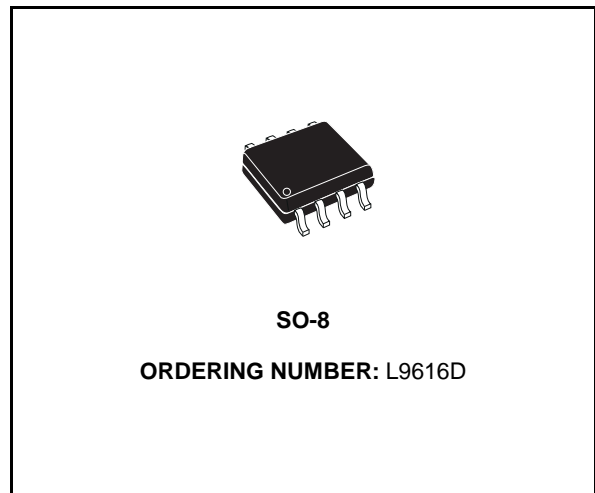


## HIGH SPEED CAN BUS TRANSCEIVER

- L9616 MEETS ISO/DIS 11898 UP TO 1MEGABAUD
- TRANSMITTER
  - GENERATION OF DIFFERENTIAL OUTPUT SIGNALS
  - SHORT CIRCUIT PROTECTED FROM -5V TO 36V, DETECTION & SHUTDOWN
  - SLOPE CONTROL TO REDUCE RFI AND EMI
  - TWO STATES ADJUSTABLE SLOPE CONTROL ( $\leq 1\text{MEGABAUD}/\leq 250\text{KBAUD}$ )
- RECEIVER
  - DIFFERENTIAL INPUT WITH HIGH INTERFERENCE SUPPRESSION
  - COMMON MODE INPUT VOLTAGE RANGE ( $V_{\text{COM}}$ ) FROM -2V TO  $V_{\text{S}}+3\text{V}$
- ESD PROTECTION LEVEL UP TO 4kV
- PACKAGE: SO-8

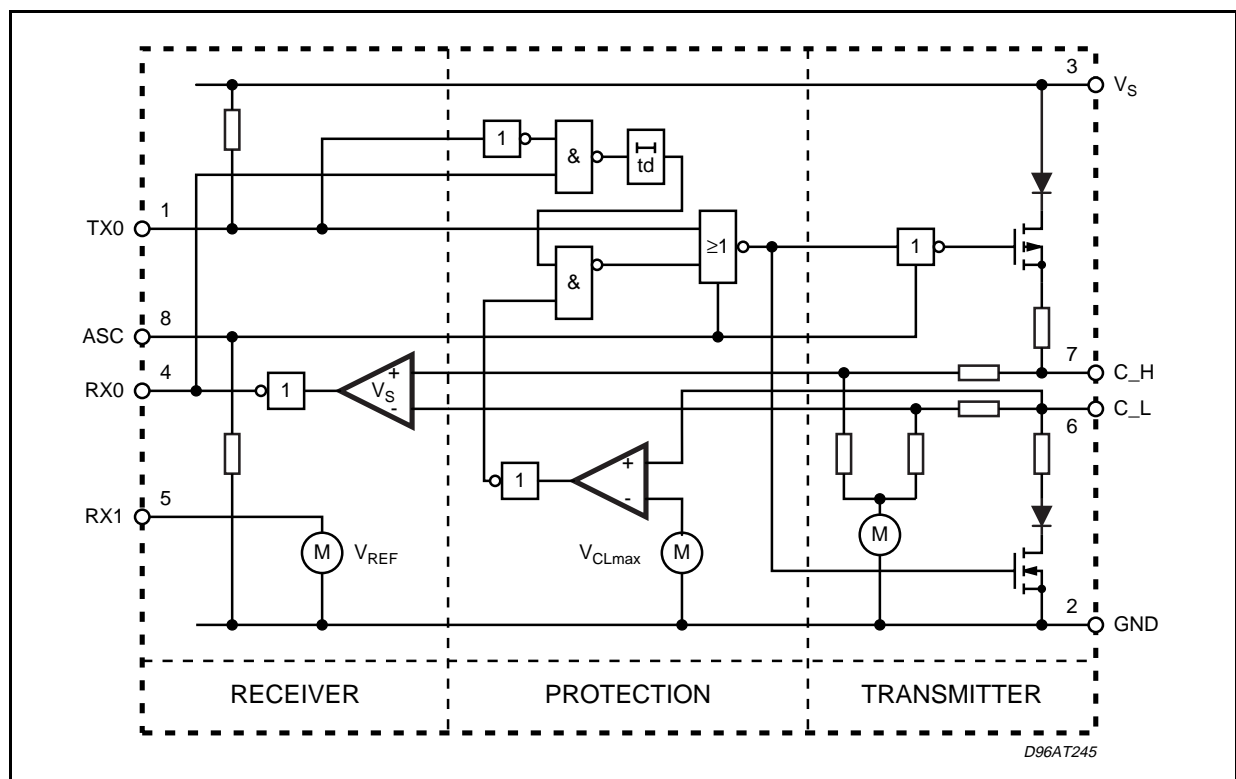


### DESCRIPTION

The L9616 is a bidirectional transceiver for signal

conditioning and processing in connection with a CAN controller. Data rates of up to 1MEGABAUD are supported using either shielded or non-shielded pair of lines.

### BLOCK DIAGRAM

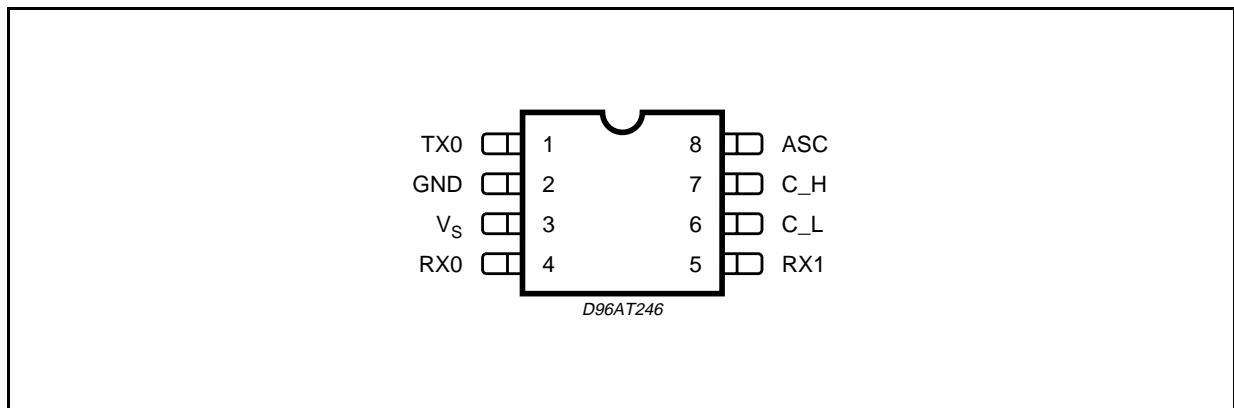


**ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit
$V_S$	Supply Voltage	-0.3 to 7	V
$V_{C\_H}, V_{C\_L}$	Bus Voltage at C_H, C_L (VS 0 to 5.5V)	-5 to 36	V
$I_{C\_H}, I_{C\_L}$	Off State Leakage Current at C_H, C_L ( VS =0 to 5.5V, $V_{C\_H} = -5$ to 36V, $V_{C\_L} = -5$ to 36 )	-3 to 5	mA
$V_{DC}$	DC Voltage at TXO, ASC (VS 0 to 5.5V)	GND -0.3 to $V_S + 0.3$	V
$I_{RXO}$	Output Current at RXO (VS 0 to 5.5V)	-0.3 to 1	mA
$T_{stg}, T_J$	Storage and Junction Temperature Range	-40 to 150	°C
$T_{op}$	Operating Temperature Range	-40 to 125	°C

All voltages, except bus voltage, are defined with respect to pin 2  
 Positive currents flow into the IC.

**PIN CONNECTION**



**THERMAL DATA**

Symbol	Parameter	Value	Unit

**PIN FUNCTIONS**

N.	Name	Function
1	TXO	Transmitter Input
2	GND	Ground
3	$V_S$	Supply Voltage
4	RXO	Receive Output
5	RX1	Reference Voltage
6	C_L	Low Side Bus Output
7	C_H	High Side Bus Output
8	ASC	Adjustable Slope Control

**ELECTRICAL CHARACTERISTICS** ( $T_{OP} = -40$  to  $125^{\circ}\text{C}$ ;  $V_S = 4.5$  to  $5.5\text{V}$ ; Dominant:  $V_{TXO} = \text{GND}$ ; Recessive:  $V_{TXO} = V_S$ ; All voltages, except bus voltage, are defined with respect to pin 2. Positive currents flow into the IC unless otherwise specified.)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
$V_S$	Supply Voltage		4.5	5	5.5	V
$I_S$	Supply Current	Dominant			80	mA
		Recessive			20	mA
<b>TRANSMITTER SECTION (RA = 60Ω between C_H and C_L)</b>						
$C_{TXO}$	TXO Input Capacitance	$0\text{V} < V_{TXO} < V_S$		25		pF
$V_{TXO}$	TXO High Level Input Voltage		$0.7 V_S$		$V_S$	
	TXO Low Level Input Voltage		0		$0.3 V_S$	
$I_{TXO}$	TXO High Level Input Current	$V_{TXO} = V_S$	-2	0	2	μA
	TXO Low Level Input Current	$V_{TXO} = \text{GND}$	-275	0	-25	μA
$C_{ASC}$	ASC Input Capacitance	$0\text{V} < V_{ASC} < V_S$		25		pF
$V_{ASC}$	ASC Input Voltage for High Speed		0		$0.1 V_S$	
	ASC Input Voltage for Low Speed		$0.9 V_S$		$V_S$	
$I_{ASC}$	ASC Input Current	$V_{ASC} = V_S$	25		275	μA
		$V_{ASC} = 0\text{V}$	-2	0	2	μA
$V_{C\_H}, V_{C\_L}$	Bus Voltage Recessive	Recessive	$0.4 V_S$	$0.5 V_S$	$0.6 V_S$	
$I_{C\_H}, I_{C\_L}$	Leakage Current Recessive	$V_{C\_L} = V_{C\_H} = -2$ to $7\text{V}$	-0.7		0.7	mA
		$V_{C\_L} = V_{C\_H} = 1$ to $4\text{V}$	-0.3		0.3	mA
$R_{IN(C\_H, C\_L)}$	Input Resistance	Recessive	5		50	KΩ
$R_{Dif(C\_H, C\_L)}$	Differential Input Resistance	Recessive	10		100	KΩ
$V_{Dif} = V_{C\_H} - V_{C\_L}$	Differential Output Voltage	Dominant, $R_A$	1.5		3	V
$V_{Dif} = V_{C\_H} - V_{C\_L}$	Differential Output Voltage	Recessive	-500	0	50	mV
$t_d$	Short Circuit Detection Time C_H to C_L ; C_H to B	$R_{CS} < 1\Omega$	1	5	10	μs
$I_A$	Supply Current in Case of Short Circuit, C_H to C_L, C_H to B (time = $t_d$ )			150		mA
$V_{C\_Lmax}$	Overvoltage Protection Threshold on C_L		7	8	10	V
<b>RECEIVE SECTION</b>						
$V_{RXO}$	RXO High Level Output Voltage	$V_{Dif} < 0.5\text{V}$ ; $I_{RXO} = 0.3\text{mA}$ ; $V_{C\_H} = -2$ to $7\text{V}$ ; $V_{C\_L} = -2$ to $7\text{V}$ ;	$0.9 V_S$		$V_S$	V
	RXO Low Level Output Voltage	$V_{Dif} > 0.9\text{V}$ ; $I_{RXO} = 1\text{mA}$ ; $V_{C\_H} = -2$ to $7\text{V}$ ; $V_{C\_L} = -2$ to $7\text{V}$ ;			0.5	V
$V_S = V_{C\_H} - V_{C\_L}$	Input Signal Threshold	$V_{C\_H} = -2$ to $7\text{V}$ ; $V_{C\_L} = -2$ to $7\text{V}$ ;	500	700	900	mV
$V_{COM} = (V_{C\_H} + V_{C\_L})/2$	Input Common Mode Voltage Range		-2		7	V
$V_{HYS}$	Differential Input Hysteresis			150		mV
<b>REFERENCE OUTPUT</b>						
$V_{RX1}$	Reference Voltage	$I_{RX1} = 0$	$0.45 V_S$	$0.5 V_S$	$0.55 V_S$	V
$R_{RX1}$	Output Resistance		2		9	KΩ

# L9616

**DINAMIC CHARACTERISTICS** ( $C_A = 47\text{pF}$  between  $C_H$  and  $C_L$ ;  $V_S = 5\text{V}$ ;  $t_R < 5\text{ns}$ ;  $C_{RXO} = 20\text{pF}$  between  $R_XO$  and  $B$ ;  $R_A = 60\Omega$  between  $C_H$  and  $C_L$ )

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
$t_{OT}$	Signal Delay TXO to $C_H$ , $C_L$				50	ns
SR	Differential Output Slew Rate (Transmitter)	$V_{ASC} = 0\text{V}$	20		50	$\text{V}/\mu\text{s}$
		$V_{ASC} = V_S$	5		20	$\text{V}/\mu\text{s}$
$t_{OR}$	Signal Delay $C_H$ , $C_L$ to $R_XO$	$V_{ASC} = 0\text{V}$			150	ns
$t_{OTR}$	Signal Delay Txo to Rxo	$V_{ASC} = 0\text{V}$			300	ns

## FUNCTIONAL DESCRIPTION

The L9616 is used as an interface between a CAN controller and the physical bus. The device provides transmitting capability to the CAN controller.

The transmitter outputs  $C_H$  and  $C_L$  are protected against short circuits and electrical transients which may occur in an automotive environment. In case of short circuit ( $C_H$  to  $C_L$ ,  $C_H$  to B) the protection circuit recognizes this fault condition and the transmitter output stages are disabled with a delay of max.  $10\mu\text{s}$  to prevent destruction of the IC and high consumption of supply current  $I_S$ . If  $V_{C_L} > V_{C_{Lmax}}$  the transmitter output stages would be disabled immediately.

Pin ASC makes it possible to select two different

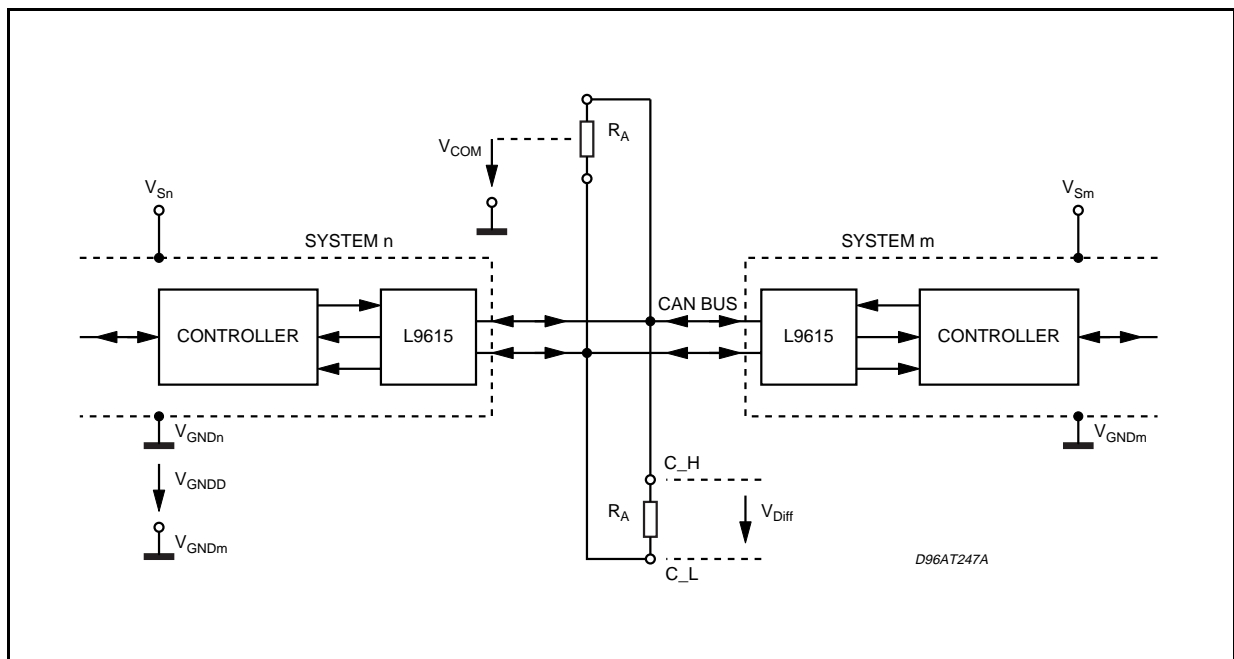
modes of operation: High speed ( $\leq 1\text{MEGABaud}$ ) and low speed ( $\leq 250\text{kBaud}$ ).

The ASC pin is tied to GND for normal operation at  $\leq 1\text{MEGABaud}$ . For slower speed operation at  $\leq 250\text{kBaud}$  the rise and fall slope of the bus output can be decreased to reduce EMI by connecting the ASC pin to  $V_S$ .

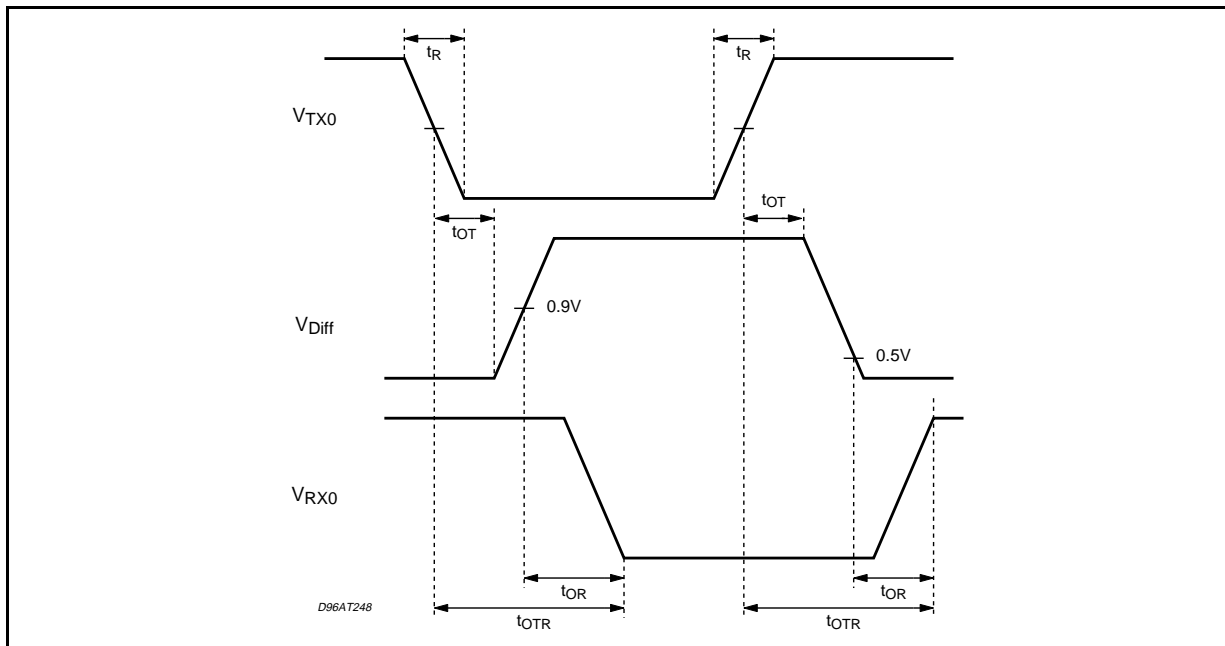
## FUNCTIONAL TABLE

TXO	$C_H$	$C_L$	Bus State	$R_XO$
L	H	L	Dominant	L
H or Floating	Floating $V_S/2$	Floating $V_S/2$	Recessive	H

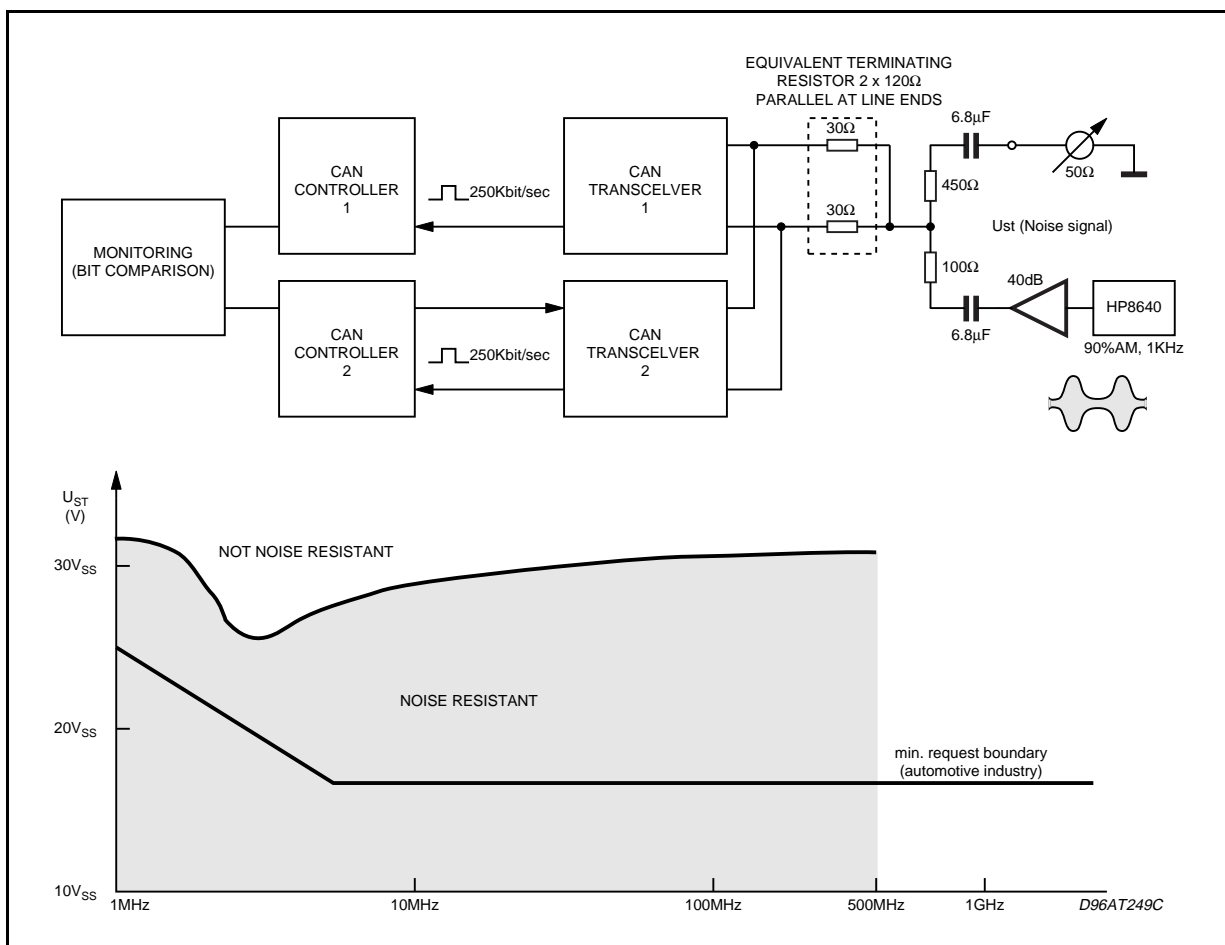
## TYPICAL APPLICATION



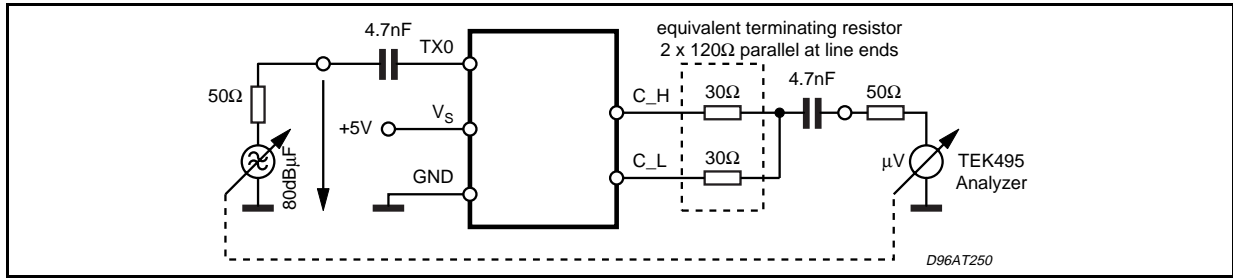
**TIMING DIAGRAM**



**EMC PERFORMANCE (RECEIVER)**

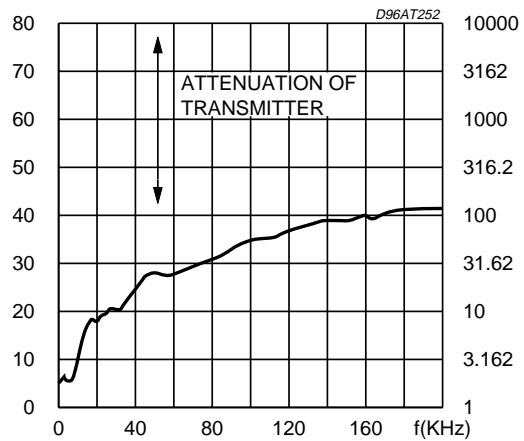
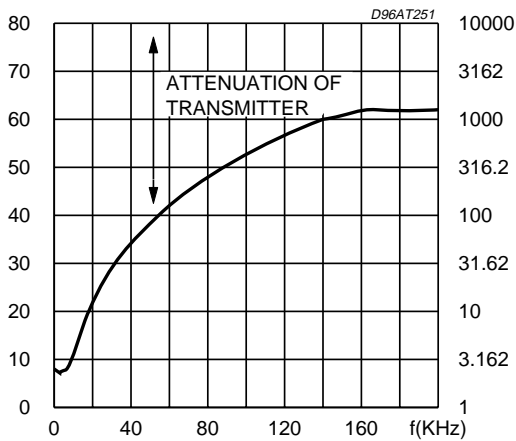


EMC PERFORMANCE (TRANSMITTER)

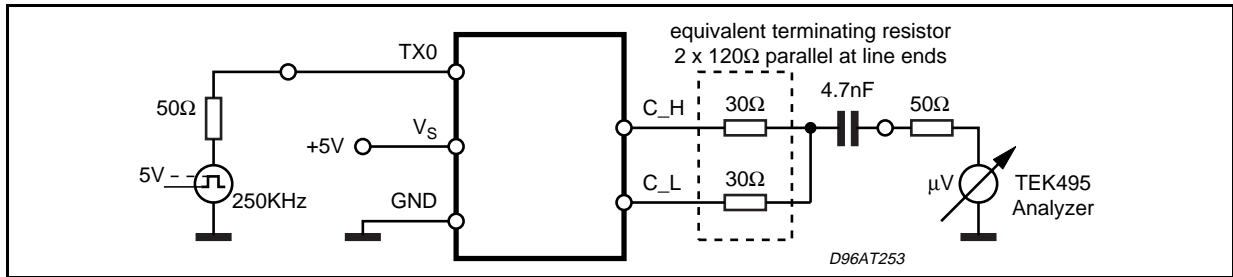


Transceiver Without Emc Reducing Measures

Transceiver With Emc Reducing Measures

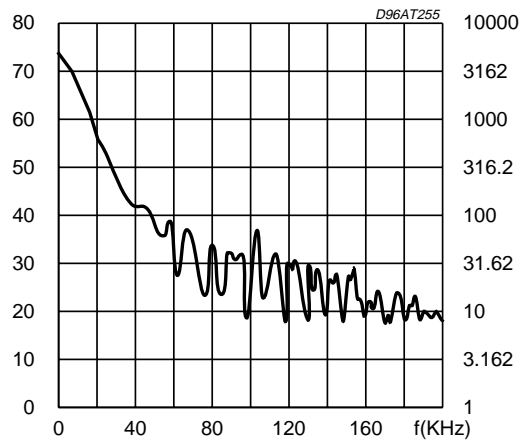
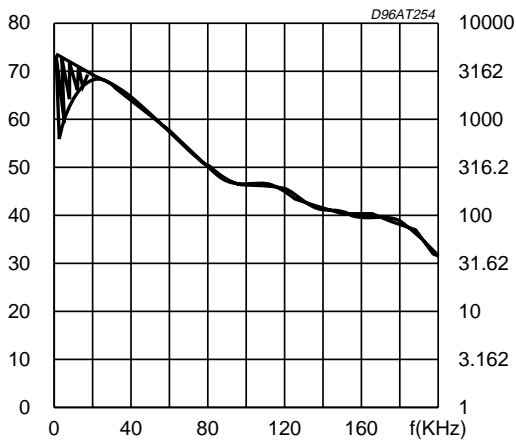


EMC PERFORMANCE (Transceiver Sending)



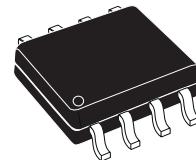
Transceiver Without Emc Reducing Measures

Transceiver With Emc Reducing Measures



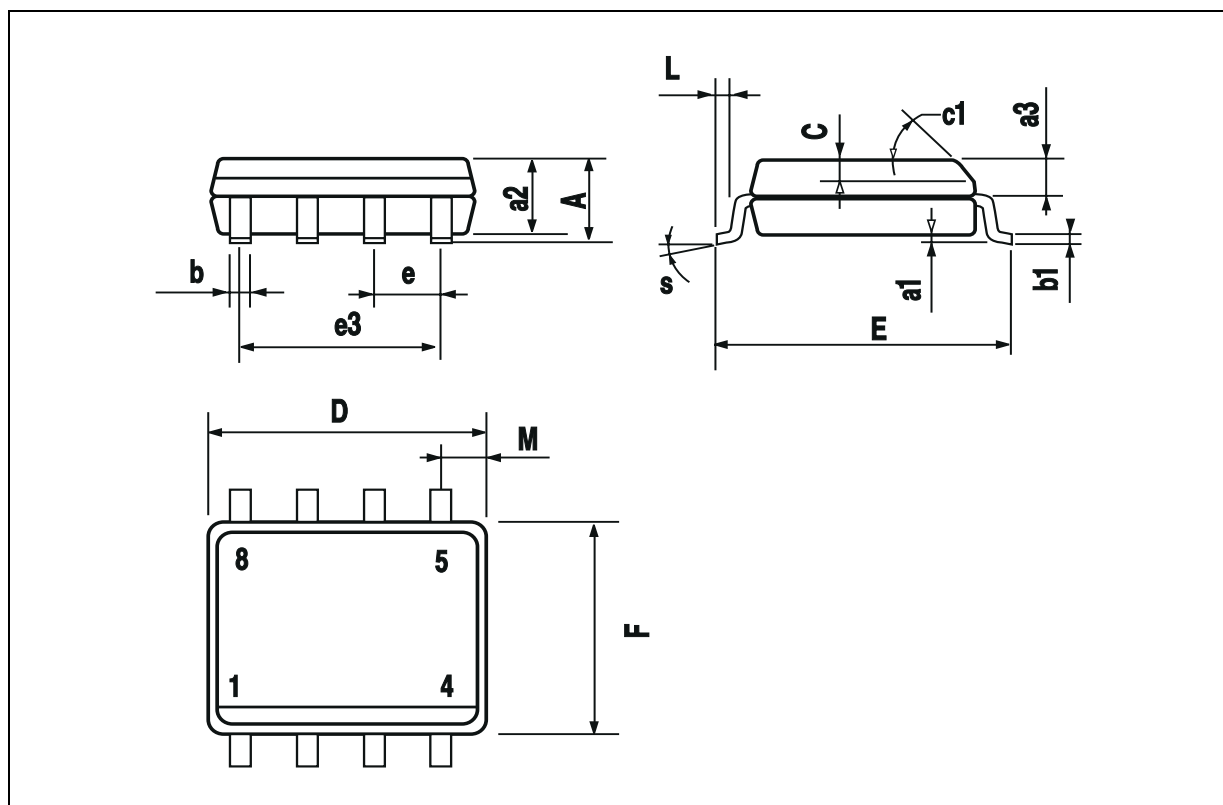
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.069
a1	0.1		0.25	0.004		0.010
a2			1.65			0.065
a3	0.65		0.85	0.026		0.033
b	0.35		0.48	0.014		0.019
b1	0.19		0.25	0.007		0.010
C	0.25		0.5	0.010		0.020
c1	45° (typ.)					
D (1)	4.8		5.0	0.189		0.197
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		3.81			0.150	
F (1)	3.8		4.0	0.15		0.157
L	0.4		1.27	0.016		0.050
M			0.6			0.024
S	8° (max.)					

## OUTLINE AND MECHANICAL DATA



**SO8**

(1) D and F do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15mm (.006inch).



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