

Designer's™ Data Sheet

Insulated Gate Bipolar Transistor with Anti-Parallel Diode

N-Channel Enhancement-Mode Silicon Gate

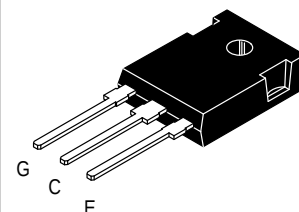
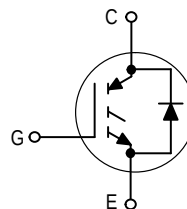
MGW12N120D

Motorola Preferred Device

IGBT & DIODE IN TO-247
12 A @ 90°C
20 A @ 25°C
1200 VOLTS
SHORT CIRCUIT RATED

This Insulated Gate Bipolar Transistor (IGBT) is co-packaged with a soft recovery ultra-fast rectifier and uses an advanced termination scheme to provide an enhanced and reliable high voltage-blocking capability. Short circuit rated IGBT's are specifically suited for applications requiring a guaranteed short circuit withstand time such as Motor Control Drives. Fast switching characteristics result in efficient operation at high frequencies. Co-packaged IGBT's save space, reduce assembly time and cost.

- Industry Standard High Power TO-247 Package with Isolated Mounting Hole
- High Speed E_{off} : 150 μ J/A typical at 125°C
- High Short Circuit Capability – 10 μ s minimum
- Soft Recovery Free Wheeling Diode is included in the package
- Robust High Voltage Termination
- Robust RBSOA



CASE 340K-01
STYLE 4
TO-247AE

MAXIMUM RATINGS ($T_J = 25^\circ\text{C}$ unless otherwise noted)

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CES}	1200	Vdc
Collector-Gate Voltage ($R_{GE} = 1.0 \text{ M}\Omega$)	V_{CGR}	1200	Vdc
Gate-Emitter Voltage — Continuous	V_{GE}	± 20	Vdc
Collector Current — Continuous @ $T_C = 25^\circ\text{C}$ — Continuous @ $T_C = 90^\circ\text{C}$ — Repetitive Pulsed Current (1)	I_{C25} I_{C90} I_{CM}	20 12 40	Adc Apc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	125 0.98	Watts W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-55 to 150	$^\circ\text{C}$
Short Circuit Withstand Time ($V_{CC} = 720 \text{ Vdc}$, $V_{GE} = 15 \text{ Vdc}$, $T_J = 125^\circ\text{C}$, $R_G = 20 \Omega$)	t_{sc}	10	μs
Thermal Resistance — Junction to Case – IGBT — Junction to Case – Diode — Junction to Ambient	$R_{\theta JC}$ $R_{\theta JD}$ $R_{\theta JA}$	1.0 1.4 45	$^\circ\text{C/W}$
Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 5 seconds	T_L	260	$^\circ\text{C}$
Mounting Torque, 6-32 or M3 screw	10 lbf•in (1.13 N•m)		

(1) Pulse width is limited by maximum junction temperature. Repetitive rating.

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. SOA Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

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Preferred devices are Motorola recommended choices for future use and best overall value.

REV 2



MGW12N120D**ELECTRICAL CHARACTERISTICS** ($T_J = 25^\circ\text{C}$ unless otherwise noted)

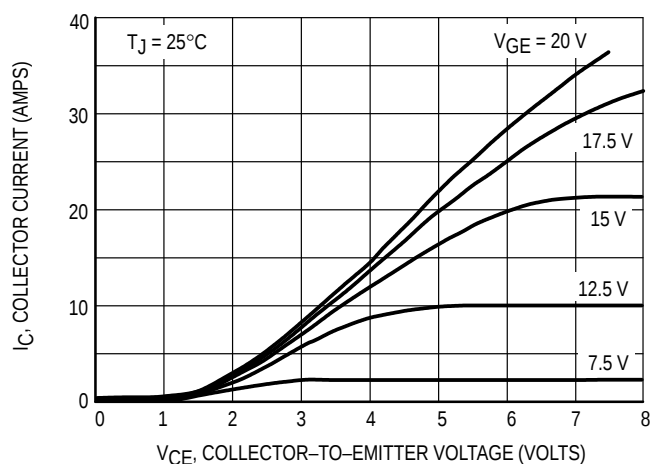
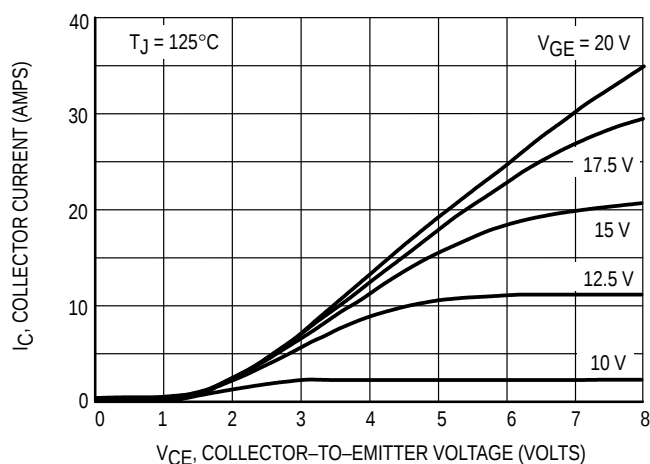
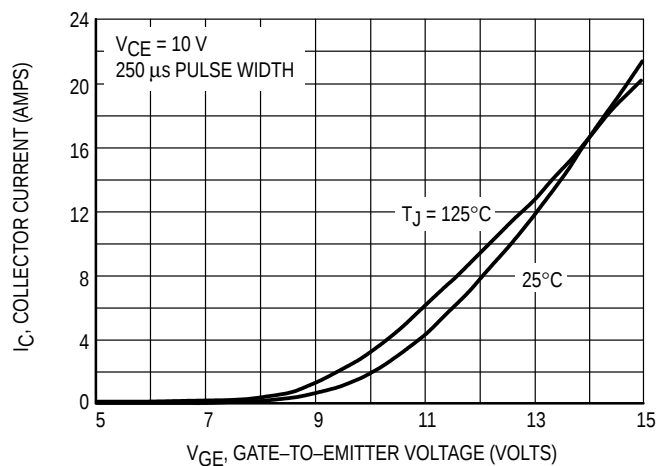
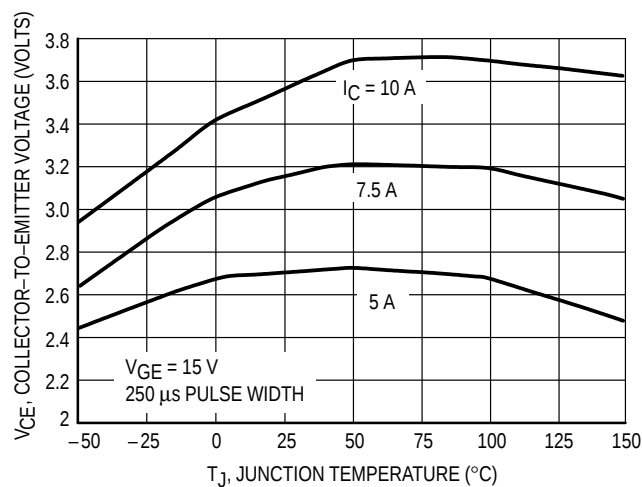
Characteristic	Symbol	Min	Typ	Max	Unit	
OFF CHARACTERISTICS						
Collector-to-Emitter Breakdown Voltage ($V_{GE} = 0$ Vdc, $I_C = 25\text{ }\mu$ Adc) Temperature Coefficient (Positive)	$V_{(BR)CES}$	1200 —	— 870	— —	Vdc mV/°C	
Zero Gate Voltage Collector Current ($V_{CE} = 1200$ Vdc, $V_{GE} = 0$ Vdc) ($V_{CE} = 1200$ Vdc, $V_{GE} = 0$ Vdc, $T_J = 125^\circ\text{C}$)	I_{CES}	— —	— —	100 2500	μ Adc	
Gate-Body Leakage Current ($V_{GE} = \pm 20$ Vdc, $V_{CE} = 0$ Vdc)	I_{GES}	—	—	250	nAdc	
ON CHARACTERISTICS (1)						
Collector-to-Emitter On-State Voltage ($V_{GE} = 15$ Vdc, $I_C = 5.0$ Adc) ($V_{GE} = 15$ Vdc, $I_C = 5.0$ Adc, $T_J = 125^\circ\text{C}$) ($V_{GE} = 15$ Vdc, $I_C = 10$ Adc)	$V_{CE(on)}$	— — —	2.71 3.78 3.5	3.37 — 4.42	Vdc	
Gate Threshold Voltage ($V_{CE} = V_{GE}$, $I_C = 1.0$ mAdc) Threshold Temperature Coefficient (Negative)	$V_{GE(th)}$	4.0 —	6.0 10	8.0 —	Vdc mV/°C	
Forward Transconductance ($V_{CE} = 10$ Vdc, $I_C = 10$ Adc)	g_{fe}	—	12	—	Mhos	
DYNAMIC CHARACTERISTICS						
Input Capacitance	$(V_{CE} = 25$ Vdc, $V_{GE} = 0$ Vdc, $f = 1.0$ MHz)	C_{ies}	—	1003	pF	
Output Capacitance		C_{oes}	—	126		
Transfer Capacitance		C_{res}	—	106		
SWITCHING CHARACTERISTICS (1)						
Turn-On Delay Time	$(V_{CC} = 720$ Vdc, $I_C = 10$ Adc, $V_{GE} = 15$ Vdc, $L = 300\text{ }\mu$ H $R_G = 20\text{ }\Omega$) Energy losses include “tail”	$t_{d(on)}$	—	74	ns	
Rise Time		t_r	—	83		
Turn-Off Delay Time		$t_{d(off)}$	—	76		
Fall Time		t_f	—	231		
Turn-Off Switching Loss		E_{off}	—	0.55	1.33	mJ
Turn-On Switching Loss		E_{on}	—	1.21	1.88	
Total Switching Loss		E_{ts}	—	1.76	3.21	
Turn-On Delay Time	$(V_{CC} = 720$ Vdc, $I_C = 10$ Adc, $V_{GE} = 15$ Vdc, $L = 300\text{ }\mu$ H $R_G = 20\text{ }\Omega$, $T_J = 125^\circ\text{C}$) Energy losses include “tail”	$t_{d(on)}$	—	66	ns	
Rise Time		t_r	—	87		
Turn-Off Delay Time		$t_{d(off)}$	—	120		
Fall Time		t_f	—	575		
Turn-Off Switching Loss		E_{off}	—	1.49	—	mJ
Turn-On Switching Loss		E_{on}	—	2.37	—	
Total Switching Loss		E_{ts}	—	3.86	—	
Gate Charge	$(V_{CC} = 720$ Vdc, $I_C = 10$ Adc, $V_{GE} = 15$ Vdc)	Q_T	—	29	nC	
		Q_1	—	13		
		Q_2	—	12		
DIODE CHARACTERISTICS						
Diode Forward Voltage Drop ($I_{EC} = 5.0$ Adc) ($I_{EC} = 5.0$ Adc, $T_J = 125^\circ\text{C}$) ($I_{EC} = 10$ Adc)	V_{FEC}	— — —	2.26 1.37 2.86	3.32 — 4.18	Vdc	

(1) Pulse Test: Pulse Width $\leq 300\text{ }\mu\text{s}$, Duty Cycle $\leq 2\%$.

(continued)

ELECTRICAL CHARACTERISTICS — continued ($T_J = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
DIODE CHARACTERISTICS — continued					
Reverse Recovery Time	t_{rr}	—	116	—	ns
	t_a	—	69	—	
	t_b	—	47	—	
Reverse Recovery Stored Charge	Q_{RR}	—	0.36	—	μC
Reverse Recovery Time	t_{rr}	—	234	—	ns
	t_a	—	149	—	
	t_b	—	85	—	
Reverse Recovery Stored Charge	Q_{RR}	—	1.40	—	μC
INTERNAL PACKAGE INDUCTANCE					
Internal Emitter Inductance (Measured from the emitter lead 0.25" from package to emitter bond pad)	L_E	—	13	—	nH

TYPICAL ELECTRICAL CHARACTERISTICS**Figure 1. Output Characteristics****Figure 2. Output Characteristics****Figure 3. Transfer Characteristics****Figure 4. Collector-to-Emitter Saturation Voltage versus Junction Temperature**

MGW12N120D

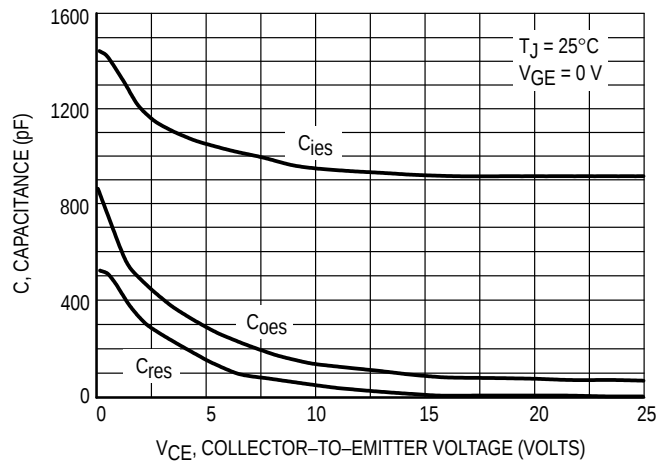


Figure 5. Capacitance Variation

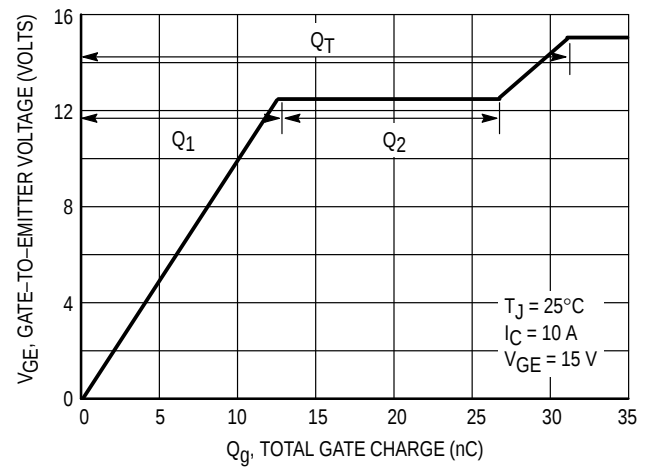


Figure 6. Gate-to-Emitter Voltage versus Total Charge

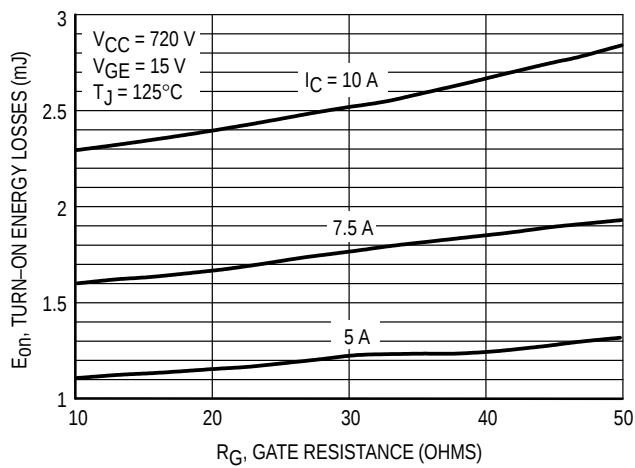


Figure 7. Turn-On Losses versus Gate Resistance

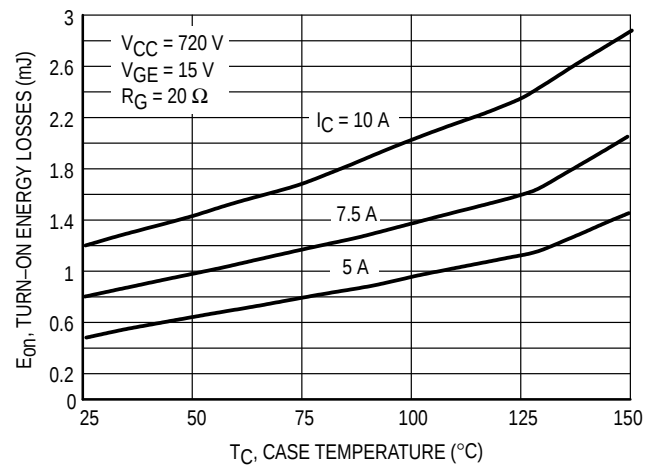


Figure 8. Turn-On Losses versus Case Temperature

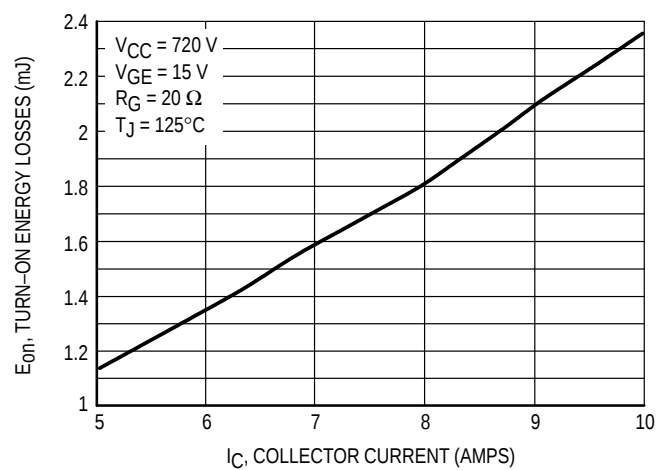


Figure 9. Turn-On Losses versus Collector Current

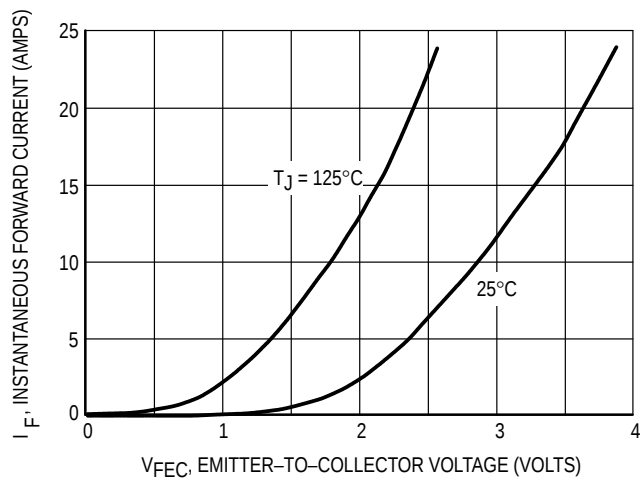


Figure 10. Diode Forward Voltage Drop

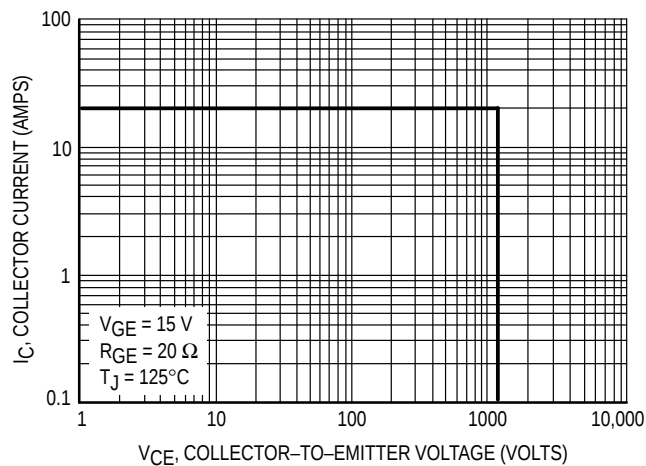


Figure 11. Reverse Biased Safe Operating Area

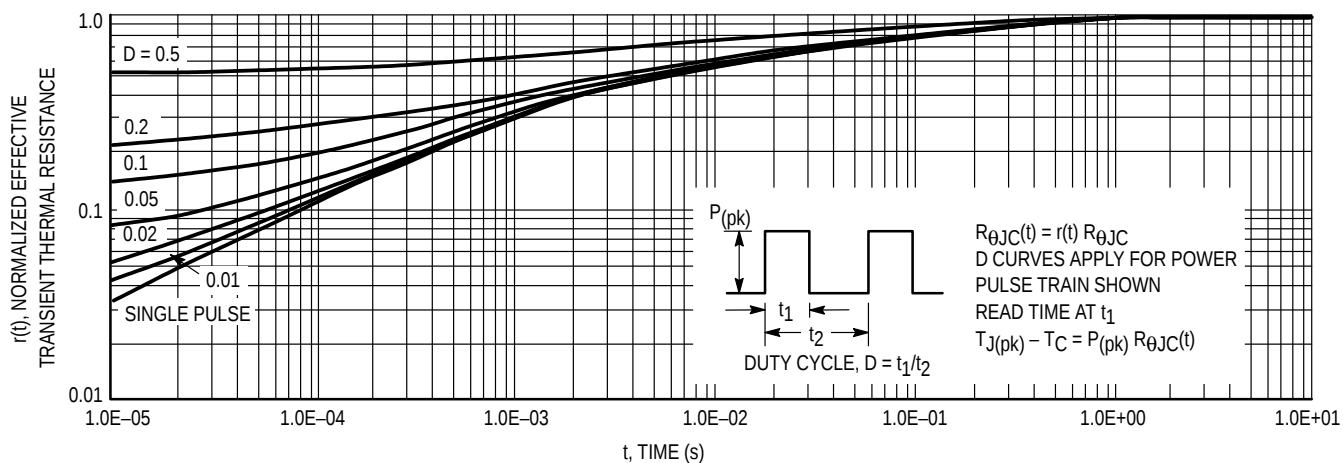
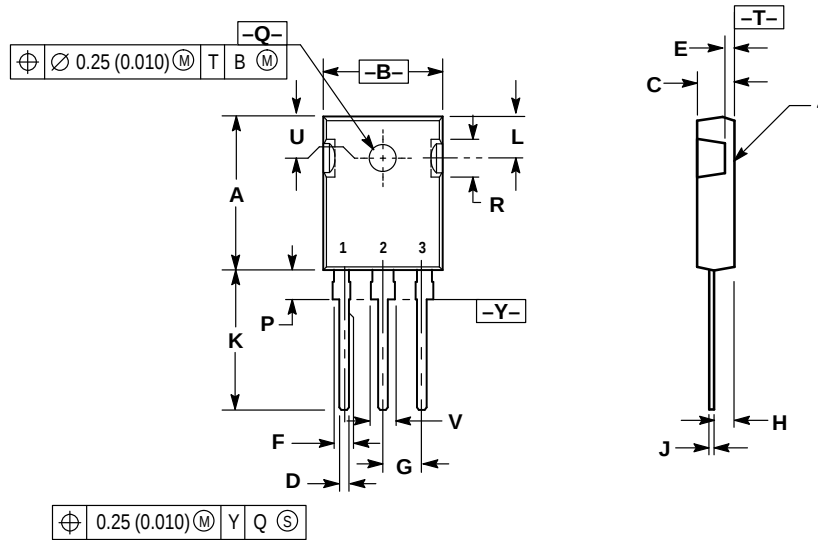


Figure 12. Thermal Response

PACKAGE DIMENSIONS



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: MILLIMETER.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	19.7	20.3	0.776	0.799
B	15.3	15.9	0.602	0.626
C	4.7	5.3	0.185	0.209
D	1.0	1.4	0.039	0.055
E	1.27 REF		0.050 REF	
F	2.0	2.4	0.079	0.094
G	5.5 BSC		0.216 BSC	
H	2.2	2.6	0.087	0.102
J	0.4	0.8	0.016	0.031
K	14.2	14.8	0.559	0.583
L	5.5 NOM		0.217 NOM	
P	3.7	4.3	0.146	0.169
Q	3.55	3.65	0.140	0.144
R	5.0 NOM		0.197 NOM	
U	5.5 BSC		0.217 BSC	
V	3.0	3.4	0.118	0.134

- STYLE 4:
1. GATE
 2. COLLECTOR
 3. EMITTER
 4. COLLECTOR

**CASE 340K-01
TO-247AE
ISSUE A**

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