# Am26LS34

## Quad Differential Line Receiver

Advanced Micro Devices

## DISTINCTIVE CHARACTERISTICS

- **Meets all requirements of EIA Standards RS-442, RS-423, CCITT V.10 and V.11, and the new party line standard in development under EIA Project Number 1360.**
- **±200 mV sensitivity over input voltage range.**
- **±150 mV sensitivity for $V_{CM}$ = 0.**
- **–7 V to + 12 V common mode input voltage range.**
- **12 kΩ minimum input impedance.**
- **Maximum guarantees for $t_{PD}$ skew.**
- **All AC and DC parameters guaranteed over military and commercial temperature ranges.**
- **Guaranteed input voltages hysteresis limits.**
  - 120mV minimum
  - 300mV maximum
- **No internal failsafe.**
- **Pin compatible with Am26LS32/32B/33**

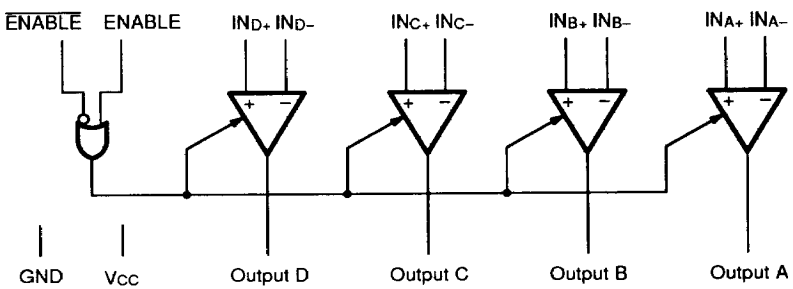
## GENERAL DESCRIPTION

The Am26LS34 is a high performance, quad, differential line receiver. It has higher impedance and higher input voltage hysteresis than the similar Am26LS32B. The Am26LS34 also does not have internal fail-safe to allow greater user flexibility.

Input threshold sensitivity is specified for three different $V_{CM}$ ranges. The improved sensitivity, guaranteed hysteresis and skew limits allow a more critical analysis of system performance in high noise environments and better system performance capability.

All performance parameters are guaranteed over ±10% supplies and over the operating temperature range. In addition; $I_{OL}$ is specified to 24 mA for easy system bus interfacing.

## BLOCK DIAGRAM




01025-001A

## RELATED PRODUCTS

| Part Number | Description |
|---|---|
| 26LS29 | Quad Three-State Single Ended RS-423 Line Driver |
| 26LS30 | Dual Differential RS-422 Party Line/Quad Single Ended RS-423 Line Driver |
| 26LS32 | Quad Differential Line Receiver |
| 26LS33 | Quad Differential Line Receiver |

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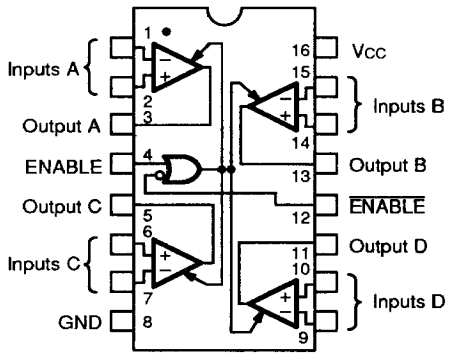
## CONNECTION DIAGRAMS
### Top View

**DIP**

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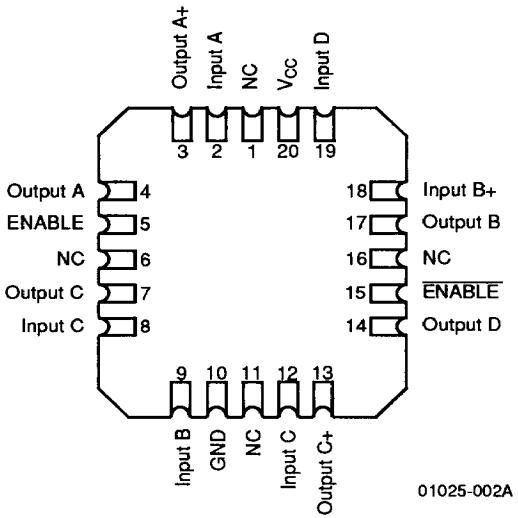
**LCC**

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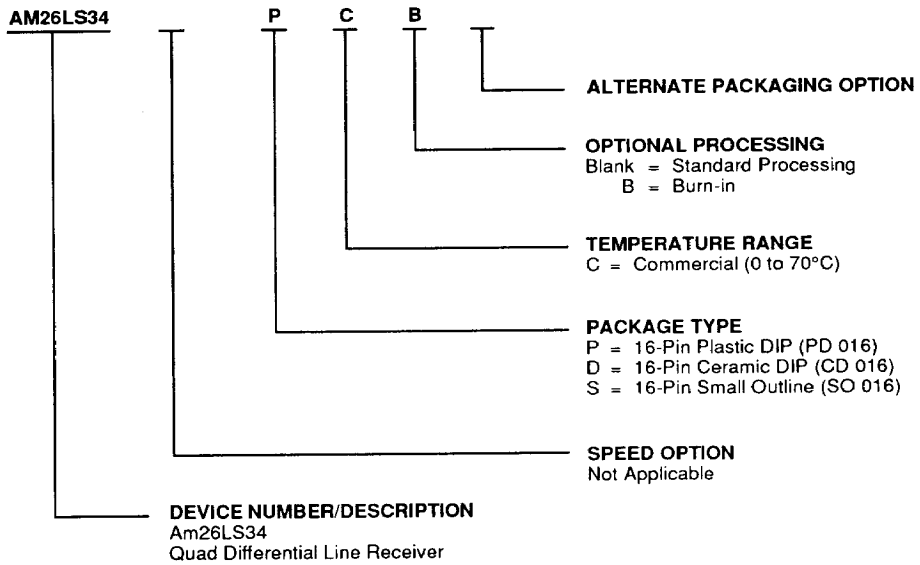
**Note:**
Pin 1 is marked for orientation

## ORDERING INFORMATION
## Standard Products

AMD products are available in several packages and operating ranges. The ordering number (Valid Combination) is formed by a combination of:



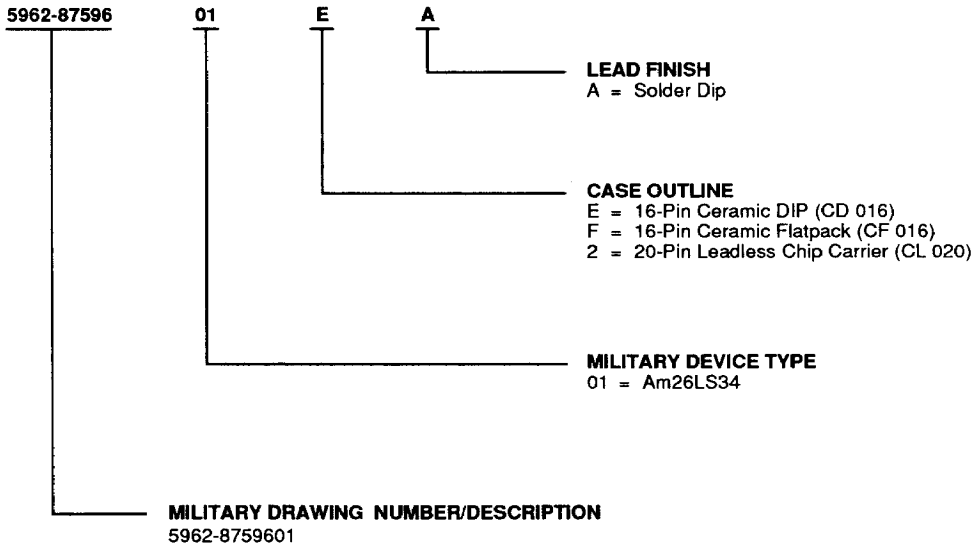

| | |
|---|---|
| AM26LS34 | PC, PCB, DC, DCB, SC |

**Valid Combinations**

The Valid Combinations table lists configurations planned to be supported in volume for this device. Consult the local AMD sales office to confirm availability of specific valid combinations, to check on newly released combinations, and to obtain additional data on AMD's standard military grade products.

## ORDERING INFORMATION
## Standard Military Drawing Products

AMD products for Aerospace and Defense applications are available in several packages and operating ranges. Standard Military Drawing (SMD)/DESC products are fully compliant with MIL-STD-883C requirements. The ordering number for SMD/DESC (Valid Combination) is formed by a combination of:




| | |
|---|---|
| 5962-8759601 | EA, FA, 2A |

**Valid Combinations**

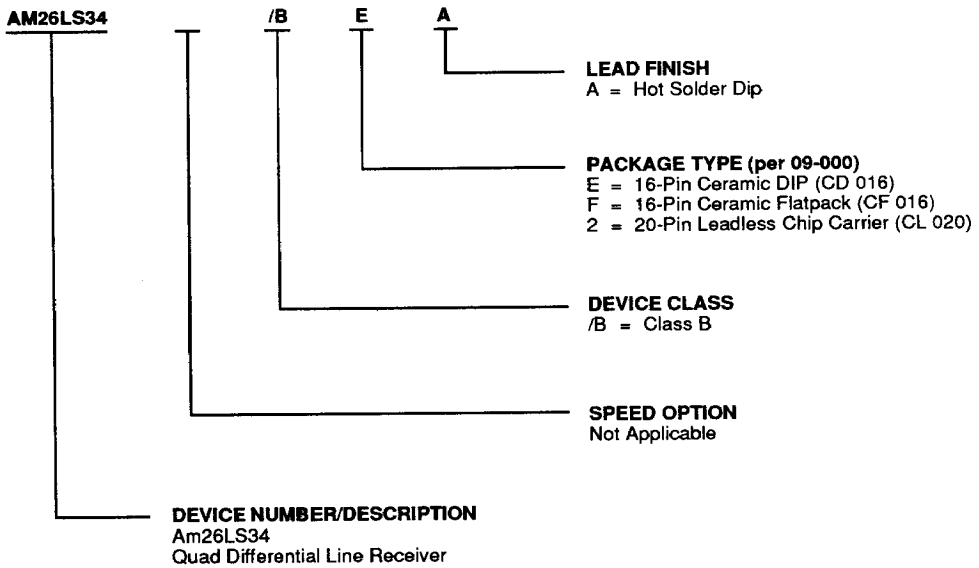
The Valid Combinations table lists configurations planned to be supported in volume for this device. Consult the local AMD sales office to confirm availability of specific valid combinations, to check on newly released combinations, and to obtain additional data on AMD's standard military grade products.

**Group A Tests**

Group A tests consist of Subgroups 1, 2, 3, 7, 8, 9, 10, 11.

## ORDERING INFORMATION
## APL Products

AMD products for Aerospace and Defense applications are available in several packages and operating ranges. APL (Approved Products List) products are fully compliant with MIL-STD-883C requirements. The ordering number (Valid Combination) is formed by a combination of:




| | |
|---|---|
| AM26LS34 | /BEA, /BFA, /B2A |

**Valid Combinations**

The Valid Combinations table lists configurations planned to be supported in volume for this device. Consult the local AMD sales office to confirm availability of specific valid combinations, to check on newly released combinations, and to obtain additional data on AMD's standard military grade products.

**Group A Tests**

Group A tests consist of Subgroups 1, 2, 3, 7, 8, 9, 10, 11.

## ABSOLUTE MAXIMUM RATINGS

| | |
|---|---|
| Supply Voltage | 7.0 V |
| Common Mode Voltage | ±25 V |
| Differential Input Voltage | ±30 V |
| Enable Voltage | 7.0 V |
| Output Sink Current | 50mA |
| Storage Temperature Range | −65°C to +165°C |

*Stresses above those listed under Absolute Maximum Ratings may cause permanent device failure. Functionality at or above these limits is not implied. Exposure to absolute maximum ratings for extended periods may affect device reliability.*

## OPERATING RANGES

**Commercial (C) Devices**

| | |
|---|---|
| Temperature ($T_A$) | 0°C to +70°C |
| Supply Voltage ($V_{CC}$) | +4.75 V to +5.25 V |

**Military (M) Devices**

| | |
|---|---|
| Temperature ($T_A$) | −55 to +125°C |
| Supply Voltage ($V_{CC}$) | +4.5 V to +5.5 V |

*Operating ranges define those limits between which the functionality of the device is guaranteed.*

## DC CHARACTERISTICS over COMMERCIAL operating range unless otherwise specified

| Parameter Symbol | Parameter Description | Test Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| $V_{TH}$ | Differential Input Voltage | $V_{OUT} = V_{OL}$ or $V_{OH}$ (Note 5) | 0V < $V_{CM}$ < + 5 V | −100 | ±90 | +100 | mV |
| | | | −7V ≤ $V_{CM}$ ≤ +12 V | −200 | | +200 | |
| | | | −15V ≤ $V_{CM}$ ≤ +15 V | −400 | | +400 | |
| $V_{HYST}$ | Input Hysteresis | $V_{CC}$ = 5.0 V | | 120 | 180 | 300 | mV |
| $R_{IN}$ | Input Resistance | −15 V ≤ $V_{CM}$ ≤ + 15 V (One input AC ground) (Note 4) | | 12k | 20k | 40k | Ω |
| $I_{IN}$ | Input Current (Under Test) | $V_{IN}$ = +12 V | | | 0.7 | 1.0 | mA |
| $I_{IN}$ | Input Current (Under Test) | $V_{IN}$ = −7 V | | | −0.5 | −0.8 | mA |
| $V_{OH}$ | Output HIGH Voltage | $V_{CC}$ = Min., Δ $V_{IN}$ = +1.0 V, $\overline{V_{ENABLE}}$ = 0.8 V | −12 mA | 2.0 | | | V |
| | | | −1 mA | 2.4 | | 3.4 | |
| $V_{OL}$ | Output LOW Voltage | $V_{CC}$ = Min., Δ $V_{IN}$ = −1.0 V, $\overline{V_{ENABLE}}$ = 0.8 V | $I_{OH}$ = 16 mA | | | 0.4 | V |
| | | | $I_{OL}$ = 24 mA | | | 0.5 | |
| $V_{IL}$ | Enable LOW Voltage | (Note 2) | | | | 0.8 | V |
| $V_{IH}$ | Enable HIGH Voltage | (Note 2) | | 2.0 | | | V |
| $V_I$ | Enable CLAMP Voltage | $V_{CC}$ = Min., $I_{IN}$ = −18 mA | | | | −1.5 | V |
| $V_{IOC}$ | Open Circuit Input Voltage | | | 2.0 | | 3.0 | V |
| $I_O$ | Off-State (High impedance) Output Current | $V_{CC}$ = Max. | $V_O$ = 2.4 V | | | 50 | µA |
| | | | $V_O$ = 0.4 V | | | −50 | |
| $I_{IL}$ | Enable LOW Current | $V_{IN}$ = 0.4 V | | | −0.03 | −0.2 | mA |
| $I_{IH}$ | Enable HIGH Current | $V_{IH}$ = 2.7 V | | | 0.5 | 20 | µA |
| $I_I$ | Enable Input High Current | $V_{IN}$ = 5.5 V | | | 1 | 100 | µA |
| $I_{SC}$ | Output Short Circuit Current | $V_O$ = 0 V, $V_{CC}$ = Max., Δ $V_{IN}$ = +1.0 V (Note 3) | | −30 | −65 | −120 | mA |
| $I_{CC}$ | Power Supply Current | $V_{CC}$ = Max., All $V_{IN}$ = GND, Outputs Disabled | | | 52 | 70 | mA |

**Notes:**

1. All typical values are $V_{CC}$ = 5.0 V, $T_A$ = 25°C.
2. Input thresholds are tested during DC tests and may be done in combination with testing of other DC parameters.
3. Not more than one output should be shorted at a time. Duration of short circuit test should not exceed one second.
4. $R_{IN}$ is not directly tested but is correlated. (See Attachment I)
5. Input voltage is not tested directly due to tester accuracy limitations but is tester correlated. (See Attachment II)

## SWITCHING CHARACTERISTICS over operating ranges unless otherwise specified

| Parameter Symbol | Parameter Description | Test Conditions | Commercial Am26LS34 Min. | Commercial Am26LS34 Max. | Military Am26LS34 Min. | Military Am26LS34 Max. | Units |
|---|---|---|---|---|---|---|---|
| $t_{PLH}$ | Propagation Delay, Input to Output | $C_L$ = 50 pF See test circuit | | 30 | | 30 | ns |
| $t_{PHL}$ | | | | 30 | | 30 | ns |
| $t_{SKEW}$ | Propagation Delay Skew, $t_{PLH} - t_{PHL}$ | | | ±5 | | ±5 | ns |
| $t_{ZL}$ | Output Enable Time, ENABLE to Output | | | 33 | | 33 | ns |
| $t_{ZH}$ | | | | 22 | | 22 | ns |
| $t_{LZ}$ | Output Disable Time, ENABLE to Output | $C_L$ = 5 pF See test circuit | | 27 | | 27 | ns |
| $t_{HZ}$ | | | | 27 | | 27 | ns |

## SWITCHING CHARACTERISTICS ($T_A$ = +25°C, $V_{CC}$ = 5.0 V)

| Parameter Symbol | Parameter Description | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{PLH}$ | Propagation Delay, Input to Output | $C_L$ = 50 pF See test circuit | | 18 | 24 | ns |
| $t_{PHL}$ | | | | 20 | 24 | ns |
| $t_{SKEW}$ | Propagation Delay Skew, $t_{PLH} - t_{PHL}$ | | | | | |
| | | | | 2 | 4 | ns |
| $t_{ZL}$ | Output Enable Time, ENABLE to Output | | | 16 | 22 | ns |
| $t_{ZH}$ | | | | 10 | 16 | ns |
| $t_{LZ}$ | Output Disable Time, ENABLE to Output | $C_L$ = 5 pF See test circuit | | 11 | 18 | ns |
| $t_{HZ}$ | | | | 13 | 18 | ns |

**Tristate Delays For Enable Bar**

| Parameter Symbol | Parameter Description | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{PZH}$ | Propagation Delay From ENABLE BAR to Output | $C_L$ = 50 pF, $R_{L1}$ =1 KΩ, $R_{L2}$ = 280 Ω | | | 26 | ns |
| $t_{PZL}$ | Propagation Delay From ENABLE BAR to Output | $C_L$ = 50 pF, $R_{L1}$ =1 KΩ, $R_{L2}$ = 280 Ω | | | 33 | ns |
| $t_{PHZ}$ | Propagation Delay From ENABLE BAR to Output | $C_L$ = 5 pF, $R_{L1}$ =1 KΩ, $R_{L2}$ = 280 Ω | | | 20 | ns |
| $t_{PLZ}$ | Propagation Delay From ENABLE BAR to Output | $C_L$ = 5 pF, $R_{L1}$ =1 KΩ, $R_{L2}$ = 280 Ω | | | 20 | ns |
| $t_{PZH}$ | Propagation Delay From ENABLE BAR to Output | $C_L$ = 50 pF, $R_{L1}$ =1 KΩ, $R_{L2}$ = 280 Ω | | | 39 | ns |
| $t_{PZL}$ | Propagation Delay From ENABLE BAR to Output | $C_L$ = 50 pF, $R_{L1}$ =1 KΩ, $R_{L2}$ = 280 Ω | | | 49 | ns |
| $t_{PHZ}$ | Propagation Delay From ENABLE BAR to Output | $C_L$ = 5 pF, $R_{L1}$ =1 KΩ, $R_{L2}$ = 280 Ω | | | 30 | ns |
| $t_{PLZ}$ | Propagation Delay From ENABLE BAR to Output | $C_L$ = 5 pF, $R_{L1}$ =1 KΩ, $R_{L2}$ = 280 Ω | | | 30 | ns |

## KEY TO SWITCHING WAVEFORMS

| WAVEFORM | INPUTS | OUTPUTS |
|---|---|---|
| | Must Be Steady | Will Be Steady |
| | May Change from H to L | Will Be Changing from H to L |
| | May Change from L to H | Will Be Changing from L to H |
| | Don't Care, Any Change Permitted | Changing State Unknown |
| | Does Not Apply | Center Line is High Impedance "Off" State |

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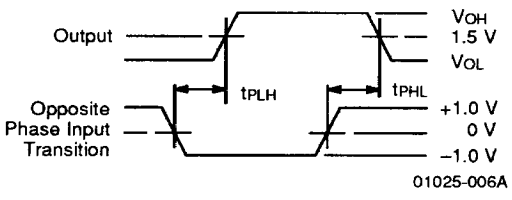
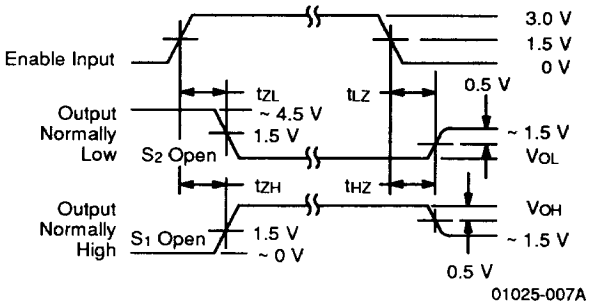
## SWITCHING WAVEFORMS




**Propagation Delay**
**(Notes 1 and 3)**

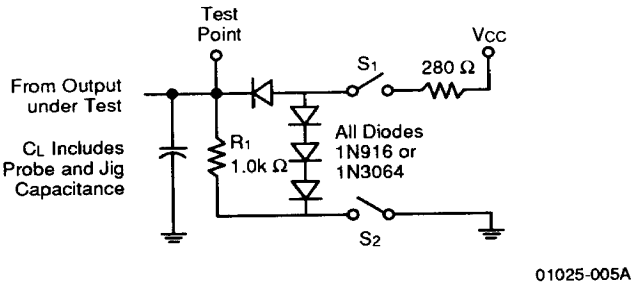



**Enable And Disable Times**
**(Notes 2 and 3)**

**Notes:**

1. Diagram shown for $\overline{\text{ENABLE}}$ LOW.
2. $S_1$ and $S_2$ of Load Circuit are closed except where shown.
3. Pulse Generator Rate ≤ 1.0 MHz; $Z_0 = 50\Omega$; $t_r$; $t_f \leq 2.5$ns.

## SWITCHING TEST CIRCUIT




**Three-State Outputs**

## ATTACHMENT I

## Am26LS32/32B/33/34 Input Resistance and Input Current

Input resistance measurement for differential inputs on line receivers are generally not measured directly. Instead they are correlated to an input current measurement and to the process resistor temperature coefficient. The assumptions made include 1) Process resistor temperature coefficient is known and 2) The open input bias voltage for the input is known or measured within the same test sequence.

Under the above assumptions $R_{IN}$ can be correlated to the input current measured. The expression

$$R_{IN} = \frac{(V_{ICM} - V_{IN})\ (R_T)}{(I_{IN})\ (R25)},$$

where $V_{ICM}$ is the open input bias voltage of the Line Receiver. When applying this correlation to the 26LS32 die, the following criteria have been set.

1) $V_{ICM}$ and $I_{IN}$ are the values screened at wafer sort.
2) Temperature coefficients are for 800 ohm/square which gives 0.96 at 0°C and 0.93 at –55°C.

When setting limits, characterized values for $V_{ICM}$ have been used instead of the test programmed limit value. $R_{IN}$ (dif) is $R_{IN}$ (dif) = 2 $R_{IN}$.

For the Am26LS32/32B/33/34

$$R_{IN}\ \text{Min.} = \frac{(2.56 - -15)\ 0.96}{I_{IN}\ (\text{Max.})} = 16.8/I_{IN}\ (\text{Max.})\ \text{Comm.},$$

and

$R_{IN}$ Min. = 16.3/$I_{IN}$ (Max.) Mil.

## Worst Case Measurement for Input Current

Two considerations have been used to determine the test condition for input current of the data path for the Am26LS32 Line Receiver.

1) Input current is tested on the 26LS32 with the pin under test at one end of the range (+15 V for example) and the untested pin at the opposite extreme of the input range under test. If both pins were at the same test voltage the internal bias generator would have a lower output voltage for tests at –15 V $V_{IN}$ and a higher output voltage at +15 V $V_{IN}$. This would produce test currents less than maximum.
2) For the 26LS32, breakdown of the differential inputs is the primary failure to the data sheet specification. Hence, both breakdown voltage and input current are tested during the input current tests.

## ATTACHMENT II

## Test Documentation For Am26LS32/32B/34 $V_{TH}$

Input threshold ($V_{TH}$) for the Am26LS32/32B/34 is described by the equation,

$V_{TH}$ = (N+1) (1+R1/R) K*T/Q ((1+Rh/(m (Rc+Rh))) /(1−Rh/ (M(Rc+Rh))).

Where N+1 is the attenuator ratio, R1/R is the attenuator ratio mismatch, M is the ratio of the input stage current to hysteresis stage current, and Rh and Rc are input stage loads. For Am26LS32 – 34 devices which pass function tests, $V_{OH}$ and $V_{OL}$ tests, thresholds for all inputs within the operating range of the circuit.

The Test system is unable to force input thresholds within the accuracy required for the Am26LS32 – 34 specifications. Figure 1 plots the expected values for $V_{TH}$, the worst case values at 25°C and 155°C. Also shown are the test values for $V_{TH}$ at the −1.5 V input ($V_{IN}$). In addition, the test voltage at −7 V $V_{IN}$ is shown.

For the figure it is seen that the worst case value for the test limit shown would be +/−165 mV, where +/− 102 mV is expected for process parameters and the equation for $V_{TH}$. Further the 25 mV negative guardband used for −7 V testing is less than half the machine uncertainty of 60 mV.

When QA testing for Am26LS32/32B/34 is done, thresholds are screened for $V_{CM}$ other than −1.5 V. These additional tests are considered functional tests only, and the precision threshold tests which insure compliance with data sheet limits are those tests performed where the inputs are tested near −1.5 V.

The actual threshold tests are done as a sequence where a setup is performed which preconditions the DUT to a logic one state, then the threshold correlation for a logic zero is tested followed by a threshold correlation for logic one to complete the sequence. The limit values for the setup (Vt SET), logic zero test (Vt "−"), and logic one test (Vt "+") are listed under $V_{TH}$ for supply value of 5.0 V.

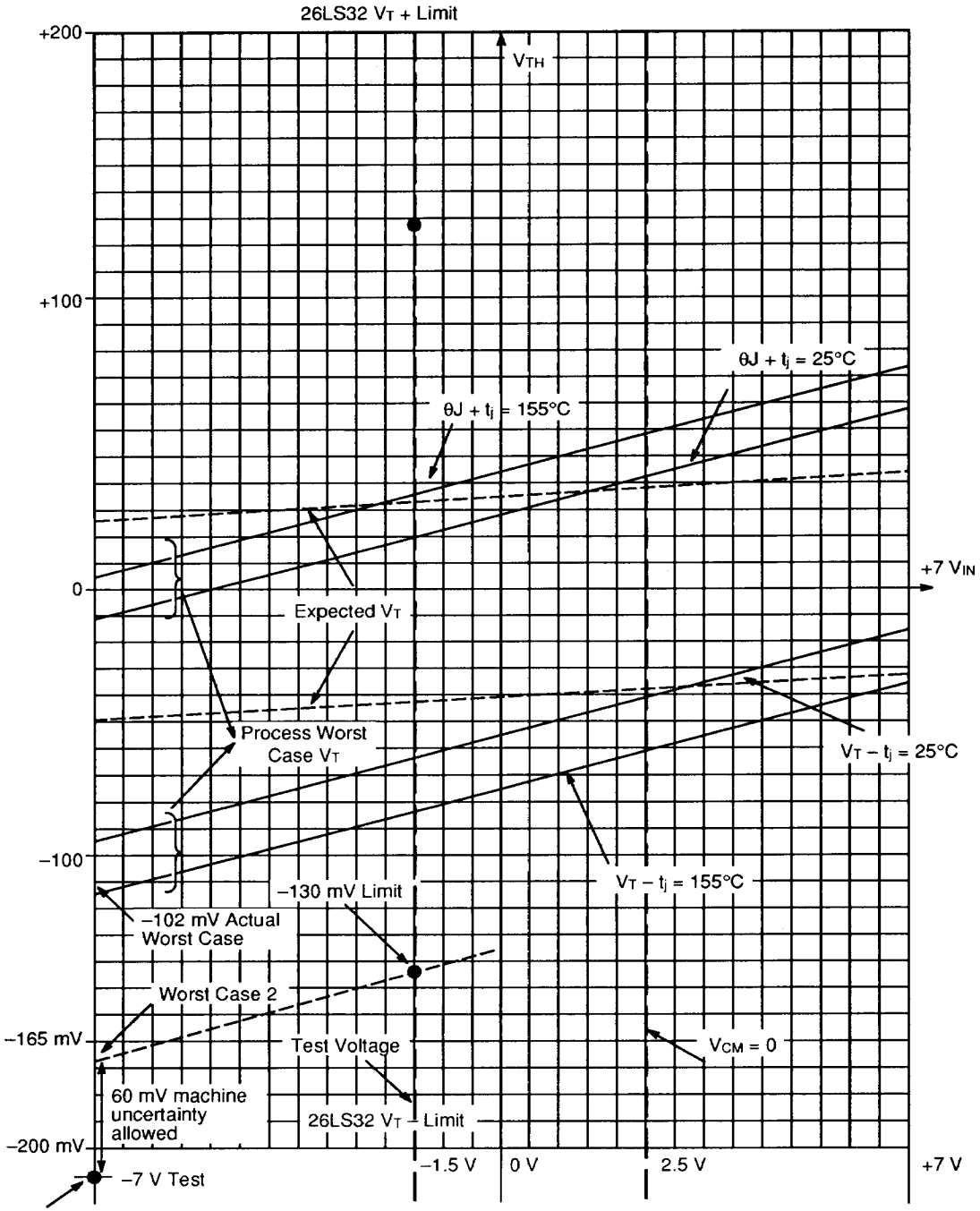



**Figure 1. 26LS32 Input Threshold $V_T$ vs. Input Voltage $V_{IN}$**