# DS16F95QML EIA-485/EIA-422A Differential Bus Transceiver

Check for Samples: DS16F95QML

## FEATURES

- **Radiation Ensured 300 krad(Si)**
- **Meets EIA-485 and EIA-422A**
- **Meets SCSI-1 (5 MHZ) Specifications**
- **Designed for Multipoint Transmission**
- **Wide Positive and Negative Input/Output Bus Voltage Ranges**
- **Thermal Shutdown Protection**
- **Driver Positive and Negative Current-Limiting**
- **High Impedance Receiver Input**
- **Receiver Input Hysteresis of 50 mV Typical**
- **Operates from Single 5.0V Supply**
- **Reduced Power Consumption**
- **Pin Compatible with DS3695 and SN75176A**

## DESCRIPTION

The DS16F95 Differential Bus Transceiver is a monolithic integrated circuit designed for bidirectional data communication on balanced multipoint bus transmission lines. The transceiver meets EIA standard RS-485 as well as RS-422A.

The DS16F95 offers improved performance due to the use of state-of-the-art L-FAST bipolar technology. The L-FAST technology allows for higher speeds and lower currents by utilizing extremely short gate delay times. Thus, the DS16F95QML features lower power, extended temperature range and improved specifications.

The DS16F95 combines a TRI-STATE differential line driver and a differential input line receiver, both of which operate from a single 5.0V power supply. The driver and receiver have an active Enable that can be externally connected to function as a direction control. The driver differential outputs and the receiver differential inputs are internally connected to form differential input/output (I/O) bus ports that are designed to offer minimum loading to the bus whenever the driver is disabled or when $V_{CC} = 0V$. These ports feature wide positive and negative common mode voltage ranges, making the device suitable for multipoint applications in noisy environments.

The driver is designed to accommodate loads of up to 60 mA of sink or source current and features positive and negative current limiting in addition to thermal shutdown for protection from line fault conditions.

The DS16F95 can be used in transmission line applications employing the DS96F172 and the DS96F174 quad differential line drivers and the DS96F173 and DS96F175 quad differential line receivers.

Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.
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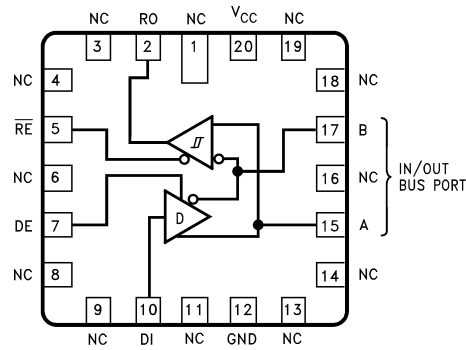
## Connection Diagram



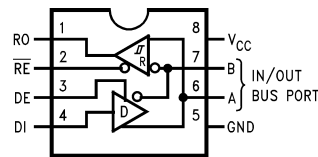**Figure 1. 20-Lead Ceramic Leadless Chip Carrier**
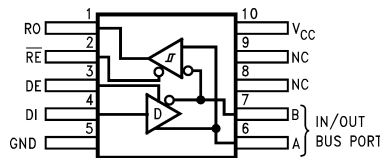


**Figure 2. 8-Lead Dual-In-Line Package**



**Figure 3. 10-Lead Flatpak Package**

### Logic Diagram
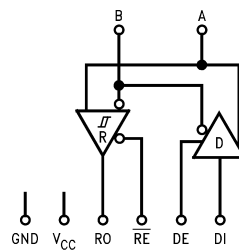


## Function Tables

### Table 1. Driver[1]

| Driver Input | Enable | Outputs | |
|---|---|---|---|
| **DI** | **DE** | **A** | **B** |
| H | H | H | L |
| L | H | L | H |
| X | L | Z | Z |

(1) H = High Level, L = Low Level, X = Immaterial, Z = High Impedance (Off)

Product Folder Links: *DS16F95QML*

**Table 2. Receiver**[1]

| Differential Inputs | Enable | Output |
|---|---|---|
| A−B | $\overline{RE}$ | RO |
| $V_{ID} \geq 0.2V$ | L | H |
| $V_{ID} \leq -0.2V$ | L | L |
| X | H | Z |

(1)  H = High Level, L = Low Level, X = Immaterial, Z = High Impedance (Off)

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

## Absolute Maximum Ratings[1]

| Storage Temperature Range | | | $-65°C \leq T_A \leq +175°C$ |
|---|---|---|---|
| Lead Temperature | (Soldering, 60 sec.) | | 300°C |
| Maximum Power Dissipation at 25°C[2] | LCCC 'NAJ' Package | | 1800 mW |
| | CDIP 'NAB' Package | | 1274 mW |
| | CLGA 'NAD' Package | | 725 mW |
| Supply Voltage | | | 7.0V |
| Input Voltage (Bus Terminal) | | | +15V/−10V |
| Enable Input Voltage | | | 5.5V |
| Junction Temperature (TJ) | | | +175°C |
| Thermal Resistance | $\theta_{JA}$ | LCCC 'NAJ' Package | 83°C/W @ 0.5W |
| | | CDIP 'NAB' Package | 118°C/W @ 1.0W |
| | | CLGA 'NAD' Package | 207°C/W @ 0.5W |
| | $\theta_{JC}$ | LCCC 'NAJ' Package | 17°C/W |
| | | CDIP 'NAB' Package | 14°C/W |
| | | CLGA 'NAD' Package | 18°C/W |
| ESD Tolerance[3] | | | 500V |

(1) Absolute Maximum Ratings are those values beyond which the safety of the device cannot be ensured. They are not meant to imply that the devices should be operated at these limits. The tables of Electrical Characteristics provide conditions for actual device operation.
(2) Above $T_A$ = 25°C, derate NAJ package 12.1mW°C, NAB package 8.5 mW/°C, NAD package 4.8mW/°C.
(3) Human body model, 1.5kΩ in series with 100pF

## Recommended Operating Conditions

| Supply Voltage ($V_{CC}$) | | 4.50 to 5.50V |
|---|---|---|
| Voltage at Any Bus Terminal | (Separately or Common Mode) ($V_I$ or $V_{CM}$) | -7.0V to +12V |
| Differential Input Voltage ($V_{ID}$) | | -7.0V to ±12V |
| Output Current HIGH ($I_{OH}$) Driver | Driver | -60mA |
| | Receiver | -400µA |
| Output Current LOW ($I_{OL}$) | Driver | 60mA |
| | Receiver | 16mA |
| Operating Temperature ($T_A$) | | -55°C to +125°C |

Product Folder Links: *DS16F95QML*

## Quality Conformance Inspection

MIL-STD-883, Method 5005 - Group A

| Subgroup | Description | Temp (°C) |
|----------|-------------|-----------|
| 1 | Static tests at | +25 |
| 2 | Static tests at | +125 |
| 3 | Static tests at | -55 |
| 4 | Dynamic tests at | +25 |
| 5 | Dynamic tests at | +125 |
| 6 | Dynamic tests at | -55 |
| 7 | Functional tests at | +25 |
| 8A | Functional tests at | +125 |
| 8B | Functional tests at | -55 |
| 9 | Switching tests at | +25 |
| 10 | Switching tests at | +125 |
| 11 | Switching tests at | -55 |

## DC - Driver Electrical Characteristics[1]

The following conditions apply to all parameters, unless otherwise specified. $V_{CC}$ = 5.5V

| Symbol | Parameter | Conditions | Notes | Min | Max | Unit | Sub-group |
|--------|-----------|------------|-------|-----|-----|------|-----------|
| VOD1 | Differential Vout | $V_{CC}$ = 5.5V, $I_O$ = 0A, $V_{IN}$ = .8V | | | 6 | V | 1, 2, 3 |
| | | $V_{CC}$ = 5.5V, $I_O$ = 0A, $V_{IN}$ = 2V | | | 6 | V | 1, 2, 3 |
| VOD2 | Differential Vout (See Figure 4) | $V_{CC}$ = 4.5V, $R_L$ = 100Ω | | 2 | | V | 1, 2, 3 |
| | | $V_{CC}$ = 4.5V, $R_L$ = 54Ω | | 1.5 | | V | 1, 2, 3 |
| $\Delta V_{OD}$ | Change In Differential Vout | $V_{CC}$ = 4.5V, $R_L$ = 100Ω | See[2] | -200 | 200 | mV | 1, 2, 3 |
| | | $V_{CC}$ = 4.5V, $R_L$ = 54Ω | | -200 | 200 | mV | 1, 2, 3 |
| $\Delta V_{OC}$ | Change In Common Mode Vout | $V_{CC}$ = 4.5V, $R_L$ = 100Ω | See[2] | -200 | 200 | mV | 1, 2, 3 |
| | | $V_{CC}$ = 4.5V, $R_L$ = 54Ω | | -200 | 200 | mV | 1, 2, 3 |
| $V_{OC}$ | Common Mode Vout | $R_L$ = 100Ω | | | 3 | V | 1, 2, 3 |
| | | $R_L$ = 54Ω | | | 3 | V | 1, 2, 3 |
| $I_{IH}$ | Logical "1" Input Current | $V_I$ = 2.4V | | | 20 | uA | 1, 2, 3 |
| $I_O$ | Output Current | Output Disable, $V_O$ = 12V | | | 1 | mA | 1, 2, 3 |
| | | Output Disable, $V_O$ = -7V | See[3] | -0.8 | | mA | 1, 2, 3 |
| | | $V_{CC}$ = 0, Output Disable, $V_O$ = 12V | | | 1 | mA | 1, 2, 3 |
| | | $V_{CC}$ = 0, Output Disable, $V_O$ = -7V | See[3] | -0.8 | | mA | 1, 2, 3 |

(1) Pre and post irradiation limits are identical to those listed under A C and DC electrical characteristics. These parts may be dose rate sensitive in a space environment and demonstrate enhanced low dose rate effect. Radiation end point limits for the noted parameters are ensured only for the conditions as specified in MIL-STD 883, Method 1019, condition A.

(2) $\Delta|V_{OD}|$ and $\Delta|V_{OC}|$ are the changes in magnitude of $V_{OD}$ and $V_{OC}$, respectively, that occur when the input is changed from a high level to a low level.

(3) Negative sign of the limits indicates the direction of the current flow only.

## DC - Driver Electrical Characteristics[1] (continued)

The following conditions apply to all parameters, unless otherwise specified. $V_{CC}$ = 5.5V

| Symbol | Parameter | Conditions | Notes | Min | Max | Unit | Sub-group |
|---|---|---|---|---|---|---|---|
| $I_{OS}$ | Output Short Circuit | $V_{IN}$ = 3V, $V_{OUT}$ = $V_{CC}$ | | | 150 | mA | 1, 2, 3 |
| | | $V_{IN}$ = 3V, $V_{OUT}$ = -7V | See[4] | -250 | | mA | 1, 2, 3 |
| | | $V_{IN}$ = 3V, $V_{OUT}$ = 0V | | -150 | | mA | 1, 2, 3 |
| | | $V_{IN}$ = 3V, $V_{OUT}$ = 12V | | | 250 | mA | 1, 2, 3 |
| | | $V_{IN}$ = 0V, $V_{OUT}$ = 12V | | | 250 | mA | 1, 2, 3 |
| | | $V_{IN}$ = 0V, $V_{OUT}$ = $V_{CC}$ | | | 150 | mA | 1, 2, 3 |
| | | $V_{IN}$ = 0V, $V_{OUT}$ = -7V | See[4] | -250 | | mA | 1, 2, 3 |
| | | $V_{IN}$ = 0V, $V_{OUT}$ = 0V | | -150 | | mA | 1, 2, 3 |
| $V_{OH}$ | Logical "1" Output Voltage | $V_{CC}$ = 4.5V, $I_O$ = -20mA | | 3 | | V | 1, 2, 3 |
| $V_{OL}$ | Logical "0" Output Voltage | $V_{CC}$ = 4.5V, $I_O$ = 20mA | | | 2 | V | 1, 2, 3 |
| VOD3 | Differential Vout | $V_{CM}$ = -7V to 12V | | 1 | | V | 1, 2, 3 |

(4) Negative sign of the limits indicates the direction of the current flow only.

## DC - Receiver Electrical Characteristics[1]

The following conditions apply to all parameters, unless otherwise specified. $V_{CC}$ = 5.5V

| Symbol | Parameter | Conditions | Notes | Min | Max | Unit | Sub-group |
|---|---|---|---|---|---|---|---|
| $V_{OH}$ | Logical "1" Output Voltage (See Figure 5) | $V_{CC}$ = 4.5V, $V_{LD}$ = 200mV, $I_{OH}$ = -400uA | | 2.5 | | V | 1, 2, 3 |
| $V_{OL}$ | Logical "0" Output Voltage (See Figure 5) | $V_{CC}$ = 4.5V, $V_{LD}$ = -200mV, $I_{OL}$ = 8mA | | | .45 | V | 1, 2, 3 |
| | | $V_{CC}$ = 4.5V, $V_{LD}$ = -200mV, $I_{OL}$ = 16mA | | | .5 | V | 1, 2, 3 |
| $I_I$ | Line Input Current | Untested Input = 0V, $V_I$ = 12V | | | 1 | mA | 1, 2, 3 |
| | | Untested Input = 0V, $V_I$ = -7V | See[2] | -.8 | | mA | 1, 2, 3 |
| | | $V_{CC}$ = 0V, Untested Input = 0V, $V_I$ = 12V | See[2] | | 1 | mA | 1, 2, 3 |
| | | $V_{CC}$ = 0V, Untested Input = 0V, $V_I$ = -7V | | -.8 | | mA | 1, 2, 3 |
| $I_{IH}$ | Logical "1" Input Current | $V_I$ = 2.7V (Receiver) | | | 20 | uA | 1, 2, 3 |
| $R_{IN}$ | Input Resistance | Untested Input = 0V, $V_I$ = 12V | See[3] | 10 | | KΩ | 1, 2, 3 |
| | | Untested Input = 0V, $V_I$ = -7V | | 10 | | KΩ | 1, 2, 3 |
| | | $V_{CC}$ = 0V, Untested Input = 0V, $V_I$ = 12V | See[3] | 10 | | KΩ | 1, 2, 3 |
| | | $V_{CC}$ = 0V, Untested Input = 0V, $V_I$ = -7V | | 10 | | KΩ | 1, 2, 3 |
| $I_{OZ}$ | High Impedance State | $V_I$ = 0.4V | | -20 | 20 | uA | 1, 2, 3 |
| | | $V_I$ = 2.4V | | -20 | 20 | uA | 1, 2, 3 |

(1) Pre and post irradiation limits are identical to those listed under A C and DC electrical characteristics. These parts may be dose rate sensitive in a space environment and demonstrate enhanced low dose rate effect. Radiation end point limits for the noted parameters are ensured only for the conditions as specified in MIL-STD 883, Method 1019, condition A.
(2) Negative sign of the limits indicates the direction of the current flow only.
(3) $R_{IN}$ is guaranteed by testing "Line Input Current" (II).

Product Folder Links: *DS16F95QML*

## DC - Receiver Electrical Characteristics[1] (continued)

The following conditions apply to all parameters, unless otherwise specified. $V_{CC}$ = 5.5V

| Symbol | Parameter | Conditions | Notes | Min | Max | Unit | Sub-group |
|---|---|---|---|---|---|---|---|
| $I_{OS}$ | Output Short Circuit | $V_{IN}$ = 1V, $V_{OUT}$ = 0V | | -85 | -15 | mA | 1, 2, 3 |
| $V_{TH}$ | Differential Input High Threshold | $V_{CC}$ = 4.5V, $V_O$ = 2.5V, $V_{CM}$ = 12V & 0V & -7V, $I_O$ = -.4mA | | | .2 | V | 1, 2, 3 |
| | | $V_{CC}$ = 5.5V, Vo = 2.5V, $V_{CM}$ = 12V & 0V & -7V, $I_O$ = -.4mA | | | .2 | V | 1, 2, 3 |
| $V_T1$ | Differential Input Low Threshold | $V_{CC}$ = 4.5V, $V_O$ = .5V, $V_{CM}$ = 12V & 0V & -7V, $I_O$ = 8mA | | -.2 | | V | 1, 2, 3 |
| | | $V_{CC}$ = 5.5V, $V_O$ = .5V, $V_{CM}$ = 12V & 0V & -7V, $I_O$ = 8mA | | -.2 | | V | 1, 2, 3 |
| $V_{TH}$+ - ($V_{TH}$-) | Hyteresis | $V_{CC}$ = 4.5V, $V_{CM}$ = 0V | | 35 | | mV | 1, 2, 3 |
| | | $V_{CC}$ = 5.5V, $V_{CM}$ = 0V | | 35 | | mV | 1, 2, 3 |

## DC - Both Driver and Receiver Electrical Characteristics[1]

The following conditions apply to all parameters, unless otherwise specified. $V_{CC}$ = 5.5V

| Symbol | Parameter | Conditions | Notes | Min | Max | Unit | Sub-group |
|---|---|---|---|---|---|---|---|
| $I_{CC}$ | Supply Current $I_{CC}$ Both Disable | $\overline{RE}$ = 2V, $\overline{DE}$ = .8V | | | 25 | mA | 1, 2, 3 |
| $I_{CC}$ | Supply Current $I_{CC}$ Both Enable | $\overline{RE}$ =.8V, $\overline{DE}$ = 2V | | | 28 | mA | 1, 2, 3 |
| $V_{IC}$ | Input Clamp Volt | $I_I$ = -18mA | | -1.3 | | V | 1, 2, 3 |
| $V_{IH}$ | Logical "1" Input Voltage | | | 2 | | V | 1, 2, 3 |
| $V_{IL}$ | Logical "0" Input Voltage | | | | .8 | V | 1, 2, 3 |
| $V_{IH}$ | Logical "1" Enable Input Voltage | | | 2 | | V | 1, 2, 3 |
| $V_{IL}$ | Logical "0" Enable Input Voltage | | | | .8 | V | 1, 2, 3 |
| $I_{IL}$ | Logical "0" Input Current | $V_I$ = 0.4V | See[2] | -50 | | uA | 1, 2, 3 |

(1) Pre and post irradiation limits are identical to those listed under A C and DC electrical characteristics. These parts may be dose rate sensitive in a space environment and demonstrate enhanced low dose rate effect. Radiation end point limits for the noted parameters are ensured only for the conditions as specified in MIL-STD 883, Method 1019, condition A.
(2) Negative sign of the limits indicates the direction of the current flow only.

## AC - Driver Electrical Characteristics[1]

The following conditions apply to all parameters, unless otherwise specified.
$V_{CC}$ = 5V, PRR = 1MH$_Z$, $T_R$ ≤ $T_F$ ≤ 6nS, 50% duty cycle, AMP = 3V, VL$_O$, $Z_{OUT}$ = 50Ω

| Symbol | Parameter | Conditions | Notes | Min | Max | Unit | Sub-group |
|---|---|---|---|---|---|---|---|
| $t_{DD}$ | Differential Output Delay Time (See Figure 6) | $R_L$ = 60Ω | See[2] | 8 | 25 | nS | 9 |
| | | | | 8 | 30 | nS | 10, 11 |
| $t_{TD}$ | Differential Output Transition Time (See Figure 6) | $R_L$ = 60Ω | See[2][3] | 8 | 25 | nS | 9 |
| | | | | 8 | 30 | nS | 10, 11 |
| $t_{PLH}$ | Propagation Delay Time Low to High (See Figure 7) | $R_L$ = 27Ω | | 6 | 18 | nS | 9 |
| | | | | 6 | 25 | nS | 10, 11 |
| $t_{PHL}$ | Propagation Delay Time high to Low (See Figure 7) | $R_L$ = 27Ω | | 6 | 18 | nS | 9 |
| | | | | 6 | 25 | nS | 10, 11 |
| $t_{PZH}$ | Output Enable Time to H (See Figure 8) | $R_L$ = 110Ω | | | 35 | nS | 9 |
| | | | | | 45 | nS | 10, 11 |
| $t_{PZL}$ | Output Enable Time to L (See Figure 9) | $R_L$ = 110Ω | | | 40 | nS | 9 |
| | | | | | 50 | nS | 10, 11 |

(1) Pre and post irradiation limits are identical to those listed under A C and DC electrical characteristics. These parts may be dose rate sensitive in a space environment and demonstrate enhanced low dose rate effect. Radiation end point limits for the noted parameters are ensured only for the conditions as specified in MIL-STD 883, Method 1019, condition A.
(2) Rise time 20% to 80%, Fall time 80% to 20%.
(3) tD = Non-inverting output rise time + inverting output fall time / 2, Non-inverting output fall time + inverting output rise time / 2.

## AC - Driver Electrical Characteristics[1] (continued)

The following conditions apply to all parameters, unless otherwise specified.

$V_{CC}$ = 5V, PRR = 1MH$_Z$, $T_R$ ≤ $T_F$ ≤ 6nS, 50% duty cycle, AMP = 3V, VL$_O$, $Z_{OUT}$ = 50Ω

| Symbol | Parameter | Conditions | Notes | Min | Max | Unit | Sub-group |
|---|---|---|---|---|---|---|---|
| $t_{PHZ}$ | Output Disable Time to H (See Figure 8) | RL = 110Ω | | | 30 | nS | 9 |
| | | | | | 40 | nS | 10, 11 |
| $t_{PLZ}$ | Output Disable Time to L (See Figure 9) | $R_L$ = 110Ω | | | 30 | nS | 9 |
| | | | | | 40 | nS | 10, 11 |
| $T_{SKEW}$ | Differential Output Skew Time (See Figure 6) | | | | 6 | nS | 9 |
| | | | | | 12 | nS | 10, 11 |

## AC - Receiver Electrical Characteristics[1]

The following conditions apply to all parameters, unless otherwise specified.

$V_{CC}$ = 5V, PRR = 1MH$_Z$, $T_R$ ≤ $T_F$ ≤ 6nS, 50% duty cycle, AMP = 3V, VL$_O$, $Z_{OUT}$ = 50Ω

| Symbol | Parameter | Conditions | Notes | Min | Max | Unit | Sub-group |
|---|---|---|---|---|---|---|---|
| $t_{PLH}$ | Propagation Delay Time Low to High (See Figure 10) | $C_L$ = 15pF | | 10 | 27 | nS | 9 |
| | | | | 10 | 38 | nS | 10, 11 |
| $t_{PHL}$ | Propagation Delay Time High to Low (See Figure 10) | $C_L$ = 15pF | | 10 | 27 | nS | 9 |
| | | | | 10 | 38 | nS | 10, 11 |
| $t_{PZH}$ | Output Enable Time to H (See Figure 11) | $C_L$ = 15pF | | | 20 | nS | 9 |
| | | | | | 30 | nS | 10, 11 |
| $t_{PZL}$ | Output Enable Time to L (See Figure 11) | $C_L$ = 15pF | | | 20 | nS | 9 |
| | | | | | 30 | nS | 10, 11 |
| $|t_{PLH} - t_{PHL}|$ | Output to Output Delay Time (See Figure 10) | | | | 8 | nS | 9 |
| | | | | | 16 | nS | 10, 11 |
| $t_{PHZ}$ | Output Disable Time From H (See Figure 11) | $C_L$ = 20pF | See[2] | | 30 | nS | 9 |
| | | | | | 40 | nS | 10, 11 |
| | | $C_L$ = 5pF | See[2] | | 20 | nS | 9 |
| | | | | | 30 | nS | 10, 11 |
| $t_{PLZ}$ | Output Disable Time From L (See Figure 11) | $C_L$ = 5pF | | | 20 | nS | 9 |
| | | | | | 30 | nS | 10, 11 |

(1) Pre and post irradiation limits are identical to those listed under A C and DC electrical characteristics. These parts may be dose rate sensitive in a space environment and demonstrate enhanced low dose rate effect. Radiation end point limits for the noted parameters are ensured only for the conditions as specified in MIL-STD 883, Method 1019, condition A.
(2) Testing at 20pF assures conformance to spec at 5pF.

Product Folder Links: *DS16F95QML*

## Parameter Measurement Information
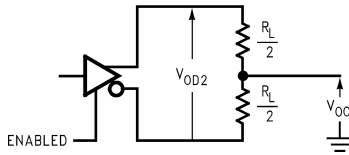


**Figure 4. Driver V$_{OD}$ and V$_{OC}$[1]**
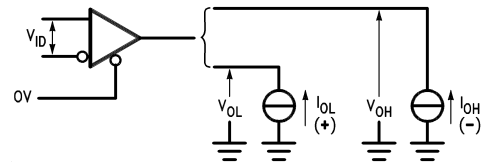


**Figure 5. Receiver V$_{OH}$ and V$_{OL}$**
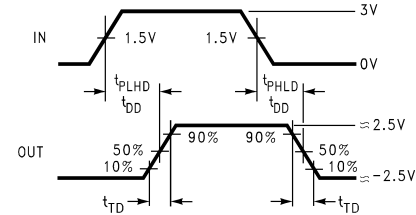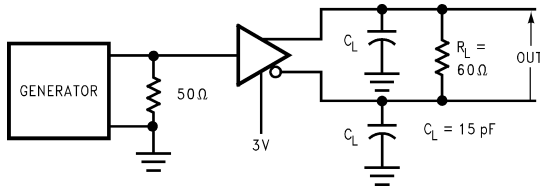


$$t_{SKEW} = |t_{PLHD} - t_{PHLD}|$$

**Figure 6. Driver Differential Output Delay and Transition Times[2][3]**
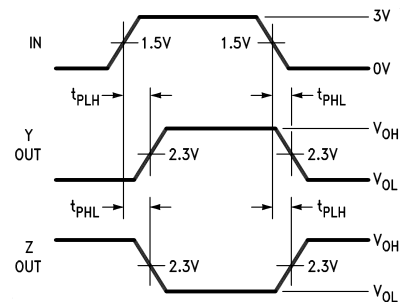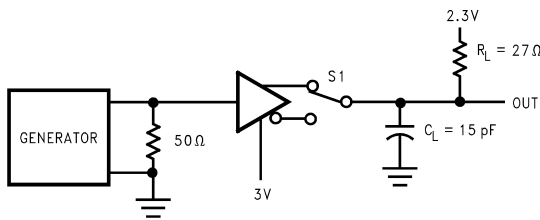


**Figure 7. Driver Propagation Times[2][4]**
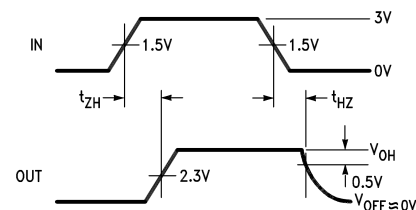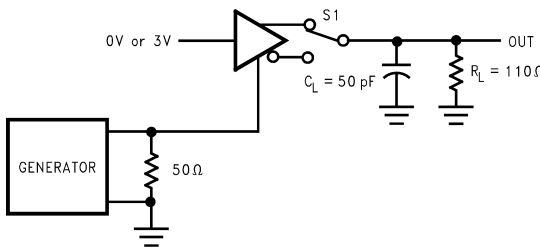


**Figure 8. Driver Enable and Disable Times (t$_{ZH}$, t$_{HZ}$)[2][3][4]**

(1) All diodes are 1N916 or equivalent.
(2) The input pulse is supplied by a generator having the following characteristics: PRR = 1.0 MHz, 50% duty cycle, t$_r$ ≤ 6.0 ns, t$_f$ ≤ 6.0 ns, Z$_O$ = 50Ω.
(3) DS16F95 Driver enable is Active-High.
(4) C$_L$ includes probe and stray capacitance.
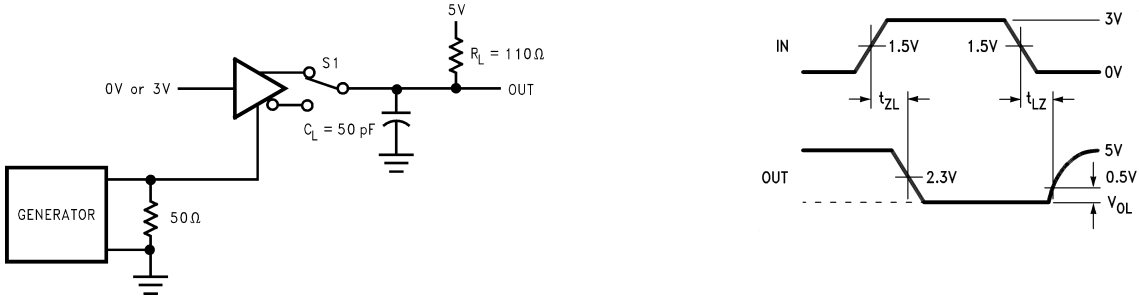
**Figure 9.  Driver Enable and Disable Times ($t_{ZL}$, $t_{LZ}$)[1][2][3]**



**Figure 10.  Receiver Propagation Delay Times[1][3]**
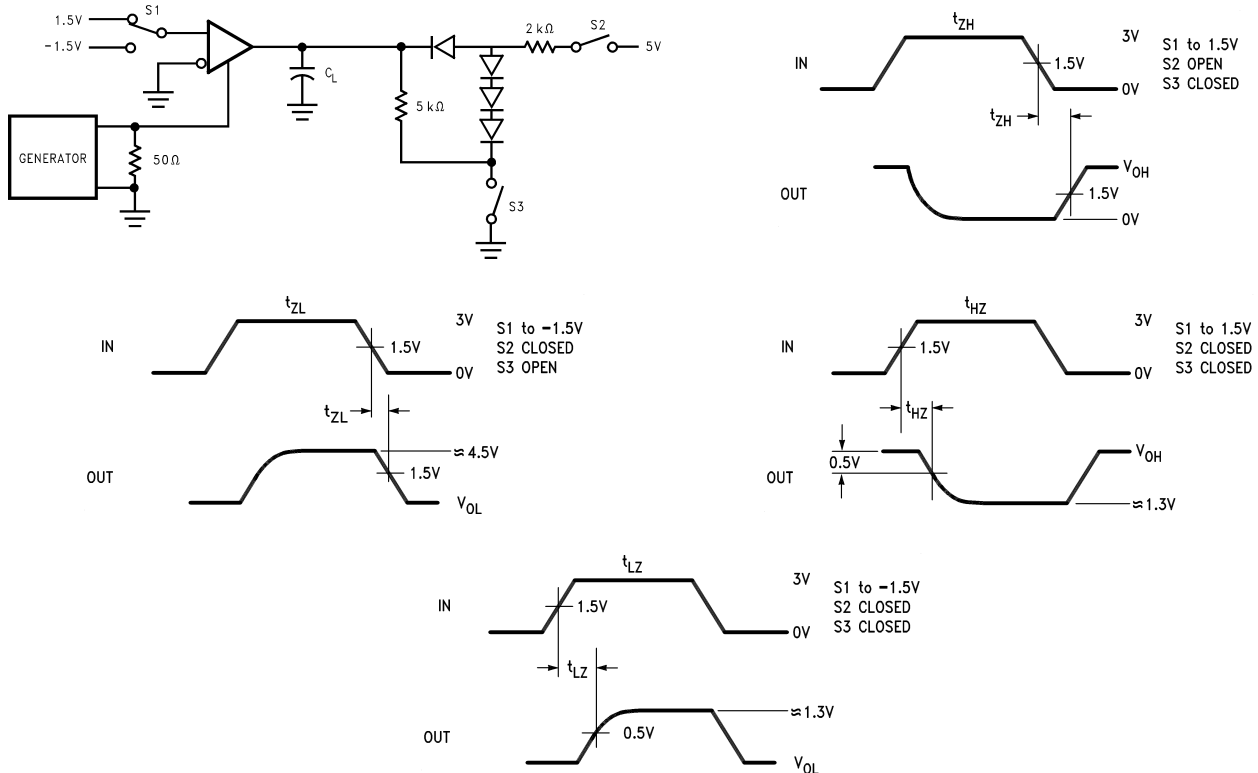


**Figure 11. Receiver Enable and Disable Times[1][3][4]**

(1) The input pulse is supplied by a generator having the following characteristics: PRR = 1.0 MHz, 50% duty cycle, $t_r$ ≤ 6.0 ns, $t_f$ ≤ 6.0 ns, $Z_O$ = 50Ω.
(2) DS16F95 Driver enable is Active-High.
(3) $C_L$ includes probe and stray capacitance.
(4) All diodes are 1N916 or equivalent.

Product Folder Links: *DS16F95QML*

## Typical Application



UP TO 32
TRANSCEIVERS
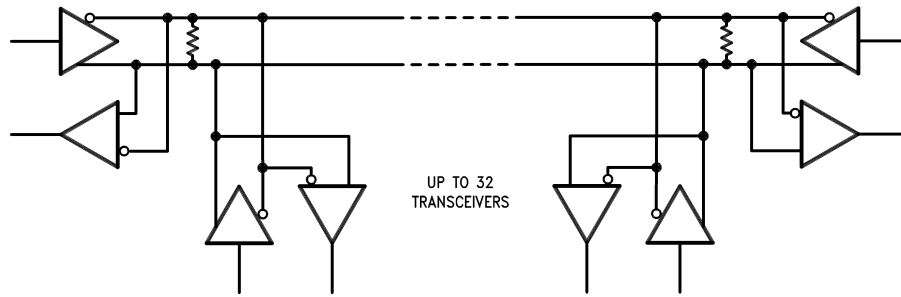
The line should be terminated at both ends in its characteristic impedance, typically 120Ω.
Stub lengths off the main line should be kept as short as possible.

## REVISION HISTORY

| Date Released | Revision | Section | Changes |
|---|---|---|---|
| 9/23/2005 | A | New Release, Corporate format | 1 MDS data sheet converted into Corporate data sheet format. MDS data sheet MNDS16F95-X-RH, Rev. 0A1 will be Archived. |
| 10/26/2010 | B | Features, Ordering Table, Connection Diagrams W pkg, Absolute Ratings, Electricals - DC Receiver $V_T$1, AC Driver conditions, Physical Dimensions Mkt drawing | Update with current device information and format. Correction to rad info., Code K NSID's removed, removed reference to WG pkg, typo correction to conditions, Removed WG pkg drawing. Revision A will be Archived |
| 4/12/2013 | B | All | Changed layout of National Data Sheet to TI format. |

Product Folder Links: *DS16F95QML*

![Texas Instruments logo]

## PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) | Op Temp (°C) | Top-Side Markings (4) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5962-89615012A | ACTIVE | LCCC | NAJ | 20 | 50 | TBD | Call TI | Call TI | -55 to 125 | DS16F95E /883 Q 5962-89615 012A ACO 012A >T | Samples |
| 5962-8961501PA | ACTIVE | CDIP | NAB | 8 | 40 | TBD | Call TI | Call TI | -55 to 125 | DS16F95J/883 5962-89615 01PA Q ACO (DS9638J/883 ~ DS9638J/883) 01PA Q >T | Samples |
| 5962F8961501VHA | ACTIVE | CFP | NAD | 10 | 19 | TBD | Call TI | Call TI | -55 to 125 | DS16F95 WFQMLV Q 5962F89615 01VHA ACO 01VHA >T | Samples |
| DS16F95E/883 | ACTIVE | LCCC | NAJ | 20 | 50 | TBD | Call TI | Call TI | -55 to 125 | DS16F95E /883 Q 5962-89615 012A ACO 012A >T | Samples |
| DS16F95J/883 | ACTIVE | CDIP | NAB | 8 | 40 | TBD | Call TI | Call TI | -55 to 125 | DS16F95J/883 5962-89615 01PA Q ACO (DS9638J/883 ~ DS9638J/883) 01PA Q >T | Samples |
| DS16F95W/883 | ACTIVE | CFP | NAD | 10 | 19 | TBD | Call TI | Call TI | -55 to 125 | DS16F95W /883 Q ACO /883 Q >T | Samples |
| DS16F95WFQMLV | ACTIVE | CFP | NAD | 10 | 19 | TBD | Call TI | Call TI | -55 to 125 | DS16F95 WFQMLV Q 5962F89615 01VHA ACO 01VHA >T | Samples |

**(1)** The marketing status values are defined as follows:
**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.
**OBSOLETE:** TI has discontinued the production of the device.

[2] Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
**TBD:** The Pb-Free/Green conversion plan has not been defined.
**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

[3] MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

[4] Multiple Top-Side Markings will be inside parentheses. Only one Top-Side Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Top-Side Marking for that device.

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**OTHER QUALIFIED VERSIONS OF DS16F95QML, DS16F95QML-SP :**

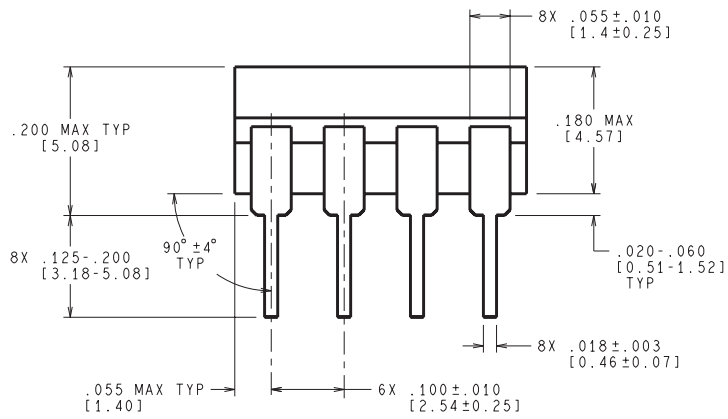- Military: DS16F95QML

- Space: DS16F95QML-SP

NOTE: Qualified Version Definitions:

- Military - QML certified for Military and Defense Applications

- Space - Radiation tolerant, ceramic packaging and qualified for use in Space-based application
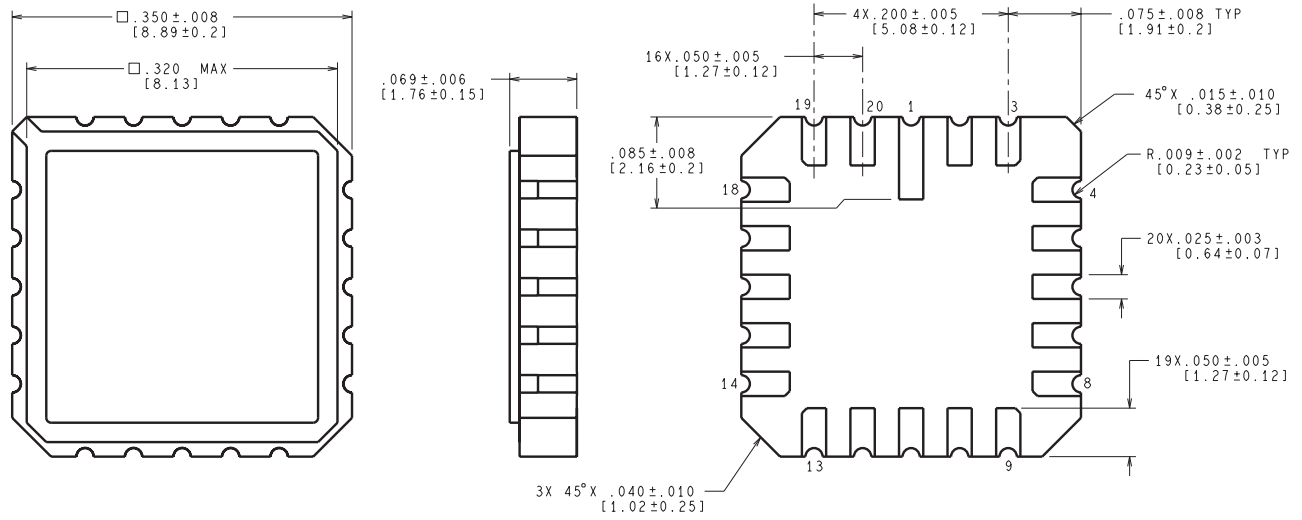
# NAB0008A

.400 MAX
[10.16]

8          5

.310 MAX
[7.87]

R.025
[0.64]

R.010 TYP
[0.25]

1          4

CONTROLLING DIMENSION IS INCH
VALUES IN [ ] ARE MILLIMETERS

8X .055±.010
[1.4±0.25]

.200 MAX TYP
[5.08]

.180 MAX
[4.57]

.290-.320
[7.37-8.13]

GLASS SEALANT

8X .125-.200
[3.18-5.08]

90° ±4°
TYP

.020-.060
[0.51-1.52]
TYP

95° ±5°
TYP

8X .010±.002
[0.25±0.05]

8X .018±.003
[0.46±0.07]

.055 MAX TYP
[1.40]

6X .100±.010
[2.54±0.25]

.310-.410
[7.87-10.41]

J08A (Rev M)

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NAJ0020A

```
     .350±.008
    [8.89±0.2]

     .320  MAX
    [8.13]
```

```
.069±.006
[1.76±0.15]
```

```
4X .200±.005
[5.08±0.12]

16X .050±.005
[1.27±0.12]

.085±.008
[2.16±0.2]
```

```
.075±.008 TYP
[1.91±0.2]

45° X .015±.010
[0.38±0.25]

R .009±.002  TYP
[0.23±0.05]

20X .025±.003
[0.64±0.07]

19X .050±.005
[1.27±0.12]
```

```
19   20   1        3

18                      4

14                      8

13             9
```

```
3X  45° X  .040±.010
    [1.02±0.25]
```

CONTROLLING DIMENSION IS INCH
VALUES IN [ ] ARE MILLIMETERS

E20A (Rev F)

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# NAD0010A

.067 +.013 -.012

.045
.026

.27 MAX

.005 MIN TYP

10                    6

5X .32±.01

.27 MAX
GLASS

.241 +.019 -.003

PIN #1 ID

5X .32±.01

1                     5

.005±.001 TYP

.010±.002

10X .017±.002

.045 MAX TYP

8X .050±.005

**DIMENSIONS ARE IN INCHES**

W10A (Rev H)

## IMPORTANT NOTICE

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