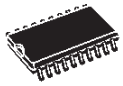
# 74VHC244

## OCTAL BUS BUFFER WITH 3 STATE OUTPUTS (NON INVERTED)

- HIGH SPEED: $t_{PD}$ = 3.9 ns (TYP.) at $V_{CC}$ = 5V
- LOW POWER DISSIPATION: $I_{CC}$ = 4 µA (MAX.) at $T_A$ = 25 °C
- HIGH NOISE IMMUNITY: $V_{NIH} = V_{NIL}$ = 28% $V_{CC}$ (MIN.)
- POWER DOWN PROTECTION ON INPUTS
- SYMMETRICAL OUTPUT IMPEDANCE: $|I_{OH}| = I_{OL}$ = 8 mA (MIN)
- BALANCED PROPAGATION DELAYS: $t_{PLH} \cong t_{PHL}$
- OPERATING VOLTAGE RANGE: $V_{CC}$ (OPR) = 2V to 5.5V
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 244
- IMPROVED LATCH-UP IMMUNITY
- LOW NOISE $V_{OLP}$ = 0.9V (Max.)



**M**
(Micro Package)

**T**
(TSSOP Package)

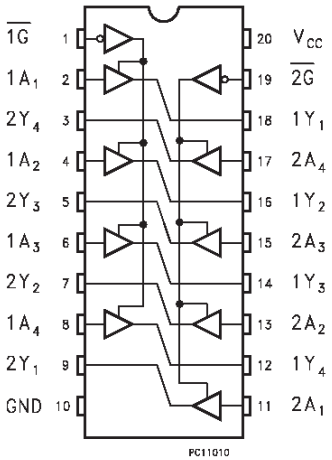
**ORDER CODES :**
74VHC244M 74VHC244T

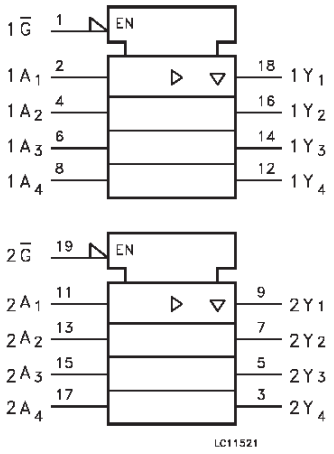
### DESCRIPTION

The 74VHC244 is an advanced high speed CMOS OCTAL BUS BUFFER (3-STATE) fabricated with sub-micron silicon gate and double-layer metal wiring $C^2MOS$ technology.
$\overline{G}$ output enable governs four BUS BUFFERs.

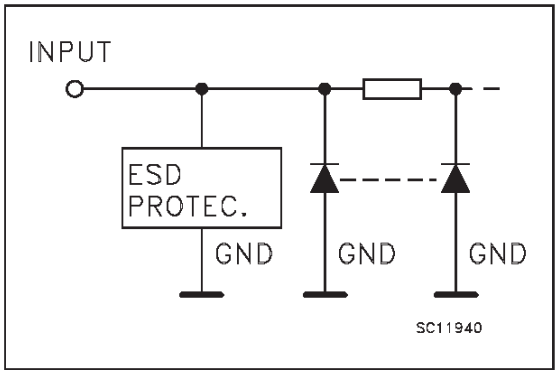
This device is designed to be used with 3 state memory address drivers, etc.
Power down protection is provided on all inputs and 0 to 7V can be accepted on inputs with no regard to the supply voltage. This device can be used to interface 5V to 3V.
All inputs and outputs are equipped with protection circuits against static discharge, giving them 2KV ESD immunity and transient excess voltage.

### PIN CONNECTION AND IEC LOGIC SYMBOLS



## INPUT EQUIVALENT CIRCUIT




## PIN DESCRIPTION

| PIN No | SYMBOL | NAME AND FUNCTION |
|---|---|---|
| 1 | $\overline{1G}$ | Output Enable Input |
| 2, 4, 6, 8 | 1A1 to 1A4 | Data Inputs |
| 9, 7, 5, 3 | 2Y1 to 2Y4 | Data Outputs |
| 11, 13, 15, 17 | 2A1 to 2A4 | Data Inputs |
| 18, 16, 14, 12 | 1Y1 to 1Y4 | Data Outputs |
| 19 | $\overline{2G}$ | Output Enable Input |
| 10 | GND | Ground (0V) |
| 20 | $V_{CC}$ | Positive Supply Voltage |

## TRUTH TABLE

| INPUT | | OUTPUT |
|---|---|---|
| $\overline{G}$ | An | Yn |
| L | L | L |
| L | H | H |
| H | X | Z |

X: "H" or "L"
Z: High impedance

## ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{CC}$ | Supply Voltage | -0.5 to +7.0 | V |
| $V_I$ | DC Input Voltage | -0.5 to +7.0 | V |
| $V_O$ | DC Output Voltage | -0.5 to $V_{CC}$ + 0.5 | V |
| $I_{IK}$ | DC Input Diode Current | - 20 | mA |
| $I_{OK}$ | DC Output Diode Current | ± 20 | mA |
| $I_O$ | DC Output Current | ± 25 | mA |
| $I_{CC}$ or $I_{GND}$ | DC $V_{CC}$ or Ground Current | ± 75 | mA |
| $T_{stg}$ | Storage Temperature | -65 to +150 | °C |
| $T_L$ | Lead Temperature (10 sec) | 300 | °C |

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.

## RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{CC}$ | Supply Voltage | 2.0 to 5.5 | V |
| $V_I$ | Input Voltage | 0 to 5.5 | V |
| $V_O$ | Output Voltage | 0 to $V_{CC}$ | V |
| $T_{op}$ | Operating Temperature | -40 to +85 | °C |
| dt/dv | Input Rise and Fall Time (see note 1) ($V_{CC}$ = 3.3 ± 0.3V)<br>($V_{CC}$ = 5.0 ± 0.5V) | 0 to 100<br>0 to 20 | ns/V<br>ns/V |

1) $V_{IN}$ from 30% to 70% of $V_{CC}$

## DC SPECIFICATIONS

| Symbol | Parameter | Test Conditions | | Value | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | $V_{CC}$ (V) | | $T_A$ = 25 °C | | | -40 to 85 °C | | |
| | | | | Min. | Typ. | Max. | Min. | Max. | |
| $V_{IH}$ | High Level Input Voltage | 2.0 | | 1.5 | | | 1.5 | | V |
| | | 3.0 to 5.5 | | 0.7$V_{CC}$ | | | 0.7$V_{CC}$ | | |
| $V_{IL}$ | Low Level Input Voltage | 2.0 | | | | 0.5 | | 0.5 | V |
| | | 3.0 to 5.5 | | | | 0.3$V_{CC}$ | | 0.3$V_{CC}$ | |
| $V_{OH}$ | High Level Output Voltage | 2.0 | $I_O$=-50 µA | 1.9 | 2.0 | | 1.9 | | V |
| | | 3.0 | $I_O$=-50 µA | 2.9 | 3.0 | | 2.9 | | |
| | | 4.5 | $I_O$=-50 µA | 4.4 | 4.5 | | 4.4 | | |
| | | 3.0 | $I_O$=-4 mA | 2.58 | | | 2.48 | | |
| | | 4.5 | $I_O$=-8 mA | 3.94 | | | 3.8 | | |
| $V_{OL}$ | Low Level Output Voltage | 2.0 | $I_O$=50 µA | | 0.0 | 0.1 | | 0.1 | V |
| | | 3.0 | $I_O$=50 µA | | 0.0 | 0.1 | | 0.1 | |
| | | 4.5 | $I_O$=50 µA | | 0.0 | 0.1 | | 0.1 | |
| | | 3.0 | $I_O$=4 mA | | | 0.36 | | 0.44 | |
| | | 4.5 | $I_O$=8 mA | | | 0.36 | | 0.44 | |
| $I_{OZ}$ | High Impedance Output Leakage Current | 5.5 | $V_I$ = $V_{IH}$ or $V_{IL}$<br>$V_O$ = $V_{CC}$ or GND | | | ±0.25 | | ±2.5 | µA |
| $I_I$ | Input Leakage Current | 0 to 5.5 | $V_I$ = 5.5V or GND | | | ±0.1 | | ±1.0 | µA |
| $I_{CC}$ | Quiescent Supply Current | 5.5 | $V_I$ = $V_{CC}$ or GND | | | 4 | | 40 | µA |

## AC ELECTRICAL CHARACTERISTICS (Input $t_r$ = $t_f$ =3 ns)

| Symbol | Parameter | Test Condition | | | Value | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | $V_{CC}$ (V) | $C_L$ (pF) | | $T_A$ = 25 °C | | | -40 to 85 °C | | |
| | | | | | Min. | Typ. | Max. | Min. | Max. | |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay Time | 3.3(*) | 15 | | | 5.8 | 8.4 | 1.0 | 10.0 | ns |
| | | 3.3(*) | 50 | | | 8.3 | 11.9 | 1.0 | 13.5 | |
| | | 5.0(**) | 15 | | | 3.9 | 5.5 | 1.0 | 6.5 | |
| | | 5.0(**) | 50 | | | 5.4 | 7.5 | 1.0 | 8.5 | |
| $t_{PZL}$<br>$t_{PZH}$ | Output Enable Time | 3.3(*) | 15 | $R_L$ = 1KΩ | | 6.6 | 10.6 | 1.0 | 12.5 | ns |
| | | 3.3(*) | 50 | $R_L$ = 1KΩ | | 9.1 | 14.1 | 1.0 | 16.0 | |
| | | 5.0(**) | 15 | $R_L$ = 1KΩ | | 4.7 | 7.3 | 1.0 | 8.5 | |
| | | 5.0(**) | 50 | $R_L$ = 1KΩ | | 6.2 | 9.3 | 1.0 | 10.5 | |
| $t_{PLZ}$<br>$t_{PHZ}$ | Output Disable Time | 3.3(*) | 50 | $R_L$ = 1KΩ | | 10.3 | 14.0 | 1.0 | 16.0 | ns |
| | | 5.0(**) | 50 | $R_L$ = 1KΩ | | 6.7 | 9.2 | 1.0 | 10.5 | |
| $t_{OSLH}$<br>$t_{OSHL}$ | Output to Output Skew Time (note 1) | 3.3(*) | 50 | | | | 1.5 | | 1.5 | ns |
| | | 5.0(**) | 50 | | | | 1.0 | | 1.0 | |

(*) Voltage range is 3.3V ± 0.3V
(**) Voltage range is 5V ± 0.5V
Note 1: Parameter guaranteed by design. $t_{soLH} = |t_{pLHm} - t_{pLHn}|$, $t_{soHL} = |t_{pHLm} - t_{pHLn}|$

## CAPACITIVE CHARACTERISTICS

| Symbol | Parameter | Test Conditions | Value | | | | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | | $T_A$ = 25 °C | | | -40 to 85 °C | | |
| | | | Min. | Typ. | Max. | Min. | Max. | |
| $C_{IN}$ | Input Capacitance | | | 4 | 10 | | 10 | pF |
| $C_{OUT}$ | Output Capacitance | | | 6 | | | | pF |
| $C_{PD}$ | Power Dissipation Capacitance (note 1) | | | 19 | | | | pF |

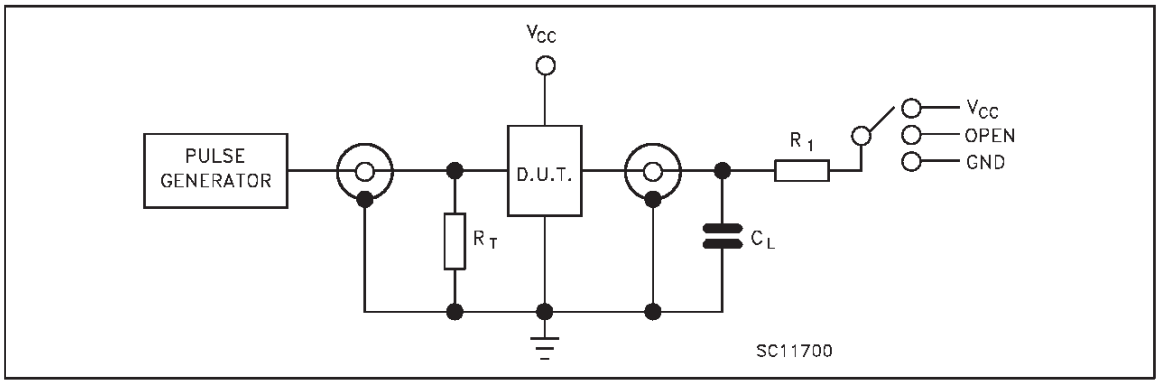
1) $C_{PD}$ is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation. $I_{CC}(opr) = C_{PD} \bullet V_{CC} \bullet f_{IN} + I_{CC}/48$(per Gate)

## DYNAMIC SWITCHING CHARACTERISTICS

| Symbol | Parameter | Test Conditions | | Value | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | $V_{CC}$ (V) | | $T_A$ = 25 °C | | | -40 to 85 °C | | |
| | | | | Min. | Typ. | Max. | Min. | Max. | |
| $V_{OLP}$ | Dynamic Low Voltage Quiet Output (note 1, 2) | 5.0 | $C_L$ = 50 pF | | 0.6 | 0.9 | | | V |
| $V_{OLV}$ | | | | -0.9 | -0.6 | | | | |
| $V_{IHD}$ | Dynamic High Voltage Input (note 1, 3) | 5.0 | | 3.5 | | | | | |
| $V_{ILD}$ | Dynamic Low Voltage Input (note 1, 3) | 5.0 | | | | 1.5 | | | |

1) Worst case package.
2) Max number of outputs defined as (n). Data inputs are driven 0V to 5.0V, (n -1) outputs switching and one output at GND.
3) Max number of data inputs (n) switching. (n-1) switching 0V to 5.0V. Inputs under test switching: 5.0V to threshold ($V_{ILD}$), 0V to threshold ($V_{IHD}$), f=1MHz.

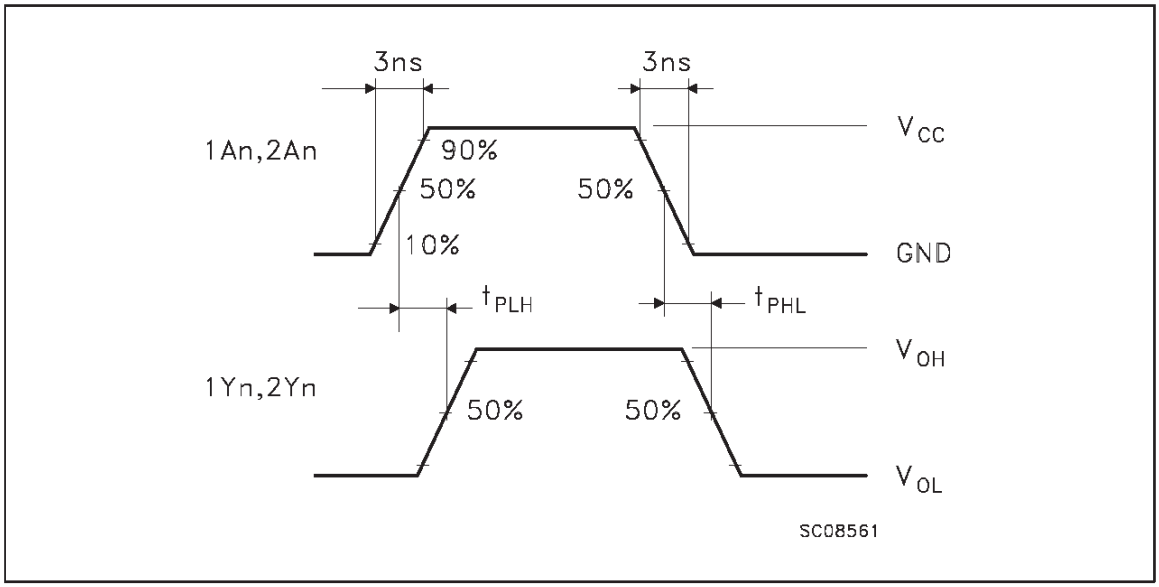
## TEST CIRCUIT



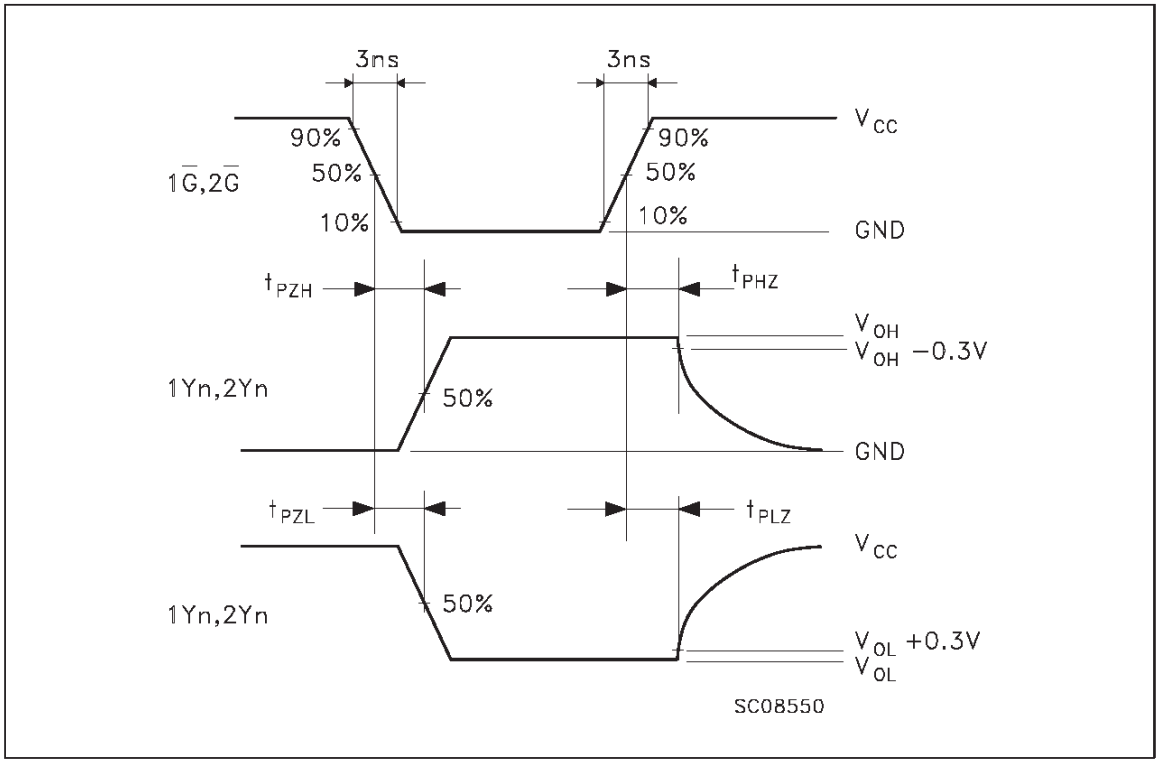

| TEST | SWITCH |
|---|---|
| $t_{PLH}$, $t_{PHL}$ | Open |
| $t_{PZL}$, $t_{PLZ}$ | $V_{CC}$ |
| $t_{PZH}$, $t_{PHZ}$ | GND |

$C_L$ = 15/50 pF or equivalent (includes jig and probe capacitance)
$R_L = R_1$ = 1KΩ or equivalent
$R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

**WAVEFORM 1: PROPAGATION DELAYS** (f=1MHz; 50% duty cycle)

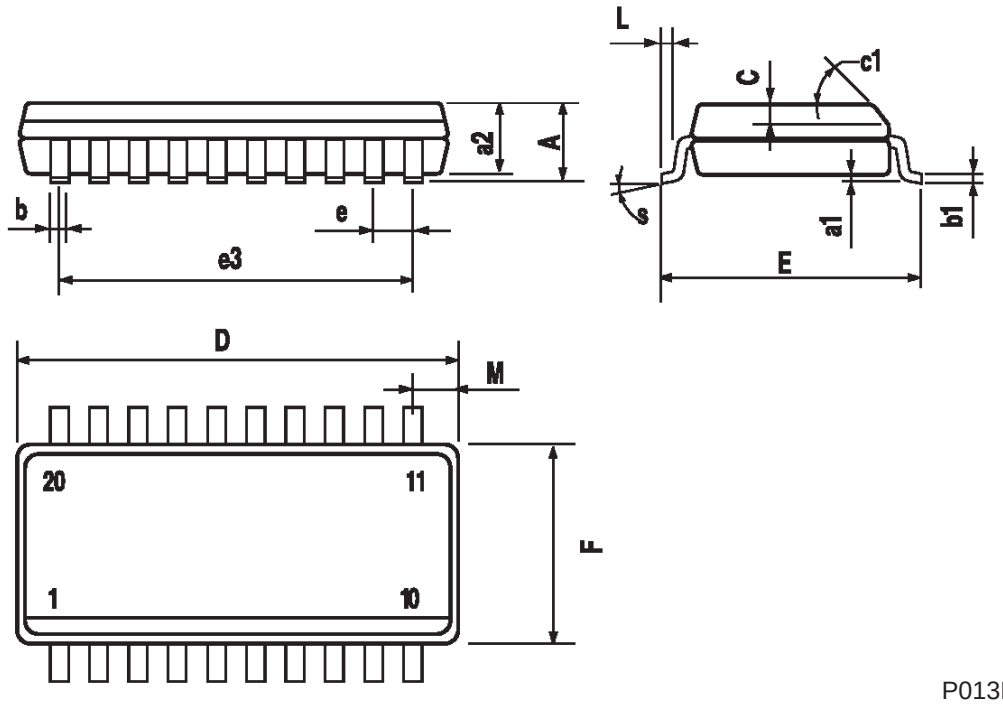



**WAVEFORM 2: OUTPUT ENABLE AND DISABLE TIME** (f=1MHz; 50% duty cycle)



## SO-20 MECHANICAL DATA

| DIM. | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 2.65 | | | 0.104 |
| a1 | 0.10 | | 0.20 | 0.004 | | 0.007 |
| a2 | | | 2.45 | | | 0.096 |
| b | 0.35 | | 0.49 | 0.013 | | 0.019 |
| b1 | 0.23 | | 0.32 | 0.009 | | 0.012 |
| C | | 0.50 | | | 0.020 | |
| c1 | 45 (typ.) | | | | | |
| D | 12.60 | | 13.00 | 0.496 | | 0.512 |
| E | 10.00 | | 10.65 | 0.393 | | 0.419 |
| e | | 1.27 | | | 0.050 | |
| e3 | | 11.43 | | | 0.450 | |
| F | 7.40 | | 7.60 | 0.291 | | 0.299 |
| L | 0.50 | | 1.27 | 0.19 | | 0.050 |
| M | | | 0.75 | | | 0.029 |
| S | 8 (max.) | | | | | |




P013L

## TSSOP20 MECHANICAL DATA

| DIM. | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 1.1 | | | 0.433 |
| A1 | 0.05 | 0.10 | 0.15 | 0.002 | 0.004 | 0.006 |
| A2 | 0.85 | 0.9 | 0.95 | 0.335 | 0.354 | 0.374 |
| b | 0.19 | | 0.30 | 0.0075 | | 0.0118 |
| c | 0.09 | | 0.2 | 0.0035 | | 0.0079 |
| D | 6.4 | 6.5 | 6.6 | 0.252 | 0.256 | 0.260 |
| E | 6.25 | 6.4 | 6.5 | 0.246 | 0.252 | 0.256 |
| E1 | 4.3 | 4.4 | 4.48 | 0.169 | 0.173 | 0.176 |
| e | | 0.65 BSC | | | 0.0256 BSC | |
| K | $0^o$ | $4^o$ | $8^o$ | $0^o$ | $4^o$ | $8^o$ |
| L | 0.50 | 0.60 | 0.70 | 0.020 | 0.024 | 0.028 |