MIP709

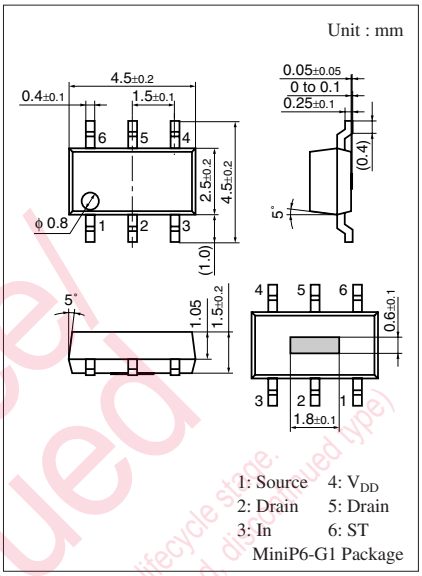
Silicon MOS IC

■ Features

- Lowside switch which contain the function to diagnose the state of load.
- Five protective functions (over-current, over-voltage, short circuit load, over heat, ESD) built-in.
- Small and is the package of a surface mount. (6-pin mini power package)

■ Applications

- For automotive electric equipment



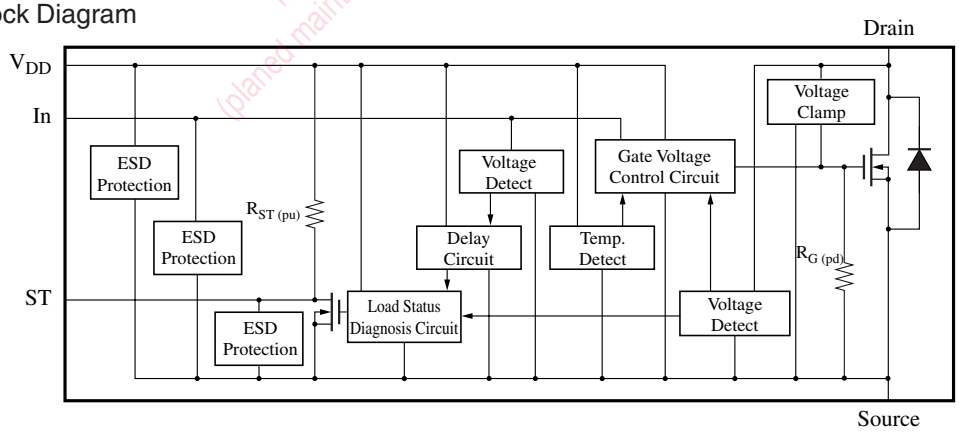
Marking Symbol: 6M

■ Absolute Maximum Ratings $T_a = 25°C$

Parameter	Symbol	Rating	Unit
Circuit supply voltage	V_{DD}	− 0.5 to +6.0	V
Circuit supply current	I_{DD}	±5	mA
Drain-source voltage	V_{DS}	40	V
Output peak current	I_{OP}	5	A
Output current	I_O	− 0.5 to +2.0	A
Status diagnosis output voltage	V_{ST}	6	V
Status diagnosis output current	I_{ST}	−1.0 to +0.1	mA
Input voltage	V_{IN}	− 0.5 to +6.0	V
Input current	I_{IN}	±5	mA
Power dissipation *1	P_D	1	W
Drain clamp energy *2	E_{CLP}	44	mJ
Operating ambient temperature	T_{opr}	−40 to +125	°C
Channel temperature	T_{ch}	150	°C
Storage temperature	T_{stg}	−55 to +150	°C

Note) ∗1 : Mounting on the PCB (More than 4 cm^2 at Copper foil area, Glass epoxy substrate)
∗2 : L = 10 mH, I_L = 2.97 A, V_{DD} = 20 V, 1 pulse, T_a = 25°C

■ Block Diagram



■ Operating Supply Voltage Range

Parameter	Symbol	Min	Typ	Max	Unit
Circuit supply voltage	V_{DD}	4.5	5.0	5.5	V
Supply voltage	V_B	6		40	V

■ Electrical Characteristics $T_C = 25°C \pm 3°C$

Parameter		Symbol	Conditions	Min	Typ	Max	Unit
Circuit supply consumption current	On	$I_{DD(on)}$	$V_{DD} = 5$ V, $V_{IN} = 5$ V, $V_{DS} = 0$ V		0.4	0.8	mA
	Off	$I_{DD(off)}$	$V_{DD} = 5$ V, $V_{IN} = 0$ V, $V_{DS} = 12$ V		0.4	0.8	mA
	Trouble	$I_{DD(ST)}$	$V_{DD} = 5$ V (V_{ST} = Low)		1	2	mA
Drain On resistance		$R_{DS(on)}$	$V_{DD} = 5$ V, $V_{IN} = 5$ V, $I_{DS} = 1$ A		0.32	0.43	Ω
Drain On voltage		$V_{DS(on)}$	$V_{DD} = 5$ V, $V_{IN} = 5$ V, $I_{DS} = 1$ A		0.32	0.43	V
Drain clamp voltage		$V_{DS(CLP)}$	$V_{DD} = 5$ V, $V_{IN} = 0$ V, $I_{DS} = 3$ mA	40	49	60	V
Drain Off current 1		$I_{DS(off)1}$	$V_{DD} = 5$ V, $V_{IN} = 0$ V, $V_{DS} = 12$ V		60	100	µA
Drain Off current 2		$I_{DS(off)2}$	$V_{DD} = 5$ V, $V_{IN} = 0$ V, $V_{DS} = 16$ V		100	160	µA
Over current protection limit		I_{OCP}	$V_{DD} = 5$ V, $V_{IN} = 5$ V	2.5	5.0	7.0	A
Short load detect voltage		$V_{DS(SHT)}$	$V_{DD} = 5$ V, $V_{IN} = 5$ V	3.0	4.3	5.9	V
Open load detect voltage		$V_{DS(OPN)}$	$V_{DD} = 5$ V, $V_{IN} = 0$ V	3.0	4.3	5.9	V
Input voltage (High level)		$V_{IN(H)}$	$V_{DD} = 5$ V, $I_{DS} = 1$ A	4			V
Input voltage (Low level)		$V_{IN(L)}$	$V_{DD} = 5$ V, $I_{DS} = 1$ mA			0.8	V
Input current (On)		$I_{IN(on)}$	$V_{DD} = 5$ V, $V_{IN} = 5$ V, $V_{DS} = 0$ V		0.15	0.3	mA
Input current (Trouble)		$I_{IN(ST)}$	$V_{DD} = 5$ V, $V_{IN} = 5$ V (short load, over heat)		0.6	1.0	mA
Status diagnosis output voltage	High level	$V_{ST(H)}$	$V_{DD} = 5$ V, $I_{ST} < 1$ µA	4.95			V
			$V_{DD} = 5$ V, $I_{ST} = 10$ µA	4.85			V
			$V_{DD} = 5$ V, $I_{ST} = 100$ µA	3.5			V
	Low level	$V_{ST(L)}$	$V_{DD} = 5$ V, $I_{ST} < -1$ µA			0.3	V
			$V_{DD} = 5$ V, $I_{ST} = -100$ µA			0.35	V
			$V_{DD} = 5$ V, $I_{ST} = -1$ mA			0.8	V
Short load detect mask time		$t_{msk(SHT)}$	$V_{DD} = 5$ V, $V_{IN} = 5$ V, $I_{ST} < -1$ µA	10	33	65	µs
Open load detect mask time		$t_{msk(OPN)}$	$V_{DD} = 5$ V, $V_{IN} = 5$ V, $I_{ST} < -1$ µA	20	46	75	µs

Note) 1. At on-state when drain voltage exceed the "Short load detect voltage", output current begin to oscillate and low signal output from ST terminal.

2. At off-state when drain voltage under the "Open load detect voltage", low signal output from ST terminal. ("Low signal" output only at trouble-state, selfreturn after trouble-state released. If overheat-state after short load, hold low level by latch circuit until rise the "Input voltage".)

3. ST terminal is "Open drain type" and including pull-up resistance to V_{DD} terminal.

■ Electrical Characteristics (Designed Specification) T_C = –40°C to 125°C

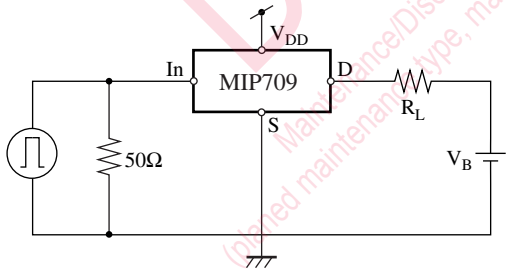
Parameter		Symbol	Conditions	Min	Typ	Max	Unit
Circuit supply consumption current	On	$I_{DD(on)}$	V_{DD} = 5 V, V_{IN} = 5 V, V_{DS} = 0 V			1.1	mA
	Off	$I_{DD(off)}$	V_{DD} = 5 V, V_{IN} = 0 V, V_{DS} = 12 V			1.1	mA
	Trouble	$I_{DD(ST)}$	V_{DD} = 5 V, (V_{ST} = Low)			2.2	mA
Drain On resistance		$R_{DS(on)}$	V_{DD} = 5 V, V_{IN} = 5 V, I_{DS} = 1 A			0.65	Ω
Drain On voltage		$V_{DS(on)}$	V_{DD} = 5 V, V_{IN} = 5 V, I_{DS} = 1 A			0.65	V
Drain clamp voltage		$V_{DS(CLP)}$	V_{DD} = 5 V, V_{IN} = 0 V, I_{DS} = 3 mA	40		60	V
Drain Off current 1		$I_{DS(off)1}$	V_{DD} = 5 V, V_{IN} = 0 V, V_{DS} = 12 V			130	µA
Drain Off current 2		$I_{DS(off)2}$	V_{DD} = 5 V, V_{IN} = 0 V, V_{DS} = 16 V			200	µA
Over current protection limit		I_{OCP}	V_{DD} = 5 V, V_{IN} = 5 V	1.5			A
Input current (On)		$I_{IN(on)}$	V_{DD} = 5 V, V_{IN} = 5 V, V_{DS} = 0 V			0.4	mA
Input current (Trouble)		$I_{IN(ST)}$	V_{DD} = 5 V, V_{IN} = 5 V (short load, over heat)			1.3	mA
Short load detect mask time		$t_{msk(SHT)}$	V_{DD} = 5 V, V_{IN} = 5 V, I_{ST} < –1 µA	6		80	µs
Open load detect mask time		$t_{msk(OPN)}$	V_{DD} = 5 V, V_{IN} = 5 V, I_{ST} < –1 µA	15		100	µs

■ Electrical Characteristics (Reference value: Non guarantee value)

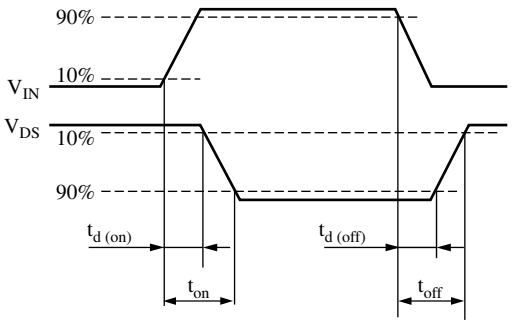
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Over heat protection temp.	T_{SHD}	V_{DD} = 5 V	150	180	210	°C
Turn On delay time	$t_{d(off)}$	V_{DD} = 5 V, V_{IN} = 5 V, V_B = 12 V		1.6		µs
Turn On time	t_{on}	I_{DS} = 1 A, R_L = 12 Ω		7.3		µs
Turn Off delay time	$t_{d(off)}$			6.8		µs
Turn Off time	t_{off}			11.3		µs
ST terminal pull-up resistance	$R_{ST(pu)}$	V_{DD} = 5 V		7.5		kΩ
Gate pull-down resistance	$R_{G(pd)}$	V_{IN} = 5 V		2.1		MΩ

Note) 1. If chip temperature exceed the "Over heat protection temp.", output current is shut down. Hold off-state until rise the "Input voltage".

2. At on-state when detect the over heat, output low signal from ST terminal, hold low level until rise the "Input voltage".



Switching time measurement circuit



Definition of the switching time

■ Truth Table

V_{IN}	V_{DS}	V_{ST}	Status
L	L	L	Open load
L	H	H	Normal Off
H	L	H	Normal On
H	H	L	Short load, Over heat

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MIP50□ MIP51□	MIP7□□		· No restrictions in terms of contract	· No restrictions in terms of contract	· For lamp driver/ car electronics accessories

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