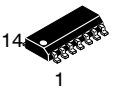
+3.3V Low Power Full-Duplex RS-485 Transceivers with 10Mbps Data Rate

The HT3490 and HT3491 devices are +3.3V low power full-duplex transceivers that meet the specifications of the RS-485 and RS-422 serial protocols. These devices are pin-to-pin compatible with the SP490 and SP491 devices as well as popular industry standards. The HT3490 and HT3491 feature BiCMOS process, allowing low power operation without sacrificing performance. The HT3490 and HT3491 meet the electrical specifications of the RS-485 and RS-422 serial protocols up to 10Mbps under load. The HT3491 is identical to the HT3490 with the addition of driver and reciveiver tri-state enable lines.

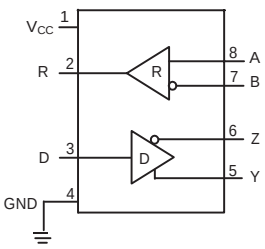
- Full-Duplex RS-485 and RS-422 Transceivers
- Operates from a single +3.3V Supply
- Interoperable with +5.0V logic
- Driver/Receiver Tri-state Enable Lines (HT3491)
- -7V to +12V Common-Mode Input Voltage Range
- +/-200mV Receiver Input Sensitivity
- Allows up to 32 transceivers on the serial bus
- Compatability with LTC490 and SN75179 (HT3490)
- Compatability with LTC491 and SN75180 (HT3491)



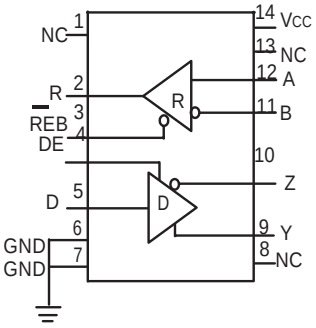
ORDERING INFORMATION

HT3490EARZ	SOP8
HT3490EBRZ	SOP8
HT3491EARZ	SOP14
HT3491EBRZ	SOP14

T_A = -40° to 85°C for all packages.



HT3490



HT3491

$T_{AMB} = T_{MIN}$ to T_{MAX} and V_{CC} = +3.3V +/-5% unless otherwise noted.

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
HT3490 DRIVER					
DC Characteristics					
Differential Output Voltage	GND		Vcc	Volts	Unloaded; R = ∞Ω ; Figure 1
Differential Output Voltage	2		Vcc	Volts	With Load; R = 50Ω (RS-422); Figure 1
Differential Output Voltage	1.5		Vcc	Volts	With Load; R = 27Ω (RS-485); Figure 1
Change in Magnitude of Driver Differential Output Voltage for Complimentary states			0.2	Volts	R = 27Ω or R = 50Ω; Figure 1
Driver Common Mode Output Voltage			3	Volts	R = 27Ω or R = 50Ω; Figure 1
Input High Voltage	2.0			Volts	
Input Low Voltage			0.8	Volts	
Input Current			+/-10	µA	
Driver Short Circuit Current					
V_{OUT} = HIGH			+/-250	mA	-7V ≤ V_O ≤ +12V; Figure 8
V_{OUT} = LOW			+/-250	mA	-7V ≤ V_O ≤ +12V; Figure 8
HT3490 DRIVER					
AC Characteristics					
Max. Transmission Rate	10			Mbps	
Driver Input to Output, t_{PLH}	20	40	60	ns	R = 27Ω, Figures 2 & 9
Driver Input to Output, t_{PHL}	20	40	60	ns	R = 27Ω, Figures 2 & 9
Differential Driver Skew		2		ns	$\lvert t_{PHL}(Y) - t_{PLH}(Y) \rvert$, $\lvert t_{PHL}(Z) - t_{PLH}(Z) \rvert$, Figures 2 and 9
Driver Rise or Fall Time		5	20	ns	From 10%-90%; Figures 3 and 10

T_{AMB} = T_{MIN} to T_{MAX} and V_{CC} = +3.3V +/-5% unless otherwise noted.

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
HT3490 RECEIVER					
DC Characteristics					
Differential Input Threshold	-0.2		+0.2	Volts	-7V ≤ V_{CM} ≤ +12V
Input Hysteresis		25		mV	V_{CM} = 0V
Output Voltage HIGH	Vcc-0.4			Volts	I_O = -1.5mA, V_{ID} = +200mV
Output Voltage LOW			0.4	Volts	I_O = +2.5mA, V_{ID} = -200mV
Input Resistance	12	15		kΩ	-7V ≤ V_{CM} ≤ +12V
Input Current (A, B); V_{IN} = 12V			+1.0	mA	V_{IN} = 12V
Input Current (A, B); V_{IN} = -7V			-0.8	mA	V_{IN} = -7V
Short Circuit Current			60	mA	0V ≤ V_O ≤ V_{CC}
HT3490 RECEIVER					
AC Characteristics					
Max. Transmission Rate	10			Mbps	
Receiver Input to Output, t_{PLH}	40	70	120	ns	Figures 6 and 12
Receiver Input to Output, t_{PLH}			85	ns	T_{AMB} = +25°C, Vcc = 3.3V Figures 6 and 12
Receiver Input to Output, t_{PHL}	40	70	120	ns	Figures 6 and 12
Receiver Input to Output, t_{PHL}			85	ns	T_{AMB} = +25°C, Vcc = 3.3V Figures 6 and 12
Differential Receiver Skew		4		ns	$\|t_{PHL}(A) - t_{PLH}(A)\|$, $\|t_{PHL}(B) - t_{PLH}(B)\|$, Figures 6 and 12
POWER REQUIREMENTS					
Supply Voltage	3.0	3.3	3.6	V	
Supply Current		1000	2000	µA	D = 0V or V_{CC}
ESD Protection for D, R, A, B, Y and Z pins		+/-2		kV	Human Body Model

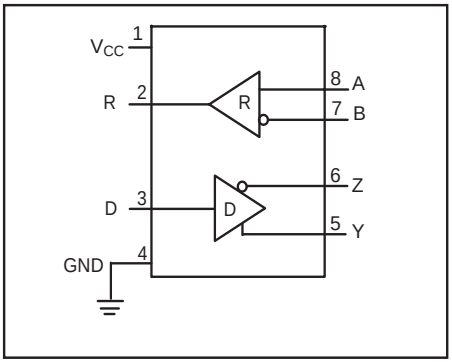
T_{AMB} = T_{MIN} to T_{MAX} and V_{CC} = +3.3V +/-5% unless otherwise noted.

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
HT3491 DRIVER					
DC Characteristics					
Differential Output Voltage	GND		Vcc	Volts	Unloaded; R = ∞Ω ; Figure 1
Differential Output Voltage	2		Vcc	Volts	With Load; R = 50Ω (RS-422); Figure 1
Differential Output Voltage	1.5		Vcc	Volts	With Load; R = 27Ω (RS-485); Figure 1
Change in Magnitude of Driver Differential Output Voltage for Complimentary states			0.2	Volts	R = 27Ω or R = 50Ω; Figure 1
Driver Common Mode Output Voltage			3	Volts	R = 27Ω or R = 50Ω; Figure 1
Input High Voltage	2.0			Volts	Applies to DE, D, REB
Input Low Voltage			0.8	Volts	Applies to DE, D, REB
Input Current			+/-10	µA	Applies to DE, D, REB
Driver Short Circuit Current					
V_{OUT} = HIGH			+/-250	mA	-7V ≤ V_O ≤ +12V; Figure 8
V_{OUT} = LOW			+/-250	mA	-7V ≤ V_O ≤ +12V; Figure 8
HT3491 DRIVER					
AC Characteristics					
Max. Transmission Rate	10			Mbps	
Driver Input to Output, t_{PLH}	20	40	60	ns	Figures 2 & 9
Driver Input to Output, t_{PHL}	20	40	60	ns	Figures 2 & 9
Differential Driver Skew		2		ns	$\lvert t_{PHL}(Y) - t_{PLH}(Y) \rvert$, $\lvert t_{PHL}(Z) - t_{PLH}(Z) \rvert$, Figures 2 and 9
Driver Rise or Fall Time		5	20	ns	From 10%-90%; Figures 3 and 10
Driver Enable to Output HIGH		52	120	ns	Figures 4 and 11
Driver Enable to Output LOW		60	120	ns	Figures 5 and 11
Driver Disable from LOW		40	120	ns	Figures 5 and 11
Driver Disable from HIGH		60	120	ns	Figures 4 and 11

T_{AMB} = T_{MIN} to T_{MAX} and V_{CC} = +3.3V +/-5% unless otherwise noted.

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
HT3491 RECEIVER					
DC Characteristics					
Differential Input Threshold	-0.2		+0.2	Volts	-7V ≤ V_{CM} ≤ +12V
Input Hysteresis		25		mV	V_{CM} = 0V
Output Voltage HIGH	Vcc-0.4			Volts	I_O = -1.5mA, V_{ID} = +200mV
Output Voltage LOW			0.4	Volts	I_O = +2.5mA, V_{ID} = -200mV
Three-State (High Impedance) Output Current			+/-1	µA	0V ≤ V_O ≤ Vcc; REB = Vcc
Input Resistance	12	15		kΩ	-7V ≤ V_{CM} ≤ +12V
Input Current (A, B); V_{IN} = 12V			+1.0	mA	DE = 0V, V_{CC} = 0V or 3.6V, V_{IN} = 12V
Input Current (A, B); V_{IN} = -7V			-0.8	mA	DE = 0V, V_{CC} = 0V or 3.6V, V_{IN} = -7V
Short Circuit Current			60	mA	0V ≤ V_O ≤ V_{CC}
HT3491 RECEIVER					
AC Characteristics					
Max. Transmission Rate	10			Mbps	REB = 0V, DE = 0V
Receiver Input to Output, t_{PLH}	40	70	120	ns	Figures 6 and 12
Receiver Input to Output, t_{PLH}			85	ns	T_{AMB} = +25°C, Vcc = 3.3V, Figures 6 and 12
Receiver Input to Output, t_{PHL}	40	70	120	ns	Figures 6 and 12
Receiver Input to Output, t_{PHL}			85	ns	T_{AMB} = +25°C, Vcc = 3.3V, Figures 6 and 12
Differential Receiver Skew		4		ns	$\lvert t_{PHL}(A) - t_{PLH}(A) \rvert$, $\lvert t_{PHL}(B) - t_{PLH}(B) \rvert$, Figures 6 and 12
Receiver Enable to Output LOW		65	150	ns	Figures 7 and 13; S_1 Closed, S_2 open
Receiver Enable to Output HIGH		65	150	ns	Figures 7 and 13; S_2 Closed, S_1 open
Receiver Disable from LOW		65	200	ns	Figures 7 and 13; S_1 Closed, S_2 open
Receiver Disable from HIGH		65	200	ns	Figures 7 and 13; S_2 Closed, S_1 open
POWER REQUIREMENTS					
Supply Voltage	+3.0		+3.6	V	
Supply Current		1000	2000	µA	REB, D = 0V or V_{CC}; DE = V_{CC}
Supply Current		800	1500	µA	DE = 0V
ESD Protection for R, D, DE, REB, A, B, Y and Z pins		+/-2		kV	Human Body Model

HT3490



Pin Function HT3490

Pin 1 - Vcc - Positive supply +3.00V < Vcc < +3.60V

Pin 2 - R - Receiver output

Pin 3 - D - Driver input

Pin 4 - GND - Ground connection

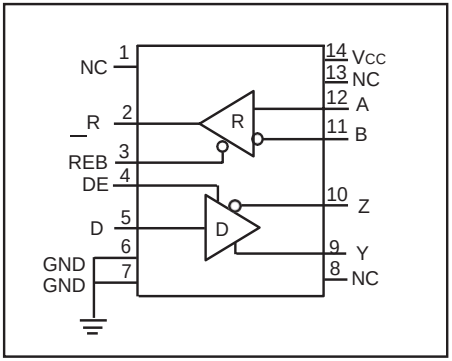
Pin 5 - Y - Non-inverting driver output

Pin 6 - Z - Inverting driver output

Pin 7 - B - Inverting receiver Input

Pin 8 - A - Non-inverting receiver input

HT3491



Pin Function HT3491

Pin 1 - NC - No connect

Pin 2 - R - Receiver output

Pin 3 - $\overline{\text{REB}}$ - Receiver cutput enable active LOW

Pin 4 - DE - Driver output enable active HIGH

Pin 5 - D - Driver input

Pin 6 - GND - Ground connection

Pin 7 - GND - Ground connection

Pin 8 - NC - No connect

Pin 9 - Y - Non-inverting driver output

Pin 10 - Z - Inverting driver output

Pin 11 - B - Inverting receiver Input

Pin 12 - A - Non-Inverting receiver input

Pin 13 - NC - No connect

Pin 14 - Vcc - Positive supply +3.00V < Vcc < +3.60V

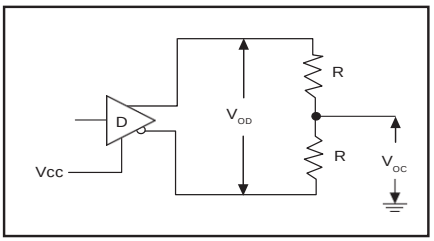


Figure 1. Driver DC Test Load Circuit

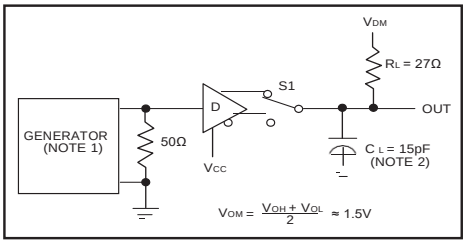


Figure 2. Driver Propagation Delay Test Circuit

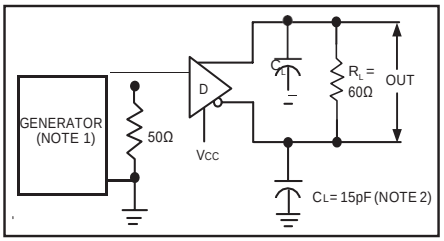


Figure 3. Driver Differential Output Delay and Transition Time Circuit.

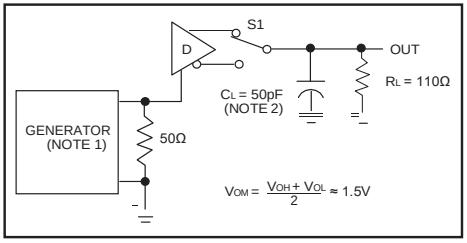


Figure 4. Driver Enable and Disable Timing Circuit, Output High

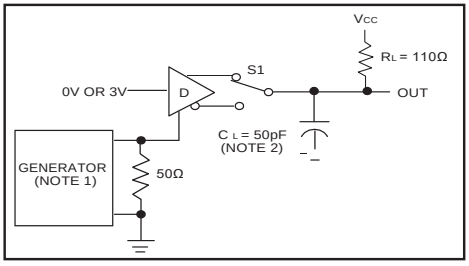


Figure 5. Driver Enable and Disable Timing Circuit, Output Low

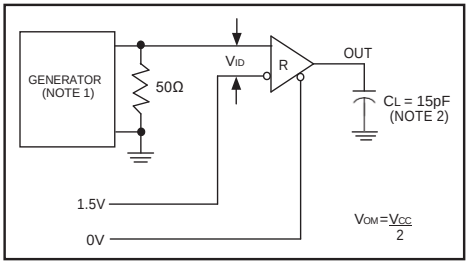


Figure 6. Receiver Propagation Delay Test Circuit

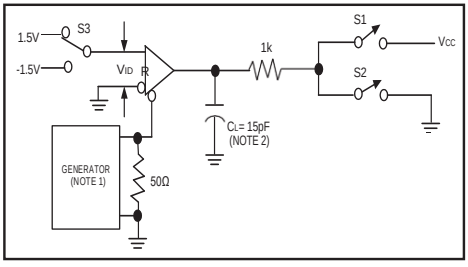


Figure 7. Receiver Enable and Disable Timing Circuit

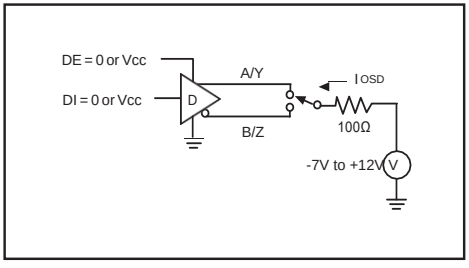


Figure 8. Driver Short Circuit Current Limit Test

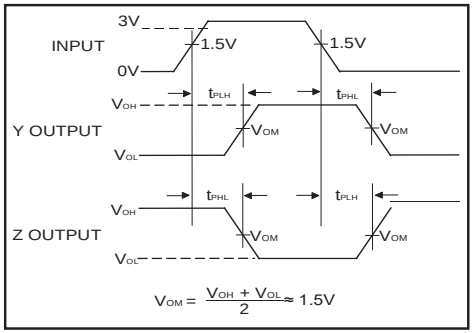


Figure 9. Driver Propagation Delay Waveforms

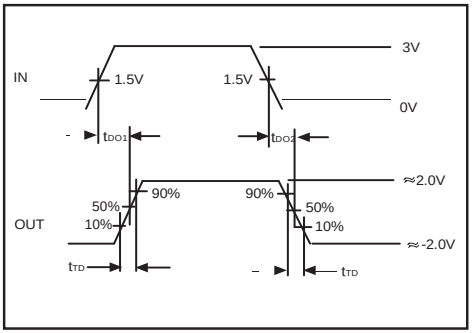


Figure 10. Driver Differential Output Delay and Transition Time Waveforms

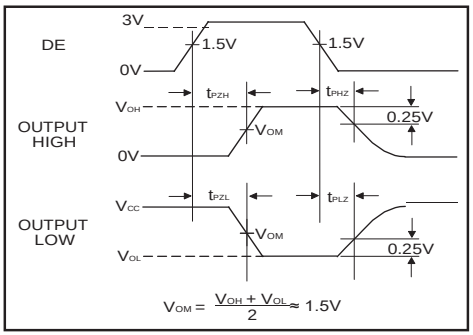


Figure 11. Driver Enable and Disable Timing Waveforms

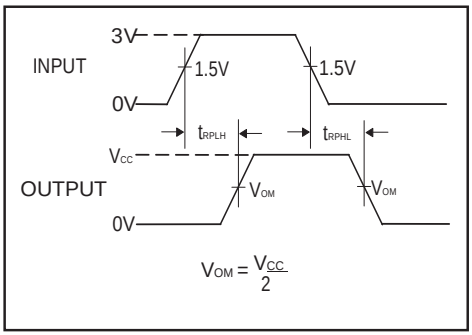


Figure 12. Receiver Propagation Delay Waveforms

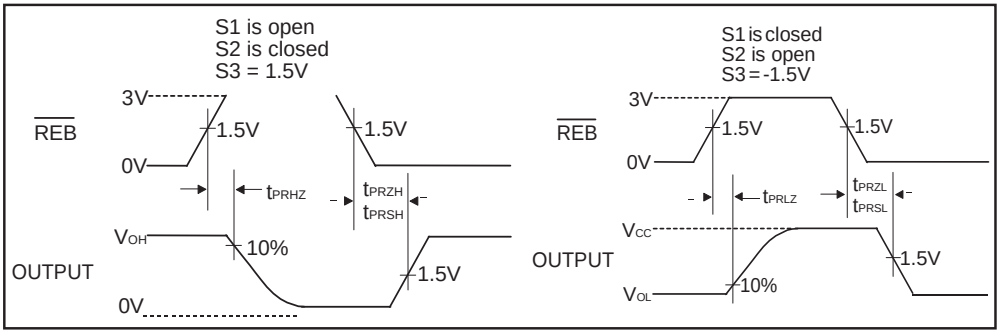


Figure 13. Receiver Enable and Disable Waveforms

NOTE 1: The input pulse is supplied by a generator with the following characteristics:
PRR = 250kHz, 50% duty cycle, t_R < 6.0ns, Z_O = 50Ω.
NOTE 2: C_L includes probe and stray capacitance.

The HT3490 and HT3491 are two members in the family of +3.3V low power full-du-plex transceivers that meet the electrical specifications of the RS-485 and RS-422 serial protocols. These devices are pin-to-pin compatible with the SP490 and SP491 devices as well as popular industry standards. The HT3490 and HT3491 feature BiCMOS process allowing low power operation without sacrificing performance.

The RS-485 standard is ideal for multi-drop applicationsandforlong-distanceinterfaces. RS-485 allows up to 32 drivers and 32 receivers to be connected to a data bus, making it an ideal choice for multi-drop applications. Since the cabling can be as long as 4,000 feet, RS-485 transceivers are equipped with a wide (-7V to +12V) common mode range to accommodate ground potential differences. Because RS-485 is a differential interface, data is virtually immune to noise in the transmission line.

Drivers

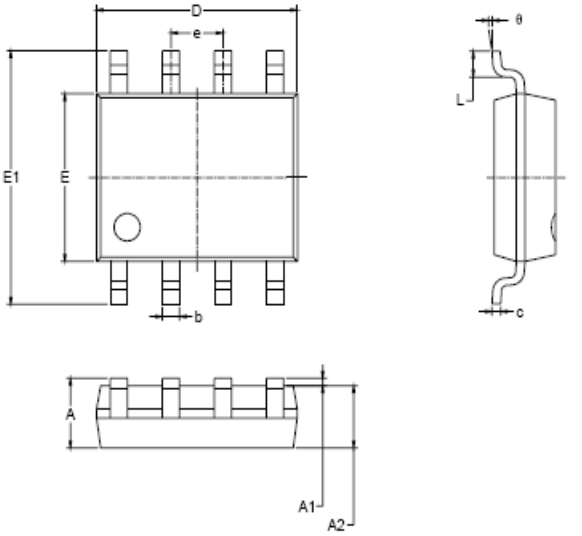
The drivers for both the HT3490 and HT3491 have differential outputs. The typical voltage outputswingwithnoloadwillbe 0 voltsto Vcc. With worst case loading of 54Ω across the differential outputs, the drivers can maintain greater than 1.5V voltage levels. The driver of the HT3491 has a driver enable control line which is active HIGH. A logic HIGH on DE (pin 4) of the HT3491 will enable the differential driver outputs. A logic LOW on the DE(pin 4) will tri-state the driver outputs. The HT3490 does not have a driver enable.

Receivers

The receivers of the HT3490 and HT3491 have differential inputs with an input sensitivity of ± 200mV. Input impedance of the receivers is typically 15kΩ (12kΩ minimum). A wide common mode range of -7V to +12V allows for large ground potential differences between systems. The receivers for both the HT3490 and HT3491 are equipped with a fail-safe feature that guarantees the receiver output will be in a HIGH state when the input is left unconnected.

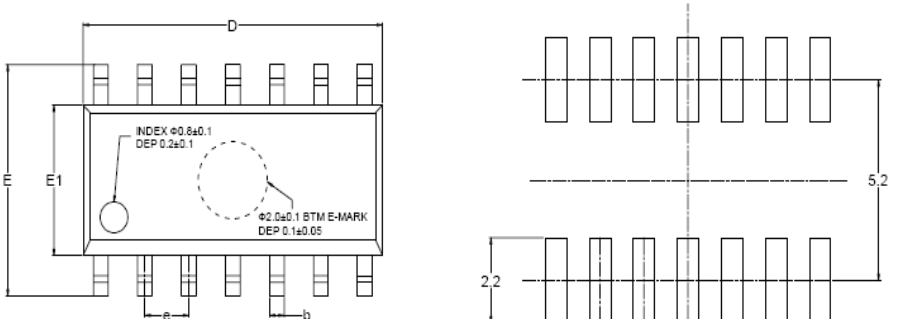
The receiver of the HT3491 has a enable control line which is active LOW. A logic LOW on REB (pin 3) of the HT3491 will enable the differential receiver. A logic HIGH on REB (pin 3) of the HT3491 will tri-state the receiver.

SOP-8



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050 BSC	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

SOP-14



Symbol	Dimensions In Millimeters			Dimensions In Inches		
	MIN	MOD	MAX	MIN	MOD	MAX
A	1.35		1.75	0.053		0.069
A1	0.10		0.25	0.004		0.010
A2	1.25		1.65	0.049		0.065
A3	0.55		0.75	0.022		0.030
b	0.36		0.49	0.014		0.019
D	8.53		8.73	0.336		0.344
E	5.80		6.20	0.228		0.244
E1	3.80		4.00	0.150		0.157
e	1.27 BSC			0.050 BSC		
L	0.45		0.80	0.018		0.032
L1	1.04 REF			0.040 REF		
L2	0.25 BSC			0.01 BSC		
R	0.07			0.003		
R1	0.07			0.003		
h	0.30		0.50	0.012		0.020
θ	0°		8°	0°		8°

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