

# MC10E195, MC100E195

## 5V ECL Programmable Delay Chip

### Description

The MC10E/100E195 is a programmable delay chip (PDC) designed primarily for clock de-skewing and timing adjustment. It provides variable delay of a differential ECL input transition.

The delay section consists of a chain of gates organized as shown in the logic symbol. The first two delay elements feature gates that have been modified to have delays 1.25 and 1.5 times the basic gate delay of approximately 80 ps. These two elements provide the E195 with a digitally-selectable resolution of approximately 20 ps. The required device delay is selected by the seven address inputs D[0:6], which are latched on chip by a high signal on the latch enable (LEN) control.

Because the delay programmability of the E195 is achieved by purely differential ECL gate delays the device will operate at frequencies of > 1.0 GHz while maintaining over 600 mV of output swing.

The E195 thus offers very fine resolution, at very high frequencies, that is selectable entirely from a digital input allowing for very accurate system clock timing.

An eighth latched input, D7, is provided for cascading multiple PDC's for increased programmable range. The cascade logic allows full control of multiple PDC's, at the expense of only a single added line to the data bus for each additional PDC, without the need for any external gating.

The  $V_{BB}$  pin, an internally generated voltage supply, is available to this device only. For single-ended input conditions, the unused differential input is connected to  $V_{BB}$  as a switching reference voltage.  $V_{BB}$  may also rebias AC coupled inputs. When used, decouple  $V_{BB}$  and  $V_{CC}$  via a 0.01  $\mu$ F capacitor and limit current sourcing or sinking to 0.5 mA. When not used,  $V_{BB}$  should be left open.

The 100 Series contains temperature compensation.

### Features

- 2.0 ns Worst Case Delay Range
- $\approx 20$  ps/Delay Step Resolution
- >1.0 GHz Bandwidth
- On Chip Cascade Circuitry
- PECL Mode Operating Range:  $V_{CC} = 4.2$  V to 5.7 V with  $V_{EE} = 0$  V
- NECL Mode Operating Range:  $V_{CC} = 0$  V with  $V_{EE} = -4.2$  V to  $-5.7$  V
- Internal Input 50 k $\Omega$  Pulldown Resistors
- ESD Protection: Human Body Model; > 2 kV, Machine Model; > 200 V

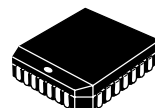
- Meets or Exceeds JEDEC Spec EIA/JESD78 IC Latchup Test
- Moisture Sensitivity Level: Pb = 1; Pb-Free = 3 For Additional Information, see Application Note AND8003/D
- Flammability Rating: UL 94 V-0 @ 0.125 in, Oxygen Index: 28 to 34
- Transistor Count = 368 devices
- Pb-Free Packages are Available\*

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



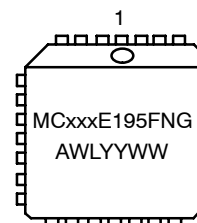
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<http://onsemi.com>



PLCC-28  
FN SUFFIX  
CASE 776

### MARKING DIAGRAM\*



|     |                     |
|-----|---------------------|
| xxx | = 10 or 100         |
| A   | = Assembly Location |
| WL  | = Wafer Lot         |
| YY  | = Year              |
| WW  | = Work Week         |
| G   | = Pb-Free Package   |

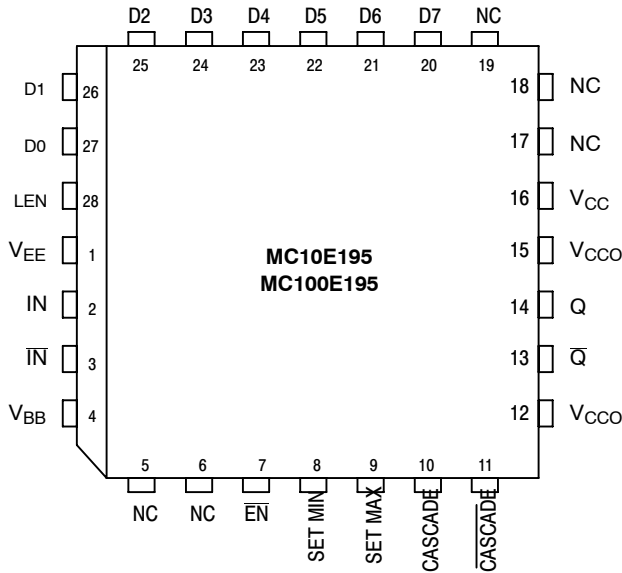
\*For additional marking information, refer to Application Note AND8002/D.

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 9 of this data sheet.

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## LOGIC DIAGRAM AND PINOUT ASSIGNMENT



\*All V<sub>CC</sub> and V<sub>CCO</sub> pins are tied together on the die.

Warning: All V<sub>CC</sub>, V<sub>CCO</sub>, and V<sub>EE</sub> pins must be externally connected to Power Supply to guarantee proper operation.

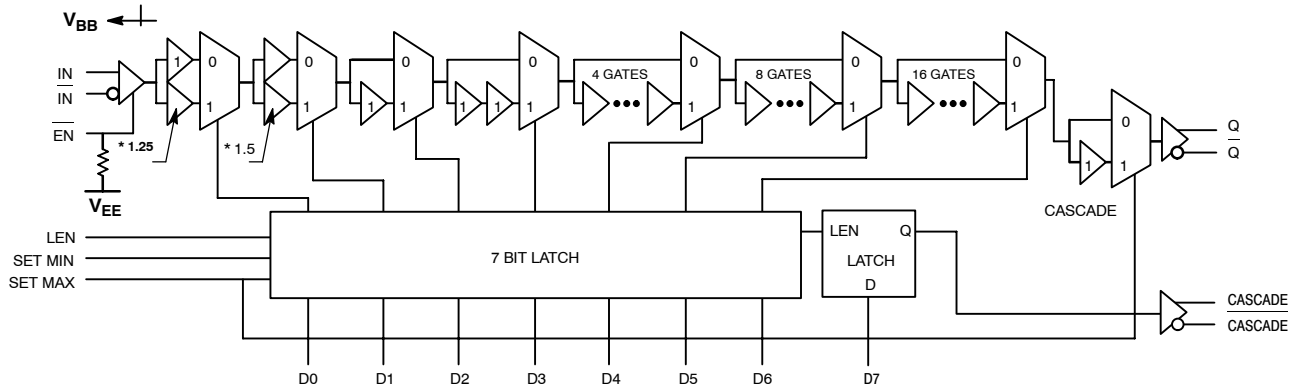
**Figure 1. Pinout: 28-Lead PLCC**  
(Top View)

**Table 1. PIN DESCRIPTION**

| PIN                                | FUNCTION                 |
|------------------------------------|--------------------------|
| IN/IN                              | ECL Signal Input         |
| EN                                 | ECL Input Enable         |
| D[0:7]                             | ECL MUX Select Inputs    |
| Q/Q                                | ECL Signal Output        |
| LEN                                | ECL Latch Enable         |
| SET MIN                            | ECL Min Delay Set        |
| SET MAX                            | ECL Max Delay Set        |
| CASCADE, CASCADE                   | ECL Cascade Signal       |
| V <sub>BB</sub>                    | Reference Voltage Output |
| V <sub>CC</sub> , V <sub>CCO</sub> | Positive Supply          |
| V <sub>EE</sub>                    | Negative Supply          |
| NC                                 | No Connect               |

**Table 2. TRUTH TABLE**

| EN     | L | Q = IN               |
|--------|---|----------------------|
| EN     | H | Q Logic Low          |
| LEN    | L | Pass Through D[0:10] |
| LEN    | H | Latch D[0:10]        |
| SETMIN | L | Normal Mode          |
| SETMIN | H | Min Delay Path       |
| SETMAX | L | Normal Mode          |
| SETMAX | H | Max Delay Path       |



\* delays are 25% or 50% longer than standard (standard ≈ 80 ps)

**Figure 2. Logic Diagram – Simplified**

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**Table 3. MAXIMUM RATINGS**

| Symbol        | Parameter                                | Condition 1           | Condition 2       | Rating       | Unit |
|---------------|------------------------------------------|-----------------------|-------------------|--------------|------|
| $V_{CC}$      | PECL Mode Power Supply                   | $V_{EE} = 0\text{ V}$ |                   | 8            | V    |
| $V_{EE}$      | NECL Mode Power Supply                   | $V_{CC} = 0\text{ V}$ |                   | -8           | V    |
| $V_I$         | PECL Mode Input Voltage                  | $V_{EE} = 0\text{ V}$ | $V_I \leq V_{CC}$ | 6            | V    |
|               | NECL Mode Input Voltage                  | $V_{CC} = 0\text{ V}$ | $V_I \geq V_{EE}$ | -6           | V    |
| $I_{out}$     | Output Current                           | Continuous<br>Surge   |                   | 50           | mA   |
|               |                                          |                       |                   | 100          | mA   |
| $I_{BB}$      | $V_{BB}$ Sink/Source                     |                       |                   | $\pm 0.5$    | mA   |
| $T_A$         | Operating Temperature Range              |                       |                   | 0 to +85     | °C   |
| $T_{stg}$     | Storage Temperature Range                |                       |                   | -65 to +150  | °C   |
| $\theta_{JA}$ | Thermal Resistance (Junction-to-Ambient) | 0 lfpm                | PLCC-28           | 63.5         | °C/W |
|               |                                          | 500 lfpm              | PLCC-28           | 43.5         | °C/W |
| $\theta_{JC}$ | Thermal Resistance (Junction-to-Case)    | Standard Board        | PLCC-28           | 22 to 26     | °C/W |
| $V_{EE}$      | PECL Operating Range                     |                       |                   | 4.2 to 5.7   | V    |
|               | NECL Operating Range                     |                       |                   | -5.7 to -4.2 | V    |
| $T_{sol}$     | Wave Solder                              |                       |                   | 265          | °C   |
|               | Pb<br>Pb-Free                            |                       |                   | 265          | °C   |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

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**Table 4. 10E SERIES PECL DC CHARACTERISTICS**  $V_{CCx} = 5.0 \text{ V}$ ;  $V_{EE} = 0.0 \text{ V}$  (Note 1)

| Symbol      | Characteristic                                                             | 0°C  |      |      | 25°C |      |      | 85°C |      |      | Unit          |
|-------------|----------------------------------------------------------------------------|------|------|------|------|------|------|------|------|------|---------------|
|             |                                                                            | Min  | Typ  | Max  | Min  | Typ  | Max  | Min  | Typ  | Max  |               |
| $I_{EE}$    | Power Supply Current                                                       |      | 130  | 156  |      | 130  | 156  |      | 130  | 156  | mA            |
| $V_{OH}$    | Output HIGH Voltage (Note 2)                                               | 3980 | 4070 | 4160 | 4020 | 4105 | 4190 | 4090 | 4185 | 4280 | mV            |
| $V_{OL}$    | Output LOW Voltage (Note 2)                                                | 3050 | 3210 | 3370 | 3050 | 3210 | 3370 | 3050 | 3227 | 3405 | mV            |
| $V_{IH}$    | Input HIGH Voltage (Single-Ended)                                          | 3830 | 3995 | 4160 | 3870 | 4030 | 4190 | 3940 | 4110 | 4280 | mV            |
| $V_{IL}$    | Input LOW Voltage (Single-Ended)                                           | 3050 | 3285 | 3520 | 3050 | 3285 | 3520 | 3050 | 3302 | 3555 | mV            |
| $V_{BB}$    | Output Voltage Reference                                                   | 3.62 |      | 3.74 | 3.65 |      | 3.75 | 3.69 |      | 3.81 | V             |
| $V_{IHCMR}$ | Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 3) | 2.2  |      | 4.6  | 2.2  |      | 4.6  | 2.2  |      | 4.6  | V             |
| $I_{IH}$    | Input HIGH Current                                                         |      |      | 150  |      |      | 150  |      |      | 150  | $\mu\text{A}$ |
| $I_{IL}$    | Input LOW Current                                                          | 0.5  | 0.3  |      | 0.5  | 0.25 |      | 0.3  | 0.2  |      | $\mu\text{A}$ |

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lfm. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

1. Input and output parameters vary 1:1 with  $V_{CC}$ .  $V_{EE}$  can vary  $-0.46 \text{ V} / +0.06 \text{ V}$ .
2. Outputs are terminated through a  $50 \Omega$  resistor to  $V_{CC} - 2.0 \text{ V}$ .
3.  $V_{IHCMR}$  min varies 1:1 with  $V_{EE}$ , max varies 1:1 with  $V_{CC}$ .

**Table 5. 10E SERIES NECL DC CHARACTERISTICS**  $V_{CCx} = 0.0 \text{ V}$ ;  $V_{EE} = -5.0 \text{ V}$  (Note 4)

| Symbol      | Characteristic                                                             | 0°C   |       |       | 25°C  |       |       | 85°C  |       |       | Unit          |
|-------------|----------------------------------------------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---------------|
|             |                                                                            | Min   | Typ   | Max   | Min   | Typ   | Max   | Min   | Typ   | Max   |               |
| $I_{EE}$    | Power Supply Current                                                       |       | 130   | 156   |       | 130   | 156   |       | 130   | 156   | mA            |
| $V_{OH}$    | Output HIGH Voltage (Note 5)                                               | -1020 | -930  | -840  | -980  | -895  | -810  | -910  | -815  | -720  | mV            |
| $V_{OL}$    | Output LOW Voltage (Note 5)                                                | -1950 | -1790 | -1630 | -1950 | -1790 | -1630 | -1950 | -1773 | -1595 | mV            |
| $V_{IH}$    | Input HIGH Voltage (Single-Ended)                                          | -1170 | -1005 | -840  | -1130 | -970  | -810  | -1060 | -890  | -720  | mV            |
| $V_{IL}$    | Input LOW Voltage (Single-Ended)                                           | -1950 | -1715 | -1480 | -1950 | -1715 | -1480 | -1950 | -1698 | -1445 | mV            |
| $V_{BB}$    | Output Voltage Reference                                                   | -1.38 |       | -1.27 | -1.35 |       | -1.25 | -1.31 |       | -1.19 | V             |
| $V_{IHCMR}$ | Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 6) | -2.8  |       | -0.4  | -2.8  |       | -0.4  | -2.8  |       | -0.4  | V             |
| $I_{IH}$    | Input HIGH Current                                                         |       |       | 150   |       |       | 150   |       |       | 150   | $\mu\text{A}$ |
| $I_{IL}$    | Input LOW Current                                                          | 0.5   | 0.3   |       | 0.5   | 0.065 |       | 0.3   | 0.2   |       | $\mu\text{A}$ |

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lfm. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

4. Input and output parameters vary 1:1 with  $V_{CC}$ .  $V_{EE}$  can vary  $-0.46 \text{ V} / +0.06 \text{ V}$ .
5. Outputs are terminated through a  $50 \Omega$  resistor to  $V_{CC} - 2.0 \text{ V}$ .
6.  $V_{IHCMR}$  min varies 1:1 with  $V_{EE}$ , max varies 1:1 with  $V_{CC}$ .

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**Table 6. 100E SERIES PECL DC CHARACTERISTICS**  $V_{CCx} = 5.0 \text{ V}$ ;  $V_{EE} = 0.0 \text{ V}$  (Note 7)

| Symbol      | Characteristic                                                             | 0°C  |      |      | 25°C |      |      | 85°C |      |      | Unit          |
|-------------|----------------------------------------------------------------------------|------|------|------|------|------|------|------|------|------|---------------|
|             |                                                                            | Min  | Typ  | Max  | Min  | Typ  | Max  | Min  | Typ  | Max  |               |
| $I_{EE}$    | Power Supply Current                                                       |      | 130  | 156  |      | 130  | 156  |      | 150  | 179  | mA            |
| $V_{OH}$    | Output HIGH Voltage (Note 8)                                               | 3975 | 4050 | 4120 | 3975 | 4050 | 4120 | 3975 | 4050 | 4120 | mV            |
| $V_{OL}$    | Output LOW Voltage (Note 8)                                                | 3190 | 3295 | 3380 | 3190 | 3255 | 3380 | 3190 | 3260 | 3380 | mV            |
| $V_{IH}$    | Input HIGH Voltage (Single-Ended)                                          | 3835 | 3975 | 4120 | 3835 | 3975 | 4120 | 3835 | 3975 | 4120 | mV            |
| $V_{IL}$    | Input LOW Voltage (Single-Ended)                                           | 3190 | 3355 | 3525 | 3190 | 3355 | 3525 | 3190 | 3355 | 3525 | mV            |
| $V_{BB}$    | Output Voltage Reference                                                   | 3.62 |      | 3.74 | 3.62 |      | 3.74 | 3.62 |      | 3.74 | V             |
| $V_{IHCMR}$ | Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 9) | 2.2  |      | 4.6  | 2.2  |      | 4.6  | 2.2  |      | 4.6  | V             |
| $I_{IH}$    | Input HIGH Current                                                         |      |      | 150  |      |      | 150  |      |      | 150  | $\mu\text{A}$ |
| $I_{IL}$    | Input LOW Current                                                          | 0.5  | 0.3  |      | 0.5  | 0.25 |      | 0.5  | 0.2  |      | $\mu\text{A}$ |

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lpm. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

7. Input and output parameters vary 1:1 with  $V_{CC}$ .  $V_{EE}$  can vary  $-0.46 \text{ V} / +0.8 \text{ V}$ .

8. Outputs are terminated through a  $50 \Omega$  resistor to  $V_{CC} - 2.0 \text{ V}$ .

9.  $V_{IHCMR}$  min varies 1:1 with  $V_{EE}$ , max varies 1:1 with  $V_{CC}$ .

**Table 7. 100E SERIES NECL DC CHARACTERISTICS**  $V_{CCx} = 0.0 \text{ V}$ ;  $V_{EE} = -5.0 \text{ V}$  (Note 10)

| Symbol      | Characteristic                                                              | 0°C   |       |       | 25°C  |       |       | 85°C  |       |       | Unit          |
|-------------|-----------------------------------------------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---------------|
|             |                                                                             | Min   | Typ   | Max   | Min   | Typ   | Max   | Min   | Typ   | Max   |               |
| $I_{EE}$    | Power Supply Current                                                        |       | 130   | 156   |       | 130   | 156   |       | 150   | 179   | mA            |
| $V_{OH}$    | Output HIGH Voltage (Note 11)                                               | -1025 | -950  | -880  | -1025 | -950  | -880  | -1025 | -950  | -880  | mV            |
| $V_{OL}$    | Output LOW Voltage (Note 11)                                                | -1810 | -1705 | -1620 | -1810 | -1745 | -1620 | -1810 | -1740 | -1620 | mV            |
| $V_{IH}$    | Input HIGH Voltage (Single-Ended)                                           | -1165 | -1025 | -880  | -1165 | -1025 | -880  | -1165 | -1025 | -880  | mV            |
| $V_{IL}$    | Input LOW Voltage (Single-Ended)                                            | -1810 | -1645 | -1475 | -1810 | -1645 | -1475 | -1810 | -1645 | -1475 | mV            |
| $V_{BB}$    | Output Voltage Reference                                                    | -1.38 |       | -1.26 | -1.38 |       | -1.26 | -1.38 |       | -1.26 | V             |
| $V_{IHCMR}$ | Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 12) | -2.8  |       | -0.4  | -2.8  |       | -0.4  | -2.8  |       | -0.4  | V             |
| $I_{IH}$    | Input HIGH Current                                                          |       |       | 150   |       |       | 150   |       |       | 150   | $\mu\text{A}$ |
| $I_{IL}$    | Input LOW Current                                                           | 0.5   | 0.3   |       | 0.5   | 0.25  |       | 0.5   | 0.2   |       | $\mu\text{A}$ |

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lpm. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

10. Input and output parameters vary 1:1 with  $V_{CC}$ .  $V_{EE}$  can vary  $-0.46 \text{ V} / +0.8 \text{ V}$ .

11. Outputs are terminated through a  $50 \Omega$  resistor to  $V_{CC} - 2.0 \text{ V}$ .

12.  $V_{IHCMR}$  min varies 1:1 with  $V_{EE}$ , max varies 1:1 with  $V_{CC}$ .

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**Table 8. AC CHARACTERISTICS**  $V_{CCx} = 5.0\text{ V}$ ;  $V_{EE} = 0.0\text{ V}$  or  $V_{CCx} = 0.0\text{ V}$ ;  $V_{EE} = -5.0\text{ V}$  (Note 13)

| Symbol                 | Characteristic                                                                                                | 0°C                         |                                             |                             | 25°C                        |                                               |                             | 85°C                        |                                             |                                  | Unit |
|------------------------|---------------------------------------------------------------------------------------------------------------|-----------------------------|---------------------------------------------|-----------------------------|-----------------------------|-----------------------------------------------|-----------------------------|-----------------------------|---------------------------------------------|----------------------------------|------|
|                        |                                                                                                               | Min                         | Typ                                         | Max                         | Min                         | Typ                                           | Max                         | Min                         | Typ                                         | Max                              |      |
| $f_{MAX}$              | Maximum Toggle Frequency                                                                                      |                             |                                             |                             |                             | > 1.0                                         |                             |                             |                                             |                                  | GHz  |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>IN to Q; Tap = 0<br>IN to Q; Tap = 127<br>$\overline{EN}$ to Q; Tap = 0<br>D7 to CASCADE | 1210<br>3200<br>1250<br>300 | 1360<br>3570<br>1450<br>450                 | 1510<br>3970<br>1650<br>700 | 1240<br>3270<br>1275<br>300 | 1390<br>3630<br>1475<br>450                   | 1540<br>4030<br>1675<br>700 | 1440<br>3885<br>1350<br>300 | 1590<br>4270<br>1650<br>450                 | 1765<br>4710<br>1950<br>700      | ps   |
| $t_{RANGE}$            | Programmable Range<br>$t_{PD}(\text{max}) - t_{PD}(\text{min})$                                               | 2000                        | 2175                                        |                             | 2050                        | 2240                                          |                             | 2375                        | 2580                                        |                                  | ps   |
| $\Delta t$             | Step Delay (Note 14)<br>D0 High<br>D1 High<br>D2 High<br>D3 High<br>D4 High<br>D5 High<br>D6 High             |                             | 17<br>34<br>68<br>115<br>272<br>544<br>1088 |                             |                             | 17.5<br>35<br>70<br>115<br>280<br>560<br>1120 |                             |                             | 21<br>42<br>84<br>168<br>336<br>672<br>1344 | 120<br>205<br>380<br>740<br>1450 | ps   |
| $L_{in}$               | Linearity (Note 15)                                                                                           | D1                          | D0                                          |                             | D1                          | D0                                            |                             | D1                          | D0                                          |                                  |      |
| $t_{SKEW}$             | Duty Cycle Skew<br>$t_{PHL} - t_{PLH}$ (Note 16)                                                              |                             | $\pm 30$                                    |                             |                             | $\pm 30$                                      |                             |                             | $\pm 30$                                    |                                  | ps   |
| $t_{JITTER}$           | Random Clock Jitter (RMS)                                                                                     |                             | < 5                                         |                             |                             | < 5                                           |                             |                             | < 5                                         |                                  | ps   |
| $t_s$                  | Setup Time<br>D to LEN<br>D to IN (Note 17)<br>$\overline{EN}$ to IN (Note 18)                                | 200<br>800<br>200           | 0                                           |                             | 200<br>800<br>200           | 0                                             |                             | 200<br>800<br>200           | 0                                           |                                  | ps   |
| $t_h$                  | Hold Time<br>LEN to D<br>IN to $\overline{EN}$ (Note 19)                                                      | 500<br>0                    | 250                                         |                             | 500<br>0                    | 250                                           |                             | 500<br>0                    | 250                                         |                                  | ps   |
| $t_R$                  | Release Time<br>$\overline{EN}$ to IN (Note 20)<br>SET MAX to LEN<br>SET MIN to LEN                           | 300<br>800<br>800           |                                             |                             | 300<br>800<br>800           |                                               |                             | 300<br>800<br>800           |                                             |                                  | ps   |
| $t_{jit}$              | Jitter                                                                                                        |                             | < 5                                         |                             |                             | < 5                                           |                             |                             | < 5                                         |                                  | ps   |
| $t_r$<br>$t_f$         | Output Rise/Fall Time<br>20–80% (Q)<br>20–80% (CASCADE)                                                       | 125<br>300                  | 225<br>450                                  | 325<br>650                  | 125<br>300                  | 225<br>450                                    | 325<br>650                  | 125<br>300                  | 225<br>450                                  | 325<br>650                       | ps   |

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lfpm. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

13. 10 Series:  $V_{EE}$  can vary  $-0.46\text{ V} / +0.06\text{ V}$ .

100 Series:  $V_{EE}$  can vary  $-0.46\text{ V} / +0.8\text{ V}$ .

14. Specification limits represent the amount of delay added with the assertion of each individual delay control pin. The various combinations of asserted delay control inputs will typically realize D0 resolution steps across the specified programmable range.

15. The linearity specification guarantees to which delay control input the programmable steps will be monotonic (i.e. increasing delay steps for increasing binary counts on the control inputs Dn). Typically the device will be monotonic to the D0 input, however under worst case conditions and process variation, delays could decrease slightly with increasing binary counts when the D0 input is the LSB. With the D1 input as the Least Significant Bit (LSB), the device is guaranteed to be monotonic over all specified environmental conditions and process variation.

16. Duty cycle skew guaranteed only for differential operation measured from the cross point of the input to the cross point of the output.

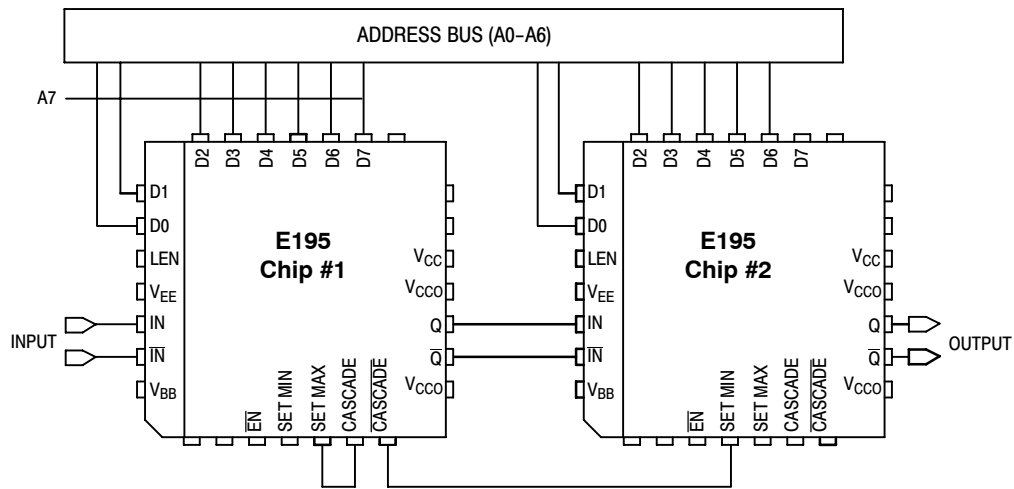
17. This setup time defines the amount of time prior to the input signal the delay tap of the device must be set.

18. This setup time is the minimum time that  $\overline{EN}$  must be asserted prior to the next transition of IN/ $\overline{IN}$  to prevent an output response greater than  $\pm 75\text{ mV}$  to that IN/ $\overline{IN}$  transition.

19. This hold time is the minimum time that  $\overline{EN}$  must remain asserted after a negative going IN or positive going  $\overline{IN}$  to prevent an output response greater than  $\pm 75\text{ mV}$  to that IN/ $\overline{IN}$  transition.

20. This release time is the minimum time that  $\overline{EN}$  must be deasserted prior to the next IN/ $\overline{IN}$  transition to ensure an output response that meets the specified IN to Q propagation delay and transition times.

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**Figure 3. Cascading Interconnect Architecture**

### Cascading Multiple E195's

To increase the programmable range of the E195 internal cascade circuitry has been included. This circuitry allows for the cascading of multiple E195's without the need for any external gating. Furthermore this capability requires only one more address line per added E195. Obviously cascading multiple PDC's will result in a larger programmable range however this increase is at the expense of a longer minimum delay.

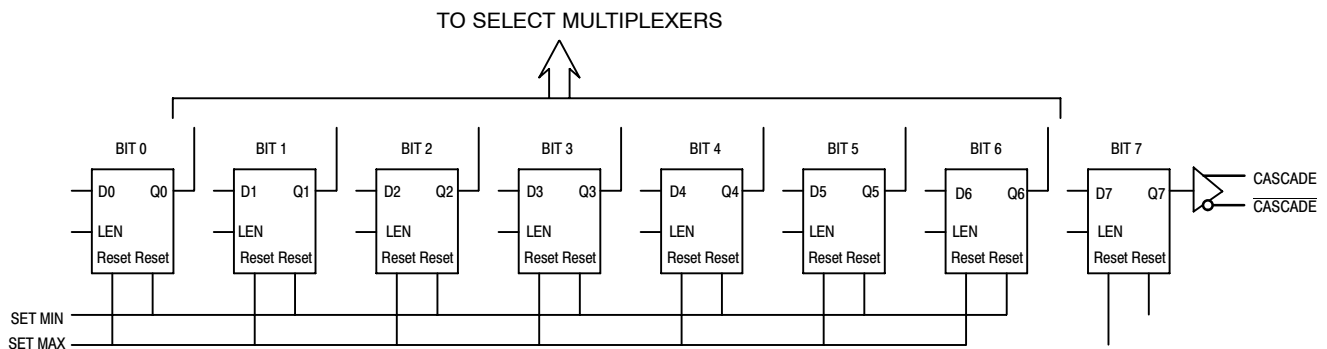
Figure 3 illustrates the interconnect scheme for cascading two E195's. As can be seen, this scheme can easily be expanded for larger E195 chains. The D7 input of the E195 is the cascade control pin. With the interconnect scheme of Figure 3 when D7 is asserted it signals the need for a larger programmable range than is achievable with a single device.

An expansion of the latch section of the block diagram is pictured below. Use of this diagram will simplify the explanation of how the cascade circuitry works. When D7 of chip #1 above is low the cascade output will also be low while the cascade bar output will be a logical high. In this condition the SET MIN pin of chip #2 will be asserted and thus all of the latches of chip #2 will be reset and the device will be set at its minimum delay. Since the RESET and SET inputs of the latches are overriding any changes on the A0-A6 address bus will not affect the operation of chip #2.

Chip #1 on the other hand will have both SET MIN and SET MAX de-asserted so that its delay will be controlled entirely by the address bus A0-A6. If the delay needed is greater than can be achieved with 31.75 gate delays (1111111 on the A0-A6 address bus) D7 will be asserted to signal the need to cascade the delay to the next E195 device. When D7 is asserted the SET MIN pin of chip #2 will be de-asserted and the delay will be controlled by the A0-A6 address bus. Chip #1 on the other hand will have its SET MAX pin asserted resulting in the device delay to be independent of the A0-A6 address bus.

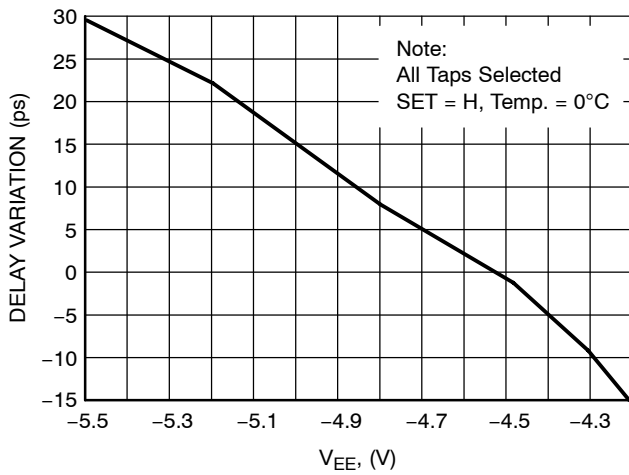
When the SET MAX pin of chip #1 is asserted the D0 and D1 latches will be reset while the rest of the latches will be set. In addition, to maintain monotonicity an additional gate delay is selected in the cascade circuitry. As a result when D7 of chip #1 is asserted the delay increases from 31.75 gates to 32 gates. A 32 gate delay is the maximum delay setting for the E195.

To expand this cascading scheme to more devices one simply needs to connect the D7 input and CASCADE outputs of the current most significant E195 to the new most significant E195 in the same manner as pictured in Figure 3. The only addition to the logic is the increase of one line to the address bus for cascade control of the second PDC.

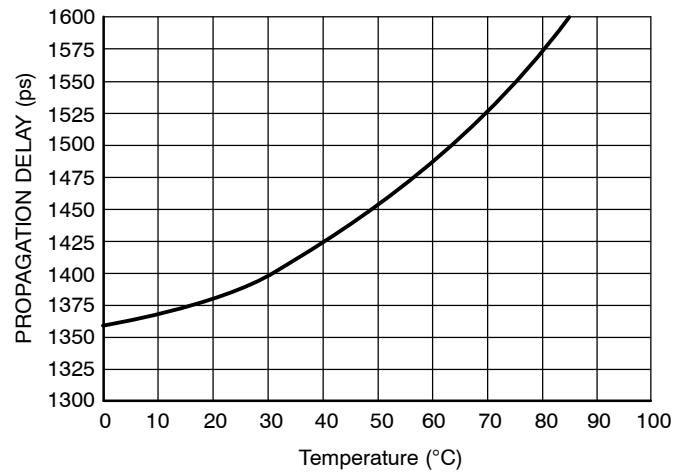


**Figure 4. Expansion of the Latch Section of the E195 Block Diagram**

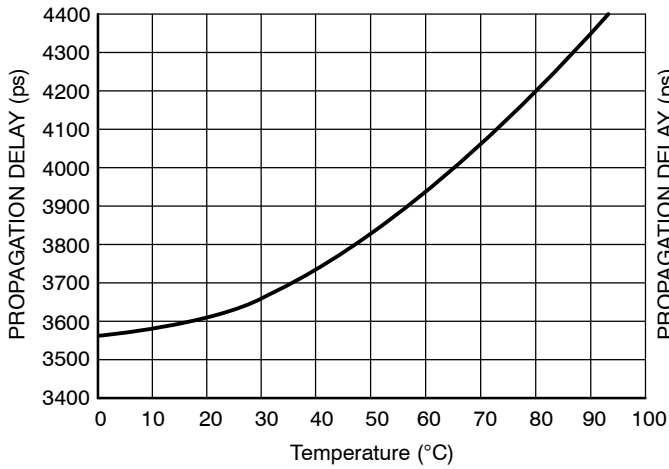
# MC10E195, MC100E195



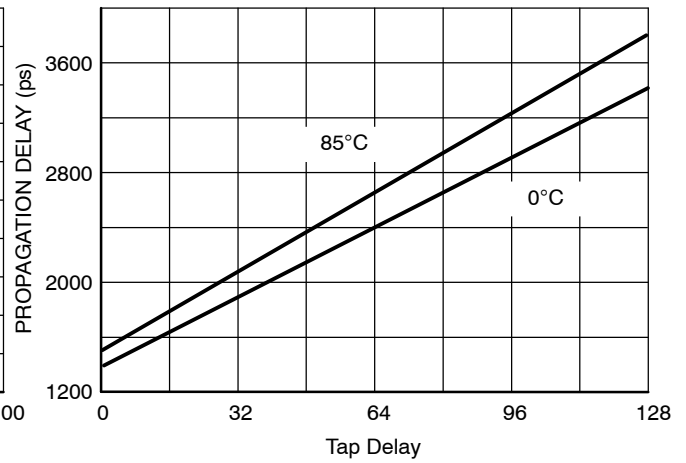
**Figure 5. Change in Delay vs. Change in Supply Voltage**



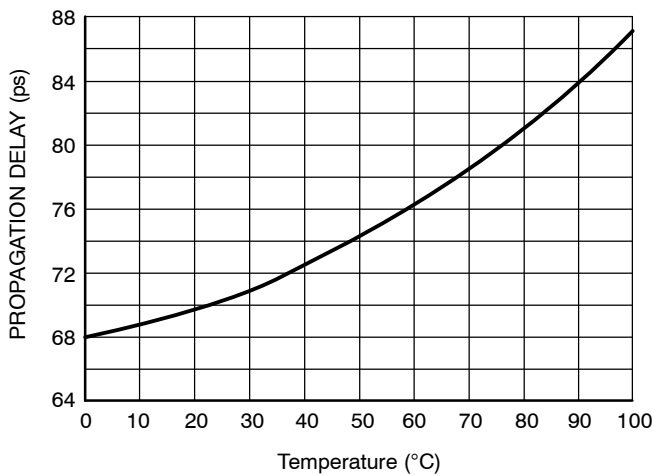
**Figure 6. Delay vs. Temperature (Fixed Path)**



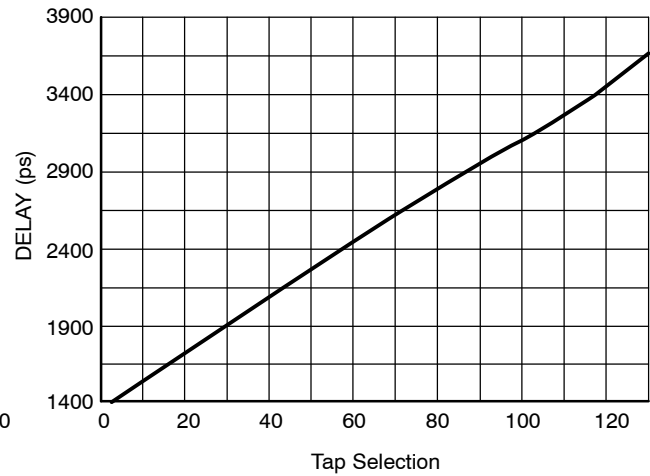
**Figure 7. Delay vs. Temperature (Max. Delay).**



**Figure 8. 100E195 Temperature Effects on Delay.**

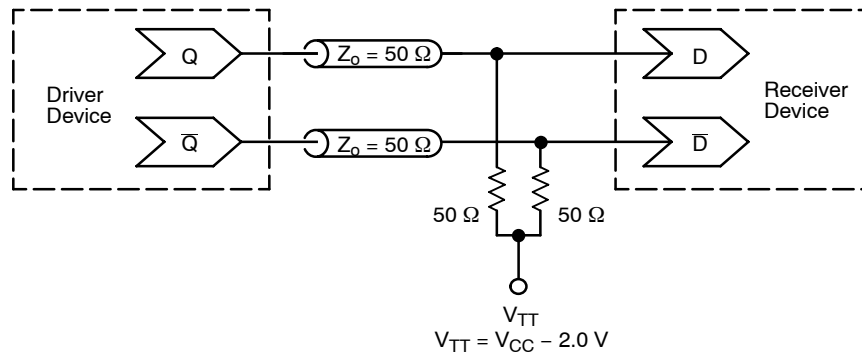


**Figure 9. Delay vs. Temperature (Per Gate).**



**Figure 10. E195 Delay Linearity.**

## MC10E195, MC100E195



**Figure 11. Typical Termination for Output Driver and Device Evaluation**  
(See Application Note AND8020/D – Termination of ECL Logic Devices.)

### ORDERING INFORMATION

| Device         | Package              | Shipping <sup>†</sup> |
|----------------|----------------------|-----------------------|
| MC10E195FN     | PLCC-28              | 37 Units / Rail       |
| MC10E195FNG    | PLCC-28<br>(Pb-Free) | 37 Units / Rail       |
| MC10E195FNR2   | PLCC-28              | 500 / Tape & Reel     |
| MC10E195FNR2G  | PLCC-28<br>(Pb-Free) | 500 / Tape & Reel     |
| MC100E195FN    | PLCC-28              | 37 Units / Rail       |
| MC100E195FNG   | PLCC-28<br>(Pb-Free) | 37 Units / Rail       |
| MC100E195FNR2  | PLCC-28              | 500 / Tape & Reel     |
| MC100E195FNR2G | PLCC-28<br>(Pb-Free) | 500 / Tape & Reel     |

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

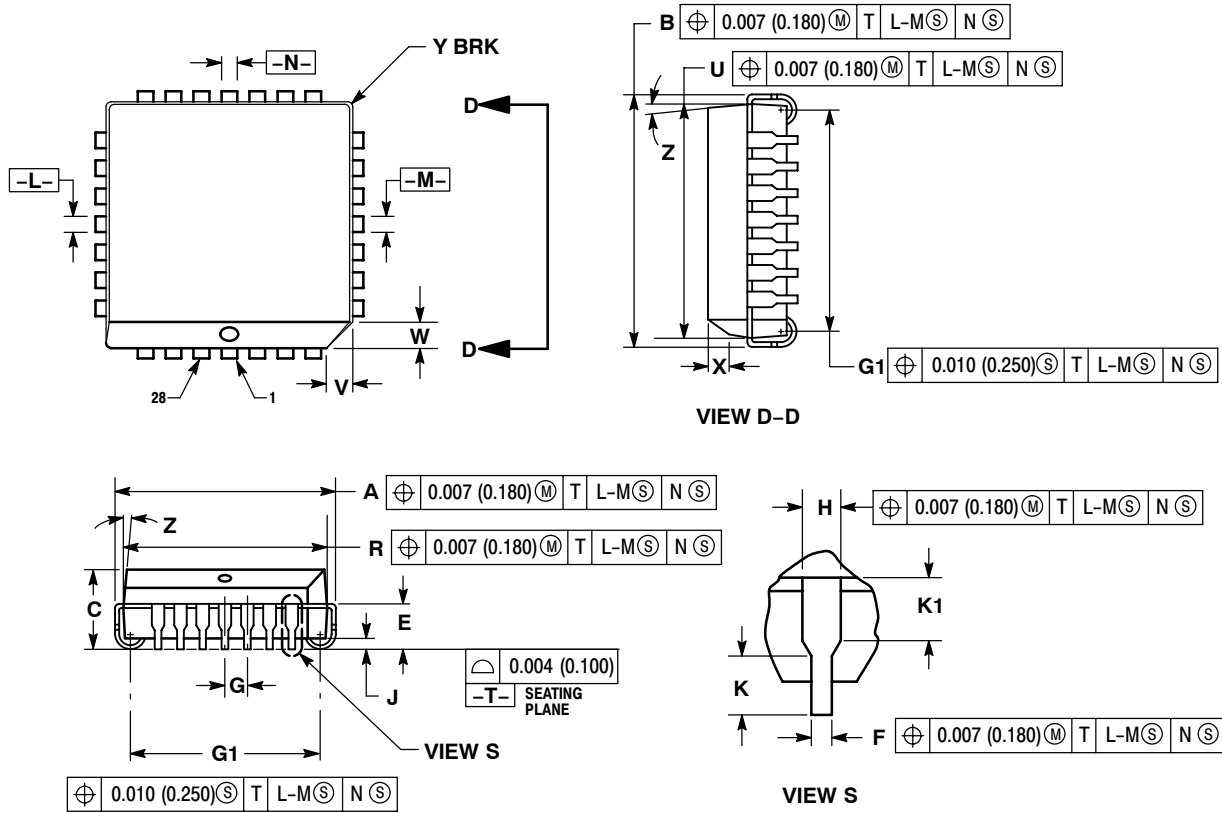
### Resource Reference of Application Notes

- AN1405/D** – ECL Clock Distribution Techniques
- AN1406/D** – Designing with PECL (ECL at +5.0 V)
- AN1503/D** – ECLinPS™ I/O SPICE Modeling Kit
- AN1504/D** – Metastability and the ECLinPS Family
- AN1568/D** – Interfacing Between LVDS and ECL
- AN1672/D** – The ECL Translator Guide
- AND8001/D** – Odd Number Counters Design
- AND8002/D** – Marking and Date Codes
- AND8020/D** – Termination of ECL Logic Devices
- AND8066/D** – Interfacing with ECLinPS
- AND8090/D** – AC Characteristics of ECL Devices

# MC10E195, MC100E195

## PACKAGE DIMENSIONS

PLCC-28  
FN SUFFIX  
PLASTIC PLCC PACKAGE  
CASE 776-02  
ISSUE E



### NOTES:

- DATUMS -L-, -M-, AND -N- DETERMINED WHERE TOP OF LEAD SHOULDER EXITS PLASTIC BODY AT MOLD PARTING LINE.
- DIMENSION G1, TRUE POSITION TO BE MEASURED AT DATUM -T-, SEATING PLANE.
- DIMENSIONS R AND U DO NOT INCLUDE MOLD FLASH. ALLOWABLE MOLD FLASH IS 0.010 (0.250) PER SIDE.
- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: INCH.
- THE PACKAGE TOP MAY BE SMALLER THAN THE PACKAGE BOTTOM BY UP TO 0.012 (0.300). DIMENSIONS R AND U ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY EXCLUSIVE OF MOLD FLASH, TIE BAR BURRS, GATE BURRS AND INTERLEAD FLASH, BUT INCLUDING ANY MISMATCH BETWEEN THE TOP AND BOTTOM OF THE PLASTIC BODY.
- DIMENSION H DOES NOT INCLUDE DAMBAR PROTRUSION OR INTRUSION. THE DAMBAR PROTRUSION(S) SHALL NOT CAUSE THE H DIMENSION TO BE GREATER THAN 0.037 (0.940). THE DAMBAR INTRUSION(S) SHALL NOT CAUSE THE H DIMENSION TO BE SMALLER THAN 0.025 (0.635).

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.485     | 0.495 | 12.32       | 12.57 |
| B   | 0.485     | 0.495 | 12.32       | 12.57 |
| C   | 0.165     | 0.180 | 4.20        | 4.57  |
| E   | 0.090     | 0.110 | 2.29        | 2.79  |
| F   | 0.013     | 0.019 | 0.33        | 0.48  |
| G   | 0.050 BSC |       | 1.27 BSC    |       |
| H   | 0.026     | 0.032 | 0.66        | 0.81  |
| J   | 0.020     | ---   | 0.51        | ---   |
| K   | 0.025     | ---   | 0.64        | ---   |
| R   | 0.450     | 0.456 | 11.43       | 11.58 |
| U   | 0.450     | 0.456 | 11.43       | 11.58 |
| V   | 0.042     | 0.048 | 1.07        | 1.21  |
| W   | 0.042     | 0.048 | 1.07        | 1.21  |
| X   | 0.042     | 0.056 | 1.07        | 1.42  |
| Y   | ---       | 0.020 | ---         | 0.50  |
| Z   | 2° 10°    |       | 2° 10°      |       |
| G1  | 0.410     | 0.430 | 10.42       | 10.92 |
| K1  | 0.040     | ---   | 1.02        | ---   |

# MC10E195, MC100E195

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