

TOSHIBA INTELLIGENT POWER MODULE SILICON N CHANNEL IGBT

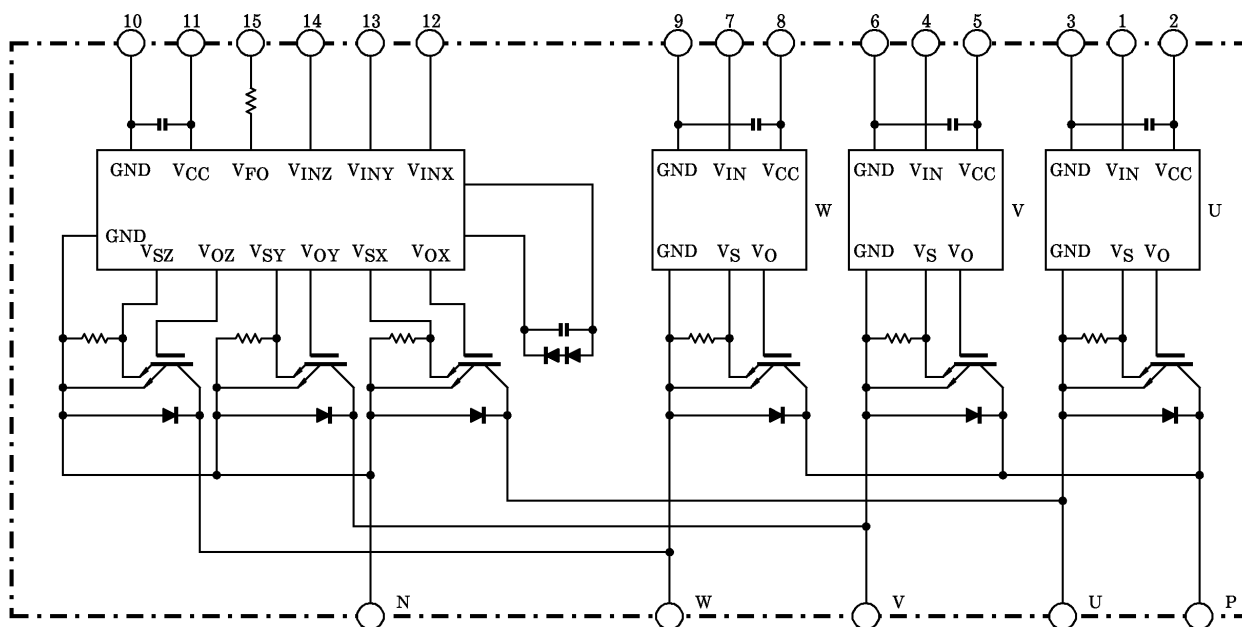
# MIG20J103H

HIGH POWER SWITCHING APPLICATIONS

MOTOR CONTROL APPLICATIONS

- Intelligent Power Module that include IGBT drive circuits, overcurrent, undervoltage lockout, and overtemperature protection.
- The Electrodes are Isolated from Case.
- High speed type IGBT :  $V_{CE(sat)}=2.7V$  (MAX.)  
 $t_{off}=2.0\mu s$  (MAX.)  
 $t_{rr}=0.2\mu s$  (MAX.)
- Outline : TOSHIBA 2-99E1A (See page 5 for the device outline)
- Weight : 80g

EQUIVALENT CIRCUIT



- |               |               |               |
|---------------|---------------|---------------|
| 1. $V_{INU}$  | 2. $V_{DU}$   | 3. $GND_U$    |
| 4. $V_{INV}$  | 5. $V_{DV}$   | 6. $GND_V$    |
| 7. $V_{INW}$  | 8. $V_{DW}$   | 9. $GND_W$    |
| 10. $GND_L$   | 11. $V_{DL}$  | 12. $V_{INX}$ |
| 13. $V_{INY}$ | 14. $V_{INZ}$ | 15. $V_{FO}$  |

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MAXIMUM RATINGS ( $T_j = 25^\circ\text{C}$ )

	SYMBOL	ITEM	CONDITION	RATING	UNIT
Inverter Part	$V_{CC}$	Supply Voltage	P-N	400	V
	$V_{CES}$	Collector-Emitter Voltage	—	600	V
	$\pm I_C$	Collector Current (DC)	$T_c = 25^\circ\text{C}$	20	A
	$P_C$	Collector Power Dissipation	$T_c = 25^\circ\text{C}$	62	W
	$T_j$	Junction Temperature	—	150	$^\circ\text{C}$
Control Part	$V_D$	Supply Voltage	—	20	V
	$V_{IN}$	Input Voltage	$V_{IN} = V_D$	20	V
	$V_{FO}$	Foul Output Voltage	$V_{FO} = V_D$	20	V
	$I_{FO}$	Foul Output Current	—	7	mA
All System	$T_c$	Operating Temperature	—	-20~+100	$^\circ\text{C}$
	$T_{stg}$	Storage Temperature Range	—	-40~+125	$^\circ\text{C}$
	$V_{ISO}$	Isolation Voltage	AC, 1 min	2500	$V_{rms}$
	—	Screw Torque	M5	2	N·m

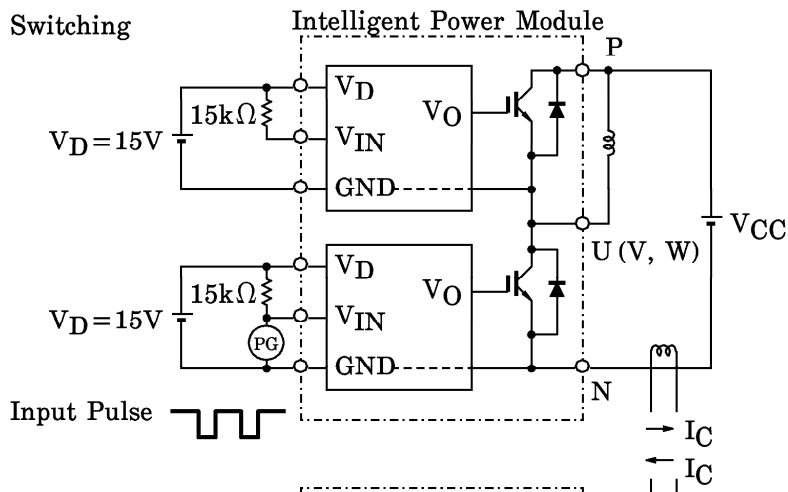
ELECTRICAL CHARACTERISTICS ( $T_j = 25^\circ\text{C}$ )

Inverter Part

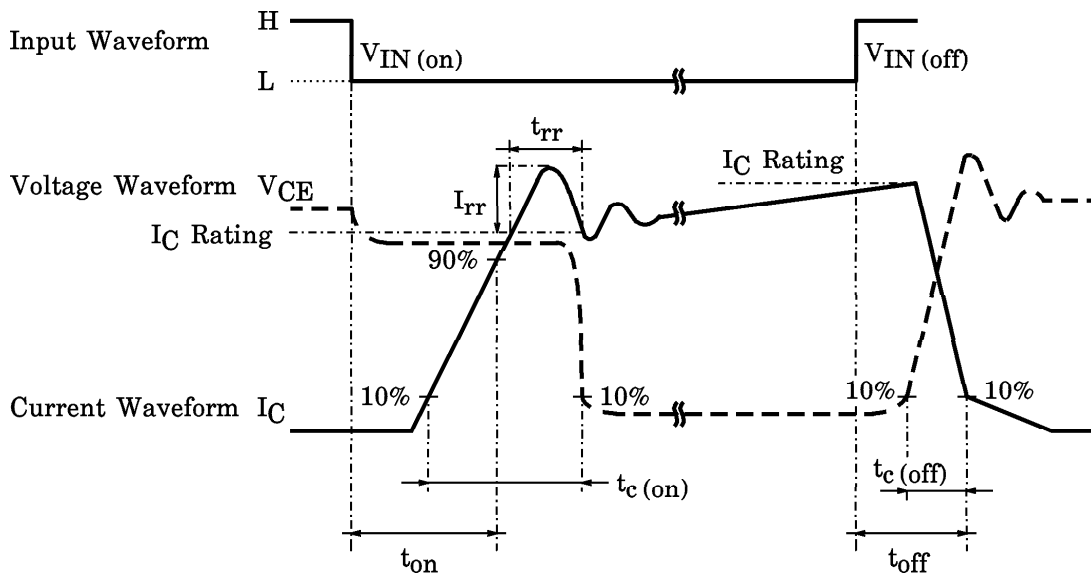
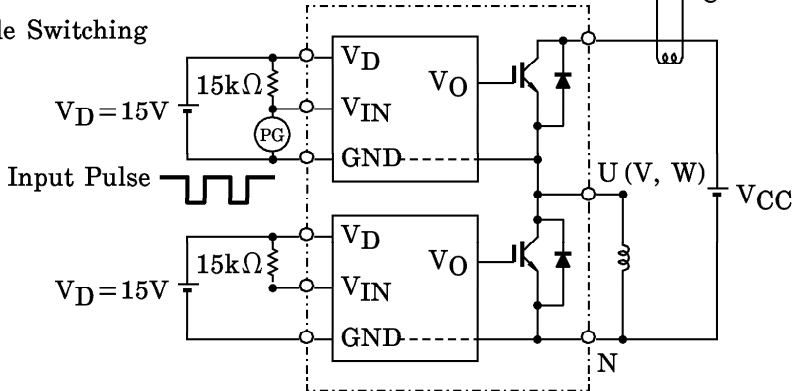
SYMBOL	ITEM	TEST CONDITION	SPEC			UNIT	
			MIN.	TYP.	MAX.		
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$V_D = 15\text{V}$ $I_{IN} = 0\text{mA}$	—	2.1	2.7	V	
		$I_C = 20\text{A}$ $T_j = 125^\circ\text{C}$					—
$V_F$	Forward Voltage	$I_F = 20\text{A}$	—	1.8	2.5	V	
$t_{on}$	Switching Time	$V_{CC} = 300\text{V}$ $I_C = 20\text{A}$ $V_D = 15\text{V}$ $I_{IN} = 1\text{mA} \leftrightarrow 0\text{mA}$ Inductive Load	0.5	1.3	2.0	$\mu\text{s}$	
$t_{c(on)}$			—	0.3	1.0		
$t_{off}$			0.5	1.0	2.0		
$t_{c(off)}$			—	0.4	1.5		
$t_{rr}$			—	0.12	0.2		
$I_{CES}$	Collector Cut-off Current	$V_{CE} = 600\text{V}$	$T_j = 25^\circ\text{C}$	—	—	1	mA
			$T_j = 125^\circ\text{C}$	—	—	20	

Note 1 : Switching Time Test Circuit & Timing Chart

a) Low Side Switching



b) High Side Switching



Control Part (T<sub>j</sub> = 25°C)

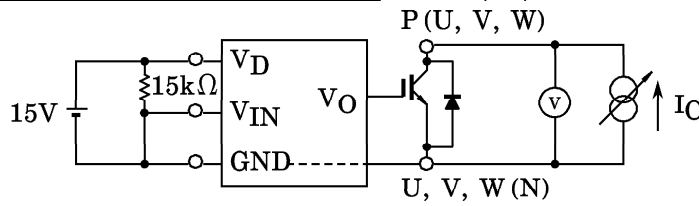
SYMBOL	ITEM	TEST CONDITION	SPEC			UNIT	
			MIN.	TYP.	MAX.		
I <sub>D</sub>	Circuit Current	V <sub>D</sub> = 15V	High Side	6	12	18	mA
			Low Side	11	23	35	
V <sub>IN (on)</sub>	Input On Signal Voltage	—		1.0	1.3	1.6	V
V <sub>IN (off)</sub>	Input Off Signal Voltage			1.5	1.8	2.1	
I <sub>FO</sub>	Foul Output Current (Protection)	V <sub>D</sub> = 15V, V <sub>FO</sub> = 15V		3	5	7	mA
	Foul Output Current (Normal)			—	—	1	
OC	Over Current Protection Trip Level	V <sub>D</sub> = 15V		40	43	—	A
		V <sub>D</sub> = 15V, T <sub>j</sub> ≤ 125°C		32	—	—	
t <sub>off (OC)</sub>	Over Current Cut Off Time	V <sub>D</sub> = 15V		5	10	18	μs
OT	Over Temperature Protection	Case Temperature	Trip Level	100	110	120	°C
			Reset Level	80	90	100	
UV	Control Supply Under-Voltage Protection	—	Trip Level	11.3	12.0	12.7	V
UV <sub>r</sub>			Reset Level	11.8	12.5	13.2	
t <sub>FO</sub>	Foul Output Pulse Width	V <sub>D</sub> = 15V		5	10	15	ms

Thermal Resistance (T<sub>j</sub> = 25°C)

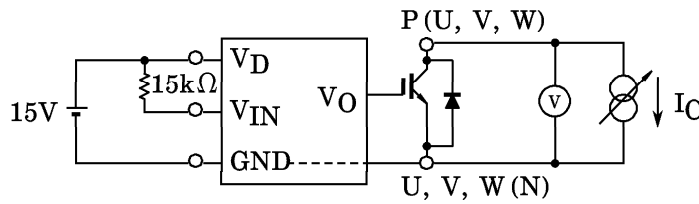
SYMBOL	ITEM	TEST CONDITION	SPEC			UNIT
			MIN.	TYP.	MAX.	
R <sub>th (j-c)</sub>	Junction to Case Thermal Resistance	INV. IGBT	—	—	2.0	°C/W
R <sub>th (j-c)</sub>		INV. FWD	—	—	4.5	
R <sub>th (c-f)</sub>	Case to Fin Thermal Resistance with compound	—	—	0.2	—	

**ELECTRICAL CHARACTERISTICS TEST CIRCUIT** ( $V_{CE(sat)}$ ,  $V_F$ ,  $I_{CES}$ ,  $I_D$ ,  $V_{IN}$ ,  $I_{FO}$ ,  $t_{FO}$ )

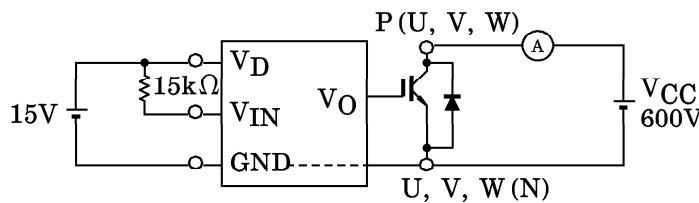
a)  $V_{CE(sat)}$



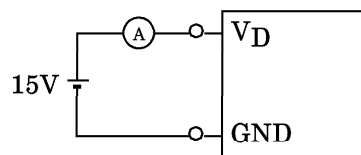
b)  $V_F$



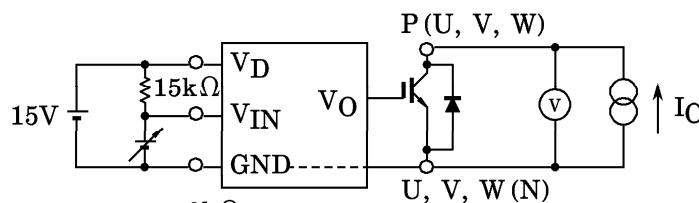
c)  $I_{CES}$



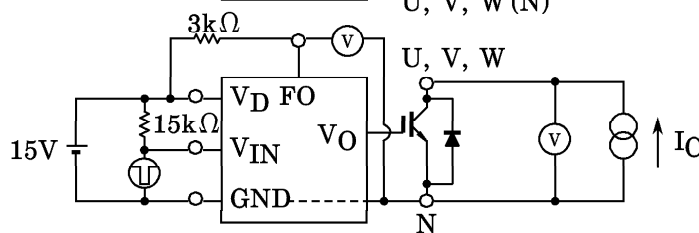
d)  $I_D$



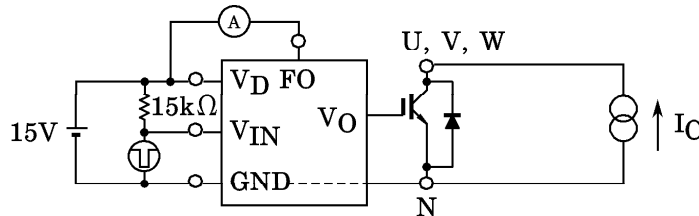
e)  $V_{IN(OFF)}$   
 $V_{IN(ON)}$



f)  $t_{FO}$

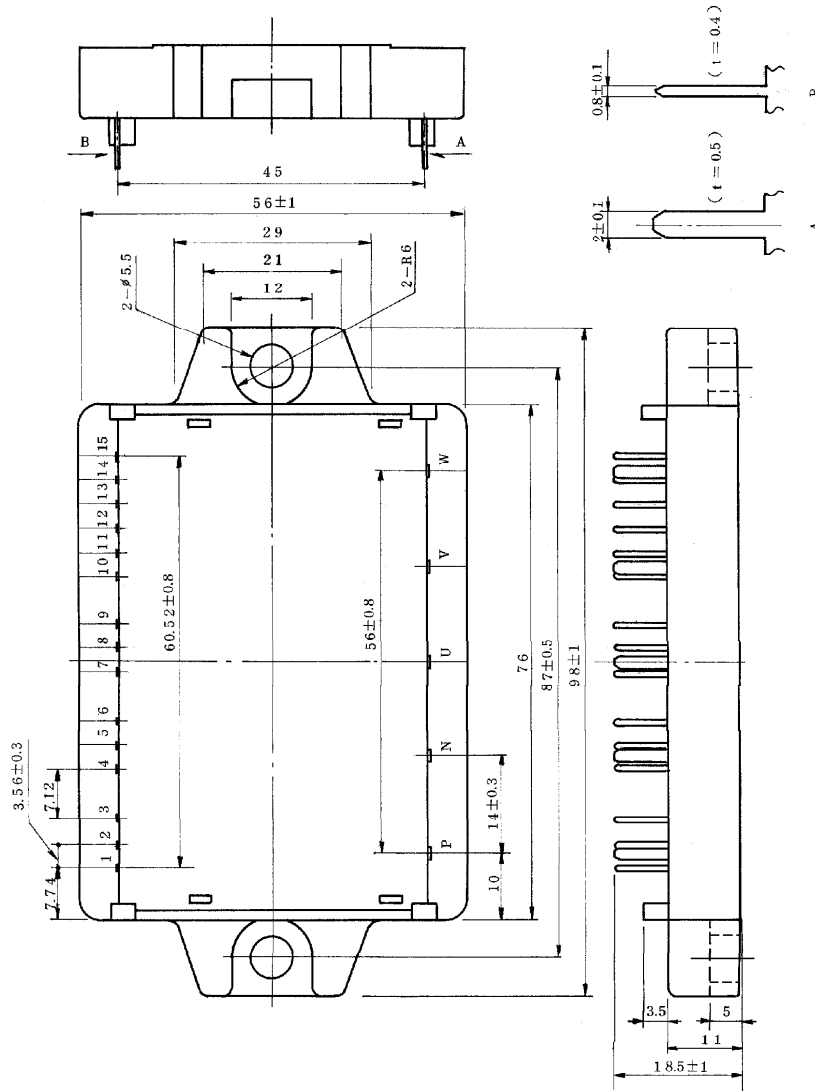


g)  $I_{FO}$



OUTLINE : TOSHIBA 2-99E1A

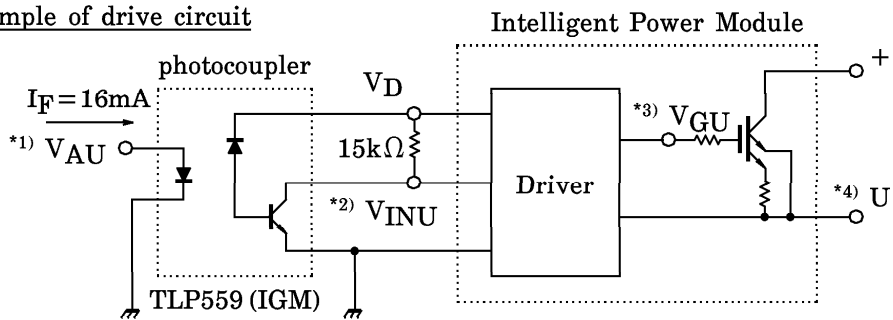
Unit in mm



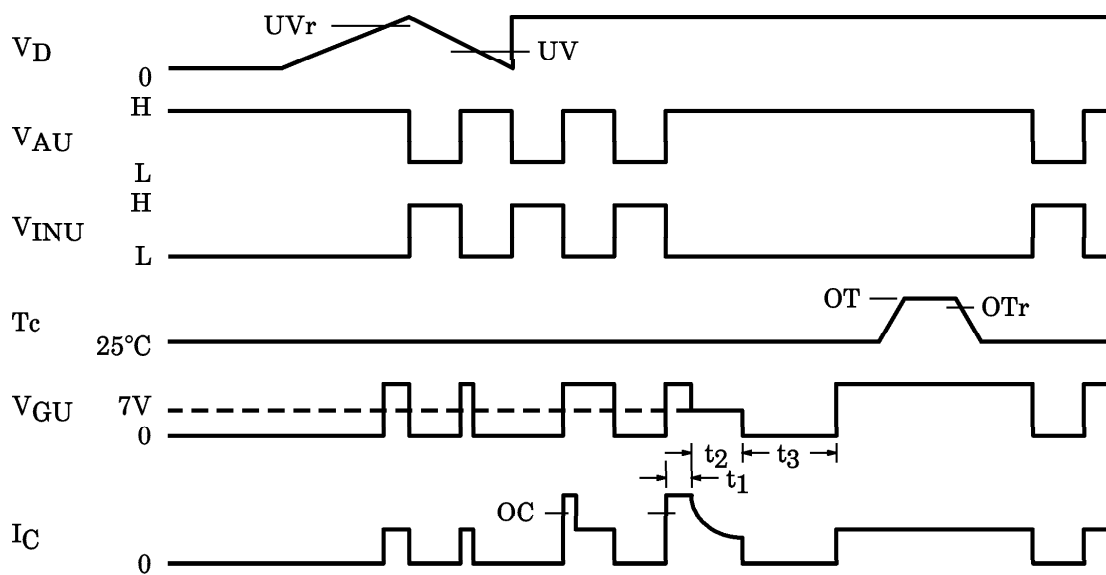
- |          |          |          |
|----------|----------|----------|
| 1. VINU  | 2. VDU   | 3. GNDU  |
| 4. VINV  | 5. VDv   | 6. GNDV  |
| 7. VINW  | 8. VDw   | 9. GNDW  |
| 10. GNDL | 11. VDL  | 12. VINX |
| 13. VINY | 14. VINZ | 15. VFO  |

TIMING CHART (High side)

Typical example of drive circuit



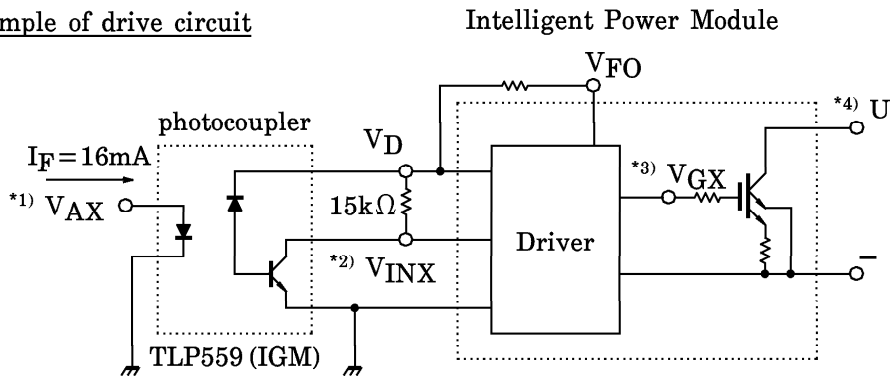
- \*1) or  $V_{AV}$ ,  $V_{AW}$
- \*2) or  $V_{INV}$ ,  $V_{INW}$
- \*3) or  $V_{GV}$ ,  $V_{GW}$
- \*4) or  $V$ ,  $W$



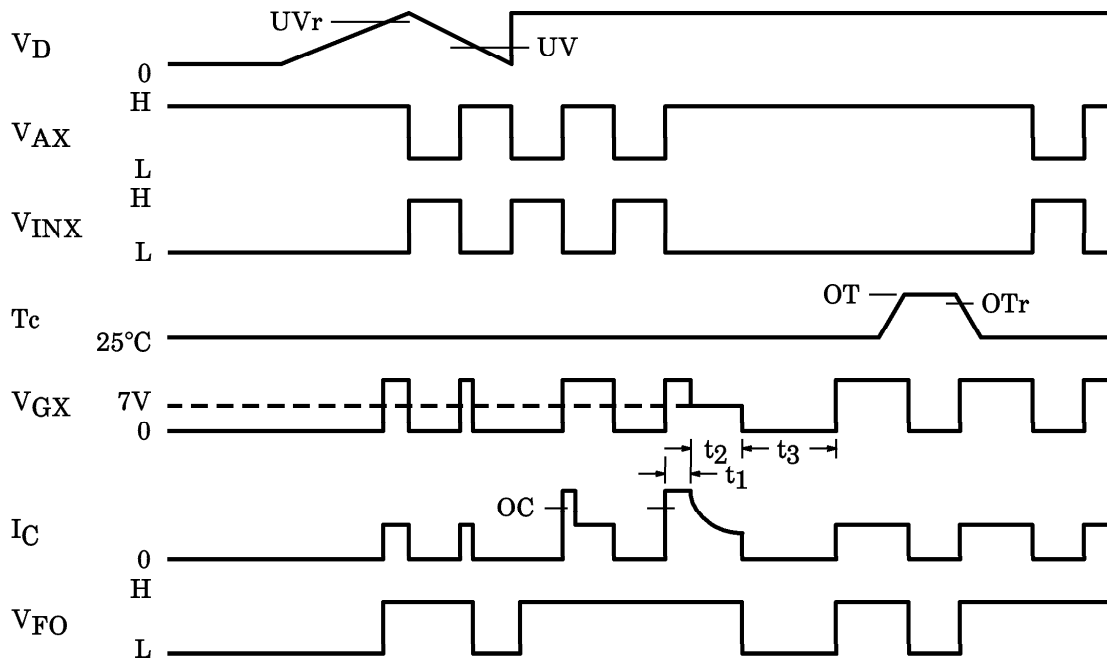
- UV : Under-Voltage Trip Level
- UVr : Under-Voltage Reset Level
- OT : Over Temperature Trip Level
- OTr : Over Temperature Reset Level
- OC : Over Current
- $t_1$  : 2.5  $\mu$ s (Typ.)
- $t_2$  : 10  $\mu$ s (Typ.)
- $t_3$  : 10ms (Typ.)

TIMING CHART (Low side)

Typical example of drive circuit



- \*1) or VAY, VAZ
- \*2) or VINY, VINZ
- \*3) or VGY, VGZ
- \*4) or V, W



- UV : Under-Voltage Trip Level
- UVr : Under-Voltage Reset Level
- OT : Over Temperature Trip Level
- OTr : Over Temperature Reset Level
- OC : Over Current
- t<sub>1</sub> : 2.5μs (Typ.)
- t<sub>2</sub> : 10μs (Typ.)
- t<sub>3</sub> : 10ms (Typ.)



