HARRIS Semiconductor

2N6975, 2N6976, 2N6977, 2N6978

April 1995

5A, 400V and 500V N-Channel IGBTs

Features

- **5A, 400V and 500V**
- **$V_{CE(ON)}$ 2V**
- **T_{FI} 1µs, 0.5µs**
- **Low On-State Voltage**
- **Fast Switching Speeds**
- **High Input Impedance**

Applications

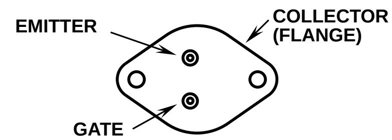
- **Power Supplies**
- **Motor Drives**
- **Protection Circuits**

Description

The 2N6975, 2N6976, 2N6977 and the 2N6978 are n-channel enhancement-mode insulated gate bipolar transistors (IGBTs) designed for high-voltage, low on-dissipation applications such as switching regulators and motor drivers. These types can be operated directly from low-power integrated circuits.

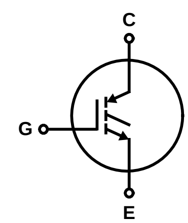
Package

JEDEC TO-204AA
BOTTOM VIEW



Terminal Diagram

N-CHANNEL ENHANCEMENT MODE



PACKAGING AVAILABILITY

PART NUMBER	PACKAGE	BRAND
2N6975	TO-204AA	
2N6976	TO-204AA	
2N6977	TO-204AA	
2N6978	TO-204AA	

NOTE: When ordering, use the entire part number.

Absolute Maximum Ratings $T_C = +25^oC$, Unless Otherwise Specified.

		2N6975/2N6977 (Note 1)	2N6976/2N6978 (Note 1)	UNITS
Collector-Emitter Voltage	V_{CES}	400	500	V
Collector-Gate Voltage ($R_{GE} = 1M\Omega$)	V_{CGR}	400	500	V
Reverse Collector-Emitter Voltage	$V_{CES(REV.)}$	5	5	V
Gate-Emitter Voltage	V_{GE}	±20	±20	V
Collector Current Continuous	I_C	5	5	A
Collector Current Pulsed	I_{CM}	10	10	A
Power Dissipation Total at $T_C = +25^oC$	P_D	100	100	W
Power Dissipation Derating $T_C > +25^oC$		0.8	0.8	W/^{o}C
Operating and Storage Junction Temperature Range	T_J, T_{STG}	-55 to +150	-55 to +150	^{o}C

NOTE:

1. JEDEC registered value.

HARRIS SEMICONDUCTOR IGBT PRODUCT IS COVERED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS:

4,364,073	4,417,385	4,430,792	4,443,931	4,466,176	4,516,143	4,532,534	4,567,641
4,587,713	4,598,461	4,605,948	4,618,872	4,620,211	4,631,564	4,639,754	4,639,762
4,641,162	4,644,637	4,682,195	4,684,413	4,694,313	4,717,679	4,743,952	4,783,690
4,794,432	4,801,986	4,803,533	4,809,045	4,809,047	4,810,665	4,823,176	4,837,606
4,860,080	4,883,767	4,888,627	4,890,143	4,901,127	4,904,609	4,933,740	4,963,951
4,969,027							

CAUTION: These devices are sensitive to electrostatic discharge. Users should follow proper I.C. Handling Procedures.

File Number **2297.2**

Electrical Specifications $T_C = +25^oC$, Unless Otherwise Specified

PARAMETERS	SYMBOL	TEST CONDITIONS	LIMITS				UNITS
			2N6975/2N6977		2N6976/2N6978		
			MIN	MAX	MIN	MAX	
Collector-Emitter Breakdown Voltage	BV_{CES}	I_C = 1 mA, V_{GE} = 0	400 (Note 1)	-	500 (Note 1)	-	V
Gate Threshold Voltage	$V_{GE(TH)}$	$V_{GE} = V_{CE}$, I_C = 1mA	2 (Note 1)	4.5 (Note 1)	2 (Note 1)	4.5 (Note 1)	V
Zero Gate Voltage Collector Current	I_{CES}	V_{CE} = 400V	-	250 (Note 1)	-	-	µA
		V_{CE} = 500V	-	-	-	250 (Note 1)	µA
		$T_C = +125^oC$	-	-	-	-	µA
		V_{CE} = 400V	-	1000 (Note 1)	-	-	µA
		V_{CE} = 500V	-	-	-	1000 (Note 1)	µA
Gate-Emitter Leakage Current	I_{GES}	V_{GE} = ±20V, V_{CE} = 0V	-	100 (Note 1)	-	100 (Note 1)	ns
Reverse Collector-Emitter Leakage Current	I_{ECS}	R_{GE} = 0Ω, V_{EC} = 5V	-	5 (Note 1)	-	5 (Note 1)	mA
Collector-Emitter On Voltage	$V_{CE(ON)}$	I_C = 5A, V_{GE} = 10V	-	2 (Note 1)	-	2 (Note 1)	V
		I_C = 10A, V_{GE} = 20V	-	2.5	-	2.5	V
Gate-Emitter Plateau Voltage	V_{GEP}	I_C = 5A, V_{CE} = 10V	3.4 (Note 1)	6.8 (Note 1)	3.4 (Note 1)	6.8 (Note 1)	V
On-State Gate Charge	$Q_{G(ON)}$	I_C = 5A, V_{CE} = 10V	12 (Note 1)	25 (Note 1)	12 (Note 1)	25 (Note 1)	nC
Turn-On Delay Time	$t_{D(ON)}$	I_C = 5A $V_{CE(CLP)}$ = 300V L = 50µH $T_J = +125^oC$ V_{GE} = 10V R_G = 50Ω	50 Max				ns
Rise Time	t_R		50 Max				ns
Turn-Off Delay Time	$t_{D(ON)}$		400 Max (Note 1)				ns
Fall Time	t_{FI}		2N6975 2N6976	1000 Max (Note 1)			ns
			2N6977 2N6978	500 Max (Note 1)			ns
Turn-Off Energy Loss per Cycle (Off Switching Dissipation= W_{OFF} x Frequency)	W_{OFF}	I_C = 5A $V_{CE(CLP)}$ = 300V L = 50µH $T_J = +125^oC$ V_{GE} = 10V R_G = 50Ω	2N6975 2N6976	1000 Max (Note 1)			µJ
			2N6977 2N6978	500 Max (Note 1)			µJ
Thermal Resistance Junction-to-Case	$R_{\theta JC}$		1.25 (Note 1)				$^oC/W$

NOTE:

1. JEDEC registered value.

Typical Performance Curves

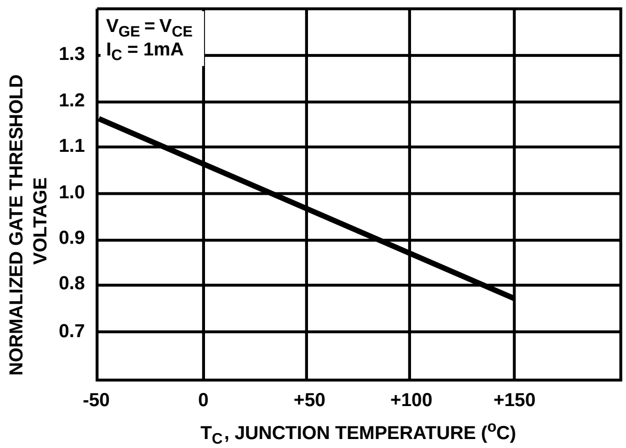


FIGURE 1. TYPICAL NORMALIZED GATE THRESHOLD VOLTAGE AS A FUNCTION OF JUNCTION TEMPERATURE FOR ALL TYPES

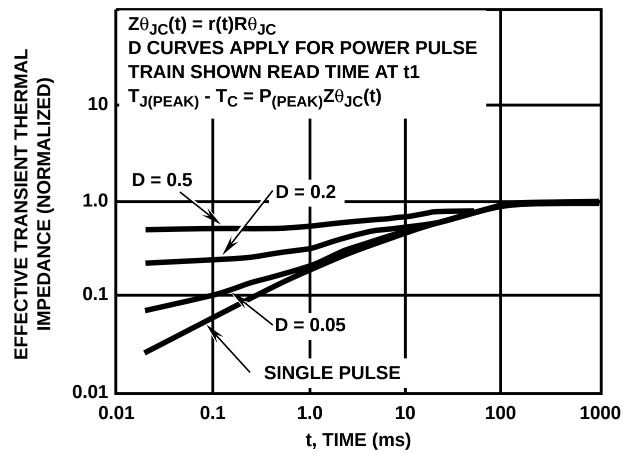


FIGURE 2. NORMALIZED THERMAL RESPONSE CHARACTERISTICS FOR ALL TYPES

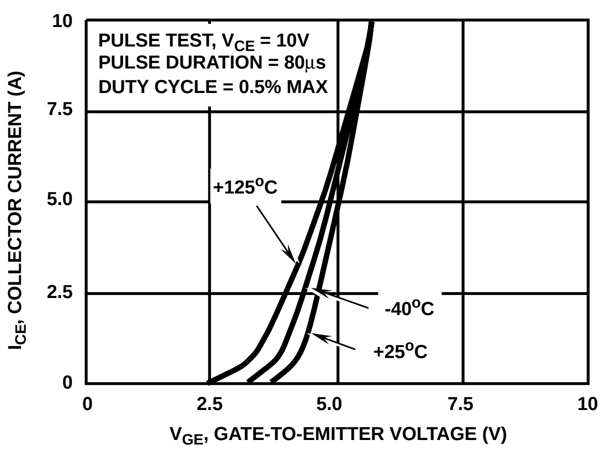


FIGURE 3. TYPICAL TRANSFER CHARACTERISTICS FOR ALL TYPES

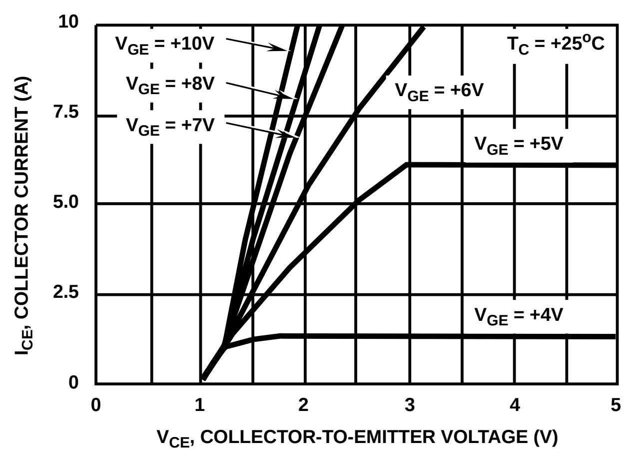


FIGURE 4. TYPICAL SATURATION CHARACTERISTICS FOR ALL TYPES

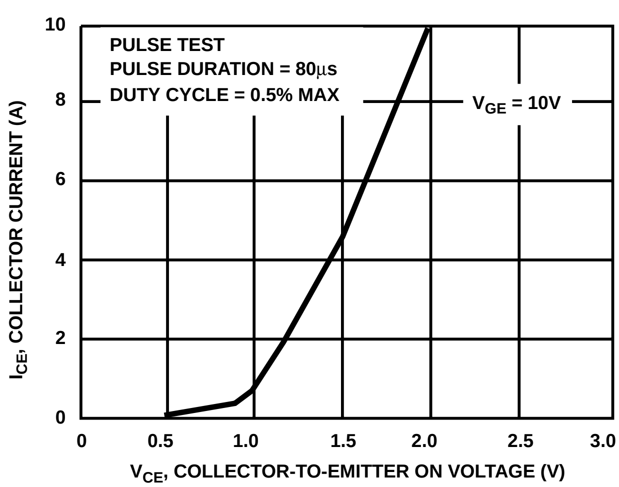


FIGURE 5. TYPICAL COLLECTOR-TO-EMITTER ON-VOLTAGE AS A FUNCTION OF COLLECTOR CURRENT FOR ALL TYPES

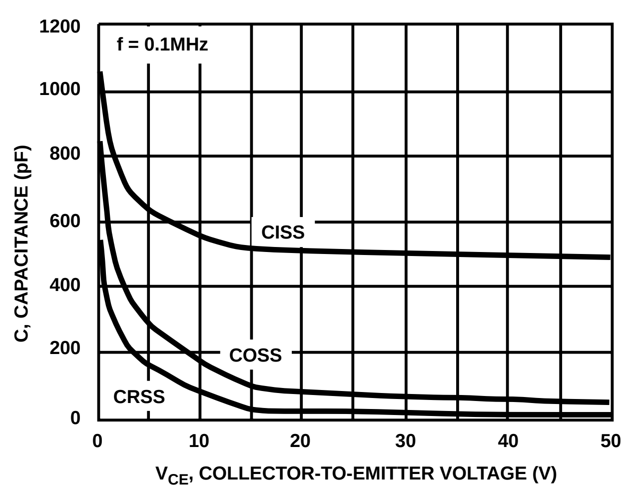


FIGURE 6. CAPACITANCE AS A FUNCTION OF COLLECTOR-TO-EMITTER VOLTAGE FOR ALL TYPES

Typical Performance Curves (Continued)

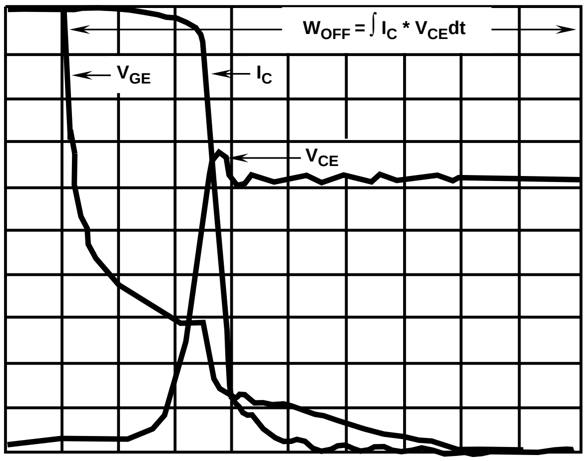
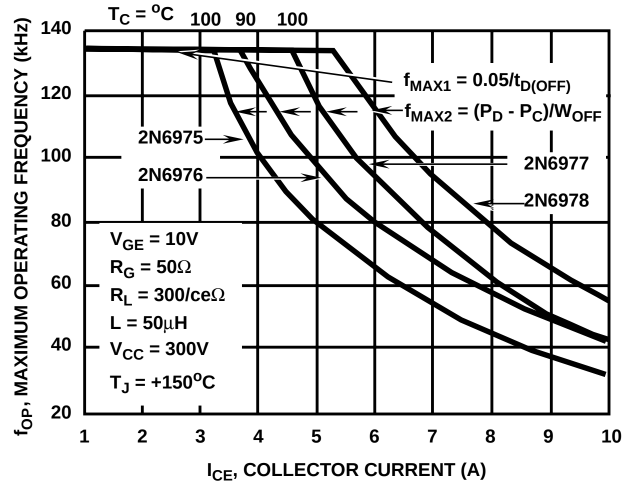


FIGURE 7. TYPICAL INDUCTIVE SWITCHING WAVEFORMS



P_D: ALLOWABLE DISSIPATION
P_C: CONDUCTION DISSIPATION

FIGURE 8. MAXIMUM OPERATING FREQUENCY vs COLLECTOR CURRENT (TYPICAL)

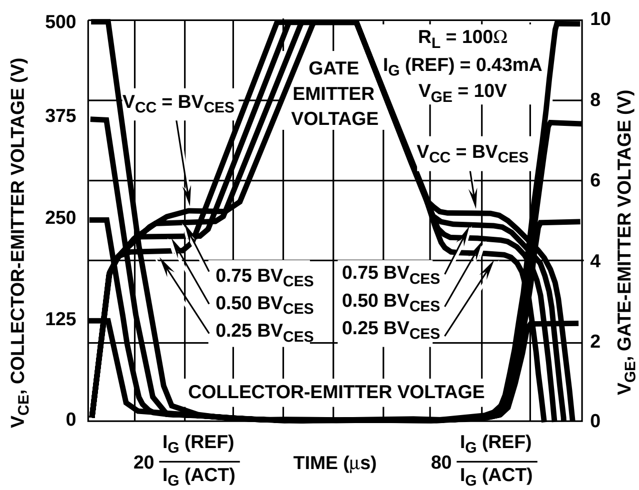


FIGURE 9. NORMALIZED SWITCHING WAVEFORMS AT CONSTANT GATE CURRENT (REFER TO APPLICATION NOTES AN7254 AND AN7260)

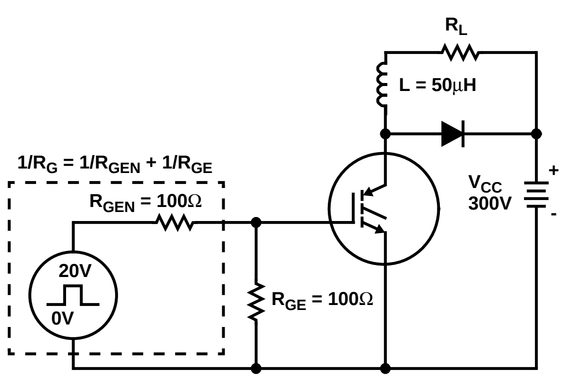


FIGURE 10. INDUCTIVE SWITCHING TEST CIRCUIT