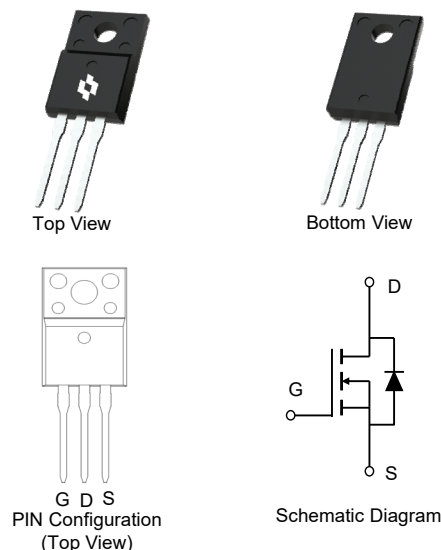


Product Summary

V_{DS}	$R_{DS(ON_MAX)}$	I_{D_MAX}
650 V	190 m Ω @ $V_{GS} = 10V$	20.0 A

TO220F-3L

Features

- Low On-Resistance
- Fast Switching Capability
- 100% ΔV_{DS} & UIS & Rg Tested


Applications

- LED Lighting
- Charger and Adapter
- PC and Telecom Power

Mechanical Data

- Green Molding Compound
- Moisture Sensitivity: Level 3 per J-STD-020
- UL Flammability Classification Rating 94V-0

Ordering Information

Orderable Part Number	Package Type	Device Marking	Form	Quantity (pcs)
SMJ65R190BNF	TO220F-3L	65R190B	Tube	50

Maximum Ratings (@ $T_C = 25^\circ\text{C}$, unless otherwise specified.)

Parameter	Symbol	Value	Unit
Drain - Source Voltage	V_{DS}	650	V
Gate - Source Voltage	V_{GS}	± 30	V
Continuous Drain Current ($V_{GS} = 10V$) ⁽¹⁾	I_D	$T_C = 25^\circ\text{C}$ 20	A
		$T_C = 100^\circ\text{C}$ 5.1	A
Pulsed Drain Current ⁽²⁾	I_{DM}	60	A
Single Pulse Avalanche Energy ⁽³⁾	E_{AS}	794	mJ
Single Pulse Avalanche Current ($L = 10.0\text{mH}$)	I_{AS}	9.1	A
Power Dissipation	P_D	$T_C = 25^\circ\text{C}$ 34	W
		$T_C = 100^\circ\text{C}$ 13.5	W
MOSFET dv/dt Ruggedness, $V_{DS}=0\dots 400V$	dv/dt	50	V/ns
Reverse Diodes dv/dt, $V_{DS}=0\dots 400V$, $I_{SD} \leq I_D$	dv/dt	50	V/ns
Junction & Storage Temperature Range	T_J, T_{STG}	-55 ~ +150	$^\circ\text{C}$

Thermal Characteristics

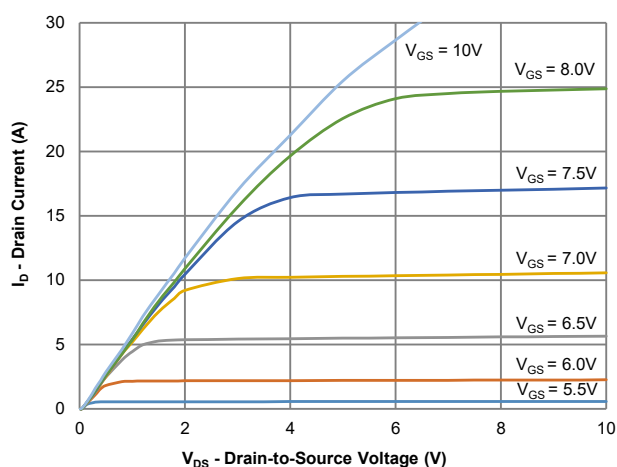
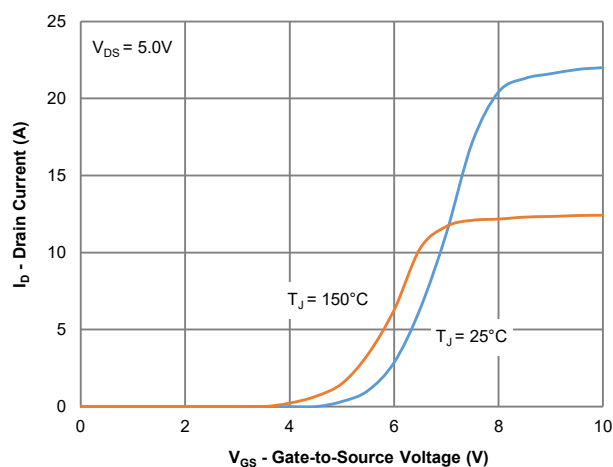
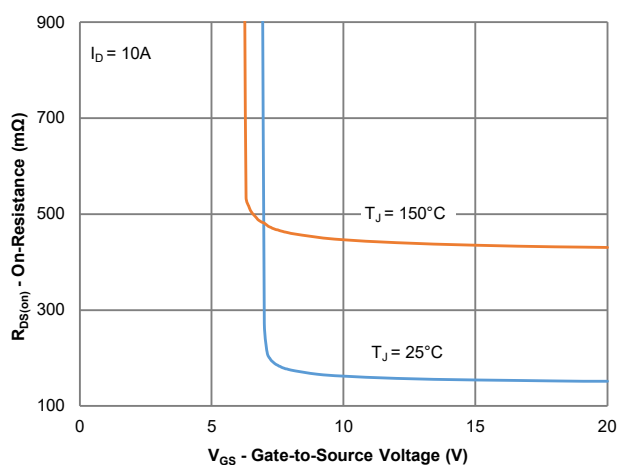
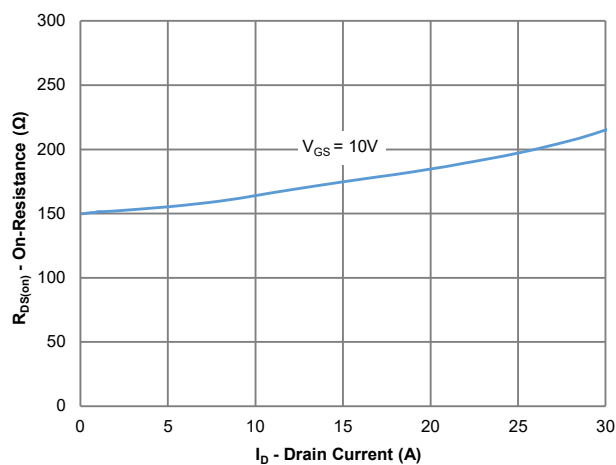
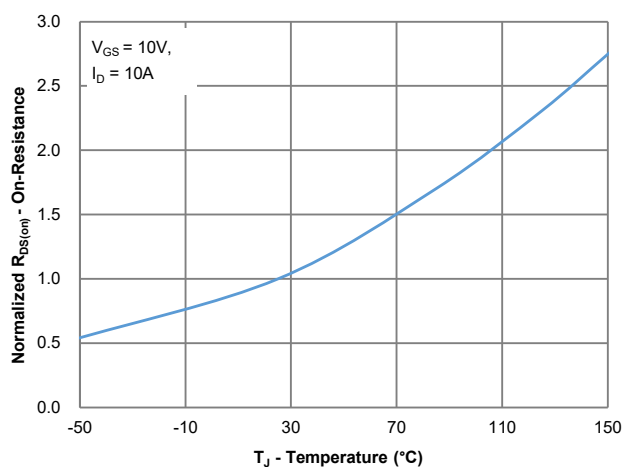
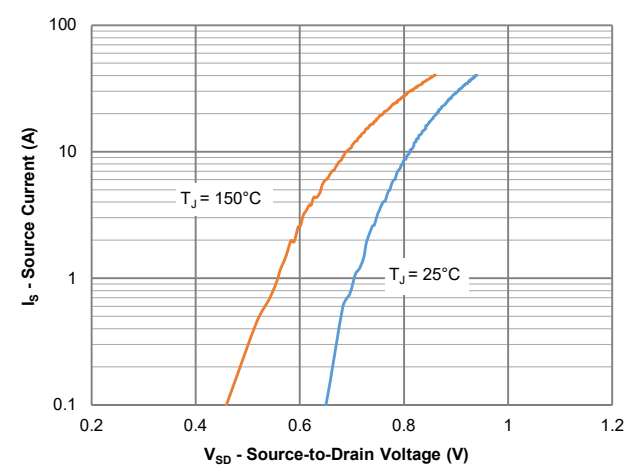
Parameter	Symbol	Typ.	Max.	Unit
Thermal Resistance, Junction-to-Ambient ⁽⁴⁾	$R_{\theta JA}$	50	65	$^\circ\text{C/W}$
Thermal Resistance, Junction-to-Case ⁽⁵⁾	$R_{\theta JC}$	2.8	3.7	$^\circ\text{C/W}$

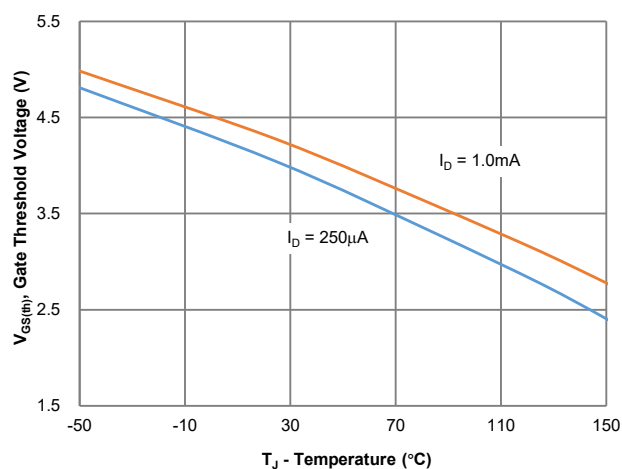
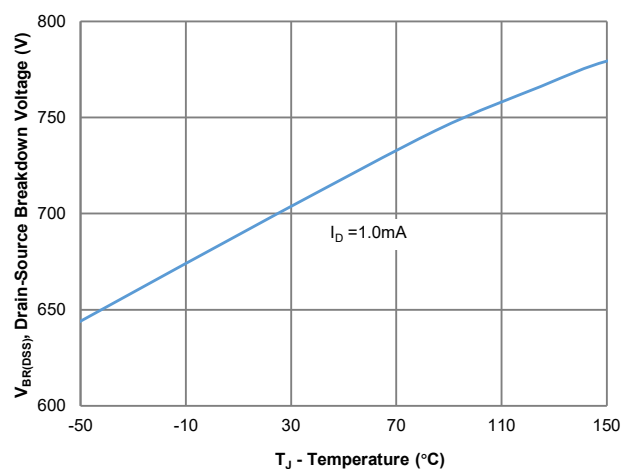
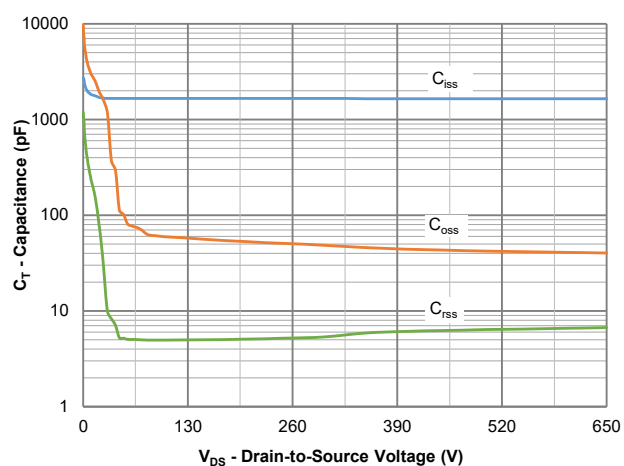
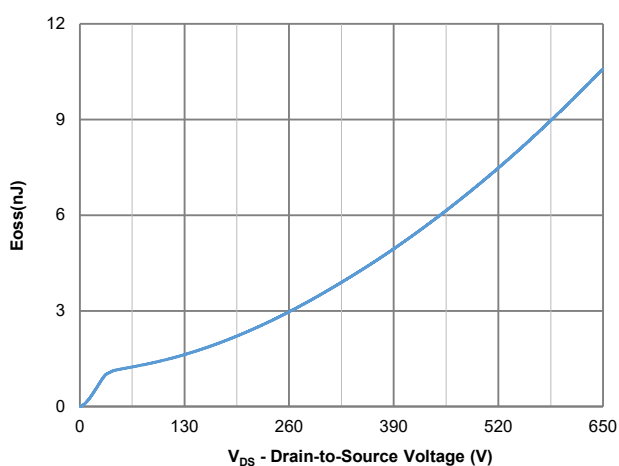
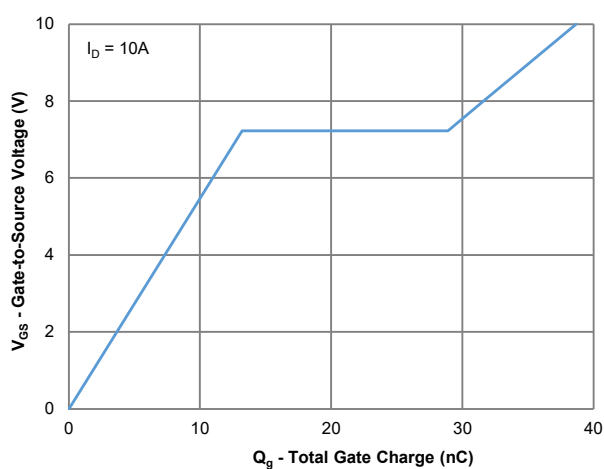
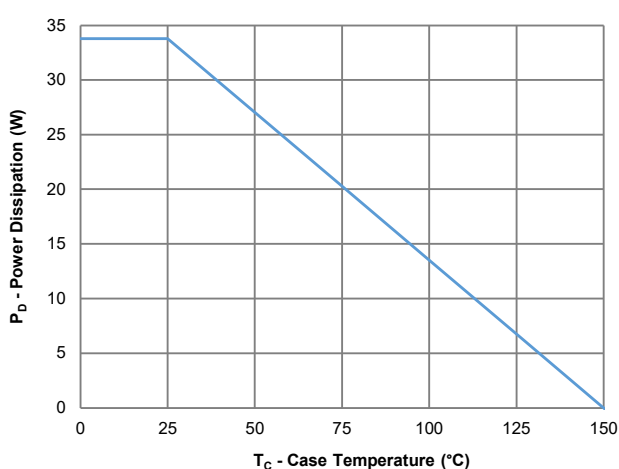
Electrical Characteristics (@ $T_J = 25^\circ\text{C}$, unless otherwise specified.)

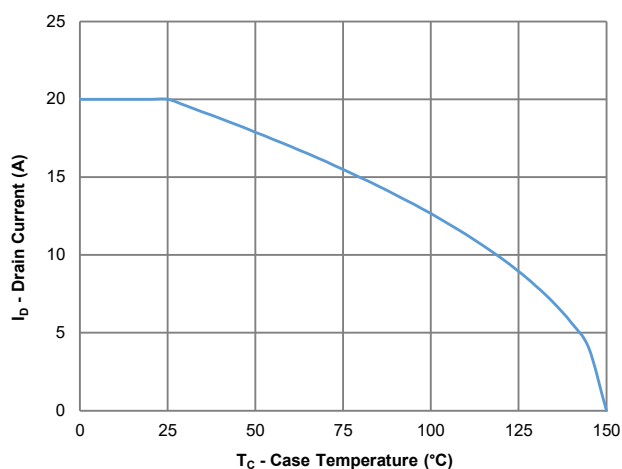
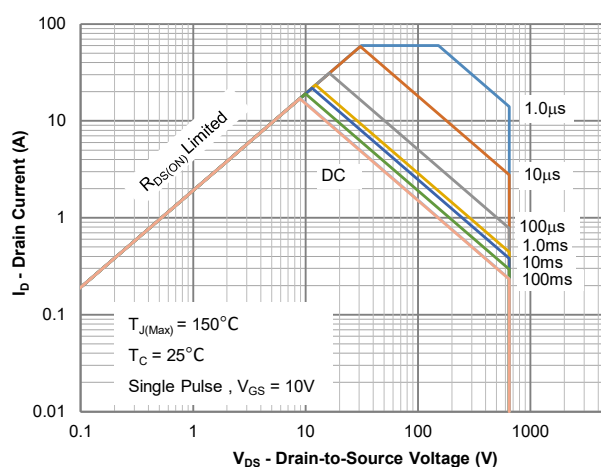
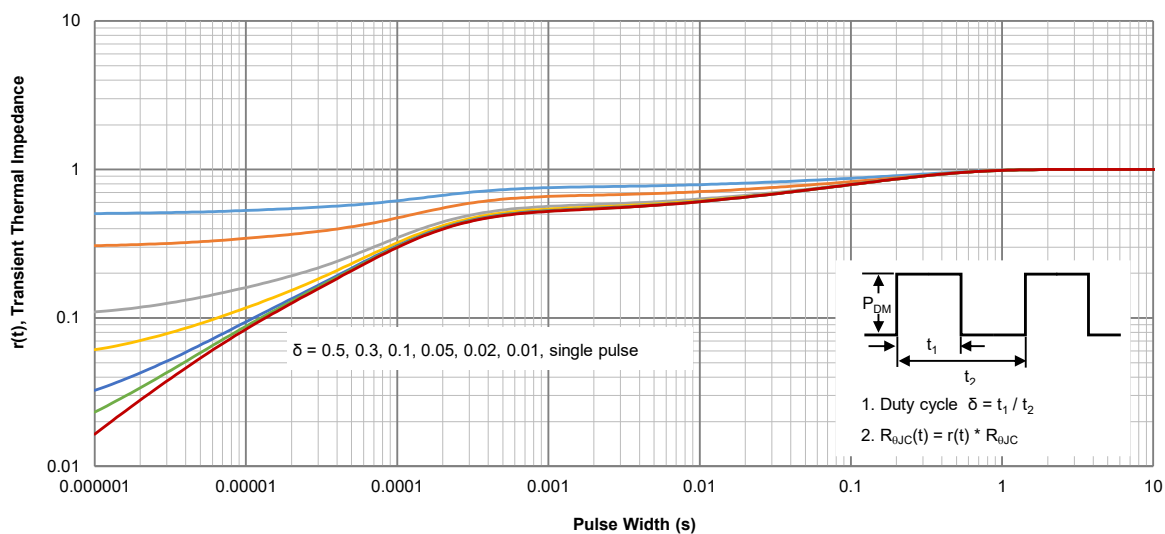
Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Off Characteristics ⁽⁶⁾						
Drain-Source Breakdown Voltage	V _{(BR)DSS}	V _{GS} = 0V, I _D = 250μA	650	-	-	V
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} = 600V, V _{GS} = 0V	-	-	1.0	μA
		T _J = 125°C	-	-	100	μA
Gate-Source Leakage Current	I _{GSS}	V _{GS} = ±30V, V _{DS} = 0V	-	-	±100	nA
On Characteristics ⁽⁶⁾						
Gate Threshold Voltage	V _{GS(th)}	V _{GS} = V _{DS} , I _D = 250μA	3.0	4.0	5.0	V
Static Drain-Source On-Resistance	R _{DS(ON)}	V _{GS} = 10V, I _D = 10A	-	169	190	mΩ
Diodes Forward Voltage	V _{SD}	I _S = 10A, V _{GS} = 0V	-	0.83	1.2	V
Dynamic Characteristics ⁽⁷⁾						
Input Capacitance	C _{iss}	V _{DS} = 100V, V _{GS} = 0V, f = 1MHz	-	1658	-	pF
Output Capacitance	C _{oss}		-	60	-	pF
Reverse Transfer Capacitance	C _{rss}		-	5.0	-	pF
Effective Output Capacitance, Energy Related ⁽⁸⁾	C _{O(er)}	V _{GS} =0V,	-	58	-	pF
Effective Output Capacitance, Time Related ⁽⁹⁾	C _{O(tr)}	V _{DS} =0...480V, f = 1MHz	-	239	-	pF
Gate Resistance	R _g	V _{GS} = 0V, V _{DS} = 0V, f = 1MHz	-	17	-	Ω
Switching Characteristics ⁽⁷⁾						
Turn-On DelayTime	t _{d(on)}	V _{GS} = 10V, V _{DS} = 400V I _D = 10A, R _{GEN} = 3.0Ω	-	57	-	ns
Rise Time	t _r		-	53	-	ns
Turn-Off DelayTime	t _{d(off)}		-	152	-	ns
Fall Time	t _f		-	30	-	ns
Gate Charge Characteristics ⁽⁷⁾						
Total Gate Charge (V _{GS} = 10V)	Q _g	V _{DS} = 400V, I _D = 10A V _{GS} = 10V	-	39	-	nC
Total Gate Charge (V _{GS} = 8.0V)	Q _g		-	32	-	nC
Gate-Source Charge	Q _{gs}		-	13.2	-	nC
Gate-Drain Charge	Q _{gd}		-	15.7	-	nC
Gate Plateau Voltage	V _{plateau}		-	7.2	-	V
Drain-Source Diode Characteristics ⁽⁷⁾						
Body Diode Reverse Recovery Time	t _{rr}	I _F = 10A, dI/dt = 100A/μs, T _J = 25°C	-	379	-	ns
Body Diode Reverse Recovery Charge	Q _{rr}		-	5.1	-	μC
Body Diode Reverse Recovery Current	I _{rrm}		-	21	-	A
Diode Forward Current	I _S	T _C = 25°C	-	-	20	A

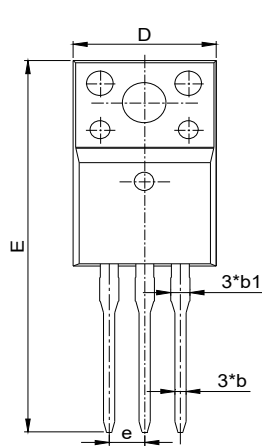
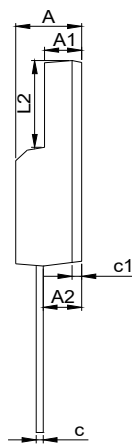
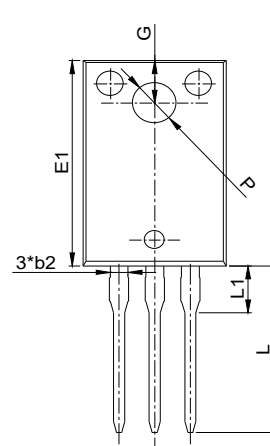
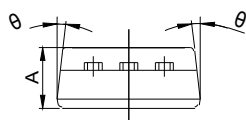
Notes:

1. This current is chip limited, which is calculated based on R_{thjc} .
2. This current is calculated on single pulse with 10 μs Pulse & Duty Cycle = 1%.
3. Defined by design, not subject to production test, E_{AS} condition: $T_J=25^\circ\text{C}$, $V_{DD}=400V$, $V_{GS}=10V$, $L=50mH$.
4. Device mounted on FR-4 substrate PC board with 2oz copper in 1inch square cooling area.
5. Thermal resistance from junction to the exposed pad).
6. Short duration pulse test used to minimize self-heating effect.
7. Defined by design, not subject to production.
8. $C_{O(er)}$ is a fixed capacitance that gives the same stored energy as C_{OSS} while V_{DS} is rising from 0 to 480V.
9. $C_{O(tr)}$ is a fixed capacitance that gives the same charging time as C_{OSS} while V_{DS} is rising from 0 to 480V.

Typical Electrical and Thermal Characteristics

Figure 1: Output Characteristics

Figure 2: Transfer Characteristics

Figure 3: On-Resistance vs. Gate-Source Voltage

Figure 4: On-Resistance vs. Gate-Source Voltage

Figure 5: On-Resistance vs. Junction Temperature

Figure 6: Source-Drain Diode Forward Voltage

Typical Electrical and Thermal Characteristics

Figure 7: Gate Threshold Variation vs. Junction Temperature

Figure 8: $V_{BR(DSS)}$ vs. Junction Temperature

Figure 9: Capacitance Characteristics

Figure 10: C_{oss} Stored Energy

Figure 11: Gate Charge Characteristics

Figure 12: Power Derating

Typical Electrical and Thermal Characteristics

Figure 13: Current Derating

Figure 14: Safe Operating Area

Figure 15: Normalized Maximum Transient Thermal Impedance

TO220F-3L Package Outline
Package Outline

Top View

Side View

Bottom View

Front View
NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994.
2. ALL DIMNESIONS IN MILLIMETER (ANNGLE IN DEGREE).
3. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH.

DIM.	MILLIMETER		
	MIN.	NOM.	MAX.
A	4.50	4.70	4.90
A1	2.34	2.54	2.74
A2	2.50	2.76	2.96
b	0.60	0.80	1.00
b1	--	--	1.47
b2	1.10	--	1.38
c	0.40	0.50	0.63
c1	0.70 REF		
D	9.96	--	10.40
e	2.54 BSC		
E	28.30	28.85	29.35
E1	15.67	15.87	16.10
G	3.20	--	3.40
L	12.68	--	13.30
L1	--	--	3.50
L2	6.48	6.68	6.88
P	3.30 REF		
θ	0°	--	12°