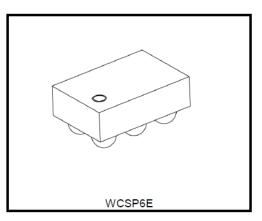
TOSHIBA CMOS Linear Integrated Circuit Silicon Monolithic

TCK401G, TCK402G

External FET Driver IC

The TCK401G and TCK402G are 28 V high input voltage External FET driver ICs. They have wide input voltage range. And they feature a slew rate control driver with small package WCSP6E (0.8 mm x 1.2 mm, t: 0.55 mm). Also they can block reverse current if switch turned off by using external series FET. Thus they are suitable for power management selector such as Battery Charge application.

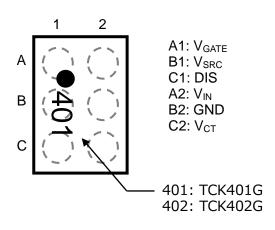


Weight: 1 mg(typ.)

Feature

- High maximum input voltage: V_{IN max} = 40 V
- Wide input voltage range: V_{IN} = 2.7 to 28 V
- Auto output discharge
- Charge pump circuit
- Inrush current reducing circuit.
- Over voltage lock out (Over 28 V)
- Under voltage lock out (Under 2.7 V)
- Reverse current protection by External Back to Back MOSFET

Top marking (Top view)



• Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Input voltage	Vin	-0.3 to 40	V
Control voltage	Vст	-0.3 to 6	V
Output GATE voltage	VGATE	-0.3 to V _{IN} _opr + V _{GS}	V
SRC voltage	VSRC	-0.3 to V _{GATE}	V
DIS voltage	VDIS	-0.3 to 40	V
Power dissipation	PD	800 (Note 1)	mW
Operating temperature range	T _{opr}	-40 to 85	°C
Junction temperature	Tj	150	°C
Storage temperature	T _{stg}	-55 to 150	°C

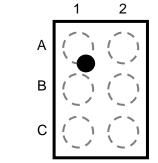
Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings. Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note1: Rating at mounting on a board: FR4 board. (40 mm \times 40 mm \times 1.6 mm, Cu 4 layer)

• Operating Conditions

Characteristics	Symbol	Min.	Тур.	Max.	Unit
Input operation voltage	V _{IN} _opr	2.7	5.0	28	V
Canaditanaa	CIN	0.1	1	_	μF
Capacitance	CGATE	_	2000	_	pF
CONTROL High-level input voltage	VIH	1.6	_	_	V
CONTROL Low-level input voltage	VIL	_	_	0.4	V

- Pin Assignment (Top view)
- WCSP6E

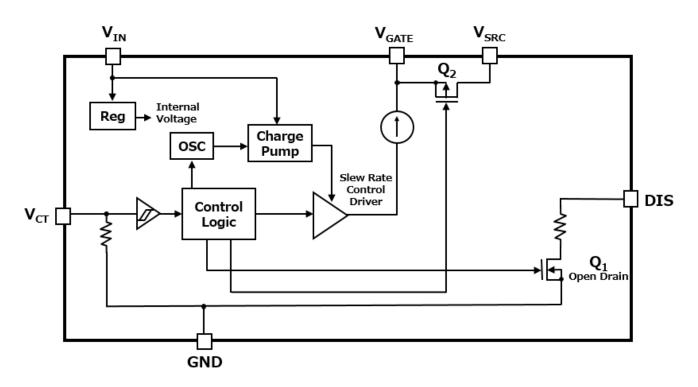


Pin #	Name	Pin #	Name
A1	V _{GATE}	A2	V _{IN}
B1	V _{SRC}	B2	GND
C1	DIS	C2	V _{CT}

• Product list

Part number	VCT function	VCT resistance
TCK401G	Active High	Pull down
TCK402G	Active Low	Pull down

• Block Diagram



TCK401G PIN Description

PIN	Name	Description
A1	V _{GATE}	Gate-Driver Output.
A2	V _{IN}	Supply voltage input.
B1	V _{SRC}	Recommend connecting V _{SRC} terminal to the common source connection of the external MOSFETs.
B2	GND	Ground
C1	DIS	Output Discharge terminal.
C2	V _{CT}	Mode control input terminal. When V_{CT} =High turn the external MOSFETs on, V_{CT} =Low, turn the external MOSFETs off.

• TCK402G PIN Description

PIN	Name	Description
A1	V _{GATE}	Gate-Driver Output.
A2	V _{IN}	Supply voltage input.
B1	V _{SRC}	Recommend connecting V_{SRC} terminal to the common source connection of the external MOSFETs.
B2	GND	Ground
C1	DIS	Output Discharge terminal.
C2	V _{CT}	Mode control input terminal. When V_{CT} =Low turn the external MOSFETs on, V_{CT} =High, turn the external MOSFETs off.

•

TCK401G Operation Status Table

2.7V ≤ V_{IN} ≤ 28 V (Ta = -40 to 85°C)

V _{CT}	V _{GATE}	Discharge Q1	comment
High	ON (Vin + Vgs)	OFF	Driver ON mode
Open	OFF	ON	Driver OFF mode
Low	UFF	ON	

TCK402G Operation Status Table

2.7V ≤ V_{IN} ≤ 28 V (Ta = -40 to 85°C)

V _{CT}	V _{GATE}	Discharge Q1	comment		
Low	ON				
Open	(VIN + VGS)	OFF	Driver ON mode		
High	OFF	ON	Driver OFF mode		



DC Characteristics (Ta = -40 to 85°C)

Characteristics	Symbol	Test Condition		Ta = 25°C			Ta = -40 to 85°C (Note 2)		Unit
				Min.	Тур.	Max.	Min	Max	
			V_{CT} : High, $V_{IN} = 5.0 V$	—	121	_	_	222	μA
		TOKADAO	VCT: High, VIN = 9.0 V		144			283	μA
		TCK401G	V _{CT} : High, V _{IN} = 12 V		159			294	μA
lanut misseent summet (ON state)	le (et s		V _{CT} : High, V _{IN} = 20 V		198			376	μA
Input quiescent current (ON state)	IQ(ON)		Vct: Low, VIN = 5.0 V		121		_	222	μА
		TOKADOO	Vct: Low, VIN = 9.0 V		144	_	_	283	μA
		TCK402G	V_{CT} : Low, $V_{IN} = 12 V$		159		_	294	μА
			V_{CT} : Low, $V_{IN} = 20 V$		198	_	_	376	μA
		TCK401G	V _{CT} : Low, V _{IN} = 5.0 V		3.0	_	_	4.8	μA
			V _{CT} : Low, V _{IN} = 9.0 V		5.9	_	_	8.2	μA
			VCT: Low, VIN = 12 V		8.0	_	_	11.2	μA
			Vct: Low, VIN = 20 V		13.8	_	_	19.2	μA
Standby current (OFF state)	lq(off)		V _{CT} : High, V _{IN} = 5.0 V		3.0		—	4.8	μA
		70// 4000	V _{CT} : High, V _{IN} = 9.0 V		5.9	_	_	8.2	μA
		TCK402G	V _{CT} : High, V _{IN} = 12 V		8.0	_	_	11.2	μA
			V_{CT} : High, $V_{IN} = 20 V$		13.8	_	_	19.2	μA
		V _{IN} = 3 V			4.0		2.8	5.1	V
		VIN = 5 V		_	6.5	_	5.1	7.9	V
GATE Drive voltage(VGATE-VIN)	Vgs	VIN = 9.0 V	,	_	6.5	_	5.1	7.9	V
		12 V ≤ VI	N ≤ 28 V	_	8.5	_	6.9	10.0	V
Output current	IGATE(ON)	VIN = 5 V			38	_		_	μA
DIS resistance	R _{DIS}	—		—	21	_	—	—	kΩ
Control pull down resistance	R _{CT}	V _{CT} = 5 V			600		—	—	kΩ

Note 2: This parameter is warranted by design.

• AC Characteristics (Ta = 25°C, VIN = 5 V, CGATE = 2000 pF)

Characteristics	Symbol	Test Condition (Figure 1,2)	Min.	Тур.	Max.	Unit
VGATE ON time	tON	Initial startup time of V _{GATE} (Note 3) voltage from 0 V to V _{IN} +1 V	_	0.58	0.8	ms
VGATE OFF time	tOFF	V _{GATE} = 0.5 V	_	16.6	_	μs
V _{GATE} rise time	tr	V_{GATE} rising from V_{IN} +1 V to V_{IN} +3 V	_	0.2	_	ms
VGATE fall time	tf	VGATE falling from VIN +3 V to VIN +1 V	_	1.5	_	μS

Note 3: This parameter is warranted by design.

• AC Characteristics (Ta = 25°C, VIN = 9 V, CGATE = 2000 pF)

Characteristics	Symbol	Test Condition (Figure 1,2)	Min.	Тур.	Max.	Unit
V _{GATE} ON time	tON	Initial startup time of V _{GATE} (Note 4) voltage from 0 V to V _{IN} +1 V	—	0.78	1.0	ms
VGATE OFF time	tOFF	VGATE = 0.5 V	_	19.7	_	μS
VGATE rise time	tr	VGATE rising from VIN +1 V to VIN +4 V	_	0.35	_	ms
V _{GATE} fall time	tf	$V_{\mbox{GATE}}$ falling from $V_{\mbox{IN}}$ +4 V to $V_{\mbox{IN}}$ +1 V		1.6		μS

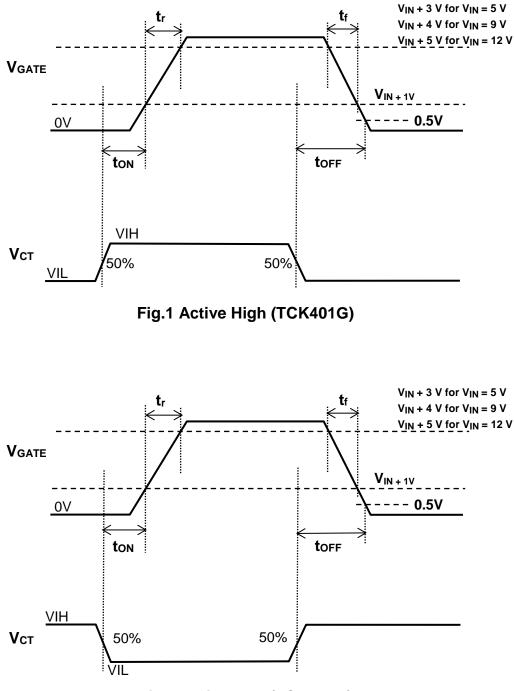
Note 4: This parameter is warranted by design.

• AC Characteristics (Ta = 25°C, VIN = 12 V, CGATE = 2000 pF)

Characteristics	Symbol	Test Condition (Figure 1,2)	Min.	Тур.	Max.	Unit
VGATE ON time	tON	Initial startup time of V _{GATE} (Note 5) voltage from 0 V to V _{IN} +1 V	_	0.92	1.2	ms
VGATE OFF time	tOFF	V _{GATE} = 0.5 V	_	21.3	_	μS
V _{GATE} rise time	tr	V_{GATE} rising from V_{IN} +1 V to V_{IN} +5 V	_	0.6	_	ms
VGATE fall time	tf	$V_{\mbox{GATE}}$ falling from $V_{\mbox{IN}}$ +5 V to $V_{\mbox{IN}}$ +1 V	_	1.7	_	μS

Note 5: This parameter is warranted by design.

Timing chart

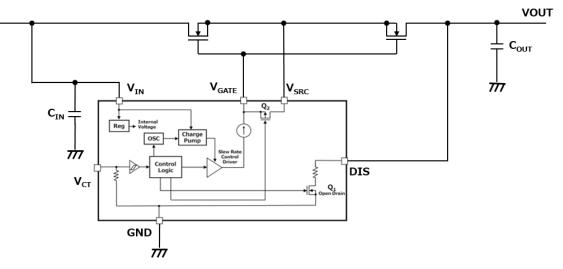




Application Note

• Application circuit example

VIN



1) Input and Output capacitor

An input capacitor (C_{IN}) and an output capacitor (C_{OUT}) are recommended for the stable operation of TCK401G and TCK402G. And it is effective to reduce voltage overshoot or undershoot due to sharp changes in output current and also for improved stability of the power supply. When used, place C_{IN} and C_{OUT} more than 1.0μ F as close to TCK40xG to improve stability of the power supply.

2) V_{CT} pin

V_{CT} pin for TCK401G and TCK402G is operated by the control voltage and has Schmitt trigger. V_{CT} pin has a tolerant function such that it can be used even if the control voltage is higher than the input voltage.

3) VSRC Pin

For Dual MOSFET Driver, $V_{\mbox{SRC}}$ works to short between $V_{\mbox{GATE}}$ and MOSFET source when Driver IC turn off.

If there are enough margins of V_{GS} of MOSFET, $\mathsf{V}_{\mathsf{SRC}}$ terminal Open state is no problem.

For Single MOSFET Driver, if there is enough margin of V_{GS} of MOSFET, V_{SRC} pin Open state is no problem. If there are not enough margins, we recommend connecting V_{SRC} and VOUT. If connect V_{SRC} and VOUT, to_{FF} time become longer because of C_{OUT}. Therefore, please consider enough margins for MOSFET selection.

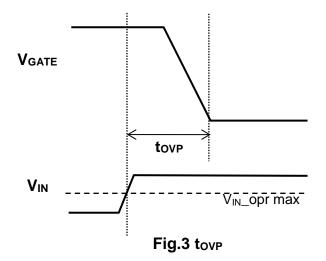
4) DIS Pin

If discharge function is needed when Driver IC turns off, please connect DIS Pin to V_{OUT} . If no need, DIS Pin Open state is no problem.

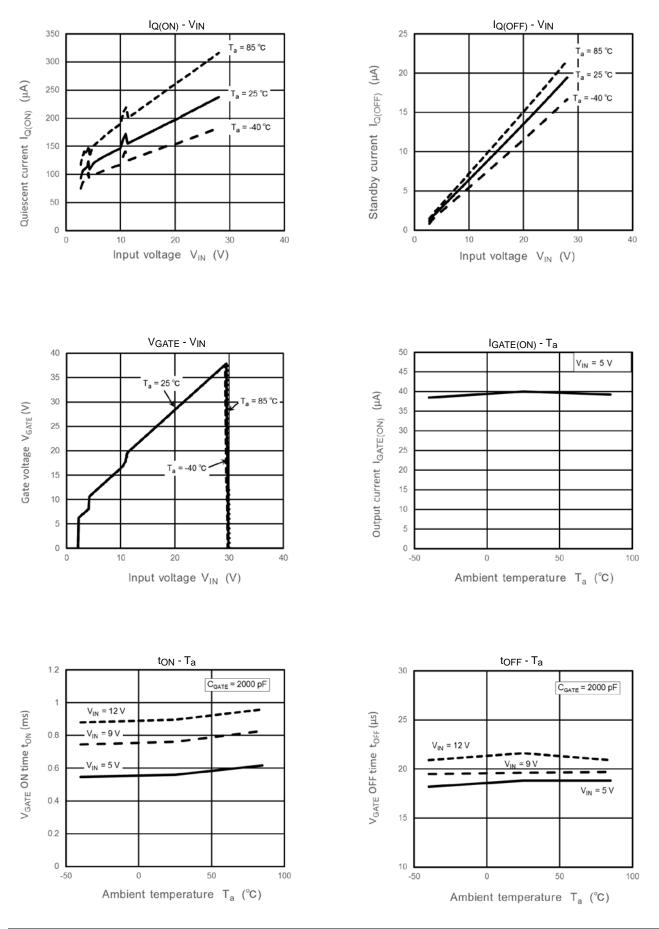
5) Over Voltage Protection off time (tovP)

Over Voltage (VIN is over VIN_opr max) Protection off time (tovP) is similar to VGATE OFF time (tOFF).

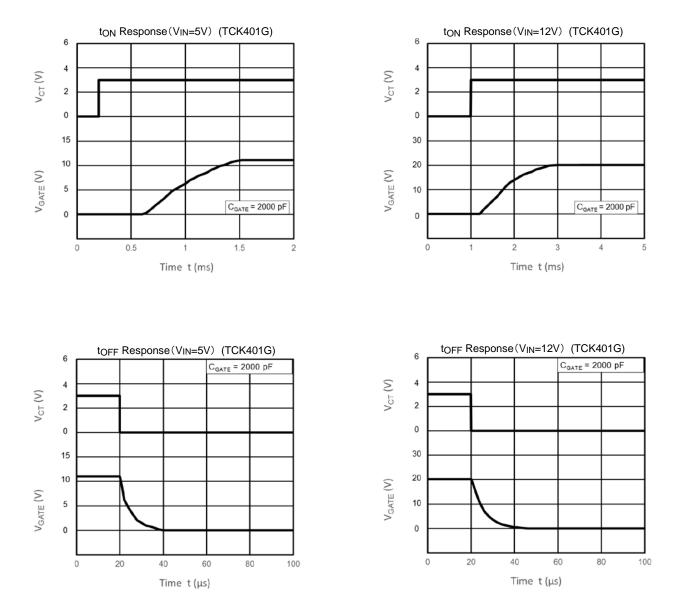
Timing chart



Representative Typical Characteristics



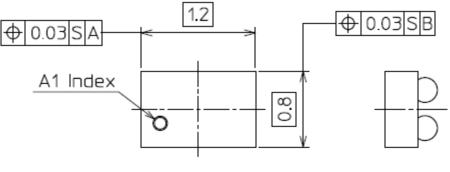




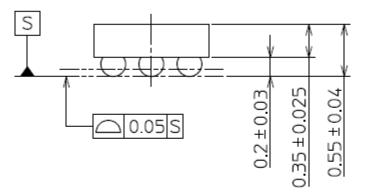
Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

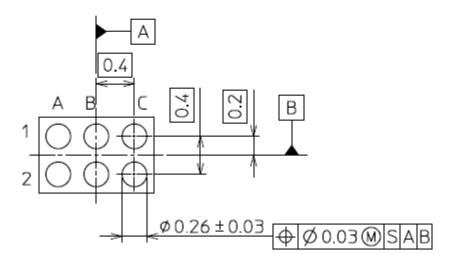
• Package dimension

Unit: mm







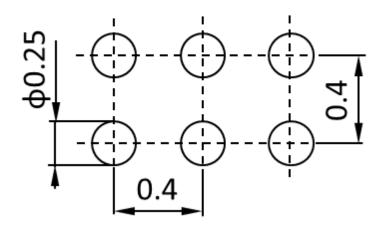


BOTTOM VIEW

Weight: 1 mg (typ.)

Land pattern dimensions (for reference only)

Unit: mm



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