

TOSHIBA INTELLIGENT POWER MODULE SILICON N CHANNEL IGBT

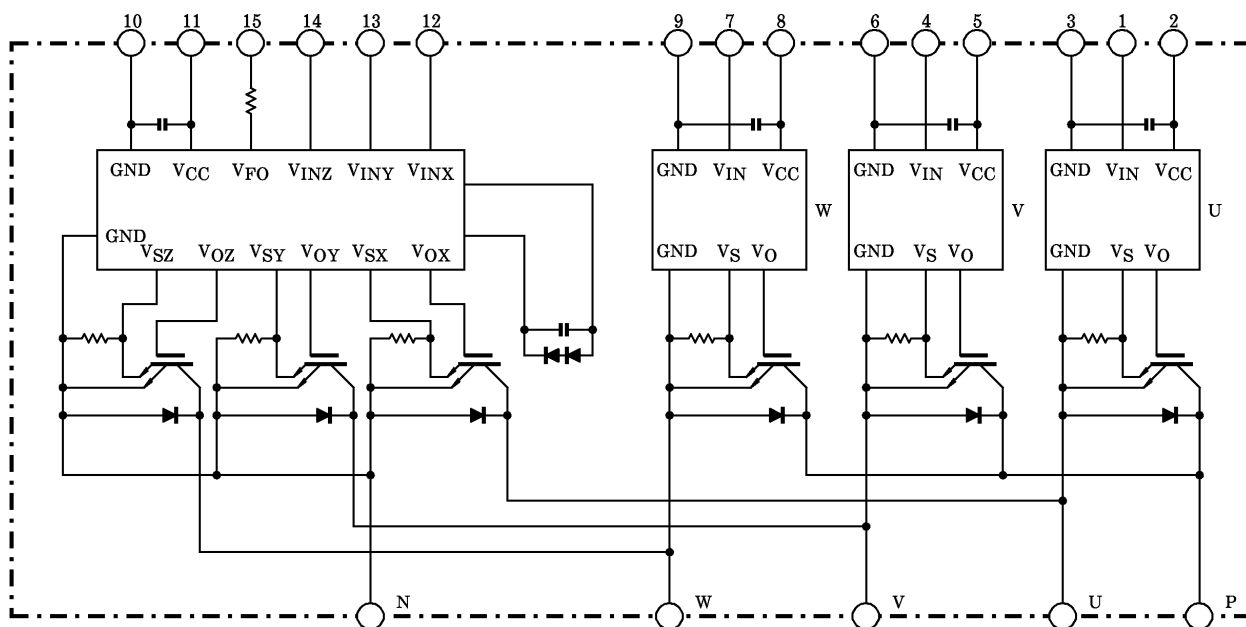
MIG20J103H

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}	Fault Output Voltage	$V_{FO} = V_D$	20	V
	I_{FO}	Fault 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

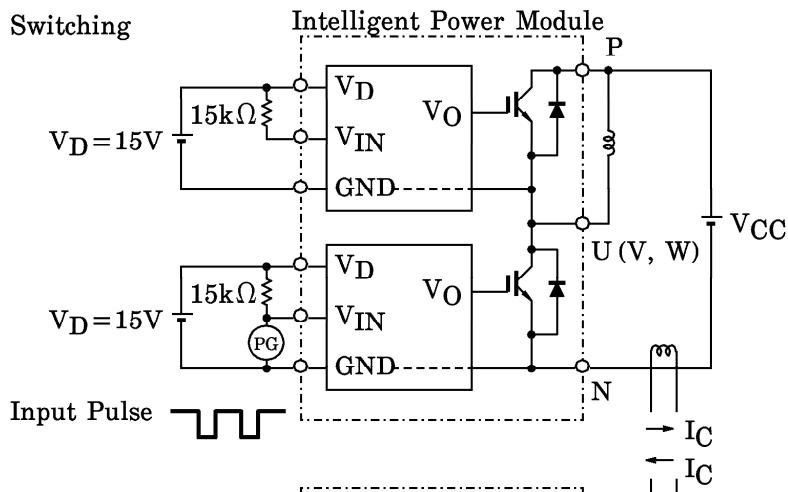
ELECTRICAL CHARACTERISTICS ($T_j = 25^\circ\text{C}$)

Inverter Part

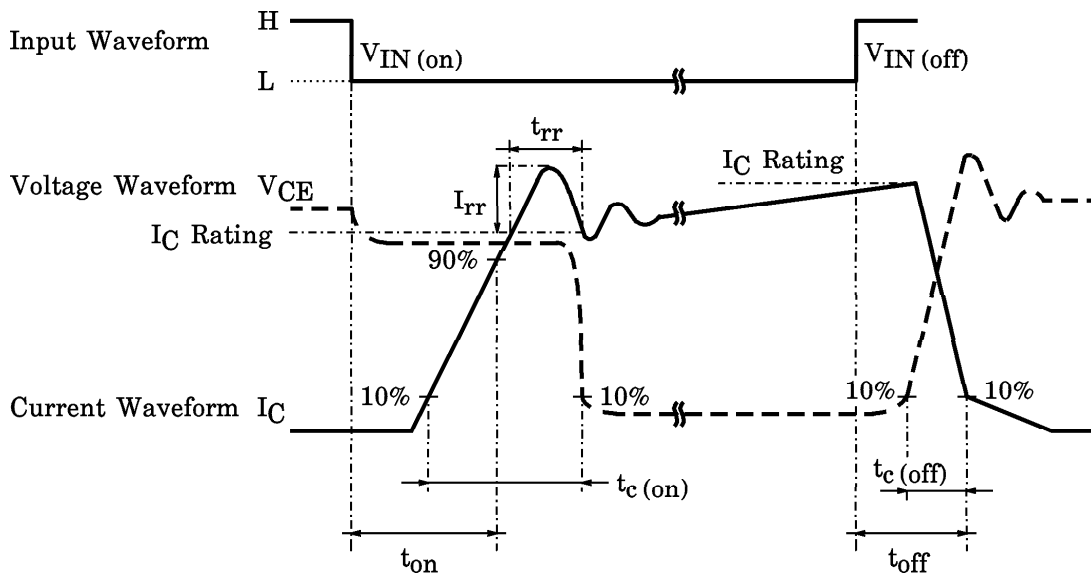
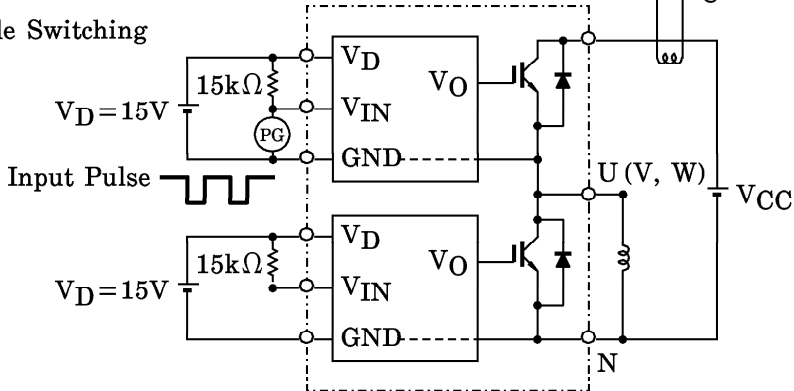
SYMBOL	ITEM	TEST CONDITION	SPEC			UNIT	
			MIN.	TYP.	MAX.		
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$V_D = 15\text{V}$ $I_{IN} = 0\text{mA}$	—	2.1	2.7	V	
		$I_C = 20\text{A}$ $T_j = 125^\circ\text{C}$					—
V_F	Forward Voltage	$I_F = 20\text{A}$	—	1.8	2.5	V	
t_{on}	Switching Time	$V_{CC} = 300\text{V}$ $I_C = 20\text{A}$ $V_D = 15\text{V}$ $I_{IN} = 1\text{mA} \leftrightarrow 0\text{mA}$ Inductive Load	0.5	1.3	2.0	μs	
$t_{c(on)}$			—	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_j = 25°C)

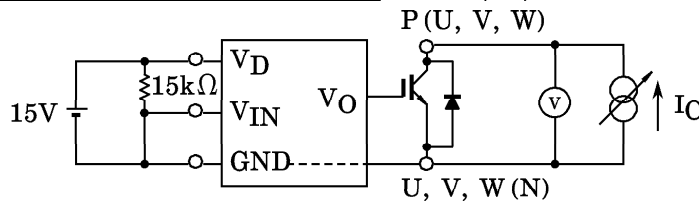
SYMBOL	ITEM	TEST CONDITION	SPEC			UNIT	
			MIN.	TYP.	MAX.		
I _D	Circuit Current	V _D = 15V	High Side	6	12	18	mA
			Low Side	11	23	35	
V _{IN} (on)	Input On Signal Voltage	—	1.0	1.3	1.6	V	
V _{IN} (off)	Input Off Signal Voltage		1.5	1.8	2.1		
I _{FO}	Foul Output Current (Protection)	V _D = 15V, V _{FO} = 15V	3	5	7	mA	
	Foul Output Current (Normal)		—	—	1		
OC	Over Current Protection Trip Level	V _D = 15V	40	43	—	A	
		V _D = 15V, T _j ≤ 125°C	32	—	—		
t _{off} (OC)	Over Current Cut Off Time	V _D = 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
UVr			Reset Level	11.8	12.5	13.2	
t _{FO}	Foul Output Pulse Width	V _D = 15V	5	10	15	ms	

Thermal Resistance (T_j = 25°C)

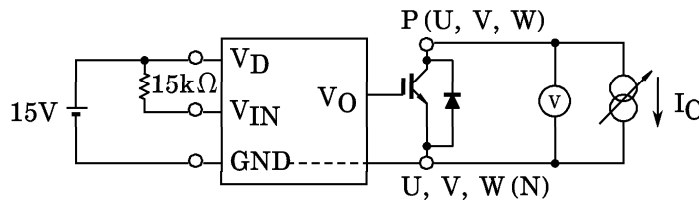
SYMBOL	ITEM	TEST CONDITION	SPEC			UNIT
			MIN.	TYP.	MAX.	
R _{th} (j-c)	Junction to Case Thermal Resistance	INV. IGBT	—	—	2.0	°C/W
R _{th} (j-c)		INV. FWD	—	—	4.5	
R _{th} (c-f)	Case to Fin Thermal Resistance with compound	—	—	0.2	—	

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

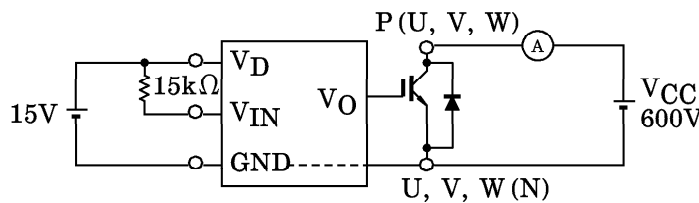
a) $V_{CE(sat)}$



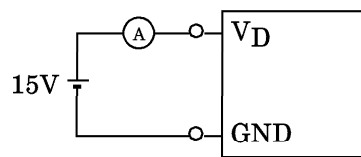
b) V_F



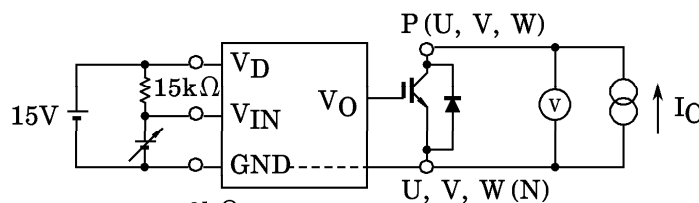
c) I_{CES}



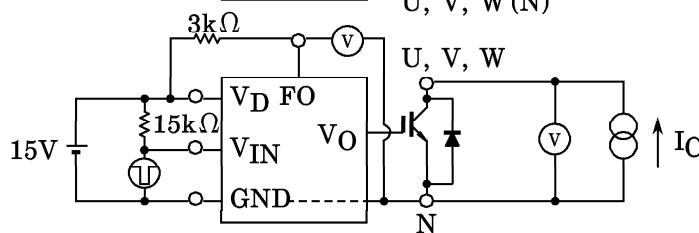
d) I_D



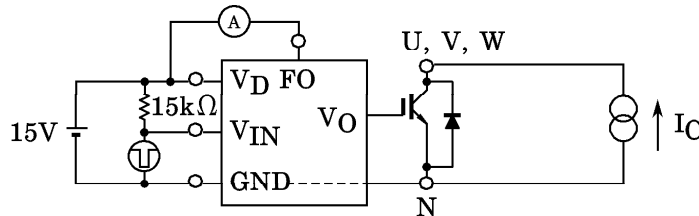
e) $V_{IN(OFF)}$
 $V_{IN(ON)}$



f) t_{FO}

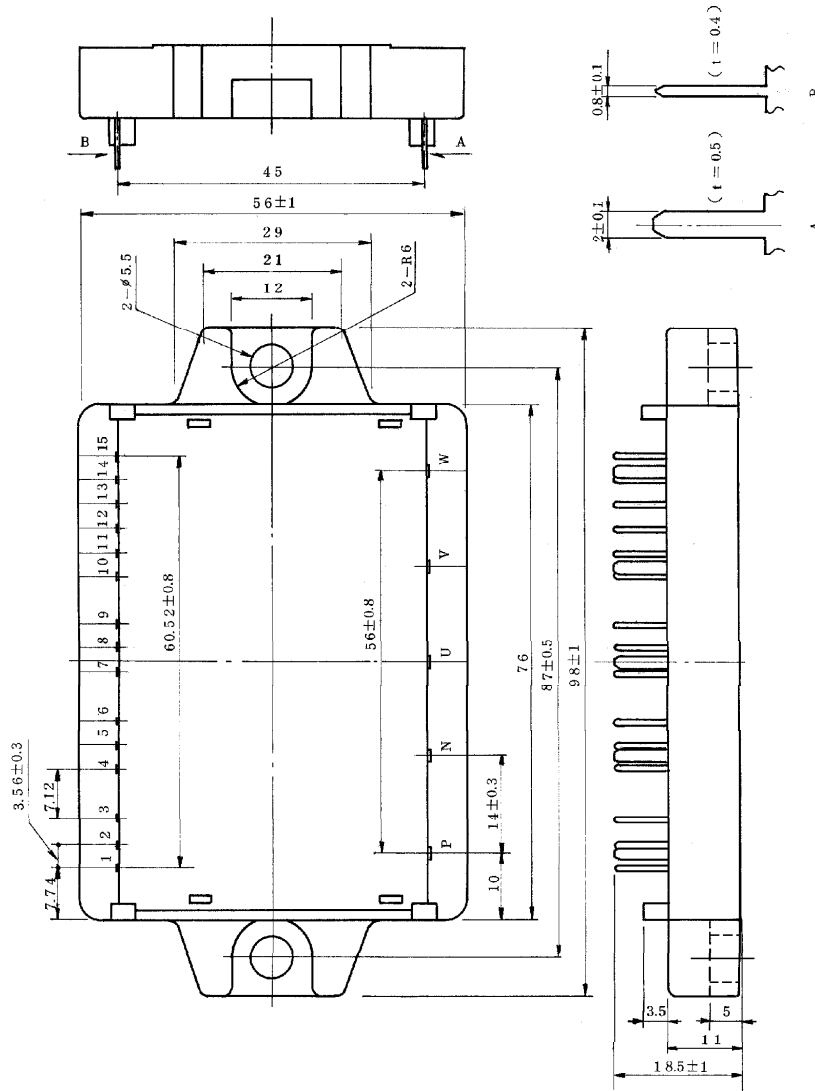


g) I_{FO}



OUTLINE : TOSHIBA 2-99E1A

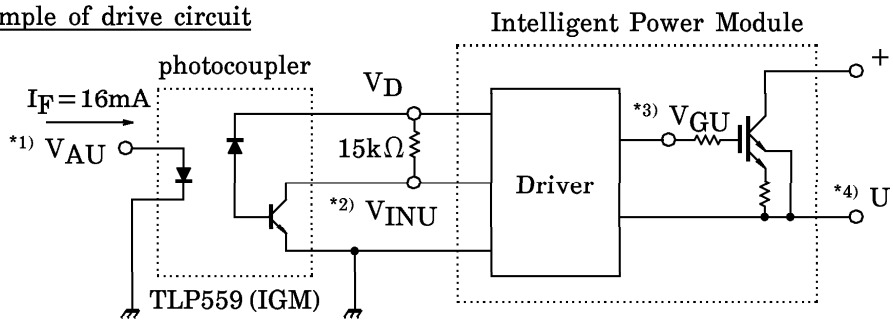
Unit in mm



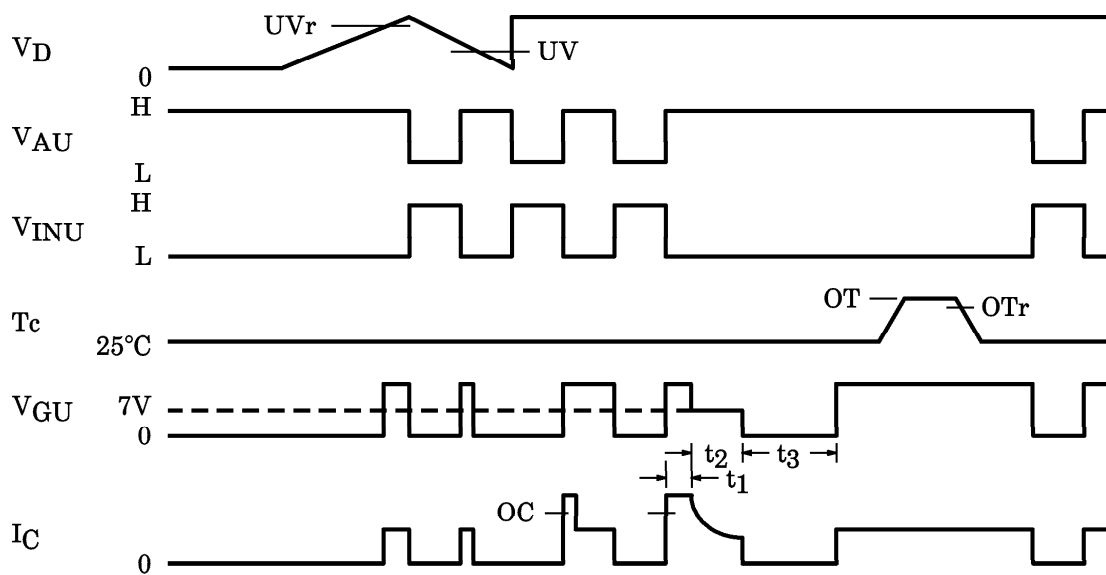
- | | | |
|----------|----------|----------|
| 1. VINU | 2. VDU | 3. GNDU |
| 4. VINV | 5. VDv | 6. GNDV |
| 7. VINW | 8. VDw | 9. GNDW |
| 10. GNDL | 11. VDL | 12. VINX |
| 13. VINY | 14. VINZ | 15. VFO |

TIMING CHART (High side)

Typical example of drive circuit



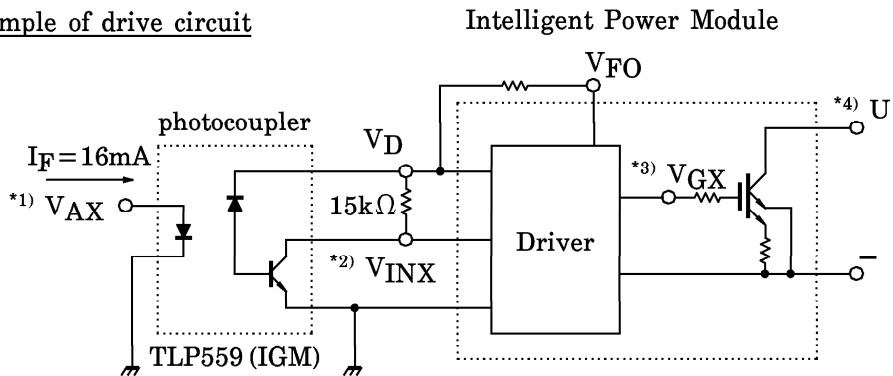
- *1) or V_{AV} , V_{AW}
- *2) or V_{INV} , V_{INW}
- *3) or V_{GV} , V_{GW}
- *4) or V , W



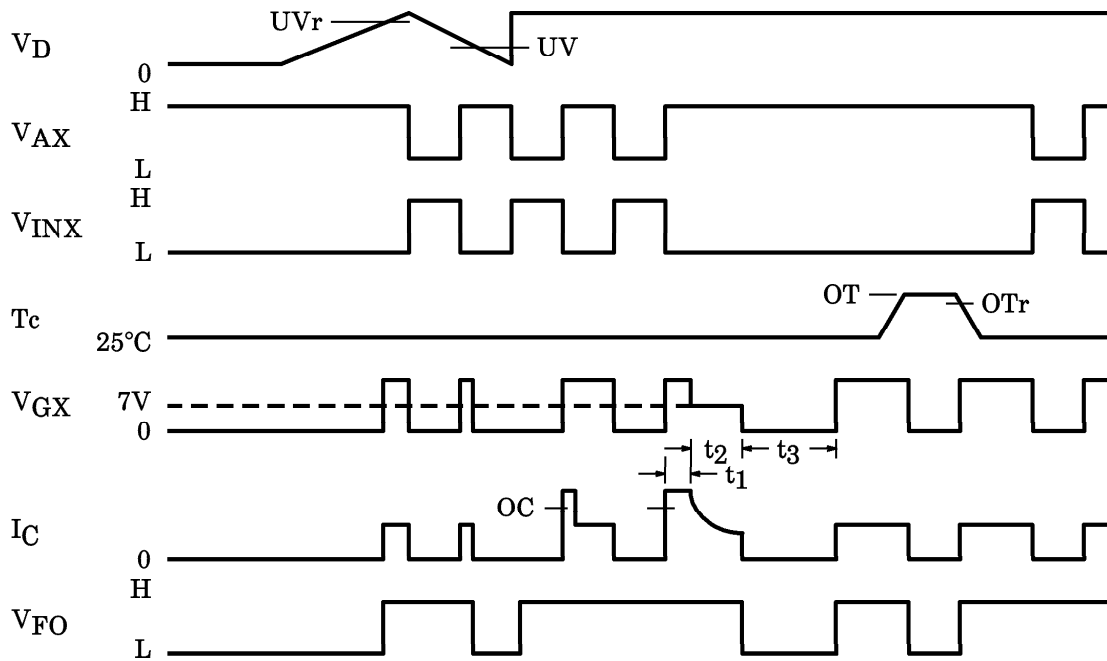
- UV : Under-Voltage Trip Level
- UVr : Under-Voltage Reset Level
- OT : Over Temperature Trip Level
- OTr : Over Temperature Reset Level
- OC : Over Current
- t_1 : 2.5 μ s (Typ.)
- t_2 : 10 μ s (Typ.)
- t_3 : 10ms (Typ.)

TIMING CHART (Low side)

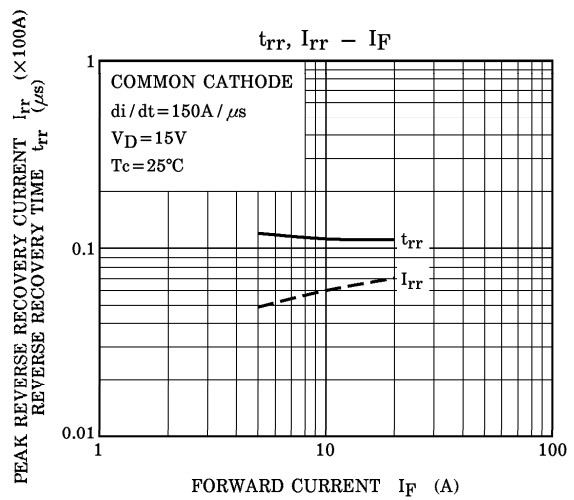
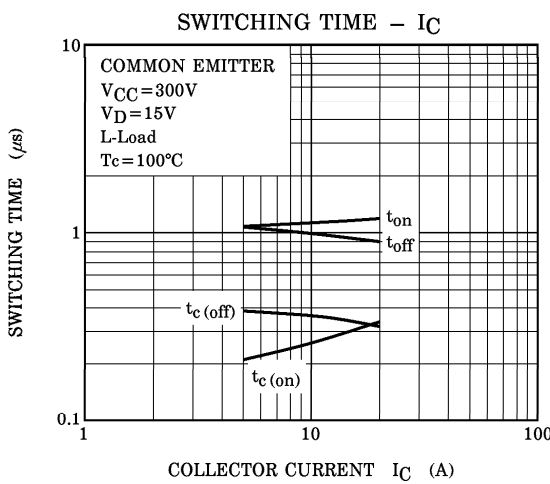
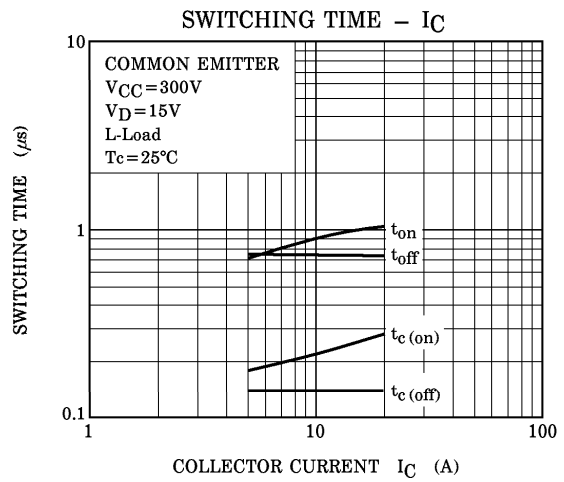
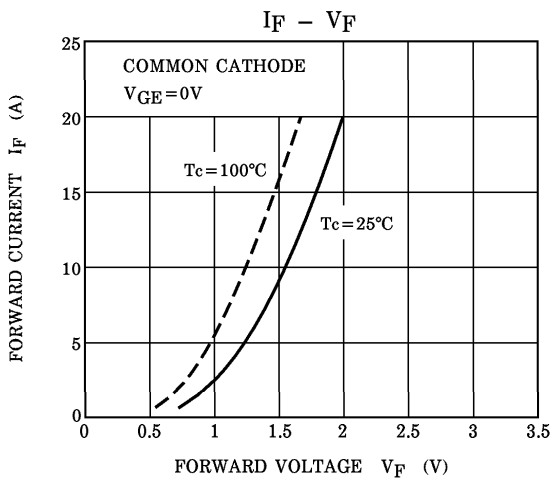
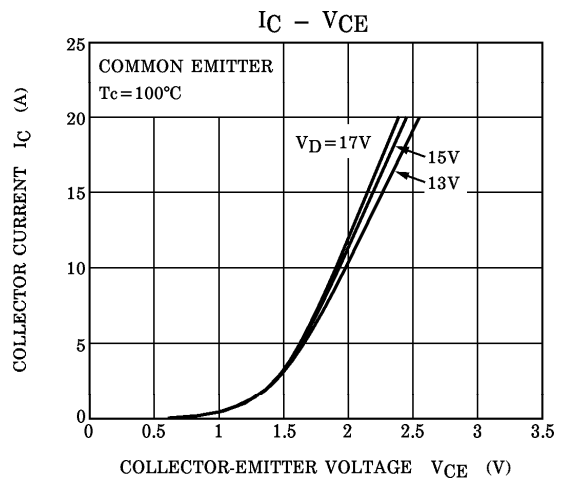
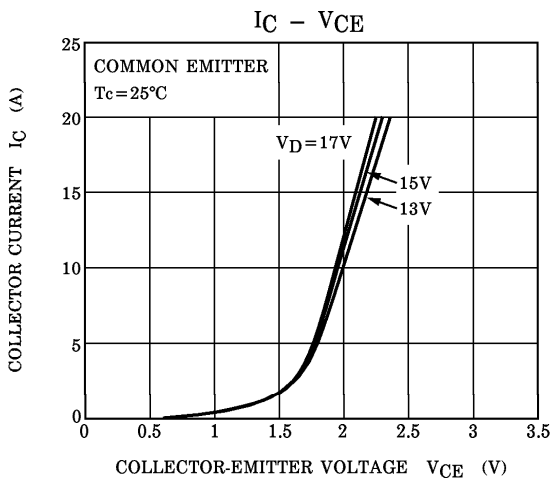
Typical example of drive circuit

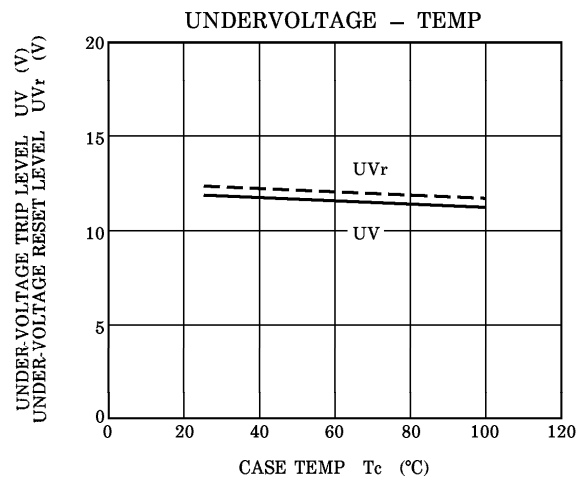
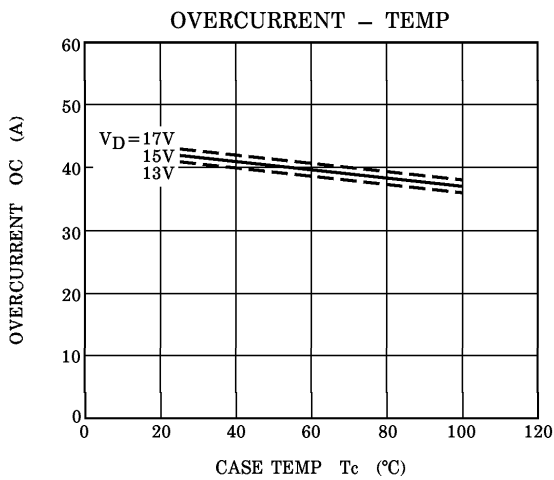
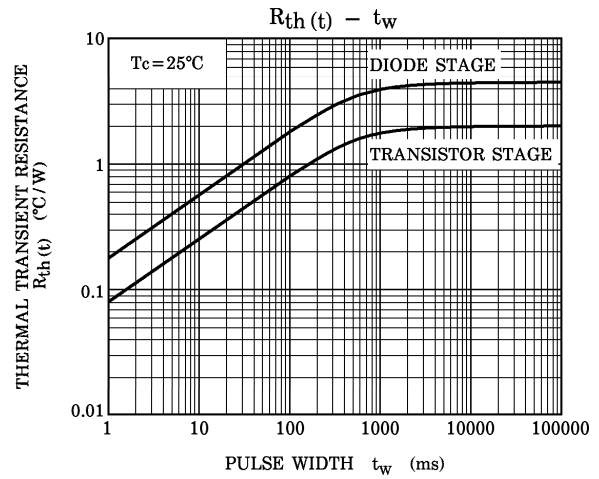
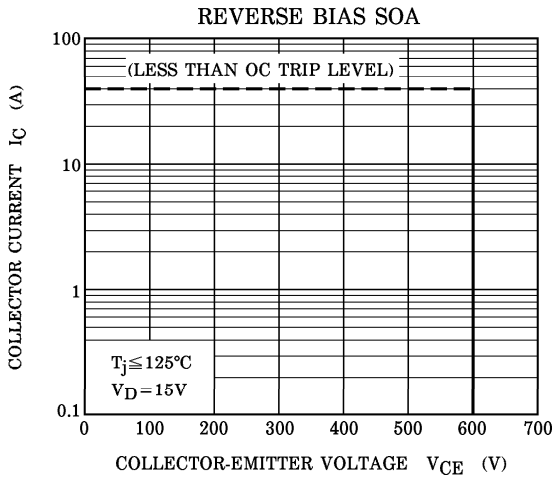
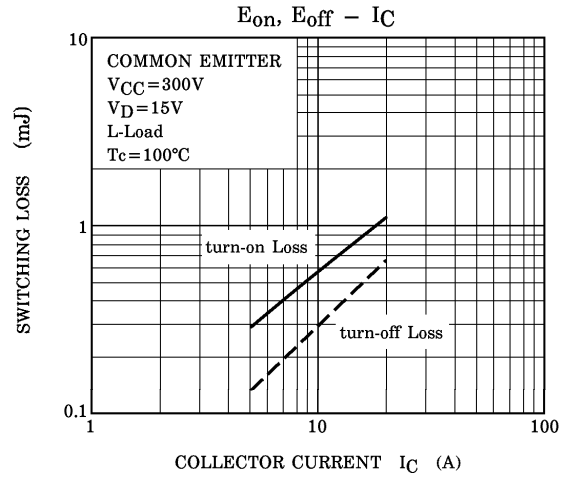
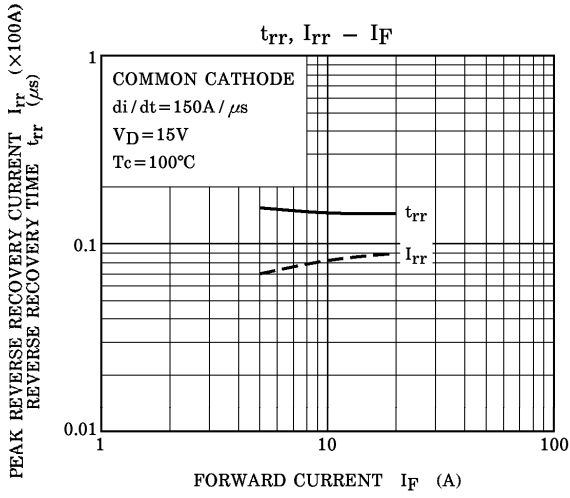


- *1) or VAY, VAZ
- *2) or VINY, VINZ
- *3) or VGY, VGZ
- *4) or V, W



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- UVr : Under-Voltage Reset Level
- OT : Over Temperature Trip Level
- OTr : Over Temperature Reset Level
- OC : Over Current
- t₁ : 2.5μs (Typ.)
- t₂ : 10μs (Typ.)
- t₃ : 10ms (Typ.)





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