

# 8-Bit Ripple Counter

The MC10E/100E137 is a very high speed binary ripple counter. The two least significant bits were designed with very fast edge rates while the more significant bits maintain standard ECLinPS™ output edge rates. This allows the counter to operate at very high frequencies while maintaining a moderate power dissipation level.

- 1.8GHz Minimum Count Frequency
- Differential Clock Input and Data Output Pins
- V<sub>BB</sub> Output for Single-Ended Use
- Internal 75kΩ Input Pulldown Resistors
- Synchronous and Asynchronous Enable Pins
- Asynchronous Master Reset
- Extended 100E V<sub>EE</sub> Range of -4.2V to -5.46V

The device is ideally suited for multiple frequency clock generation as well as a counter in a high performance ATE time measurement board.

Both asynchronous and synchronous enables are available to maximize the device's flexibility for various applications. The asynchronous enable input, A\_Start, when asserted enables the counter while overriding any synchronous enable signals. The E137 features XORed enable inputs, EN1 and EN2, which are synchronous to the CLK input. When only one synchronous enable is asserted the counter becomes disabled on the next CLK transition; all outputs remain in the previous state poised for the other synchronous enable or A\_Start to be asserted to re-enable the counter. Asserting both synchronous enables causes the counter to become enabled on the next transition of the CLK. If EN1 (or EN2) and CLK edges are coincident, sufficient delay has been inserted in the CLK path (to compensate for the XOR gate delay and the internal D-flip flop setup time) to insure that the synchronous enable signal is clocked correctly, hence, the counter is disabled.

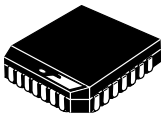
The E137 can also be driven single-endedly utilizing the V<sub>BB</sub> output supply as the voltage reference for the CLK input signal. If a single-ended signal is to be used the V<sub>BB</sub> pin should be connected to the CLK input and bypassed to ground via a 0.01μF capacitor. V<sub>BB</sub> can only source/sink 0.5mA, therefore it should be used as a switching reference for the E137 only.

All input pins left open will be pulled LOW via an input pulldown resistor. Therefore, do not leave the differential CLK inputs open. Doing so causes the current source transistor of the input clock gate to become saturated, thus upsetting the internal bias regulators and jeopardizing the stability of the device.

The asynchronous Master Reset resets the counter to an all zero state upon assertion.

MC10E137  
MC100E137

8-BIT RIPPLE  
COUNTER

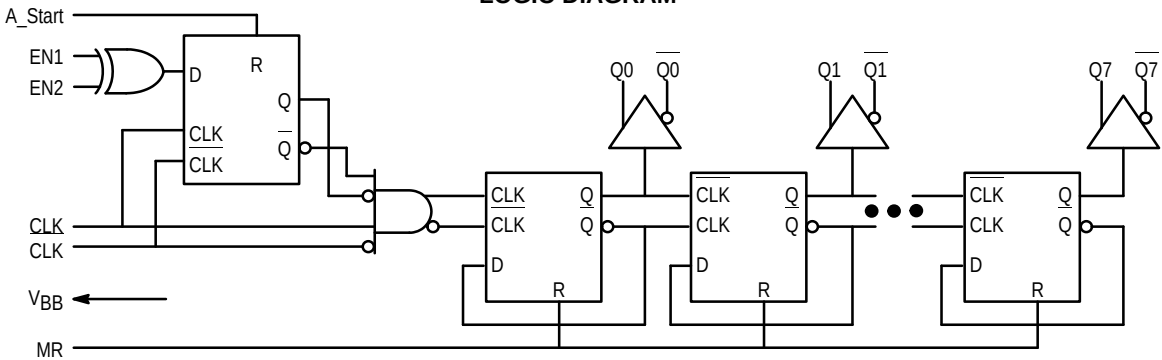


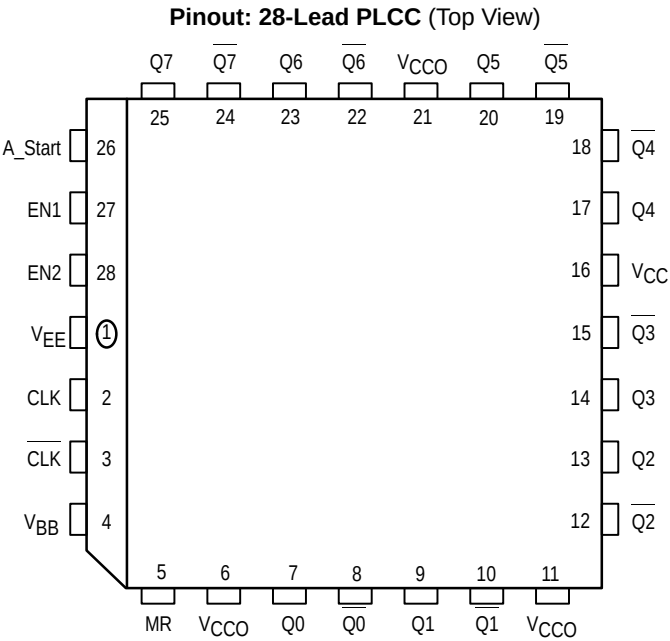
FN SUFFIX  
PLASTIC PACKAGE  
CASE 776-02

## PIN NAMES

| PIN          | FUNCTION                   |
|--------------|----------------------------|
| CLK, CLK     | Differential Clock Inputs  |
| Q0-Q7, Q0-Q7 | Differential Q Outputs     |
| A_Start      | Asynchronous Enable Input  |
| EN1, EN2     | Synchronous Enable Inputs  |
| MR           | Asynchronous Master Reset  |
| VBB          | Switching Reference Output |

## LOGIC DIAGRAM





SEQUENTIAL TRUTH TABLE

| Function    | EN1 | EN2 | A_Start | MR | CLK | Q7 | Q6 | Q5 | Q4 | Q3 | Q2 | Q1 | Q0 |
|-------------|-----|-----|---------|----|-----|----|----|----|----|----|----|----|----|
| Reset       | X   | X   | X       | H  | X   | L  | L  | L  | L  | L  | L  | L  | L  |
| Count       | L   | L   | L       | L  | Z   | L  | L  | L  | L  | L  | L  | L  | H  |
|             | L   | L   | L       | L  | Z   | L  | L  | L  | L  | L  | L  | H  | L  |
|             | L   | L   | L       | L  | Z   | L  | L  | L  | L  | L  | L  | H  | L  |
| Stop        | H   | L   | L       | L  | Z   | L  | L  | L  | L  | L  | L  | H  | H  |
|             | H   | L   | L       | L  | Z   | L  | L  | L  | L  | L  | L  | H  | H  |
|             | L   | L   | H       | L  | Z   | L  | L  | L  | L  | L  | H  | H  | L  |
| Count       | L   | L   | L       | L  | Z   | L  | L  | L  | L  | L  | H  | H  | H  |
|             | L   | L   | L       | L  | Z   | L  | L  | L  | L  | H  | L  | L  | L  |
|             | L   | L   | L       | L  | Z   | L  | L  | L  | L  | H  | L  | L  | H  |
| Stop        | L   | H   | L       | L  | Z   | L  | L  | L  | L  | H  | L  | L  | H  |
|             | L   | H   | L       | L  | Z   | L  | L  | L  | L  | H  | L  | L  | H  |
|             | H   | H   | L       | L  | Z   | L  | L  | L  | L  | H  | L  | H  | L  |
| Synch Start | H   | H   | L       | L  | Z   | L  | L  | L  | L  | H  | L  | H  | L  |
|             | H   | H   | L       | L  | Z   | L  | L  | L  | L  | H  | L  | H  | H  |
|             | H   | H   | L       | L  | Z   | L  | L  | L  | L  | H  | H  | L  | L  |
| Stop        | H   | L   | L       | L  | Z   | L  | L  | L  | L  | H  | H  | L  | L  |
|             | H   | L   | L       | L  | Z   | L  | L  | L  | L  | H  | H  | L  | L  |
|             | L   | L   | L       | L  | Z   | L  | L  | L  | L  | H  | H  | L  | L  |
| Count       | L   | L   | L       | L  | Z   | L  | L  | L  | L  | H  | H  | L  | H  |
|             | L   | L   | L       | L  | Z   | L  | L  | L  | L  | H  | H  | H  | L  |
|             | L   | L   | L       | L  | Z   | L  | L  | L  | L  | H  | H  | H  | H  |
| Reset       | X   | X   | X       | H  | X   | L  | L  | L  | L  | L  | L  | L  | L  |

Z = Low to High Transition

**DC CHARACTERISTICS** ( $V_{EE} = V_{EE(min)}$  to  $V_{EE(max)}$ ;  $V_{CC} = V_{CCO} = GND$ )

| Symbol   | Characteristic                          | 0°C            |            |                | 25°C           |            |                | 85°C           |            |                | Unit    | Condition |
|----------|-----------------------------------------|----------------|------------|----------------|----------------|------------|----------------|----------------|------------|----------------|---------|-----------|
|          |                                         | Min            | Typ        | Max            | Min            | Typ        | Max            | Min            | Typ        | Max            |         |           |
| $V_{BB}$ | Output Reference Voltage<br>10E<br>100E | -1.38<br>-1.38 |            | -1.27<br>-1.27 | -1.35<br>-1.38 |            | -1.25<br>-1.26 | -1.31<br>-1.38 |            | -1.19<br>-1.26 | V       |           |
| $I_{IH}$ | Input HIGH Current                      |                |            | 150            |                |            | 150            |                |            | 150            | $\mu A$ |           |
| $I_{EE}$ | Power Supply Current<br>10E<br>100E     |                | 121<br>121 | 145<br>145     |                | 121<br>121 | 145<br>145     |                | 121<br>139 | 145<br>167     | mA      |           |

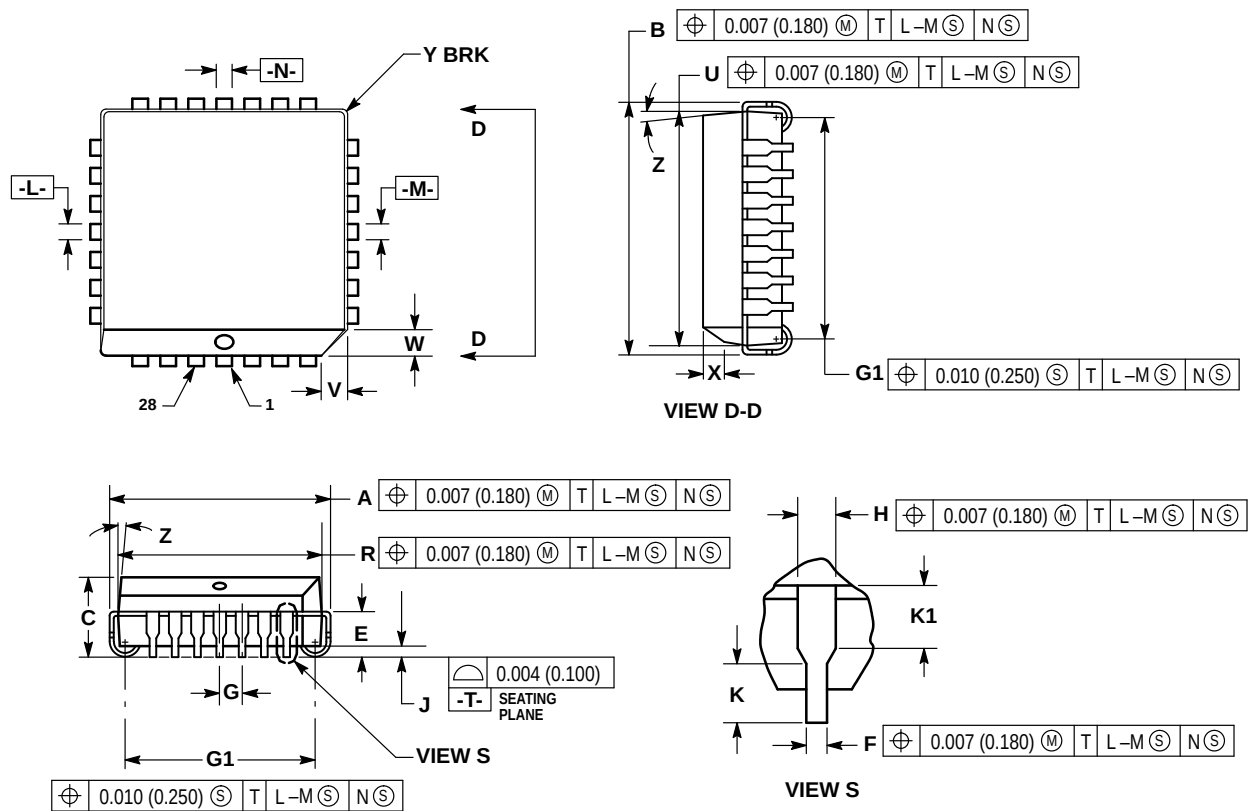
**AC CHARACTERISTICS** ( $V_{EE} = V_{EE(min)}$  to  $V_{EE(max)}$ ;  $V_{CC} = V_{CCO} = GND$ )

| Symbol                 | Characteristic                                                                                                                                                   | 0°C                                                                        |                                                                              |                                                                              | 25°C                                                                       |                                                                              |                                                                              | 85°C                                                                       |                                                                              |                                                                              | Unit | Condition |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------|----------------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------|----------------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------|------|-----------|
|                        |                                                                                                                                                                  | Min                                                                        | Typ                                                                          | Max                                                                          | Min                                                                        | Typ                                                                          | Max                                                                          | Min                                                                        | Typ                                                                          | Max                                                                          |      |           |
| $f_{COUNT}$            | Maximum Count Frequency                                                                                                                                          | 1800                                                                       | 2200                                                                         |                                                                              | 1800                                                                       | 2200                                                                         |                                                                              | 1800                                                                       | 2200                                                                         |                                                                              | MHz  |           |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay to Output<br>CLK to Q0<br>CLK to Q1<br>CLK to Q2<br>CLK to Q3<br>CLK to Q4<br>CLK to Q5<br>CLK to Q6<br>CLK to Q7<br>A_Start to Q0<br>MR to Q0 | 1300<br>1600<br>1950<br>2275<br>2625<br>2950<br>3250<br>3575<br>950<br>700 | 1700<br>2025<br>2425<br>2750<br>3125<br>3450<br>3775<br>4075<br>1325<br>1000 | 2150<br>2500<br>2925<br>3350<br>3750<br>4150<br>4450<br>4800<br>1700<br>1300 | 1300<br>1600<br>1950<br>2275<br>2625<br>2950<br>3250<br>3575<br>950<br>700 | 1700<br>2050<br>2450<br>2775<br>3150<br>3475<br>3800<br>4125<br>1325<br>1000 | 2150<br>2500<br>2925<br>3350<br>3750<br>4150<br>4450<br>4800<br>1700<br>1300 | 1350<br>1650<br>2025<br>2350<br>2700<br>3050<br>3375<br>3700<br>950<br>700 | 1750<br>2100<br>2500<br>2850<br>3225<br>3550<br>3925<br>4250<br>1325<br>1000 | 2200<br>2550<br>3000<br>3425<br>3825<br>4250<br>4600<br>4950<br>1700<br>1300 | ps   |           |
| $t_s$                  | Setup Time (EN1, EN2)                                                                                                                                            | 0                                                                          | -150                                                                         |                                                                              | 0                                                                          | -150                                                                         |                                                                              | 0                                                                          | -150                                                                         |                                                                              | ps   |           |
| $t_h$                  | Hold Time (EN1, EN2)                                                                                                                                             | 300                                                                        | 150                                                                          |                                                                              | 300                                                                        | 150                                                                          |                                                                              | 300                                                                        | 150                                                                          |                                                                              | ps   |           |
| $t_{RR}$               | Reset Recovery Time<br>MR, A_Start                                                                                                                               | 400                                                                        | 200                                                                          |                                                                              | 400                                                                        | 200                                                                          |                                                                              | 400                                                                        | 200                                                                          |                                                                              | ps   |           |
| $t_{PW}$               | Minimum Pulse Width<br>CLK, MR, A_Start                                                                                                                          | 400                                                                        |                                                                              |                                                                              | 400                                                                        |                                                                              |                                                                              | 400                                                                        |                                                                              |                                                                              | ps   |           |
| $V_{PP}$               | Minimum Input Swing (CLK)                                                                                                                                        | 0.25                                                                       |                                                                              | 1.0                                                                          | 0.25                                                                       |                                                                              | 1.0                                                                          | 0.25                                                                       |                                                                              | 1.0                                                                          | V    | Note 1    |
| $V_{CMR}$              | Com Mode Range (CLK)                                                                                                                                             | -0.4                                                                       |                                                                              | -2.0                                                                         | -0.4                                                                       |                                                                              | -2.0                                                                         | -0.4                                                                       |                                                                              | -2.0                                                                         | V    |           |
| $t_r$<br>$t_f$         | Rise/Fall Times<br>Q0, Q1<br>Q2 to Q7                                                                                                                            | 150<br>275                                                                 |                                                                              | 400<br>600                                                                   | 150<br>275                                                                 |                                                                              | 400<br>600                                                                   | 150<br>275                                                                 |                                                                              | 400<br>600                                                                   | ps   | 20%–80%   |

1. Minimum input swing for which AC parameters are guaranteed. Full DC ECL output swings will be generated with only 50mV input swings.

OUTLINE DIMENSIONS

FN SUFFIX  
PLASTIC PLCC PACKAGE  
CASE 776-02  
ISSUE D



NOTES:

- DATUMS -L-, -M-, AND -N- DETERMINED WHERE TOP OF LEAD SHOULDER EXITS PLASTIC BODY AT MOLD PARTING LINE.
- DIM G1, TRUE POSITION TO BE MEASURED AT DATUM -T-, SEATING PLANE.
- DIM 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        | —     |

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