

CAN-Transceiver

TLE 6250 TLE 6250 V33

Final Data Sheet

Features

- CAN data transmission rate up to 1 MBaud
- Suitable for 12 V and 24 V applications
- Excellent EMC performance (very high immunity and very low emission)
- Version for 5 V and 3.3 V micro controllers
- Bus pins are short circuit proof to ground and battery voltage
- Over-temperature protection
- Very wide temperature range (- 40°C up to 150°C)



Туре	Ordering Code	Package
TLE 6250 G	Q67006-A9427	P-DSO-8-3
TLE 6250 C	Q67000-A9594	(chip)
TLE 6250 G V33	Q67006-A9523	P-DSO-8-3
TLE 6250 C V33	Q67000-A9538	(chip)

Description

The CAN-transceiver TLE 6250 is a monolithic integrated circuit that is available as bare die as well as in a P-DSO-8-3 package. The IC is optimized for high speed differential mode data transmission in automotive and industrial applications and is compatible to ISO/DIS 11898 (see page 12 and 20). It works as an interface between the CAN protocol controller and the physical differential bus in both, 12 V and 24 V systems.

Note:

There are two versions available: one for 5 V logic and the other one for 3.3 V logic requiring additional supply via the V_{33V} pin. The IC can be set to stand-by mode via an control input. In addition the 5 V-version offers a receive only mode feature to support diagnostic functions.

The IC is based on the **S**mart **P**ower **T**echnology SPT[®] which allows bipolar and CMOS control circuitry in accordance with DMOS power devices existing on the same monolithic circuit. The TLE 6250 is designed to withstand the severe conditions of automotive applications and provides excellent EMC performance.







Pin Definitions and Functions

Pin No.	Symbol	Function
1	TxD	CAN transmit data input; 20 k Ω pull up, LOW in dominant state
2	GND	Ground;
3	V _{CC}	5 V Supply;
4	RxD	CAN receive data output; LOW in dominant state, integrated pull up
5	RM	Receive-only input; (5 V-version), 20 k Ω pull up, set low to activate RxD-only mode
	V _{33V}	Logic supply; (3.3 V-version) <u>3.3 V OR 5V</u> microcontroller logic supply can be connected here! The digital I/Os of the TLE6250V33 adopt to the connected microcontroller logic supply at V_{33V}
6	CANL	Low line input; LOW in dominant state
7	CANH	High line output; HIGH in dominant state
8	INH	Control input; 20 k Ω pull, set LOW for normal mode



Functional Block Diagram



Figure 2 Block Diagram TLE 6250 G





Figure 3 Block Diagram TLE 6250 G V33



Application Information



Figure 4 Mode State Diagram

Both, the TLE 6250 G as well as the TLE 6250 C offer three different operation modes (see **Figure 4**), controlled by the INH and RM pin for the TLE6250 and only by the INH pin for the 6250 V33. In the normal mode the device is able to receive and to transmit messages whereas in the receive-only mode signals at the TxD input are not transmitted to the CAN bus. The receive-only mode can be used for diagnostic purposes as well as to prevent the bus being blocked by a faulty permanent dominant TxD input signal. The stand-by mode is a low power mode that disables both, the receiver as well as the transmitter. For the TLE 6250 G V33 and TLE 6250 C V33 the receive only mode feature is not available. The inhibit feature for this versions works in the same way as for the 5V versions.

In case the receive-only feature is not used the RM pin has to be left open. When the stand-by mode is not used the INH pin has to be connected to ground level in order to switch the TLE 6250 in normal mode.



Application Information for the 3.3V Version

The TLE 6250V33 can be used for both; 3.3V and 5V microcontroller logic supply as shown below. Don't apply external resistors between the power supply and this pin. This may cause a voltage drop and so reduce the available voltage at this pin.





Electrical Characteristics TLE6250 G (5V Version)



Electrical Characteristics

Absolute Maximum Ratings

Parameter	Symbol	Limit Values		Unit	Remarks
		min.	max.		

Voltages

Supply voltage	V _{CC}	- 0.3	6.5	V	-
CAN input voltage (CANH, CANL)	V _{CANH/L}	- 40	40	V	_
Logic voltages at INH, RM, TxD, RxD	VI	- 0.3	V _{CC}	V	$0 V < V_{CC} < 5.5 V$
Electrostatic discharge voltage at CANH,CANL	V _{ESD}	- 6	6	kV	human body model (100 pF via 1.5 k Ω)
Electrostatic discharge voltage	V _{ESD}	-2	2	kV	human body model (100 pF via 1.5 k Ω)

Temperatures

Junction temperature	T _j	- 40	160	°C	_

Note: Maximum ratings are absolute ratings; exceeding any one of these values may cause irreversible damage to the integrated circuit.



Operating Range

Parameter	Symbol	Limit Values		Limit Values		Limit Values		Limit Values		Unit	Remarks
		min.	max.								
Supply voltage	V _{CC}	4.5	5.5	V	-						
Junction temperature	Tj	- 40	150	°C	-						

Thermal Resistances

Junction ambient	R _{thj-a}	_	185	K/W	_
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Thermal Shutdown (junction temperature)

Thermal shutdown	T_{jsD}	160	200	°C	10 °C hysteresis
temperature	,				



Electrical Characteristics

4.5 V < V_{CC} < 5.5 V; R_{L} = 60 Ω ; V_{INH} < $V_{INH,ON}$; – 40 °C < T_{j} < 150 °C; all voltages with respect to ground; positive current flowing into pin; unless otherwise specified.

Parameter	Symbol	Limit Values			Unit	Remarks
		min.	typ.	max.		

Current Consumption

Current consumption	I _{CC}	-	6	10	mA	recessive state; $V_{TxD} = V_{CC}$
Current consumption	I _{CC}	-	45	70	mA	dominant state; $V_{TxD} = 0 V$
Current consumption	I _{CC}	-	6	10	mA	receive-only mode; RM = low
Current consumption	I _{CC,stb}	-	1	10	μA	stand-by mode; TxD = RM = high

Receiver Output R×D

HIGH level output current	$I_{\rm RD,H}$	_	-4	-2	mA	$V_{ m RD}$ = 0.8 × $V_{ m CC}$, $V_{ m diff}$ < 0.4 V ^{note 1)}
LOW level output current	$I_{\rm RD,L}$	2	4	_	mA	$V_{ m RD}$ = 0.2 × $V_{ m CC}$, $V_{ m diff}$ > 1 V ^{note 1)}

Transmission Input T×D

HIGH level input voltage threshold	$V_{TD,H}$	_	0.5× V _{CC}	0.7× V _{CC}	V	recessive state;
LOW level input voltage threshold	$V_{TD,L}$	0.3× V _{CC}	$0.4 \times V_{CC}$	_	V	dominant state
TxD pull up resistance	R _{TD}	10	25	50	kΩ	-

note1) $V_{\text{diff}} = V_{\text{CANH}} - V_{\text{CANL}}$



4.5 V < V_{CC} < 5.5 V; R_{L} = 60 Ω ; V_{INH} < $V_{INH,ON}$; – 40 °C < T_{j} < 150 °C; all voltages with respect to ground; positive current flowing into pin; unless otherwise specified.

Parameter	Symbol	Limit Values		Unit	Remarks	
		min.	typ.	max.		

Inhibit Input (pin INH)

HIGH level input voltage threshold	$V_{\rm INH,H}$	_	0.5× V _{CC}	0.7× V _{CC}	V	stand-by mode;
LOW level input voltage threshold	$V_{INH,L}$	0.3× V _{CC}	0.4× V _{CC}	_	V	normal mode
INH pull up resistance	R _{INH}	10	25	50	kΩ	-

Receive only Input (RM) (5V version only)

HIGH level input voltage threshold	$V_{RM,H}$	_	$0.5 \times V_{CC}$	0.7× V _{CC}	V	normal mode;
LOW level input voltage threshold	$V_{RM,L}$	0.3× V _{CC}	0.4× V _{CC}	_	V	receive-only mode
RM pull up resistance	R _{RM}	10	25	50	kΩ	-



4.5 V < V_{CC} < 5.5 V; R_{L} = 60 Ω ; V_{INH} < $V_{INH,ON}$; – 40 °C < T_{j} < 150 °C; all voltages with respect to ground; positive current flowing into pin; unless otherwise specified.

Parameter	Symbol	Limit Values		Unit	Remarks	
		min.	typ.	max.		

Bus Receiver

Differential receiver threshold voltage, recessive to dominant edge	$V_{\rm diff,d}$	_	0.75	0.90	V	$\begin{array}{l} - 20 \ \mathrm{V} < (V_{\mathrm{CANH}}, \\ V_{\mathrm{CANL}}) < 25 \ \mathrm{V} \\ V_{\mathrm{diff}} = V_{\mathrm{CANH}} - V_{\mathrm{CANL}} \end{array}$
Differential receiver threshold voltage dominant to recessive edge	$V_{\rm diff,r}$	0.50	0.60	_	V	$-20 V < (V_{CANH}, V_{CANL}) < 25 V$ $V_{diff} = V_{CANH} - V_{CANL}$
Common Mode Range	CMR	-20	_	25	V	$V_{\rm CC} = 5V$
Differential receiver hysteresis	$V_{\rm diff,hys}$	_	150	_	mV	_
CANH, CANL input resistance	R _i	10	20	30	kΩ	recessive state
Differential input resistance	R _{diff}	20	40	60	kΩ	recessive state



4.5 V < V_{CC} < 5.5 V; R_{L} = 60 Ω ; V_{INH} < $V_{INH,ON}$; – 40 °C < T_{j} < 150 °C; all voltages with respect to ground; positive current flowing into pin; unless otherwise specified.

Parameter	Symbol	Limit Values		Unit	Remarks	
		min.	typ.	max.		

Bus Transmitter

CANL/CANH recessive output voltage	V _{CANL/H}	$0.4 imes V_{ m CC}$	_	$0.6 imes V_{ m CC}$	V	$V_{TxD} = V_{CC}$
CANH, CANL recessive output voltage difference $V_{\text{diff}} = V_{\text{CANH}} - V_{\text{CANL}}$ no load; (see note 2)	V_{diff}	- 1	_	0.05	V	$V_{TxD} = V_{CC}$
CANL dominant output voltage	V_{CANL}	_	_	2.0	V	$V_{TxD} = 0 V;$ $V_{CC} = 5 V$
CANH dominant output voltage	V _{CANH}	2.8	_	_	V	$V_{\text{TxD}} = 0 \text{ V};$ $V_{\text{CC}} = 5 \text{ V}$
CANH, CANL dominant output voltage difference $V_{\text{diff}} = V_{\text{CANH}} - V_{\text{CANL}}$	V_{diff}	1.5	_	3.0	V	$V_{\text{TxD}} = 0 \text{ V};$ $V_{\text{CC}} = 5 \text{ V}$
CANL short circuit	I _{CANLsc}	50	120	200	mA	$V_{\text{CANLshort}} = 18 \text{ V}$
current		_	150	_	mA	$V_{\text{CANLshort}} = 36 \text{ V}$
CANH short circuit current	I _{CANHsc}	-200	-120	-50	mA	$V_{\text{CANHshort}} = 0 \text{ V}$
CANH short circuit ent	I _{CANHsc}	_	-120	_	mA	$V_{\text{CANHshort}} = -5 \text{ V}$
Output current	$I_{\rm CANH,lk}$	-50	-300	-400	μA	$V_{\rm CC}$ = 0 V, $V_{\rm CANH}$ = $V_{\rm CANL}$ = -7 V
		-50	-100	-150	μA	$V_{\rm CC}$ = 0 V, $V_{\rm CANH}$ = $V_{\rm CANL}$ = -2 V
Output current	I _{CANH,Ik}	50	280	400	μA	$V_{CC} = 0 V, V_{CANH} = V_{CANL} = 7 V$
		50	100	150	μA	$V_{\rm CC}$ = 0 V, $V_{\rm CANH}$ = $V_{\rm CANL}$ = 2 V

note 2) deviation from ISO/DIS 11898



4.5 V < V_{CC} < 5.5 V; R_{L} = 60 Ω ; V_{INH} < $V_{INH,ON}$; – 40 °C < T_{j} < 150 °C; all voltages with respect to ground; positive current flowing into pin; unless otherwise specified.

Parameter	Symbol	Limit Values			Unit	Remarks
		min.	typ.	max.		

Dynamic CAN-Transceiver Characteristics

Propagation delay TxD-to-RxD LOW (recessive to dominant)	$t_{d(L),TR}$	_	150	280	ns	$\begin{split} C_{\rm L} &= \overline{\rm 47 \ pF}; \\ R_{\rm L} &= 60 \ \Omega; \ V_{\rm CC} = 5 \ {\rm V}; \\ C_{\rm RxD} &= 20 \ {\rm pF} \end{split}$
Propagation delay TxD-to-RxD HIGH (dominant to recessive)	$t_{\rm d(H),TR}$	_	150	280	ns	$\begin{array}{l} C_{\rm L} = 47 \ {\rm pF}; \\ R_{\rm L} = 60 \ \Omega; \ V_{\rm CC} = 5 \ {\rm V}; \\ C_{\rm RxD} = 20 \ {\rm pF} \end{array}$
Propagation delay TxD LOW to bus dominant	t _{d(L),T}	_	100	140	ns	$C_{\rm L}$ = 47 pF; $R_{\rm L}$ = 60 Ω ; $V_{\rm CC}$ = 5 V
Propagation delay TxD HIGH to bus recessive	t _{d(H),T}	-	100	140	ns	$C_{\rm L}$ = 47 pF; $R_{\rm L}$ = 60 Ω ; $V_{\rm CC}$ = 5 V
Propagation delay bus dominant to RxD LOW	t _{d(L),R}	_	50	140	ns	$C_{L} = 47 \text{ pF};$ $R_{L} = 60 \Omega; V_{CC} = 5 \text{ V};$ $C_{RxD} = 20 \text{ pF}$
Propagation delay bus recessive to RxD HIGH	t _{d(H),R}	_	50	140	ns	$\begin{array}{l} C_{\rm L} = 47 \; {\rm pF}; \\ R_{\rm L} = 60 \; \Omega; \; V_{\rm CC} = 5 \; {\rm V}; \\ C_{\rm RxD} = 20 \; {\rm pF} \end{array}$

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Electrical Characteristics TLE6250 GV33 (3.3V Version)



Electrical Characteristics

Absolute Maximum Ratings

Parameter	Symbol	Limit \	/alues	Unit	Remarks
		min.	max.		

Voltages

Supply voltage	V _{CC}	- 0.3	6.5	V	-
3.3 V supply	V _{33V}	- 0.3	5.5	V	-
CAN input voltage (CANH, CANL)	V _{CANH/L}	- 40	40	V	_
Logic voltages at INH, RM, TxD, RxD	V _I	- 0.3	V _{CC}	V	0 V < V _{CC} < 5.5 V
Electrostatic discharge voltage at CANH,CANL	V _{ESD}	- 6	6	kV	human body model (100 pF via 1.5 k Ω)
Electrostatic discharge voltage	V _{ESD}	-2	2	kV	human body model (100 pF via 1.5 k Ω)

Temperatures

Junction temperature	T _j	- 40	160	°C	-
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Note: Maximum ratings are absolute ratings; exceeding any one of these values may cause irreversible damage to the integrated circuit.



Operating Range

Parameter	Symbol	Limit Values		Unit	Remarks
		min.	max.		
Supply voltage	V _{CC}	4.5	5.5	V	-
3.3 V supply voltage	V _{33V}	3.0	5.5	V	-
Junction temperature	Tj	- 40	150	°C	-

Thermal Resistances

Junction ambient	R _{thj-a}	_	185	K/W	_

Thermal Shutdown (junction temperature)

Thermal shutdown	T_{isD}	160	200	°C	10 °C hysteresis
temperature	, -				



Electrical Characteristics

4.5 V < V_{CC} < 5.5 V; (3.0 V < V_{33V} < 3.6 V for 3.3 V version); $R_L = 60 \Omega$; $V_{INH} < V_{INH,ON}$; - 40 °C < T_j < 150 °C; all voltages with respect to ground; positive current flowing into pin; unless otherwise specified.

Parameter	Symbol	Limit Values			Unit	Remarks
		min.	typ.	max.		

Current Consumption (3.3V version)

Current consumption	I _{CC+33V}	_	6	10	mA	recessive state; $V_{TxD} = V_{33V}$
Current consumption	I _{CC+33V}	-	45	70	mA	dominant state; $V_{TxD} = 0 V$
Current consumption	I _{33V}	-	-	2	mA	
Current consumption	I _{CC+33V,stb}	_	1	10	μA	stand-by mode TxD = high

Receiver Output R×D

HIGH level output current	I _{RD,H}	_	-2	-1	mA	$\begin{split} V_{\rm RD} &= 0.8 \times V_{\rm 33V}, \\ V_{\rm diff} &< 0.4 \ {\rm V}^{\rm note \ 1)} \end{split}$
LOW level output current	$I_{\rm RD,L}$	1	2	_	mA	$V_{ m RD}$ = 0.2 × $V_{ m 33V}$, $V_{ m diff}$ > 1 V ^{note 1)}

Transmission Input T×D

HIGH level input voltage threshold	$V_{TD,H}$	_	0.55× V _{33V}	0.7× V _{33V}	V	recessive state;
LOW level input voltage threshold	$V_{\rm TD,L}$	0.3× V _{33V}	0.45× V _{33V}	_	V	dominant state;
TxD pull up resistance	R _{TD}	10	25	50	kΩ	-

note1) $V_{\text{diff}} = V_{\text{CANH}} - V_{\text{CANL}}$



4.5 V < V_{CC} < 5.5 V; (3.0 V < V_{33V} < 3.6 V for 3.3 V version); $R_L = 60 \Omega$; $V_{INH} < V_{INH,ON}$; - 40 °C < T_j < 150 °C; all voltages with respect to ground; positive current flowing into pin; unless otherwise specified.

Parameter	Symbol	Limit Values			Unit	Remarks
		min.	typ.	max.		

Inhibit Input (pin INH)

HIGH level input voltage threshold	$V_{\rm INH,H}$	_	0.55× V _{33V}	0.7× V _{33V}	V	stand-by mode;
LOW level input voltage threshold	$V_{INH,L}$	0.3× V _{33V}	0.45× V _{33V}	-	V	normal mode;
INH pull up resistance	R _{INH}	10	25	50	kΩ	_



4.5 V < V_{CC} < 5.5 V; (3.0 V < V_{33V} < 3.6 V for 3.3 V version); $R_L = 60 \Omega$; $V_{INH} < V_{INH,ON}$; - 40 °C < T_j < 150 °C; all voltages with respect to ground; positive current flowing into pin; unless otherwise specified.

Parameter	Symbol	Limit Values			Unit	Remarks
		min.	typ.	max.		

Bus Receiver

Differential receiver threshold voltage, recessive to dominant edge	$V_{\rm diff,d}$	_	0.75	0.90	V	$-20 V < (V_{CANH}, V_{CANL}) < 25 V$ $V_{diff} = V_{CANH} - V_{CANL}$
Differential receiver threshold voltage dominant to recessive edge	$V_{\mathrm{diff,r}}$	0.50	0.60	-	V	$-20 V < (V_{CANH}, V_{CANL}) < 25 V$ $V_{diff} = V_{CANH} - V_{CANL}$
Common Mode Range	CMR	-20	_	25	V	$V_{\rm CC} = 5V$
Differential receiver hysteresis	$V_{\rm diff,hys}$	_	150	_	mV	_
CANH, CANL input resistance	R _i	10	20	30	kΩ	recessive state
Differential input resistance	R _{diff}	20	40	60	kΩ	recessive state



4.5 V < V_{CC} < 5.5 V; (3.0 V < V_{33V} < 3.6 V for 3.3 V version); $R_L = 60 \Omega$; $V_{INH} < V_{INH,ON}$; - 40 °C < T_j < 150 °C; all voltages with respect to ground; positive current flowing into pin; unless otherwise specified.

Parameter	Symbol	Limit Values			Unit	Remarks
		min.	typ.	max.		

Bus Transmitter

CANL/CANH recessive output voltage	V _{CANL/H}	$0.4 imes V_{ m CC}$	_	$0.6 imes V_{ m CC}$	V	$V_{TxD} = V_{33V}$
CANH, CANL recessive output voltage difference $V_{\text{diff}} = V_{\text{CANH}} - V_{\text{CANL}}$ no load; (see note 2)	V_{diff}	- 1	-	0.05	V	$V_{TxD} = V_{33V}$
CANL dominant output voltage	V_{CANL}	_	_	2.0	V	$V_{TxD} = 0 V;$ $V_{CC} = 5 V$
CANH dominant output voltage	V _{CANH}	2.8	_	_	V	$V_{\text{TxD}} = 0 \text{ V};$ $V_{\text{CC}} = 5 \text{ V}$
CANH, CANL dominant output voltage difference $V_{\text{diff}} = V_{\text{CANH}} - V_{\text{CANL}}$	V_{diff}	1.5	_	3.0	V	$V_{\text{TxD}} = 0 \text{ V};$ $V_{\text{CC}} = 5 \text{ V}$
CANL short circuit	I _{CANLsc}	50	120	200	mA	$V_{\text{CANLshort}} = 18 \text{ V}$
current		-	150	-	mA	$V_{\text{CANLshort}} = 36 \text{ V}$
CANH short circuit current	I _{CANHsc}	-200	-120	-50	mA	$V_{\text{CANHshort}} = 0 \text{ V}$
CANH short circuit current	I _{CANHsc}	_	-120	_	mA	$V_{\text{CANHshort}} = -5 \text{ V}$
Output current	$I_{\rm CANH,lk}$	-50	-300	-400	μA	$V_{\rm CC}$ = 0 V, $V_{\rm CANH}$ = $V_{\rm CANL}$ = -7 V
		-50	-100	-150	μA	$V_{\rm CC}$ = 0 V, $V_{\rm CANH}$ = $V_{\rm CANL}$ = -2 V
Output current	I _{CANH,Ik}	50	280	300	μA	$V_{\rm CC}$ = 0 V, $V_{\rm CANH}$ = $V_{\rm CANL}$ = 7 V
		50	100	150	μA	$V_{\rm CC}$ = 0 V, $V_{\rm CANH}$ = $V_{\rm CANL}$ = 2 V

note 2) deviation from ISO/DIS 11898



4.5 V < V_{CC} < 5.5 V; (3.0 V < V_{33V} < 3.6 V for 3.3 V version); $R_L = 60 \Omega$; $V_{INH} < V_{INH,ON}$; - 40 °C < T_j < 150 °C; all voltages with respect to ground; positive current flowing into pin; unless otherwise specified.

Parameter	Symbol	Limit Values			Unit	Remarks
		min.	typ.	max.		

Dynamic CAN-Transceiver Characteristics

Propagation delay TxD-to-RxD LOW (recessive to dominant)	t _{d(L),TR}	_	150	280	ns	$C_{L} = 47 \text{ pF};$ $R_{L} = 60 \Omega; V_{CC} = 5 \text{ V};$ $C_{RxD} = 20 \text{ pF}$
Propagation delay TxD-to-RxD HIGH (dominant to recessive)	t _{d(H),TR}	_	150	280	ns	$C_{L} = 47 \text{ pF};$ $R_{L} = 60 \Omega; V_{CC} = 5 \text{ V};$ $C_{RxD} = 20 \text{ pF}$
Propagation delay TxD LOW to bus dominant	$t_{d(L),T}$	_	100	140	ns	$C_{\rm L}$ = 47 pF; $R_{\rm L}$ = 60 Ω ; $V_{\rm CC}$ = 5 V
Propagation delay TxD HIGH to bus recessive	t _{d(H),T}	_	100	140	ns	$C_{\rm L}$ = 47 pF; $R_{\rm L}$ = 60 Ω ; $V_{\rm CC}$ = 5 V
Propagation delay bus dominant to RxD LOW	$t_{d(L),R}$	_	50	140	ns	$C_{L} = 47 \text{ pF};$ $R_{L} = 60 \Omega; V_{CC} = 5 \text{ V};$ $C_{RxD} = 20 \text{ pF}$
Propagation delay bus recessive to RxD HIGH	t _{d(H),R}	_	50	140	ns	$C_{L} = 47 \text{ pF};$ $R_{L} = 60 \Omega; V_{CC} = 5 \text{ V};$ $C_{RxD} = 20 \text{ pF}$



Diagrams



Figure 5 Test Circuits for Dynamic Characteristics





Figure 6 Timing Diagrams for Dynamic Characteristics



Application



Figure 7 Application Circuit



Package Outlines



Sorts of Packing Package outlines for tubes, trays etc. are contained in our Data Book "Package Information" SMD = Surface Mounted Device

Dimensions in mm



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