WCR650N60T/ WCR650N60TF/ WCR650N60TG/ WCR650N60TN
600V N-Channel Super Junction MOSFET

Description

The WCR600N60T series is new generation of high voltage MOSFET family that is utilizing an advanced charge balance mechanism for outstanding low on resistance and lower gate charge performance. This advanced technology has been tailored to minimize conduction loss, provide superior switching performance, and withstand extreme dv/dt rate and higher avalanche energy. This device is suitable for various AC/DC power conversion in switching mode operation for higher efficiency.

Features

- 650V@T_J=150°**C**
- Typ.$R_{DS(on)}$=0.57Ω
- Low gate charge(typ. Qg= 9.6nC)
- 100% avalanche tested
- 100% R_g tested

Order Information

Device	Package	Marking	Units/Tube
WCR650N60T-3/T	TO-220	WCR650N60TYYWW	50
WCR650N60TF-3/T	TO-220-F	WCR650N60TFYYWW	50
WCR650N60TN-3/T	TO-251(IPAK)	WCR650N60TGYYWW	70
WCR650N60TG-3/T	TO-252E-2	WCR650N60TNYYWW	70

Note 1: WCR650N60T=Device code ; YY=Year ;WW=Week (A~z);
Note 2: WCR650N60TF=Device code ; YY=Year ;WW=Week (A~z);
Note 3: WCR650N60TG=Device code ; YY=Year ;WW=Week (A~z);
Note 4: WCR650N60TN=Device code ; YY=Year ;WW=Week (A~z);

TO-220F   TO-220   TO-251(IPAK)   TO-252E-2
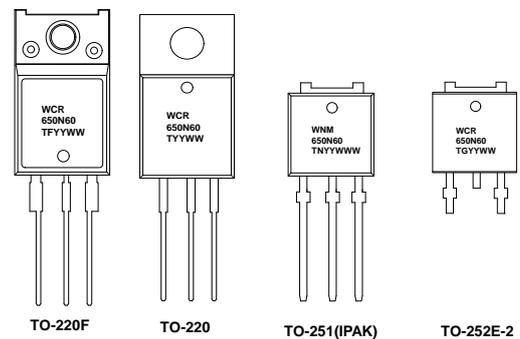
**Absolution Maximum Ratings** T_A=25^{0}C unless otherwise noted

Parameter		Symbol	WCR650N60T WCR650N60TN WCR650N60TG	WCR650N60TF	Unit
Drain-Source Voltage		V_{DS}	600		V
Gate-Source Voltage		V_{GS}	±30		
Continuous Drain Current [A]	T_C=25°**C**	I_D	7.3		A
	T_C=100°**C**		4.6		
Pulsed Drain Current [B]		I_{DM}	16		A
Single Pulsed Avalanche Energy [C]		E_{AS}	86		mJ
Avalanche Current [B]		I_{AR}	1.7		A
Repetitive Avalanche Energy [B]		E_{AR}	0.2		mJ
Power Dissipation	T_C=25°**C**	P_D	62.5	27.7	W
	Derate above 25°**C**		0.5	0.22	W/°C
Operating and Storage Temperature Range		T_J,T_{STG}	-55~150		°C
Lead Temperature		T_L	260		°C
Thermal Resistance Ratings					
Maximum Junction-to-Ambient		$R_{θJA}$	60	80	°C/W
Maximum Junction-to-Case		$R_{θJC}$	2	4.5	

Electronics Characteristics (T_A=25°C, unless otherwise noted)

| Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Drain-to-Source Breakdown Voltage	BV_{DSS}	V_{GS} = 0 V, I_D = 250uA,T_J=25°C	600			V
		V_{GS} = 0 V, I_D = 250uA,T_J=150°C		650		V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 600V, V_{GS} = 0V,T_J=25°C			1	uA
		V_{DS} = 480V, V_{GS} = 0V,T_J=125°C			10	uA
Gate-to-source Leakage Current	I_{GSS}	V_{DS} = 0 V, V_{GS} =±30 V			±100	nA
ON CHARACTERISTICS						
Gate Threshold Voltage	$V_{GS(TH)}$	V_{GS} = V_{DS}, I_D = 250uA	2.5		4.5	V
Drain-to-source On-resistance	$R_{DS(on)}$	V_{GS} = 10V, I_D = 3.5A		0.55	0.65	Ω
Forward Transconductance	gFS	VDS= 40V, ID= 3.5A (NOTE D)			20	s
DYNAMIC PARAMETERS						
Input Capacitance	C_{ISS}	V_{GS} = 0 V,		403		pF
Output Capacitance	C_{OSS}	f = 1.0 MHz, V_{DS} = 25 V		96		
Reverse Transfer Capacitance	C_{RSS}			21		
Total Gate Charge	$Q_{G(TOT)}$	V_{GS} = 10 V,		9.6		nC
Gate-to-Source Charge	Q_{GS}	V_{DS} = 480 V,I_D = 3.5A		2.9		
Gate-to-Drain Charge	Q_{GD}	(NOTE D、E)		3.6		
Gate resistance	R_g	V_{GS}=0V,V_{DS}=0V,F=1MHZ		5		Ω
SWITCHING CHARACTERISTICS						
Turn-On Delay Time	$t_{d(on)}$	V_{GS} = 10V,		17.1		ns
Rise Time	t_r	V_{DS} = 400 V,		15.9		
Turn-Off Delay Time	$t_{d(off)}$	I_D = 3.5 A, R_G=20 Ω		33.2		
Fall Time	t_f	(NOTE D、E		11.2		
Drain to Source Diode Characteristics and Maximum Ratings						
Forward Voltage	V_{SD}	V_{GS} = 0 V, I_S = 7.0A			1.5	V
Body-Diode Continuous Current	I_S				7.3	A
Body-Diode Pulsed Current	I_{SM}				16	A
Body Diode Reverse Recovery Time	T_{rr}	I_F=7A,dI/dt=100A/us, V_{DS}=100V		416		nS
Body Diode Reverse Recovery Charge	Q_{rr}			2.58		uC
Peak reverse recovery current	I_{rr}	(NOTE D)		12.4		A

NOTES:

A. Drain current limited by maximum junction temperature. Maximum duty cycle D=0.75

B. Pulse width limited by maximum junction temperature

C. L=60mH, I_{AS}=1.7A, V_{DD}=150V, Starting T_J=25℃

D. Pulse Test: Pulse width≤300us, Duty Cycle ≤2%

E. Essentially Independent of Operating Temperature Typical Characteristics

F. These curves are based on the junction-to-case thermal impedance which is measured with the device mounted to a large heat sink, assuming a maximum junction temperature of $T_{J(MAX)}$=150°C. The SOA curve provides a single pulse rating.

Typical Characteristics (T_A=25°C, unless otherwise noted)
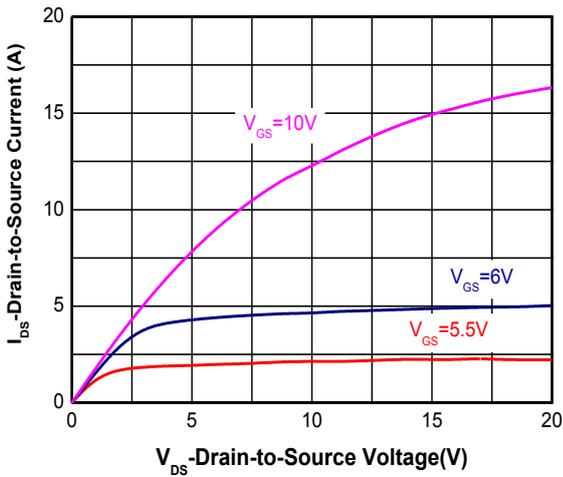
Output characteristics
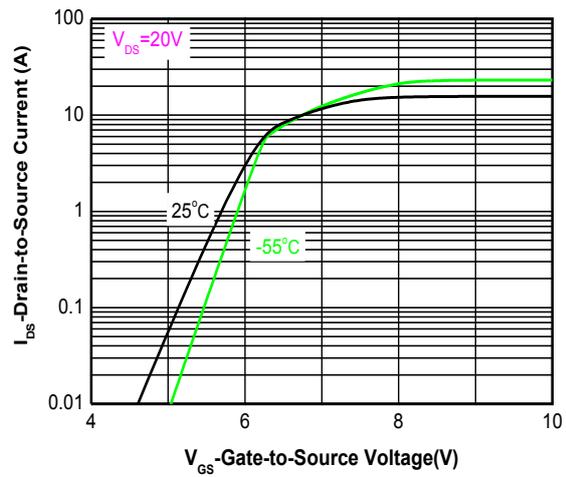
Transfer characteristics
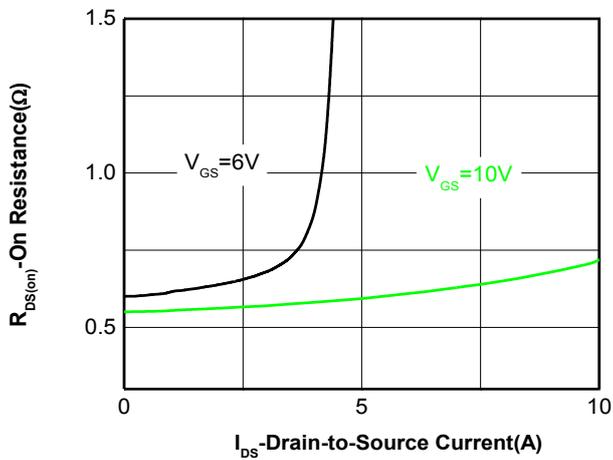
On-Resistance vs. Drain current
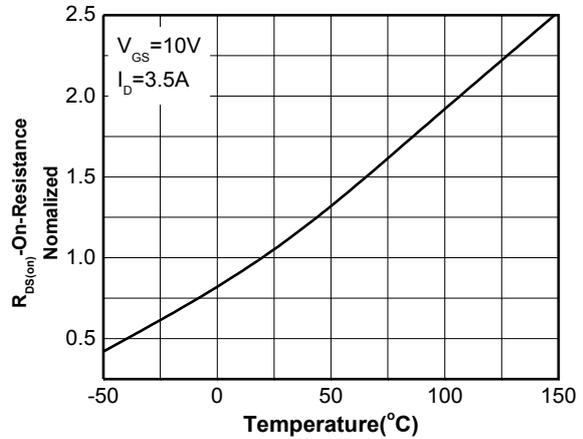
On-Resistance vs. Junction temperature
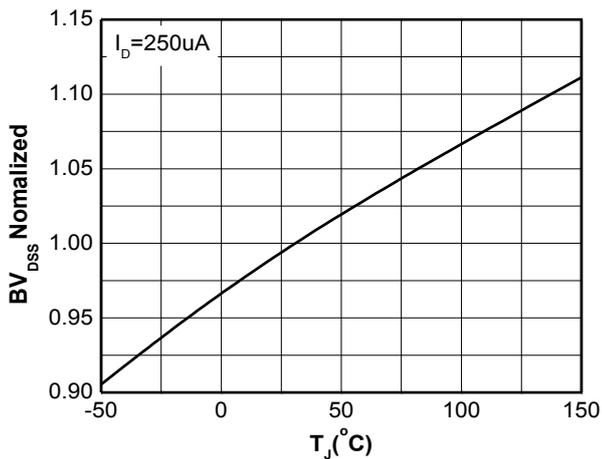
Breakdown Voltage vs. Junction temperature
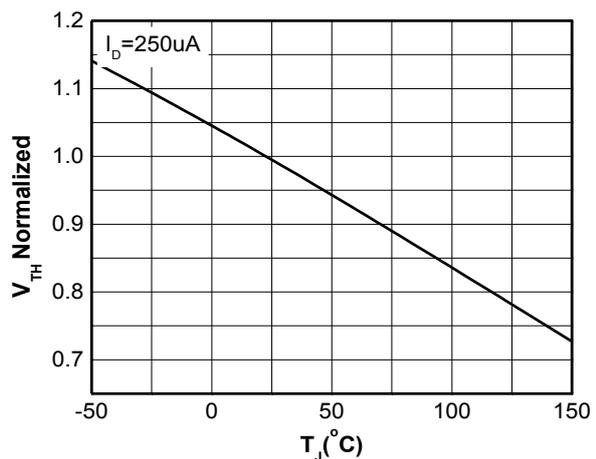
Threshold voltage vs. Junction temperature
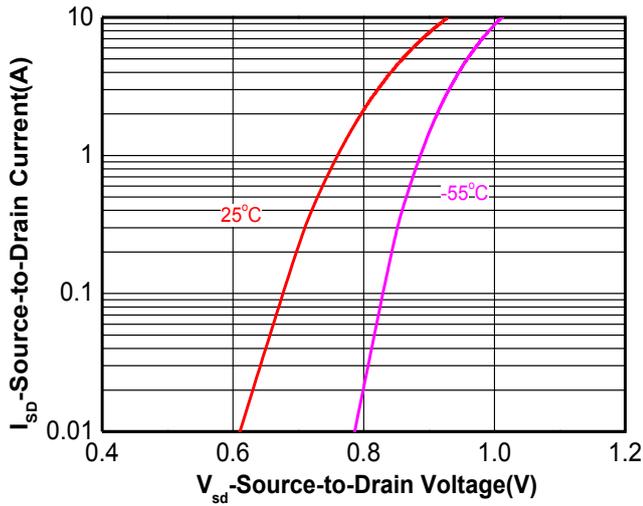
Body diode forward voltage
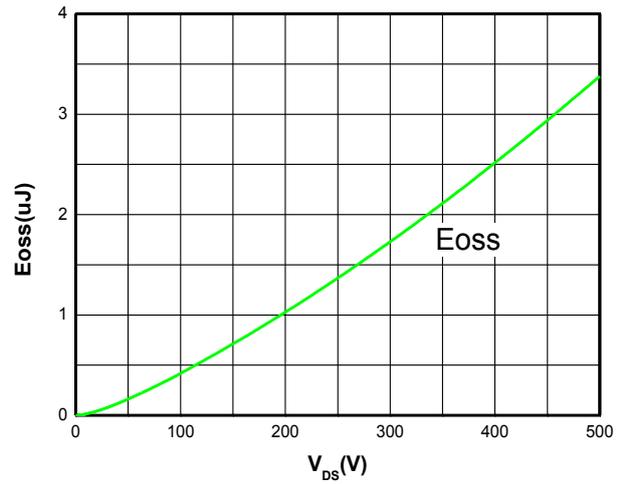
Coss stored Energy
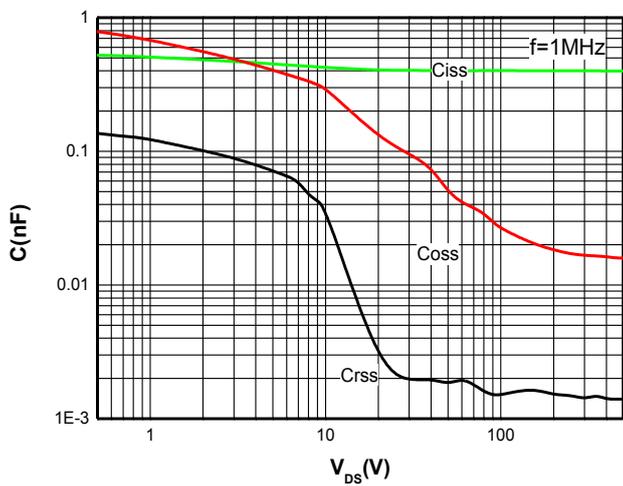
Capacitance
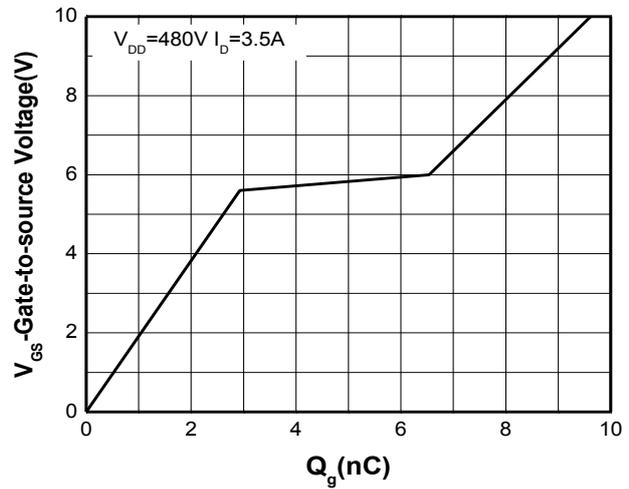
Gate charge Characteristics
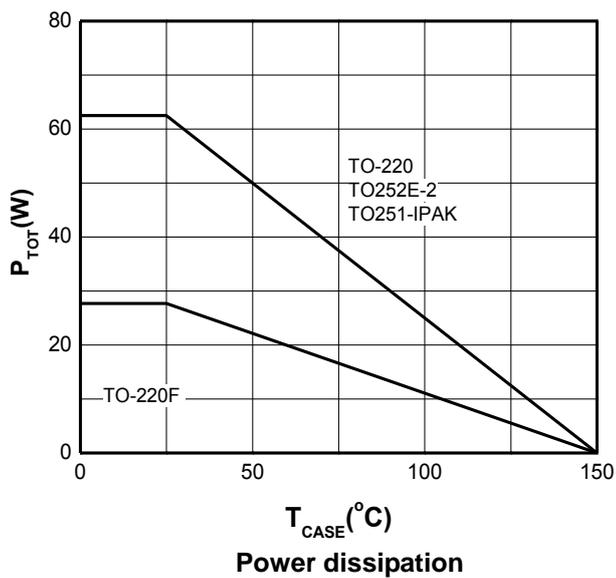
Power dissipation
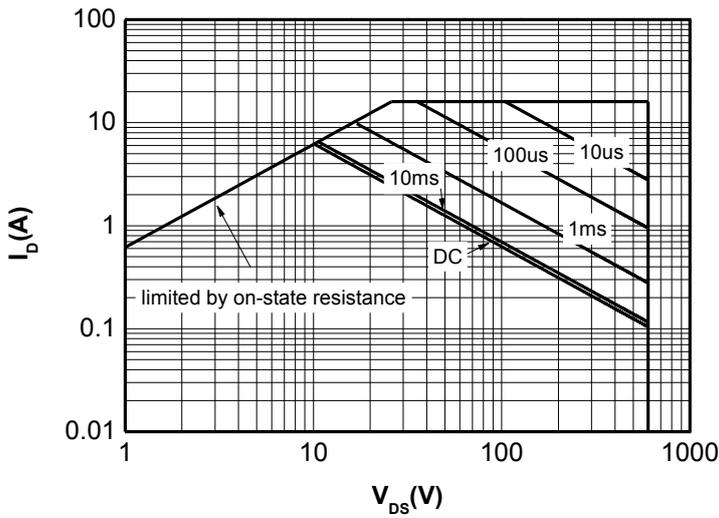
TO-220 TO-252E-2 TO-251(IPAK)

Safe Operating Area(Note F)
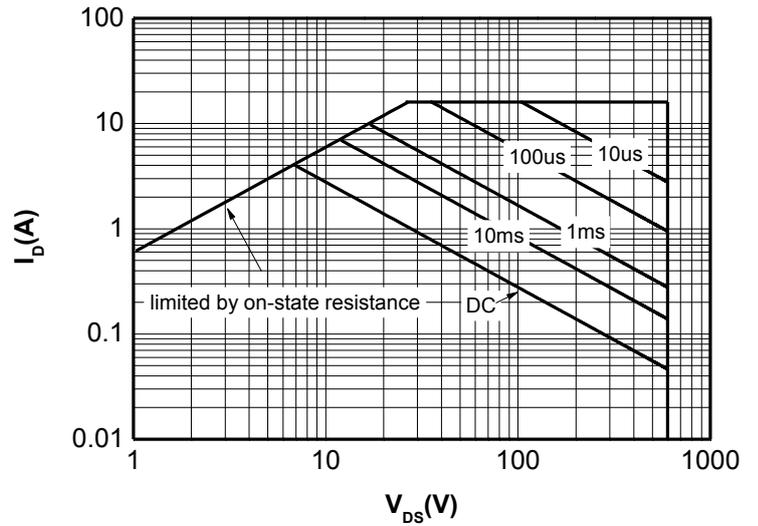
TO-220F

Safe Operating Area(Note F)
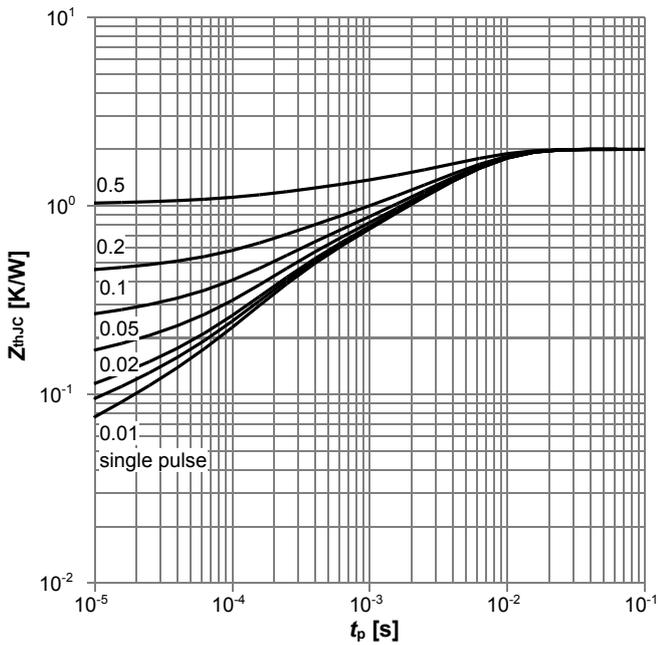
TO-220 TO-252E-2 TO-251(IPAK)
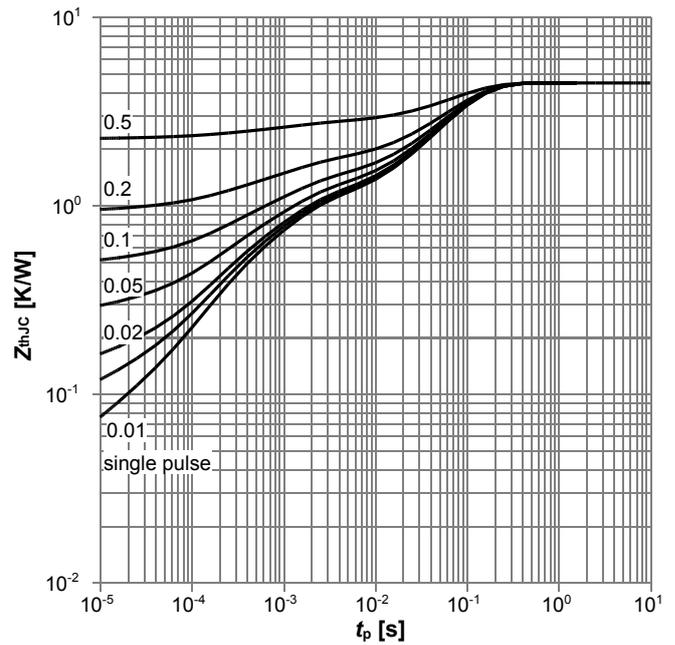
TO-220F

Transient thermal response (Junction-to-Case)(Note F)

Package outline dimensions

TO-220

COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	4.40	4.57	4.70
A1	1.22	-	1.32
A2	2.59	2.69	2.79
b	0.77	-	0.90
b1	0.76	0.81	0.86
b2	1.23	-	1.36
b3	1.22	1.27	1.32
c	0.34	-	0.47
c1	0.33	0.38	0.43
D	15.15	15.45	15.75
D1	9.05	9.15	9.25
D2	11.40	-	12.88
E	9.96	10.16	10.36
E1	6.86	-	8.89
e	2.44	2.54	2.64
e1	4.98	5.08	5.18
H1	6.10	6.30	6.50
L	12.70	-	13.12
L1	-	-	3.90
L2		2.50REF	
ØP	3.80	3.84	3.88
Q	2.60	-	2.90
θ1	5°	7°	9°
θ2	1°	3°	5°

NOTES:
1, ALL DIMENSIONS REFER TO JEDEC STANDARD TO-220 AB DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS,
⚠ 2,'D2' AND 'E1' ARE VARIABLES DEPENDING ON DIE PAD SIZES,

TO-220F

COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	4.40	4.50	4.60
A1	2.50	2.60	2.70
A2	1.10	1.20	1.30
A3	2.49	2.59	2.69
b	0.76	—	0.89
b1	0.75	0.80	0.85
c	0.46	—	0.59
c1	0.45	0.50	0.55
C1	0.20	0.30	0.40
C2	1.00	1.10	1.20
D	10.10	10.20	10.30
E	9.05	9.15	9.25
e	4.98	5.08	5.18
e1	2.44	2.54	2.64
F1	1.22	—	1.60
F2	1.17	—	1.55
H	0.32	0.37	0.42
L	10.00	10.20	10.40
L1	3.15	3.30	3.45
L2	15.85	16.00	16.15
L3	29.30	29.60	29.90
L4	16.00	16.10	16.20
P	3.00	3.10	3.20
Θ	3°	5°	7°
Θ1	4°	6°	8°

NOTES:
1.ALL DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.

TO-251E(IPAK)

COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	2.20	2.30	2.38
A1	0.90	1.00	1.10
b	0.77	–	0.89
b1	0.76	0.81	0.86
b2	0.77	–	1.10
b3	0.77	–	1.10
b4	5.23	5.33	5.43
c	0.47	–	0.60
c1	0.46	0.51	0.56
c2	0.47	–	0.60
D	6.00	6.10	6.20
D1	5.25	–	–
E	6.50	6.60	6.70
E1	4.70	–	–
e		2.28BSC	
L	9.00	9.30	9.60
L1	1.90	2.00	2.10
L2	0.90	–	1.25
L3	1.15	–	1.50
L4		1.80REF	
θ1	3°	5°	7°
θ2	1°	3°	5°

SECTION B-B&C-C

NOTES:
ALL DIMENSIONS REFER TO JEDEC STANDARD
TO−251 AA DO NOT INCLUDE MOLD FLASH
OR PROTRUSIONS.

TO-252E-2

COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	2.20	2.30	2.38
A1	0	–	0.10
A2	0.90	1.00	1.10
b	0.77	–	0.89
b1	0.76	0.81	0.86
b2	0.77	–	1.10
b3	5.23	5.33	5.43
c	0.47	–	0.60
c1	0.46	0.51	0.56
c2	0.47	–	0.60
D	6.00	6.10	6.20
D1	5.25	–	–
E	6.50	6.60	6.70
E1	4.70	–	–
e		2.28BSC	
H	9.80	10.10	10.40
L	1.40	1.50	1.70
L1		2.90REF	
L2		0.51BSC	
L3	0.90	–	1.25
L4	0.60	0.80	1.00
L5	0.90	–	1.50
L6		1.80REF	
θ	0°	–	8°
θ1	3°	5°	7°
θ2	1°	3°	5°

SECTION C-C

NOTES:
ALL DIMENSIONS REFER TO JEDEC STANDARD
TO−252 AA DO NOT INCLUDE MOLD FLASH
OR PROTRUSIONS.