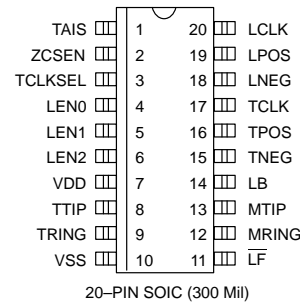
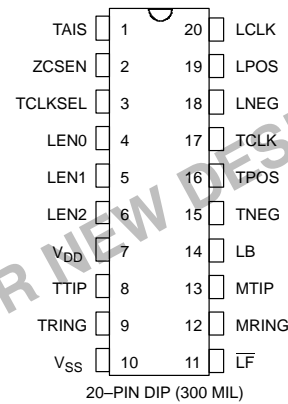


## FEATURES

- Line interface for T1 (1.544 MHz) and CEPT (2.048 MHz) primary rate networks
- On-chip transmit LBO (line build out) and line drivers eliminate external components
- Programmable output pulse shape supports short- and long-loop applications
- Supports bipolar and unipolar input data formats
- Transparent B8ZS and HDB3 zero code suppression modes
- Compatible with DS2180A T1 and DS2181A CEPT Transceivers DS2141A T1 and DS2143 E1 Controllers
- Companion to the DS2187 Receive Line Interface and DS2188 T1/CEPT Jitter Attenuator
- Single 5V supply; low-power CMOS technology

## PIN ASSIGNMENT



## DESCRIPTION

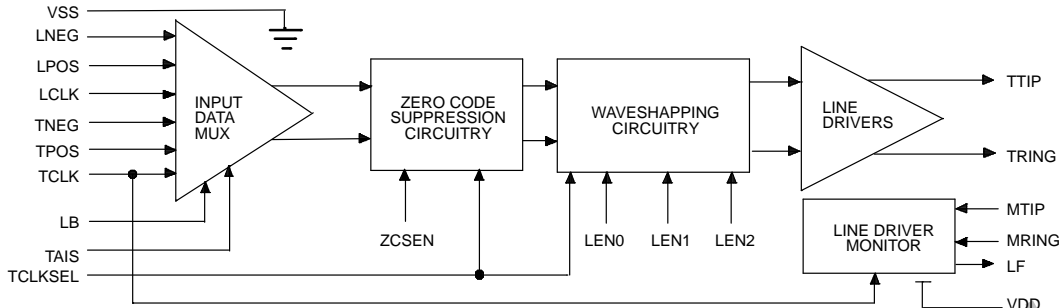
The DS2186 T1/CEPT Transmit Line Interface Chip interfaces user equipment to North American (T1–1.544 MHz) and European (CEPT–2.048 MHz) primary rate communications networks. The device is compatible with all types of twisted pair and coax cable found in such networks.

Key on-chip components include: programmable wave shaping circuitry, line drivers, remote loopback, and zero suppression logic. A line-coupling transformer is the only external component required.

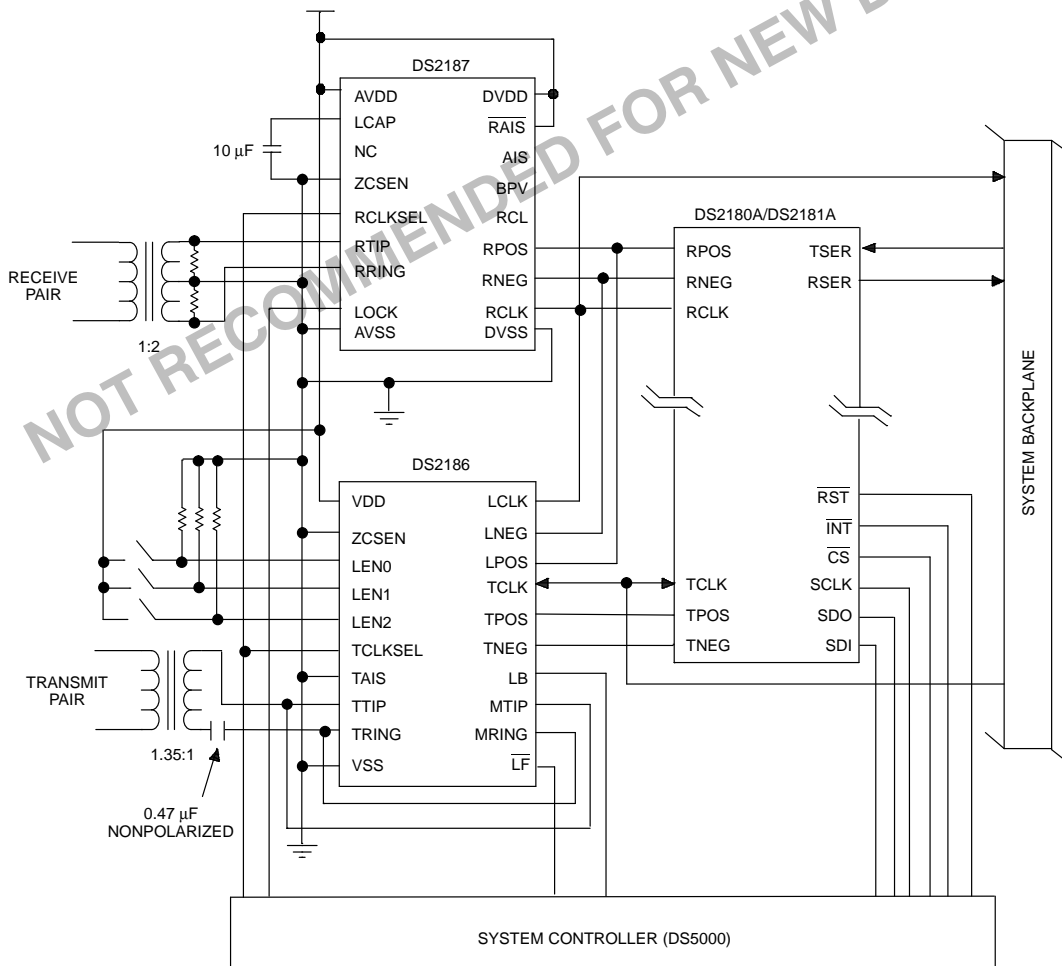
Short loop (DSX–1, 0 to 655 feet) and long loop (CSU; 0 dB, –7.5 dB and –15 dB) pulse templates found in T1 applications are supported. Appropriate CCITT recommendations are met in the CEPT mode.

Application areas include DACS, CSU, CPE, channel banks, and PABX-to-computer interfaces such as DMI and CPI. The DS2186 supports ISDN–PRI (Primary Rate Interface) specifications.

**DS2186 BLOCK DIAGRAM** Figure 1



**SYSTEM LEVEL INTERCONNECT** Figure 2



PIN DESCRIPTION Table 1

PIN	SYMBOL	TYPE	DESCRIPTION
1	TAIS	I	<b>Transmit Alarm Indication Signal.</b> When high, output data is forced to all ones at the TCLK (LB=0) or LCLK (LB=1) rate.
2	ZCSEN	I	<b>Zero Code Suppression Enable.</b> When high, B8ZS or HDB3 encoder enabled.
3	TCLKSEL	I	<b>Transmit Clock Select.</b> Tie to V <sub>SS</sub> for 1.544 MHz (T1) applications, to V <sub>DD</sub> for 2.048 MHz (CEPT) applications.
4 5 6	LEN0 LEN1 LEN2	I	<b>Length Select 0, 1 and 2.</b> State determines output T1 waveform shape and characteristics.
7	V <sub>DD</sub>	–	<b>Positive Supply.</b> 5.0 volts.
8 9	TTIP, TRING	O	<b>Transmit Tip and Ring.</b> Line driver outputs; connect to transmit line transformer.
10	V <sub>SS</sub>	–	<b>Signal Ground.</b> 0.0 volts.
11	$\overline{\text{LF}}$	O	<b>Line Fault.</b> Open collector active low output. Held low during an output driver fault and/or failure; tri-stated otherwise.
12 13	MRING, MTIP	I	<b>Monitor Tip and Ring.</b> Normally connected to TTIP and TRING. Sense inputs for line fault detection circuitry.
14	LB	I	<b>Loopback.</b> When high, input data is sampled at LPOS and LNEG on falling edges of LCLK; when low, input data is sampled at TPOS and TNEG on falling TCLK.
15 16	TNEG, TPOS	I	<b>Transmit Data.</b> Sampled on falling edges of TCLK when LB=0.
17	TCLK	I	<b>Transmit Clock.</b> 1.544 MHz or 2.048 MHz primary data clock.
18 19	LNEG, LPOS	I	<b>Loopback Data.</b> Sampled on falling edges of LCLK when LB=1.
20	LCLK	I	<b>Loopback Clock.</b> 1.544 MHz or 2.048 MHz loopback data clock.

**INPUT DATA MODES**

Input data is sampled on the falling edge of TCLK or LCLK and can be bipolar (dual rail) or unipolar (single rail, NRZ). TPOS, TNEG and TCLK are the data and clock inputs when LB=0, LPOS, LNEG and LCLK when LB=1. TPOS and TNEG (LPOS and LNEG) must be tied together in NRZ applications.

**ZERO CODE SUPPRESSION MODES**

Transmitted data is treated transparently (no zero code suppression) when ZCSEN=0. HDB3 code words replace any all-zero nibble when ZCSEN=1 and TCLKSEL=1. B8ZS code words replace any incoming all-zero byte when ZCSEN=1 and TCLKSEL=0.

**ALARM INDICATION SIGNAL**

When TAIS is set, an all ones code is continuously transmitted at the TCLK rate (LB=0) or the LCLK rate (LB=1).

**WAVE SHAPING**

The device supports T1 short loop (DSX-1; 0 to 655 feet), T1 long loop (CSU; 0 dB, -7.5 dB and -15 dB) and CEPT (CCITT G.703) pulse template requirements. On-chip laser trimmed delay lines clocked by either TCLK or LCLK control a precision digital-to-analog converter to build the desired waveforms, which are buffered differentially by the line drivers.

The shape of the “pre-emphasized” T1 waveform is controlled by inputs LENO, LEN1, and LEN2 (TCLKSEL=0). These control inputs allow the user to select the appropriate output pulse shape to meet DSX-1 or CSU templates over a wide variety of cable types and lengths. Those cable types include ABAM, PIC, and PULP.

The CEPT mode is enabled when TCLKSEL=1. Only one output pulse shape is available in the CEPT mode; inputs LENO, LEN1 and LEN2 can be any state except all zeros.

The line coupling transformer also contributes to the pulse shape seen at the cross-connect point. Transformers for both T1 and CEPT applications must be 1:1.35.

The wave shaping circuitry does not contribute significantly to output jitter (less than 0.01 U<sub>pp</sub> broadband). Output jitter will be dominated by the jitter on TCLK or LCLK. TCLK and LCLK need only be accurate in frequency, not duty cycle.

## LINE DRIVERS

The on-chip differential line drivers interface directly to the output transformer. To optimize device performance, length of the TTIP and TRING traces should be minimized and isolated from neighboring interconnect.

## FAULT PROTECTION

The line drivers are fault-protected and will withstand a shorted transformer secondary (or primary) without damage. Inputs MTIP and MRING are normally tied to TTIP and TRING to provide fault monitoring capability. Output LF will transition low if 192 TCLK cycles occur without a one occurring at MTIP or MRING. LF will tri-state on the next one occurrence or two TCLK periods later, whichever is greater.

The threshold of MTIP and MRING varies with the line type selected at LENO, LEN1 and LEN2. This insures detection of the lowest level zero to one transition (–15 dB buildout) as it occurs on TTIP and TRING.

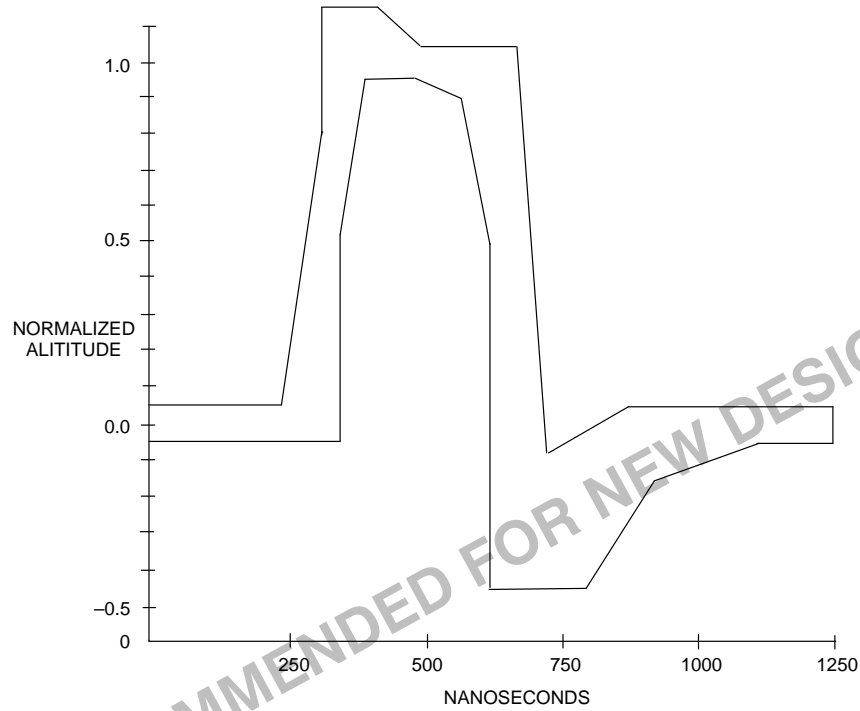
**T1 LINE LENGTH SELECTION** Table 2

LEN2	LEN1	LENO	OPTION SELECTED	APPLICATION
0	0	0	Test mode	Do not use
0	0	1	–7.5 dB buildout	T1 CSU
0	1	0	–15 dB buildout	T1 CSU
0	1	1	0 dB buildout, 0 – 133 feet	T1 CSU, DSX-1 Cross connect
1	0	0	133 – 266 feet	DSX-1 Cross connect
1	0	1	266 – 399 feet	DSX-1 Cross connect
1	1	0	399 – 533 feet	DSX-1 Cross connect
1	1	1	533 – 655 feet	DSX-1 Cross connect

## NOTE:

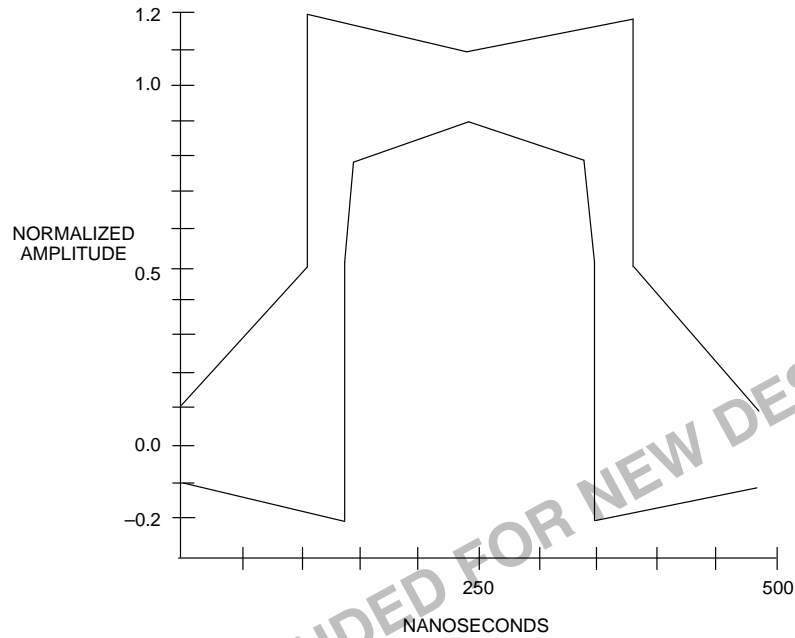
1. The LENO, LEN1 and LEN2 inputs control T1 output waveshapes when TCLKSEL=0. The G.703 (CEPT) template is selected when TCLKSEL=1 and LENO, LEN1, and LEN2 are at any state except all zeros.

DSX-1 ISOLATED PULSE TEMPLATE Figure 3

**NOTES:**

1. Template shown is measured at the cross-connect point.
2. Amplitude shown is normalized; the actual midpoint voltage measured may be between 2.4 and 3.6 volts.
3. The corner points shown below are joined by straight lines to form the template.

MAXIMUM CURVE	MINIMUM CURVE
(0, 0.05)	(0, -0.05)
(250, 0.05)	(350, -0.05)
(325, 0.80)	(350, 0.5)
(325, 1.15)	(400, 0.95)
(425, 1.15)	(500, 0.95)
(500, 1.05)	(600, 0.9)
(675, 1.05)	(650, 0.5)
(725, -0.07)	(650, -0.45)
(875, 0.05)	(800, -0.45)
(1250, 0.05)	(925, -0.2)
	(1100, -0.05)
	(1250, -0.05)

**OUTPUT PULSE TEMPLATE AT 2.048 MHz Figure 4****NOTES:**

1. Unlike the DSX-1 template, which is specified at the cross-connect point, the CEPT (2.048 MHz) template is specified at the transmit line output.
2. The template shown above is normalized. The actual pulse height is cable dependent and is specified in Table 3.
3. The corner points shown below are joined by straight lines to form the template.

MAXIMUM CURVE	MINIMUM CURVE
(0, 0.1)	(0, -0.1)
(109.5, 0.5)	(134.5, -0.2)
(109.5, 1.2)	(134.5, 0.5)
(244, 1.1)	(147, 0.8)
(378.5, 1.2)	(244, 0.9)
(378.5, 0.5)	(341, 0.8)
(488, 0.1)	(353.5, 0.5)
	(353.5, -0.2)
	(488, -0.1)

**CHARACTERISTICS OF T1 AND CEPT INTERFACES** Table 3

CHARACTERISTIC	T1	CEPT
LINE RATE	1.544 MHz	2.048 MHz
LINE CODE	AMI <sup>1</sup> or B8ZS	AMI or HDB3
TEST LOAD IMPEDANCE	100 ohm Resistive	120 ohm Resistive (wire pair) 75 ohm Resistive (coax)
NOMINAL PEAK VOLTAGE	2.4V to 3.6 V <sup>2</sup>	3.0V (wire pair) 2.37V (coax)
PULSE SHAPE	–Scaled to fit templates shown–	
NOMINAL PULSE WIDTH	324 ns	244 ns
PULSE IMBALANCE	< 0.5 dB difference between total power of positive and negative pulses.	1) Negative peak = positive peak $\pm 5\%$ 2) Positive width at nominal half amplitude = negative width at nominal half amplitude $\pm 5\%$ .

**NOTES:**

1. With a ones density of at least 12.5% and no more than 15 consecutive zeros.
2. Measured at the cross-connect (DSX-1) point; CSU applications may be 7.5 to 15 dB below these levels.

**ABSOLUTE MAXIMUM RATINGS\***

Voltage on any Pin Relative to Ground	-1.0V to +7V
Operating Temperature	0°C to 70°C
Storage Temperature	-55°C to +125°C
Soldering Temperature	260°C for 10°C

\* This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operation sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

**RECOMMENDED DC OPERATING CONDITIONS**

(0°C to 70°C)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	NOTES
Logic 1	$V_{IH}$	2.0		$V_{DD}+0.3$	V	1
Logic 0	$V_{IL}$	-0.3		+0.8	V	1
Supply	$V_{DD}$	4.75		5.25	V	

**DC ELECTRICAL CHARACTERISTICS**(0°C to 70°C;  $V_{DD} = 5V \pm 5\%$ )

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	NOTES
Supply Current	$I_{DD}$		50		mA	2,3
Supply Current	$I_{DD}$		35		mA	2,4
Supply Current	$I_{DD}$		20		mA	2,5
Input Leakage	$I_{IL}$	-1.0		+1.0	$\mu A$	6
Output Current @ 0.4V	$I_{OL}$	+4.0			mA	7

**CAPACITANCE** $(t_A = 25^\circ C)$ 

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	NOTES
Input Capacitance	$C_{IN}$			5	pF	
Output Capacitance	$C_{OUT}$			7	pF	

**NOTES:**

- All inputs except MTIP and MRING.
- $V_{DD}=5.25V$ ;  $TCLK = LCLK = 1.544 MHz$ ; output line transformer and load as shown in Figure 2.
- $TAIS = 1$
- 50% ones density.
- All zeros at data inputs.
- $0.0V < V_{IN} < 5.0V$ .
- Output LF (open collector).

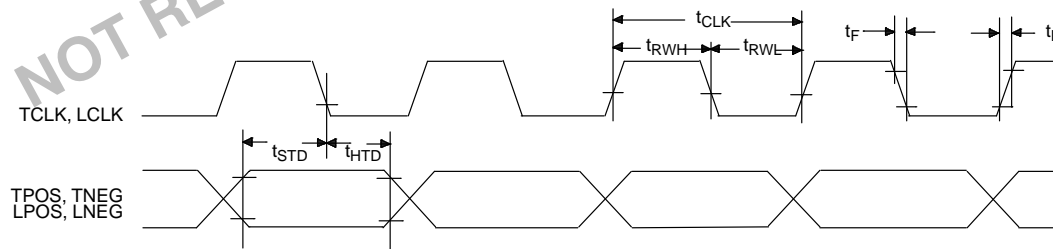


**AC ELECTRICAL CHARACTERISTICS**(0°C to 70°C;  $V_{DD} = 5V \pm 5\%$ )

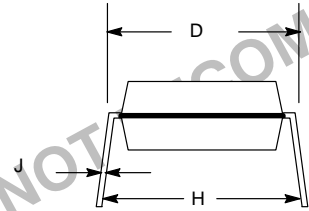
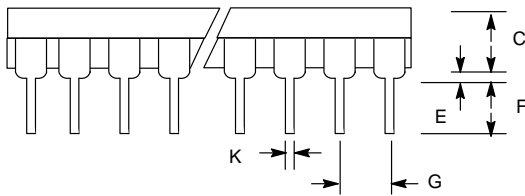
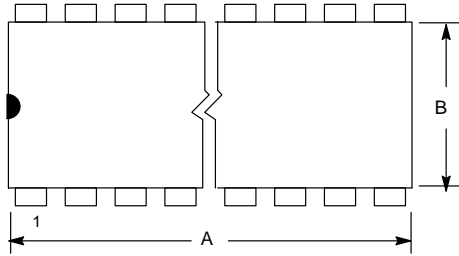
PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	NOTES
TCLK, LCLK Period	$t_{CLK}$		648		ns	1
TCLK, LCLK Period	$t_{CLK}$		488		ns	2
TCLK, LCLK Pulse Width	$t_{RWH}$ , $t_{RWL}$	70	324		ns	1
TCLK, LCLK Pulse Width	$t_{RWH}$ , $t_{RWL}$	70	244		ns	2
TCLK, LCLK Rise and Fall Times	$t_R$ , $t_F$			20	ns	
TPOS, TNEG Setup to TCLK Falling	$t_{STD}$	50			ns	
LPOS, LNEG Setup to LCLK Falling	$t_{STD}$	50			ns	
TPOS, TNEG Hold from TCLK Falling	$t_{HTD}$	50			ns	
LPOS, LNEG Hold from LCLK Falling	$t_{HTD}$	50			ns	

**NOTES:**

1. T1 applications.
2. CEPT applications.

**AC TIMING DIAGRAM** Figure 5

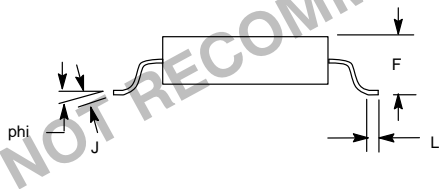
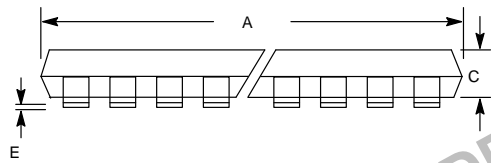
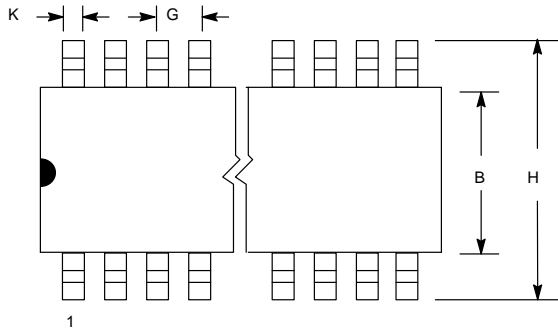
**DS2186 TRANSMIT LINE INTERFACE 20-PIN DIP**



PKG	20-PIN	
	DIM	MIN
A IN.	1.020	1.040
MM	25.91	26.42
B IN.	0.240	0.260
MM	6.10	6.60
C IN.	0.120	0.140
MM	3.05	3.56
D IN.	0.300	0.325
MM	7.62	8.26
E IN.	0.015	0.040
MM	0.38	1.02
F IN.	0.120	0.140
MM	3.04	3.56
G IN.	0.090	0.110
MM	2.23	2.79
H IN.	0.320	0.370
MM	8.13	9.40
J IN.	0.008	0.012
MM	0.20	0.30
K IN.	0.015	0.021
MM	0.38	0.53

NOT RECOMMENDED FOR NEW DESIGN

**DS2186S TRANSMIT LINE INTERFACE 20-PIN SOIC**



PKG	20-PIN	
DIM	MIN	MAX
A IN. MM	0.500 12.70	0.511 12.99
B IN. MM	0.290 7.37	0.300 7.65
C IN. MM	0.089 2.26	0.095 2.41
E IN. MM	0.004 0.102	0.012 0.30
F IN. MM	0.094 2.38	0.105 2.68
G IN. MM	0.050 BSC 1.27 BSC	
H IN. MM	0.398 10.11	0.416 10.57
J IN. MM	0.009 0.229	0.013 0.33
K IN. MM	0.013 0.33	0.019 0.48
L IN. MM	0.016 0.406	0.040 1.20
phi	0°	8°

NOT RECOMMENDED FOR NEW DESIGN