V_{DS} = Max Rating × 0.85 $T_c = 100°C$			250 1000	μA μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 20$ V			± 100	nA

ON *

Symbol	Parameters	Test Conditions	Min.	Typ.	Max.	Unit
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ $I_D = 1$ mA $V_{DS} = V_{GS}$ $I_D = 1$ mA $T_c = 100°C$	2 1.5		4.5 4	V V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10$ V $I_D = 20$ A			0.028	Ω
$V_{DS(on)}$	Drain-source on voltage	$V_{GS} = 10$ V $I_D = 40$ A $V_{GS} = 10$ V $I_D = 20$ A $T_c = 100°C$			1.4 1.12	V V

ENERGY TEST

Symbol	Parameters	Test Conditions	Min.	Typ.	Max.	Unit
I_{UIS}	Unclamped inductive switching current (single pulse)	$V_{DD} = 30$ V L = 100 μH starting $T_j = 25°C$	40			A

DYNAMIC

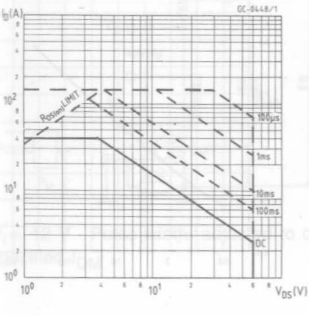
Symbol	Parameters	Test Conditions	Min.	Typ.	Max.	Unit
g_{fs} *	Forward transconductance	$V_{DS} = 15$ V $I_D = 20$ A	10			mho
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 25$ V f = 1 MHz $V_{GS} = 0$			5000 2500 1000	pF pF pF
Q_g	Total gate charge	$V_{DS} = 50$ V $I_D = 40$ A $V_{GS} = 10$ V			120	nC

ELECTRICAL CHARACTERISTICS (Continued)

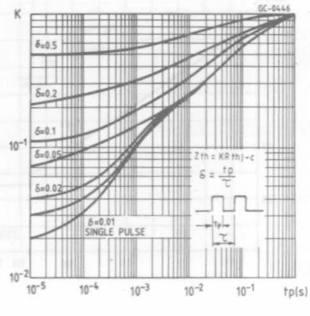
Parameters		Test Conditions		Min.	Typ.	Max.	Unit
SWITCHING							
$t_{d\,(on)}$	Turn-on time	$V_{DD} = 25$ V	$I_D = 20$ A			50	ns
t_r	Rise time	$R_{gen} = 50\ \Omega$				300	ns
$t_{d\,(off)}$	Turn-off delay time					150	ns
t_f	Fall time					100	ns
SOURCE DRAIN DIODE							
V_{SD}	Forward on voltage	$I_{SD} = 40$ A	$V_{GS} = 0$			3	V
t_{rr}	Reverse recovery time	$I_{SD} = 40$ A	$V_{GS} = 0$		200		ns
t_{on}	Forward turn-on time				150		ns

* Pulsed: Pulse duration ⩽ 300 μs, duty cycle ⩽ 2%
■ See note on ISOWATT218 in this datasheet

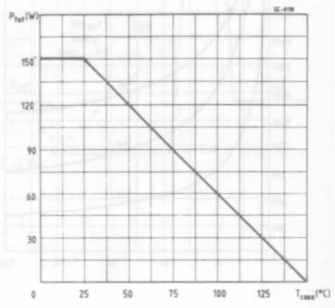
Safe operating areas (standard package)



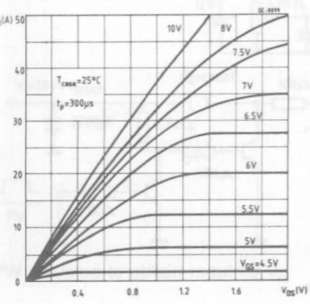
Thermal impedance (standard package)



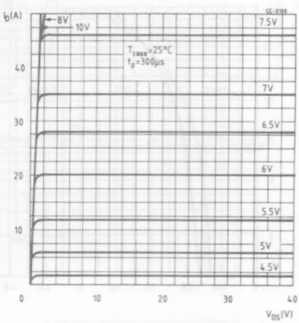
Derating curve (standard package)



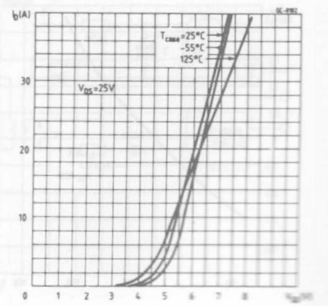
Output characteristics



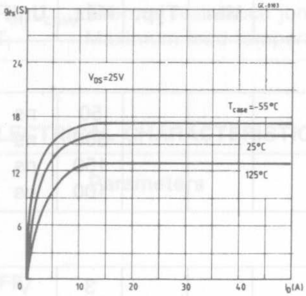
Output characteristics



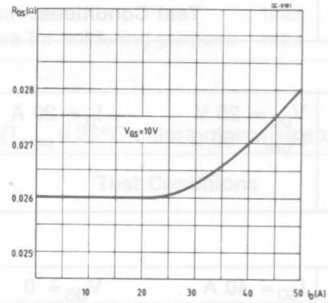
Transfer characteristics



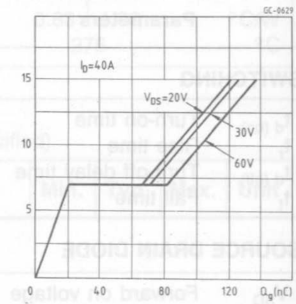
Transconductance



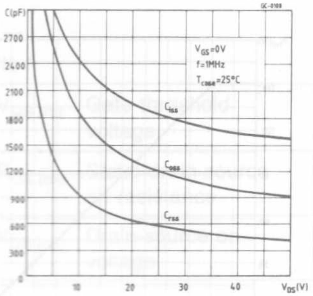
Static drain-source on resistance



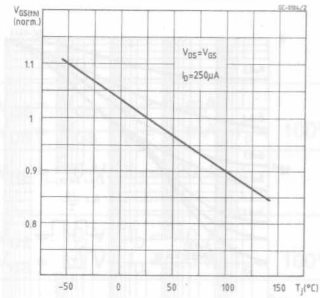
Gate charge vs gate-source voltage



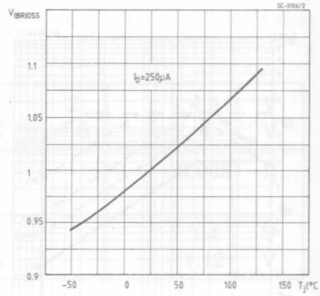
Capacitance variation



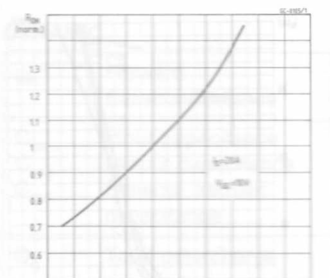
Normalized gate threshold voltage vs temperature



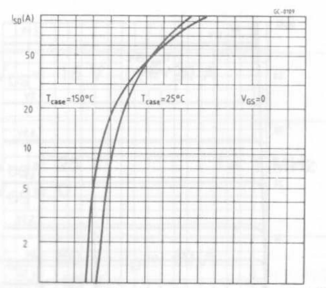
Normalized breakdown voltage vs temperature



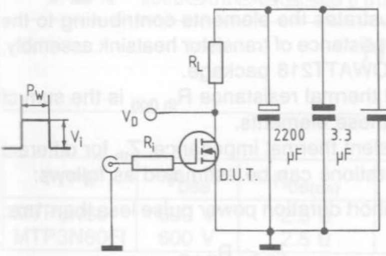
Normalized on resistance vs temperature



Source-drain diode forward characteristics

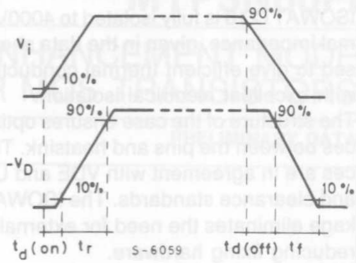


Switching times test circuit for resistive load

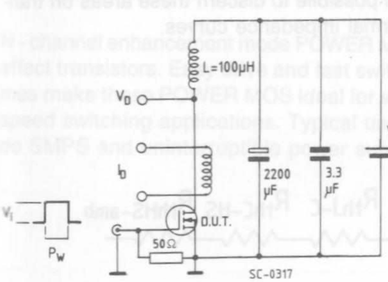


Pulse width ⩽ 100 µs
Duty cycle ⩽ 2%

Switching time waveforms for resistive load

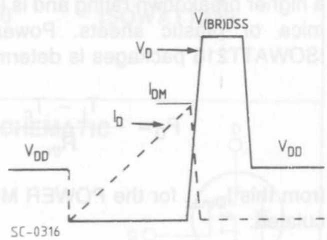


Unclamped inductive load test circuit

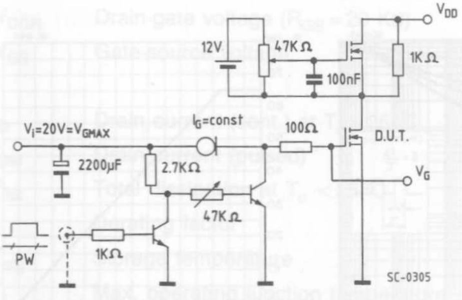


V_i = 12 V - Pulse width: adjusted to obtain specified I_{DM}

Unclamped inductive waveforms

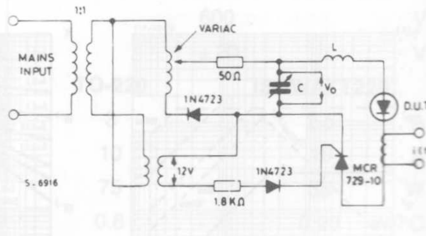


Gate charge test circuit



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 optimised 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:

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

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;

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

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

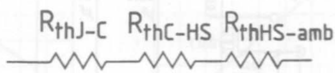
$$Z_{th} = R_{thJ\text{-}C}$$

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

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

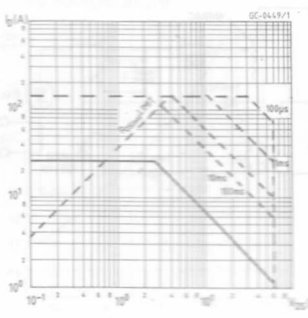
It is often possibile to discern these areas on transient thermal impedance curves.

Fig. 1

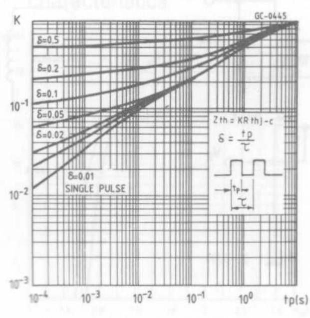


ISOWATT DATA

Safe operating areas



Thermal impedance



Derating curve