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# HM5117805 Series

16 M EDO DRAM (2-Mword × 8-bit)  
2 k Refresh

**ELPIDA**

E0156H10 (Ver. 1.0)  
(Previous ADE-203-630D (Z))  
Jun. 27, 2001

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## Description

The HM5117805 is a CMOS dynamic RAM organized 2,097,152-word × 8-bit. It employs the most advanced CMOS technology for high performance and low power. The HM5117805 offers Extended Data Out (EDO) Page Mode as a high speed access mode. Multiplexed address input permits the HM5117805 to be packaged in standard 28-pin plastic SOJ and 28-pin TSOP.

## Features

- Single 5 V (±10%)
- Access time: 50 ns/60 ns/70 ns (max)
- Power dissipation
  - Active mode: 605 mW/550 mW/495 mW (max)
  - Standby mode : 11 mW (max)  
: 0.83 mW (max) (L-version)
- EDO page mode capability
- Long refresh period
  - 2048 refresh cycles : 32 ms  
: 128 ms (L-version)
- 4 variations of refresh
  - $\overline{\text{RAS}}$ -only refresh
  - $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$  refresh
  - Hidden refresh
  - Self refresh (L-version)
- Battery backup operation (L-version)

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## HM5117805 Series

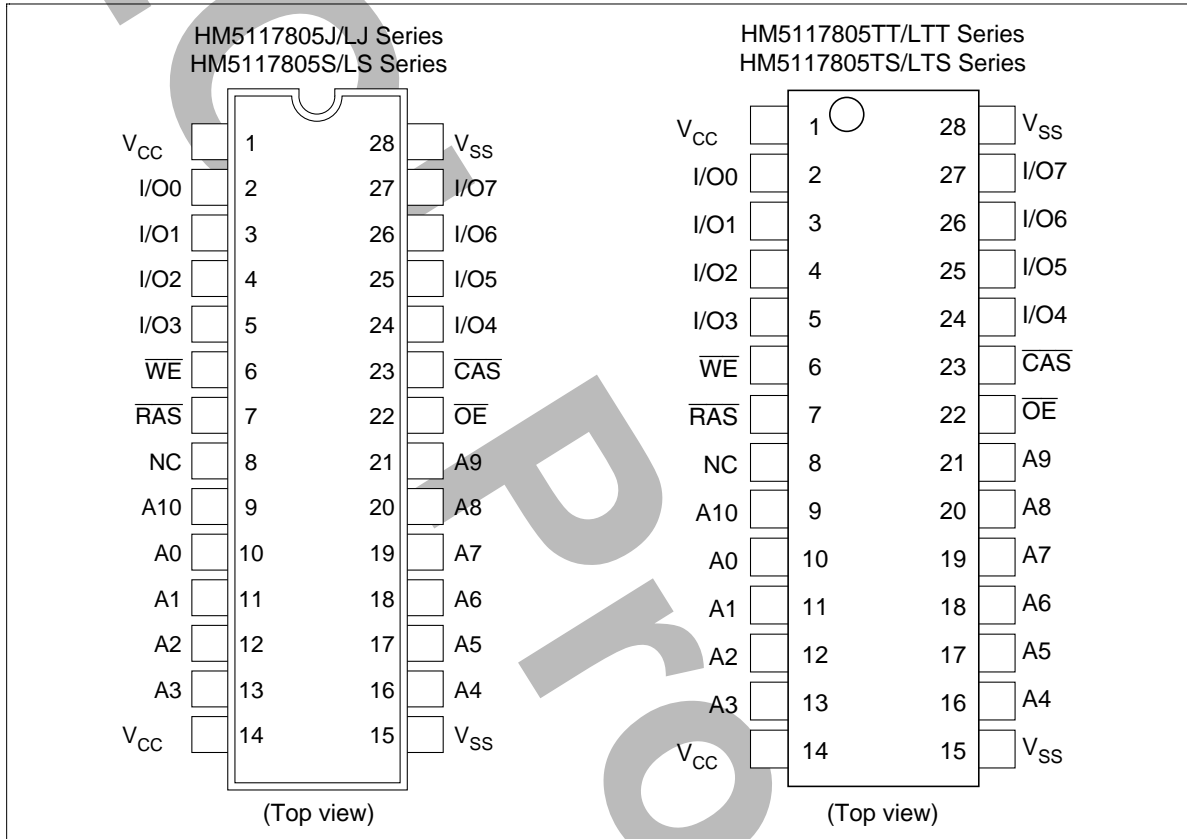
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### Ordering Information

| Type No.       | Access time | Package                                   |
|----------------|-------------|---|
| HM5117805J-5   | 50 ns       | 400-mil 28-pin plastic SOJ (CP-28DA)      |
| HM5117805J-6   | 60 ns       |   |
| HM5117805J-7   | 70 ns       |   |
| HM5117805LJ-5  | 50 ns       |   |
| HM5117805LJ-6  | 60 ns       |   |
| HM5117805LJ-7  | 70 ns       |   |
| HM5117805S-5   | 50 ns       | 300-mil 28-pin plastic SOJ (CP-28DNA)     |
| HM5117805S-6   | 60 ns       |   |
| HM5117805S-7   | 70 ns       |   |
| HM5117805LS-5  | 50 ns       |   |
| HM5117805LS-6  | 60 ns       |   |
| HM5117805LS-7  | 70 ns       |   |
| HM5117805TT-5  | 50 ns       | 400-mil 28-pin plastic TSOP II (TTP-28DA) |
| HM5117805TT-6  | 60 ns       |   |
| HM5117805TT-7  | 70 ns       |   |
| HM5117805LTT-5 | 50 ns       |   |
| HM5117805LTT-6 | 60 ns       |   |
| HM5117805LTT-7 | 70 ns       |   |
| HM5117805TS-5  | 50 ns       | 300-mil 28-pin plastic TSOP II (TTP-28DB) |
| HM5117805TS-6  | 60 ns       |   |
| HM5117805TS-7  | 70 ns       |   |
| HM5117805LTS-5 | 50 ns       |   |
| HM5117805LTS-6 | 60 ns       |   |
| HM5117805LTS-7 | 70 ns       |   |

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## Pin Arrangement



## Pin Description

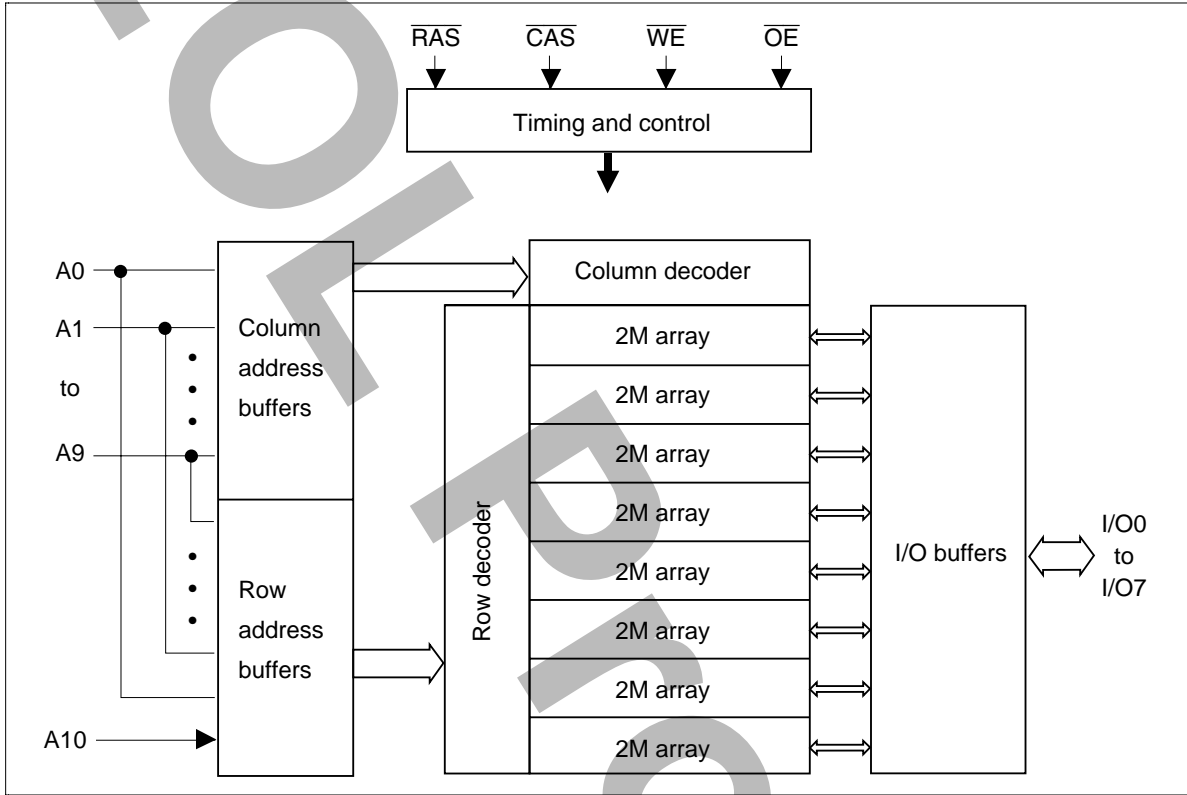
| Pin name         | Function  |
|------------------|---|
| A0 to A10        | Address input<br>— Row/Refresh address A0 to A10<br>— Column address A0 to A9 |
| I/O0 to I/O7     | Data input/Data output  |
| $\overline{RAS}$ | Row address strobe  |
| $\overline{CAS}$ | Column address strobe   |
| $\overline{WE}$  | Read/Write enable   |
| $\overline{OE}$  | Output enable   |
| V <sub>CC</sub>  | Power supply  |
| V <sub>SS</sub>  | Ground  |
| NC               | No connection   |

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# HM5117805 Series

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## Block Diagram



**Absolute Maximum Ratings**

| Parameter                               | Symbol    | Value        | Unit |
|---|-----------|--------------|------|
| Voltage on any pin relative to $V_{SS}$ | $V_T$     | -1.0 to +7.0 | V    |
| Supply voltage relative to $V_{SS}$     | $V_{CC}$  | -1.0 to +7.0 | V    |
| Short circuit output current            | $I_{out}$ | 50           | mA   |
| Power dissipation                       | $P_T$     | 1.0          | W    |
| Operating temperature                   | $T_{opr}$ | 0 to +70     | °C   |
| Storage temperature                     | $T_{stg}$ | -55 to +125  | °C   |

**Recommended DC Operating Conditions ( $T_a = 0$  to +70°C)**

| Parameter          | Symbol   | Min  | Typ | Max | Unit | Note |
|--------------------|----------|------|-----|-----|------|------|
| Supply voltage     | $V_{CC}$ | 4.5  | 5.0 | 5.5 | V    | 1    |
| Input high voltage | $V_{IH}$ | 2.4  | —   | 6.5 | V    | 1    |
| Input low voltage  | $V_{IL}$ | -1.0 | —   | 0.8 | V    | 1    |

Note: 1. All voltage referred to  $V_{SS}$ .

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DC Characteristics (Ta = 0 to +70°C, V<sub>CC</sub> = 5 V ± 10%, V<sub>SS</sub> = 0 V)

| Parameter   | Symbol            | HM5117805 |                 |     |                 |     |                 | Unit | Test conditions   |
|---|-------------------|-----------|-----------------|-----|-----------------|-----|-----------------|------|---|
|   |                   | -5        |                 | -6  |                 | -7  |                 |      |   |
|   |                   | Min       | Max             | Min | Max             | Min | Max             |      |   |
| Operating current* <sup>1, *2</sup>   | I <sub>CC1</sub>  | —         | 110             | —   | 100             | —   | 90              | mA   | t <sub>RC</sub> = min   |
| Standby current   | I <sub>CC2</sub>  | —         | 2               | —   | 2               | —   | 2               | mA   | TTL interface<br>RAS, CAS = V <sub>IH</sub><br>Dout = High-Z  |
|   |                   | —         | 1               | —   | 1               | —   | 1               | mA   | CMOS interface<br>RAS, CAS ≥ V <sub>CC</sub> - 0.2 V<br>Dout = High-Z                                     |
| Standby current (L-version)   | I <sub>CC2</sub>  | —         | 150             | —   | 150             | —   | 150             | μA   | CMOS interface<br>RAS, CAS ≥ V <sub>CC</sub> - 0.2 V<br>Dout = High-Z                                     |
| RAS-only refresh current* <sup>2</sup>                                      | I <sub>CC3</sub>  | —         | 110             | —   | 100             | —   | 90              | mA   | t <sub>RC</sub> = min   |
| Standby current* <sup>1</sup>   | I <sub>CC5</sub>  | —         | 5               | —   | 5               | —   | 5               | mA   | RAS = V <sub>IH</sub><br>CAS = V <sub>IL</sub><br>Dout = enable   |
| CAS-before-RAS refresh current  | I <sub>CC6</sub>  | —         | 110             | —   | 100             | —   | 90              | mA   | t <sub>RC</sub> = min   |
| EDO page mode current* <sup>1, *3</sup>                                     | I <sub>CC7</sub>  | —         | 100             | —   | 90              | —   | 85              | mA   | t <sub>HPC</sub> = min  |
| Battery backup current* <sup>4</sup> (Standby with CBR refresh) (L-version) | I <sub>CC10</sub> | —         | 500             | —   | 500             | —   | 500             | μA   | CMOS interface<br>Dout = High-Z<br>CBR refresh:<br>t <sub>RC</sub> = 62.5 μs<br>t <sub>RAS</sub> ≤ 0.3 μs |
| Self refresh mode current (L-version)                                       | I <sub>CC11</sub> | —         | 300             | —   | 300             | —   | 300             | μA   | CMOS interface<br>RAS, CAS ≤ 0.2V<br>Dout = High-Z  |
| Input leakage current   | I <sub>LI</sub>   | -10       | 10              | -10 | 10              | -10 | 10              | μA   | 0 V ≤ Vin ≤ 7 V   |
| Output leakage current  | I <sub>LO</sub>   | -10       | 10              | -10 | 10              | -10 | 10              | μA   | 0 V ≤ Vout ≤ 7 V<br>Dout = disable  |
| Output high voltage   | V <sub>OH</sub>   | 2.4       | V <sub>CC</sub> | 2.4 | V <sub>CC</sub> | 2.4 | V <sub>CC</sub> | V    | High Iout = -2 mA   |
| Output low voltage  | V <sub>OL</sub>   | 0         | 0.4             | 0   | 0.4             | 0   | 0.4             | V    | Low Iout = 2 mA   |

Notes: 1. I<sub>CC</sub> depends on output load condition when the device is selected. I<sub>CC</sub> max is specified at the output open condition.

2. Address can be changed once or less while  $\overline{\text{RAS}} = V_{IL}$ .

3. Address can be changed once or less while  $\overline{\text{CAS}} = V_{IH}$ .

4.  $\overline{\text{CAS}} = L$  (≤ 0.2 V) while  $\overline{\text{RAS}} = L$  (≤ 0.2 V).

**Capacitance** ( $T_a = 25^\circ\text{C}$ ,  $V_{CC} = 5\text{ V} \pm 10\%$ )

| Parameter                              | Symbol   | Typ | Max | Unit | Notes |
|--|----------|-----|-----|------|-------|
| Input capacitance (Address)            | $C_{11}$ | —   | 5   | pF   | 1     |
| Input capacitance (Clocks)             | $C_{12}$ | —   | 7   | pF   | 1     |
| Output capacitance (Data-in, Data-out) | $C_{IO}$ | —   | 7   | pF   | 1, 2  |

Notes: 1. Capacitance measured with Boonton Meter or effective capacitance measuring method.  
 2.  $\overline{\text{CAS}} = V_{IH}$  to disable Dout.

**AC Characteristics** ( $T_a = 0$  to  $+70^\circ\text{C}$ ,  $V_{CC} = 5\text{ V} \pm 10\%$ ,  $V_{SS} = 0\text{ V}$ )<sup>\*1, \*2, \*18</sup>
**Test Conditions**

- Input rise and fall time: 2 ns
- Input levels:  $V_{IL} = 0\text{ V}$ ,  $V_{IH} = 3\text{ V}$
- Input timing reference levels: 0.8 V, 2.4 V
- Output timing reference levels: 0.8 V, 2.0 V
- Output load: 1 TTL gate +  $C_L$  (100 pF) (Including scope and jig)

## HM5117805 Series

### Read, Write, Read-Modify-Write and Refresh Cycles (Common parameters)

| Parameter   | Symbol    | HM5117805 |       |     |       |     |       | Unit | Notes |
|---|-----------|-----------|-------|-----|-------|-----|-------|------|-------|
|   |           | -5        |       | -6  |       | -7  |       |      |       |
|   |           | Min       | Max   | Min | Max   | Min | Max   |      |       |
| Random read or write cycle time                     | $t_{RC}$  | 84        | —     | 104 | —     | 124 | —     | ns   |       |
| $\overline{RAS}$ precharge time                     | $t_{RP}$  | 30        | —     | 40  | —     | 50  | —     | ns   |       |
| $\overline{CAS}$ precharge time                     | $t_{CP}$  | 7         | —     | 10  | —     | 13  | —     | ns   |       |
| $\overline{RAS}$ pulse width                        | $t_{RAS}$ | 50        | 10000 | 60  | 10000 | 70  | 10000 | ns   |       |
| $\overline{CAS}$ pulse width                        | $t_{CAS}$ | 7         | 10000 | 10  | 10000 | 13  | 10000 | ns   |       |
| Row address setup time                              | $t_{ASR}$ | 0         | —     | 0   | —     | 0   | —     | ns   |       |
| Row address hold time                               | $t_{RAH}$ | 7         | —     | 10  | —     | 10  | —     | ns   |       |
| Column address setup time                           | $t_{ASC}$ | 0         | —     | 0   | —     | 0   | —     | ns   |       |
| Column address hold time                            | $t_{CAH}$ | 7         | —     | 10  | —     | 13  | —     | ns   |       |
| $\overline{RAS}$ to $\overline{CAS}$ delay time     | $t_{RCD}$ | 11        | 37    | 14  | 45    | 14  | 52    | ns   | 3     |
| $\overline{RAS}$ to column address delay time       | $t_{RAD}$ | 9         | 25    | 12  | 30    | 12  | 35    | ns   | 4     |
| $\overline{RAS}$ hold time                          | $t_{RSH}$ | 10        | —     | 13  | —     | 13  | —     | ns   |       |
| $\overline{CAS}$ hold time                          | $t_{CSH}$ | 35        | —     | 40  | —     | 45  | —     | ns   |       |
| $\overline{CAS}$ to $\overline{RAS}$ precharge time | $t_{CRP}$ | 5         | —     | 5   | —     | 5   | —     | ns   |       |
| $\overline{OE}$ to Din delay time                   | $t_{OED}$ | 13        | —     | 15  | —     | 18  | —     | ns   | 5     |
| $\overline{OE}$ delay time from Din                 | $t_{DZO}$ | 0         | —     | 0   | —     | 0   | —     | ns   | 6     |
| $\overline{CAS}$ delay time from Din                | $t_{DZC}$ | 0         | —     | 0   | —     | 0   | —     | ns   | 6     |
| Transition time (rise and fall)                     | $t_T$     | 2         | 50    | 2   | 50    | 2   | 50    | ns   | 7     |



## HM5117805 Series

### Read Cycle

| Parameter   | Symbol            | HM5117805 |     |     |     |     |     | Unit | Notes     |
|---|-------------------|-----------|-----|-----|-----|-----|-----|------|-----------|
|   |                   | -5        |     | -6  |     | -7  |     |      |           |
|   |                   | Min       | Max | Min | Max | Min | Max |      |           |
| Access time from $\overline{\text{RAS}}$                        | $t_{\text{RAC}}$  | —         | 50  | —   | 60  | —   | 70  | ns   | 8, 9      |
| Access time from CAS  | $t_{\text{CAC}}$  | —         | 13  | —   | 15  | —   | 18  | ns   | 9, 10, 17 |
| Access time from address  | $t_{\text{AA}}$   | —         | 25  | —   | 30  | —   | 35  | ns   | 9, 11, 17 |
| Access time from $\overline{\text{OE}}$                         | $t_{\text{OEA}}$  | —         | 13  | —   | 15  | —   | 18  | ns   | 9         |
| Read command setup time   | $t_{\text{RCS}}$  | 0         | —   | 0   | —   | 0   | —   | ns   |           |
| Read command hold time to $\overline{\text{CAS}}$               | $t_{\text{RCH}}$  | 0         | —   | 0   | —   | 0   | —   | ns   | 12        |
| Read command hold time from $\overline{\text{RAS}}$             | $t_{\text{RCHR}}$ | 50        | —   | 60  | —   | 70  | —   | ns   |           |
| Read command hold time to $\overline{\text{RAS}}$               | $t_{\text{RRH}}$  | 0         | —   | 0   | —   | 0   | —   | ns   | 12        |
| Column address to $\overline{\text{RAS}}$ lead time             | $t_{\text{RAL}}$  | 25        | —   | 30  | —   | 35  | —   | ns   |           |
| Column address to $\overline{\text{CAS}}$ lead time             | $t_{\text{CAL}}$  | 15        | —   | 18  | —   | 23  | —   | ns   |           |
| $\overline{\text{CAS}}$ to output in low-Z                      | $t_{\text{CLZ}}$  | 0         | —   | 0   | —   | 0   | —   | ns   |           |
| Output data hold time   | $t_{\text{OH}}$   | 3         | —   | 3   | —   | 3   | —   | ns   | 20        |
| Output data hold time from $\overline{\text{OE}}$               | $t_{\text{OHO}}$  | 3         | —   | 3   | —   | 3   | —   | ns   |           |
| Output buffer turn-off time                                     | $t_{\text{OFF}}$  | —         | 13  | —   | 15  | —   | 15  | ns   | 13, 20    |
| Output buffer turn-off to $\overline{\text{OE}}$                | $t_{\text{OEZ}}$  | —         | 13  | —   | 15  | —   | 15  | ns   | 13        |
| $\overline{\text{CAS}}$ to Din delay time                       | $t_{\text{CDD}}$  | 13        | —   | 15  | —   | 18  | —   | ns   | 5         |
| Output data hold time from $\overline{\text{RAS}}$              | $t_{\text{OHR}}$  | 3         | —   | 3   | —   | 3   | —   | ns   | 20        |
| Output buffer turn-off to $\overline{\text{RAS}}$               | $t_{\text{OFR}}$  | —         | 13  | —   | 15  | —   | 15  | ns   | 20        |
| Output buffer turn-off to $\overline{\text{WE}}$                | $t_{\text{WEZ}}$  | —         | 13  | —   | 15  | —   | 15  | ns   |           |
| $\overline{\text{WE}}$ to Din delay time                        | $t_{\text{WED}}$  | 13        | —   | 15  | —   | 18  | —   | ns   |           |
| $\overline{\text{RAS}}$ to Din delay time                       | $t_{\text{RDD}}$  | 13        | —   | 15  | —   | 18  | —   | ns   |           |
| $\overline{\text{RAS}}$ next $\overline{\text{CAS}}$ delay time | $t_{\text{RNCD}}$ | 50        | —   | 60  | —   | 70  | —   | ns   |           |

## HM5117805 Series

### Write Cycle

|   |           | HM5117805 |     |     |     |     |     |      |       |
|---|-----------|-----------|-----|-----|-----|-----|-----|------|-------|
|   |           | -5        |     | -6  |     | -7  |     |      |       |
| Parameter                                   | Symbol    | Min       | Max | Min | Max | Min | Max | Unit | Notes |
| Write command setup time                    | $t_{WCS}$ | 0         | —   | 0   | —   | 0   | —   | ns   | 14    |
| Write command hold time                     | $t_{WCH}$ | 7         | —   | 10  | —   | 13  | —   | ns   |       |
| Write command pulse width                   | $t_{WP}$  | 7         | —   | 10  | —   | 10  | —   | ns   |       |
| Write command to $\overline{RAS}$ lead time | $t_{RWL}$ | 7         | —   | 10  | —   | 13  | —   | ns   |       |
| Write command to $\overline{CAS}$ lead time | $t_{CWL}$ | 7         | —   | 10  | —   | 13  | —   | ns   |       |
| Data-in setup time                          | $t_{DS}$  | 0         | —   | 0   | —   | 0   | —   | ns   | 15    |
| Data-in hold time                           | $t_{DH}$  | 7         | —   | 10  | —   | 13  | —   | ns   | 15    |

### Read-Modify-Write Cycle

|  |           | HM5117805 |     |     |     |     |     |      |       |
|--|-----------|-----------|-----|-----|-----|-----|-----|------|-------|
|  |           | -5        |     | -6  |     | -7  |     |      |       |
| Parameter                                      | Symbol    | Min       | Max | Min | Max | Min | Max | Unit | Notes |
| Read-modify-write cycle time                   | $t_{RWC}$ | 111       | —   | 135 | —   | 161 | —   | ns   |       |
| $\overline{RAS}$ to $\overline{WE}$ delay time | $t_{RWD}$ | 67        | —   | 79  | —   | 92  | —   | ns   | 14    |
| $\overline{CAS}$ to $\overline{WE}$ delay time | $t_{CWD}$ | 30        | —   | 34  | —   | 40  | —   | ns   | 14    |
| Column address to $\overline{WE}$ delay time   | $t_{AWD}$ | 42        | —   | 49  | —   | 57  | —   | ns   | 14    |
| $\overline{OE}$ hold time from $\overline{WE}$ | $t_{OEH}$ | 13        | —   | 15  | —   | 18  | —   | ns   |       |

### Refresh Cycle

|  |           | HM5117805 |     |     |     |     |     |      |       |
|--|-----------|-----------|-----|-----|-----|-----|-----|------|-------|
|  |           | -5        |     | -6  |     | -7  |     |      |       |
| Parameter  | Symbol    | Min       | Max | Min | Max | Min | Max | Unit | Notes |
| $\overline{CAS}$ setup time (CBR refresh cycle)          | $t_{CSR}$ | 5         | —   | 5   | —   | 5   | —   | ns   |       |
| $\overline{CAS}$ hold time (CBR refresh cycle)           | $t_{CHR}$ | 7         | —   | 10  | —   | 10  | —   | ns   |       |
| $\overline{WE}$ setup time (CBR refresh cycle)           | $t_{WRP}$ | 0         | —   | 0   | —   | 0   | —   | ns   |       |
| $\overline{WE}$ hold time (CBR refresh cycle)            | $t_{WRH}$ | 7         | —   | 10  | —   | 10  | —   | ns   |       |
| $\overline{RAS}$ precharge to $\overline{CAS}$ hold time | $t_{RPC}$ | 5         | —   | 5   | —   | 5   | —   | ns   |       |

## HM5117805 Series

### EDO Page Mode Cycle

|   |            | HM5117805 |        |     |        |     |        |      |       |
|---|------------|-----------|--------|-----|--------|-----|--------|------|-------|
|   |            | -5        |        | -6  |        | -7  |        |      |       |
| Parameter                                 | Symbol     | Min       | Max    | Min | Max    | Min | Max    | Unit | Notes |
| EDO page mode cycle time                  | $t_{HPC}$  | 20        | —      | 25  | —      | 30  | —      | ns   | 19    |
| EDO page mode RAS pulse width             | $t_{RASP}$ | —         | 100000 | —   | 100000 | —   | 100000 | ns   | 16    |
| Access time from CAS precharge            | $t_{CPA}$  | —         | 28     | —   | 35     | —   | 40     | ns   | 9, 17 |
| RAS hold time from CAS precharge          | $t_{CPRH}$ | 28        | —      | 35  | —      | 40  | —      | ns   |       |
| Output data hold time from CAS low        | $t_{DOH}$  | 3         | —      | 3   | —      | 3   | —      | ns   | 9, 17 |
| CAS hold time referred OE                 | $t_{COL}$  | 7         | —      | 10  | —      | 13  | —      | ns   |       |
| CAS to OE setup time                      | $t_{COP}$  | 5         | —      | 5   | —      | 5   | —      | ns   |       |
| Read command hold time from CAS precharge | $t_{RCHC}$ | 28        | —      | 35  | —      | 40  | —      | ns   |       |

### EDO Page Mode Read-Modify-Write Cycle

|   |             | HM5117805 |     |     |     |     |     |      |       |
|---|-------------|-----------|-----|-----|-----|-----|-----|------|-------|
|   |             | -5        |     | -6  |     | -7  |     |      |       |
| Parameter                                   | Symbol      | Min       | Max | Min | Max | Min | Max | Unit | Notes |
| EDO page mode read- modify-write cycle time | $t_{HPRWC}$ | 57        | —   | 68  | —   | 79  | —   | ns   |       |
| WE delay time from CAS precharge            | $t_{CPW}$   | 45        | —   | 54  | —   | 62  | —   | ns   | 14    |

### Refresh

| Parameter                  | Symbol    | Max | Unit | Note        |
|----------------------------|-----------|-----|------|-------------|
| Refresh period             | $t_{REF}$ | 32  | ms   | 2048 cycles |
| Refresh period (L-version) | $t_{REF}$ | 128 | ms   | 2048 cycles |

## HM5117805 Series

### Self Refresh Mode (L-version)

| Parameter                         | Symbol     | HM5117805L |     |     |     |     |     | Unit    | Notes |
|-----------------------------------|------------|------------|-----|-----|-----|-----|-----|---------|-------|
|                                   |            | -5         |     | -6  |     | -7  |     |         |       |
|                                   |            | Min        | Max | Min | Max | Min | Max |         |       |
| RAS pulse width (self refresh)    | $t_{RASS}$ | 100        | —   | 100 | —   | 100 | —   | $\mu$ s |       |
| RAS precharge time (self refresh) | $t_{RPS}$  | 90         | —   | 110 | —   | 130 | —   | ns      |       |
| CAS hold time (self refresh)      | $t_{CHS}$  | -50        | —   | -50 | —   | -50 | —   | ns      |       |

- Notes:
- AC measurements assume  $t_T = 2$  ns.
  - An initial pause of 200  $\mu$ s is required after power up followed by a minimum of eight initialization cycles (any combination of cycles containing  $\overline{RAS}$ -only refresh or  $\overline{CAS}$ -before- $\overline{RAS}$  refresh). If the internal refresh counter is used, a minimum of eight  $\overline{CAS}$ -before- $\overline{RAS}$  refresh cycles are required.
  - Operation with the  $t_{RCD}$  (max) limit insures that  $t_{RAC}$  (max) can be met,  $t_{RCD}$  (max) is specified as a reference point only; if  $t_{RCD}$  is greater than the specified  $t_{RCD}$  (max) limit, then access time is controlled exclusively by  $t_{CAC}$ .
  - Operation with the  $t_{RAD}$  (max) limit insures that  $t_{RAC}$  (max) can be met,  $t_{RAD}$  (max) is specified as a reference point only; if  $t_{RAD}$  is greater than the specified  $t_{RAD}$  (max) limit, then access time is controlled exclusively by  $t_{AA}$ .
  - Either  $t_{OED}$  or  $t_{CDD}$  must be satisfied.
  - Either  $t_{DZO}$  or  $t_{DZC}$  must be satisfied.
  - $V_{IH}$  (min) and  $V_{IL}$  (max) are reference levels for measuring timing of input signals. Also, transition times are measured between  $V_{IH}$  (min) and  $V_{IL}$  (max).
  - Assumes that  $t_{RCD} \leq t_{RCD}$  (max) and  $t_{RAD} \leq t_{RAD}$  (max). If  $t_{RCD}$  or  $t_{RAD}$  is greater than the maximum recommended value shown in this table,  $t_{RAC}$  exceeds the value shown.
  - Measured with a load circuit equivalent to 1 TTL loads and 100 pF.
  - Assumes that  $t_{RCD} \geq t_{RCD}$  (max) and  $t_{RAD} \leq t_{RAD}$  (max).
  - Assumes that  $t_{RCD} \leq t_{RCD}$  (max) and  $t_{RAD} \geq t_{RAD}$  (max).
  - Either  $t_{RCH}$  or  $t_{RRH}$  must be satisfied for a read cycles.
  - $t_{OFF}$  (max) and  $t_{OEZ}$  (max) define the time at which the outputs achieve the open circuit condition and are not referred to output voltage levels.
  - $t_{WCS}$ ,  $t_{RWD}$ ,  $t_{CWD}$ ,  $t_{AWD}$  and  $t_{CPW}$  are not restrictive operating parameters. They are included in the data sheet as electrical characteristics only; if  $t_{WCS} \geq t_{WCS}$  (min), the cycle is an early write cycle and the data out pin will remain open circuit (high impedance) throughout the entire cycle; if  $t_{RWD} \geq t_{RWD}$  (min),  $t_{CWD} \geq t_{CWD}$  (min), and  $t_{AWD} \geq t_{AWD}$  (min), or  $t_{CWD} \geq t_{CWD}$  (min),  $t_{AWD} \geq t_{AWD}$  (min) and  $t_{CPW} \geq t_{CPW}$  (min), the cycle is a read-modify-write and the data output will contain data read from the selected cell; if neither of the above sets of conditions is satisfied, the condition of the data out (at access time) is indeterminate.
  - These parameters are referred to  $\overline{CAS}$  leading edge in early write cycles and to  $\overline{WE}$  leading edge in delayed write or read-modify-write cycles.
  - $t_{RASP}$  defines  $\overline{RAS}$  pulse width in EDO page mode cycles.
  - Access time is determined by the longest among  $t_{AA}$ ,  $t_{CAC}$  and  $t_{CPA}$ .
  - In delayed write or read-modify-write cycles,  $\overline{OE}$  must disable output buffer prior to applying data to the device.
  - $t_{HPC}$  (min) can be achieved during a series of EDO page mode write cycles or EDO page mode read cycles. If both write and read operation are mixed in a EDO page mode  $\overline{RAS}$  cycle (EDO page mode mix cycle (1), (2)), minimum value of  $\overline{CAS}$  cycle ( $t_{CAS} + t_{CP} + 2 t_T$ ) becomes greater than the specified  $t_{HPC}$  (min) value. The value of  $\overline{CAS}$  cycle time of mixed EDO page mode is shown in EDO page mode mix cycle (1) and (2).

20. Data output turns off and becomes high impedance from later rising edge of  $\overline{\text{RAS}}$  and  $\overline{\text{CAS}}$ . Hold time and turn off time are specified by the timing specifications of later rising edge of  $\overline{\text{RAS}}$  and  $\overline{\text{CAS}}$  between  $t_{\text{OHR}}$  and  $t_{\text{OH}}$  and between  $t_{\text{OFR}}$  and  $t_{\text{OFF}}$ .
21. Please do not use  $t_{\text{RASS}}$  timing,  $10 \mu\text{s} \leq t_{\text{RASS}} \leq 100 \mu\text{s}$ . During this period, the device is in transition state from normal operation mode to self refresh mode. If  $t_{\text{RASS}} \geq 100 \mu\text{s}$ , then  $\overline{\text{RAS}}$  precharge time should use  $t_{\text{RPS}}$  instead of  $t_{\text{RP}}$ .
22. If you use  $\overline{\text{RAS}}$  only refresh or CBR burst refresh mode in normal read/write cycles, 2048 cycles of distributed CBR refresh with  $15.6 \mu\text{s}$  interval should be executed within 32 ms immediately after exiting from and before entering into the self refresh mode.
23. If you use distributed CBR refresh mode with  $15.6 \mu\text{s}$  interval in normal read/write cycle, CBR refresh should be executed within  $15.6 \mu\text{s}$  immediately after exiting from and before entering into self refresh mode.
24. Repetitive self refresh mode without refreshing all memory is not allowed. Once you exit from self refresh mode, all memory cells need to be refreshed before re-entering the self refresh mode again.
25. XXX: H or L (H:  $V_{\text{IH}}(\text{min}) \leq V_{\text{IN}} \leq V_{\text{IH}}(\text{max})$ , L:  $V_{\text{IL}}(\text{min}) \leq V_{\text{IN}} \leq V_{\text{IL}}(\text{max})$ )

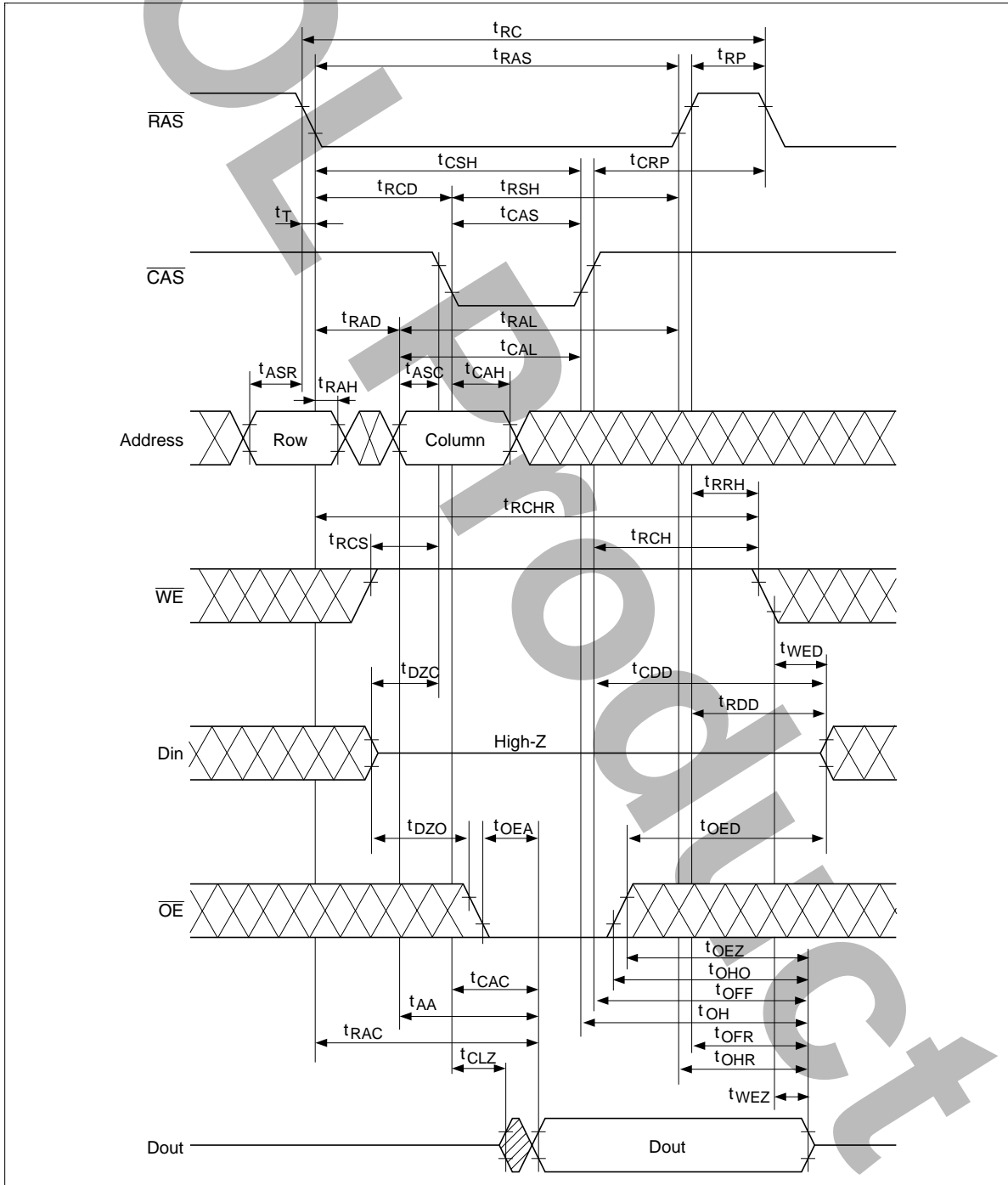
//////: Invalid Dout

When the address, clock and input pins are not described on timing waveforms, their pins must be applied  $V_{\text{IH}}$  or  $V_{\text{IL}}$ .

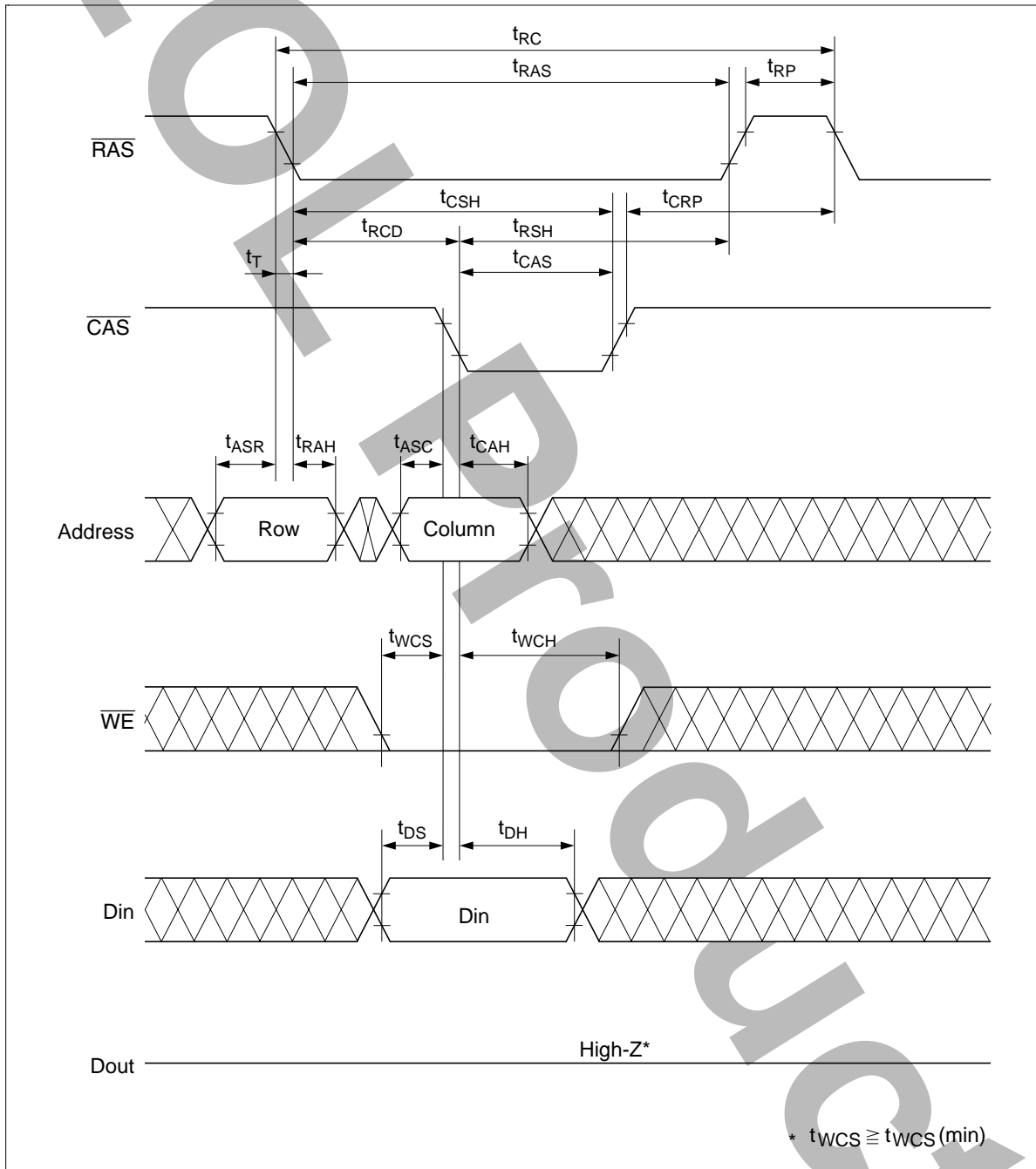
# HM5117805 Series

## Timing Waveforms<sup>\*25</sup>

### Read Cycle

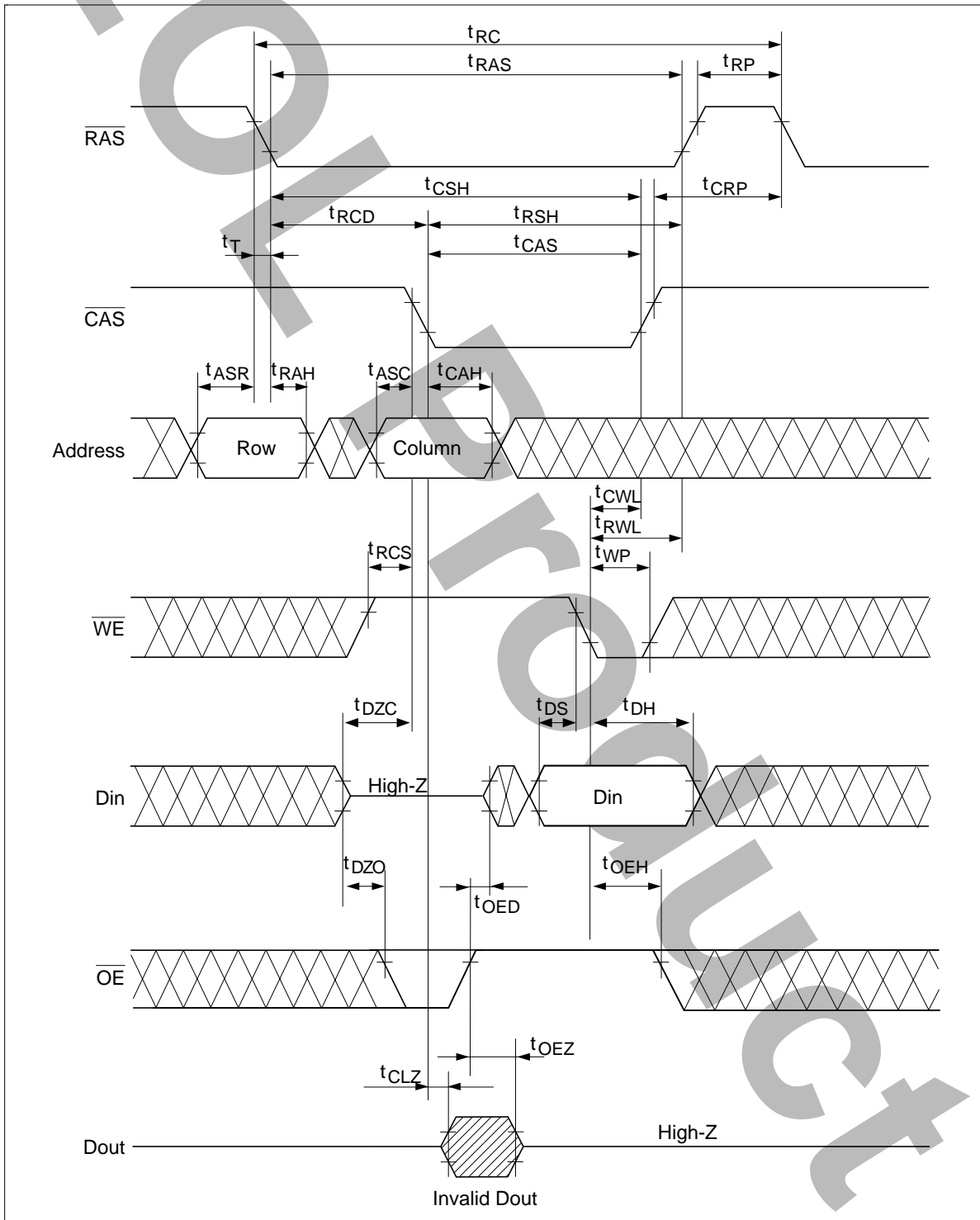


Early Write Cycle



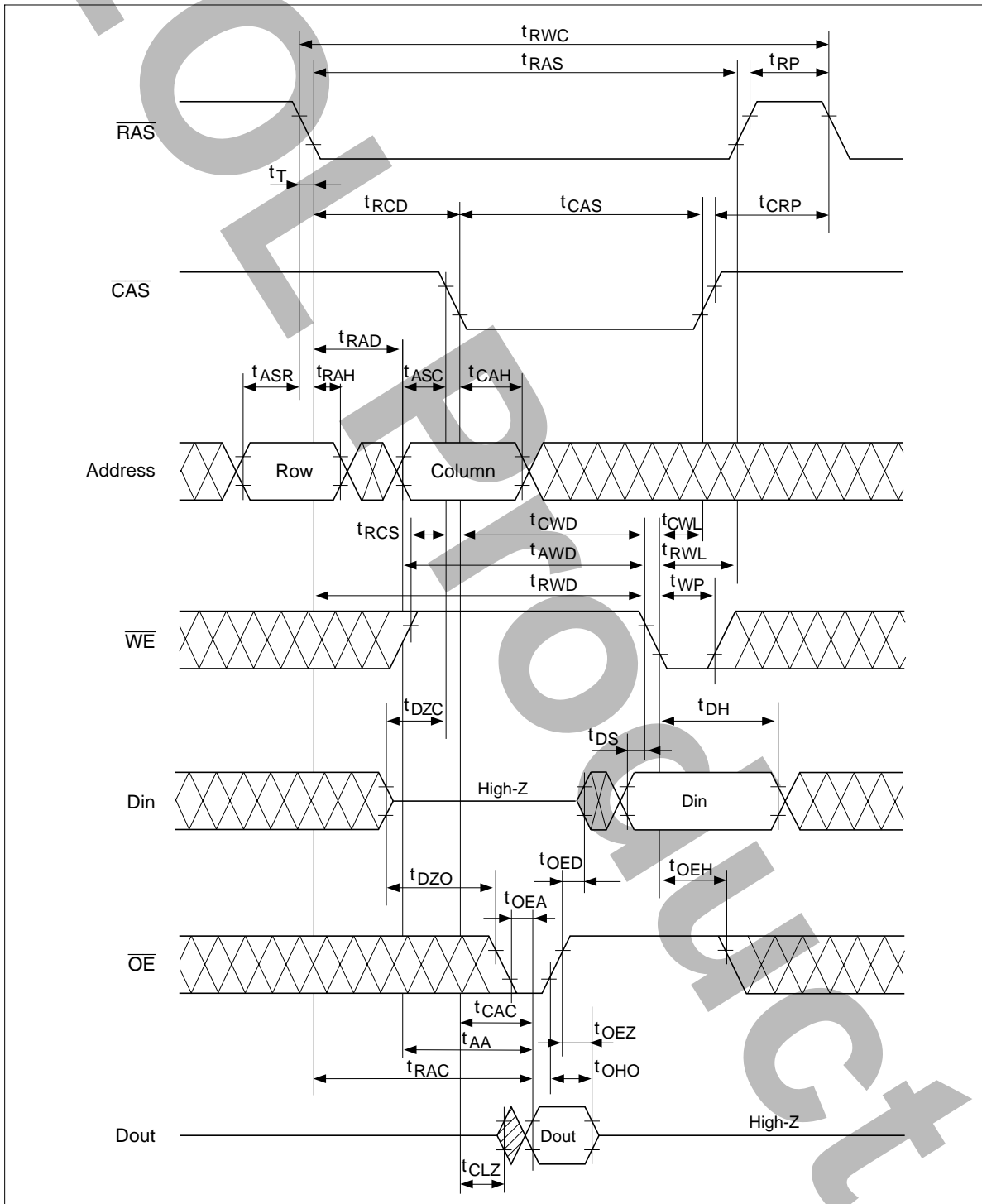
# HM5117805 Series

## Delayed Write Cycle<sup>18</sup>



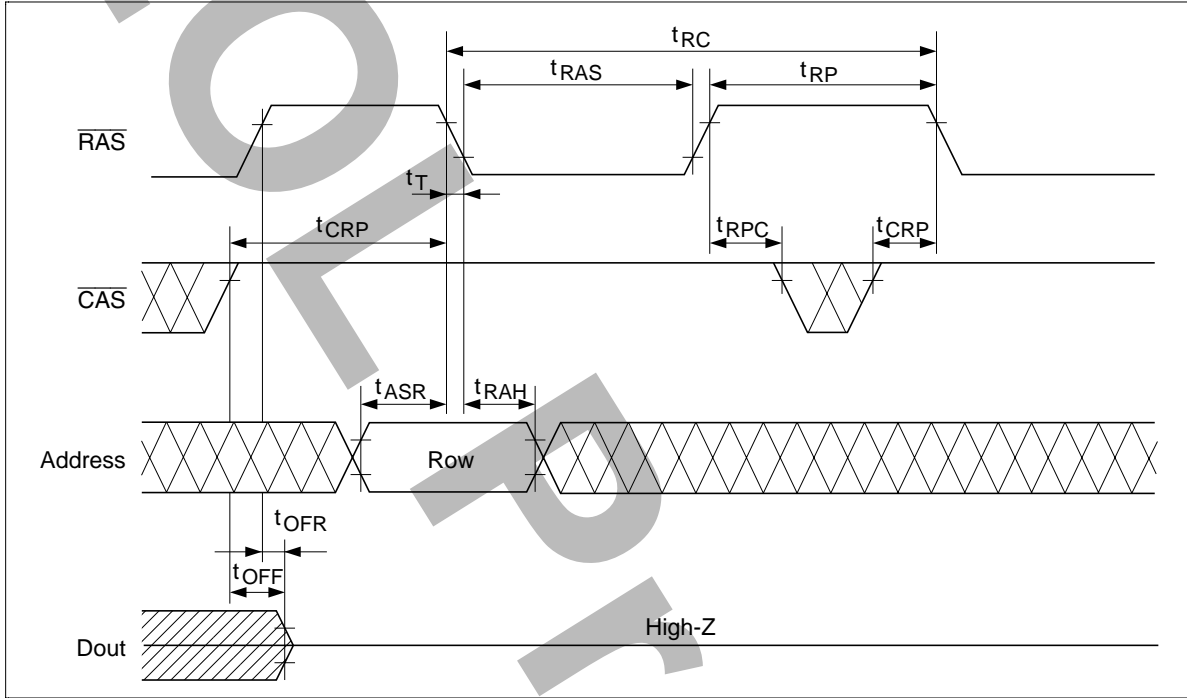


Read-Modify-Write Cycle<sup>\*18</sup>

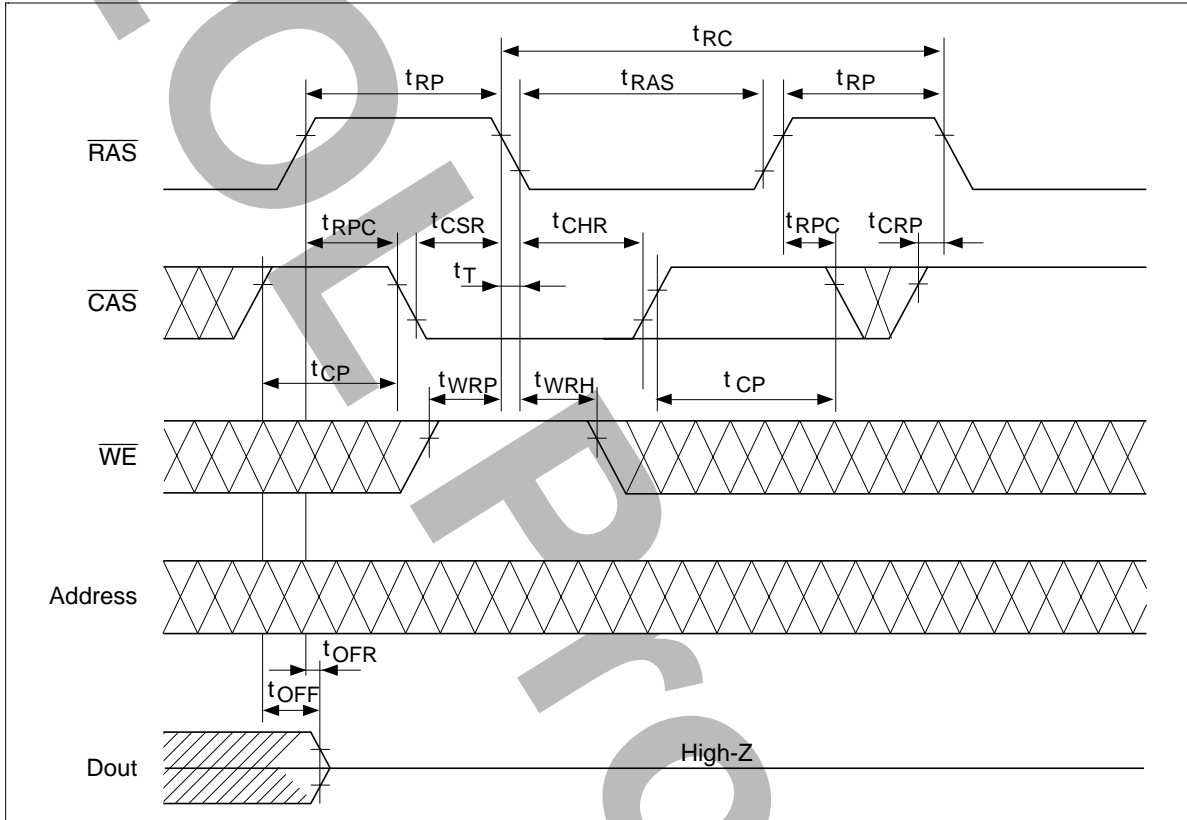


# HM5117805 Series

## RAS-Only Refresh Cycle

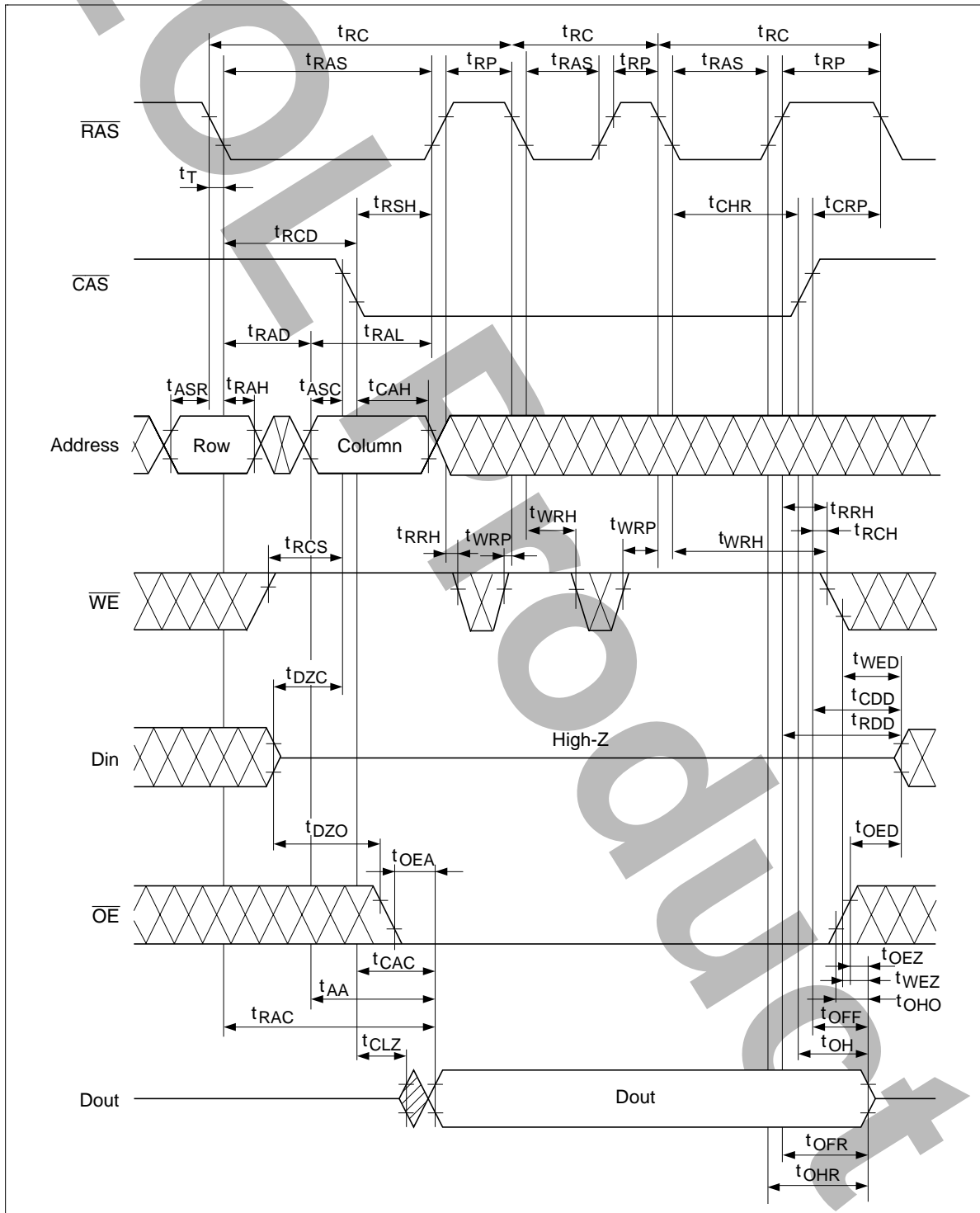


CAS-Before-RAS Refresh Cycle

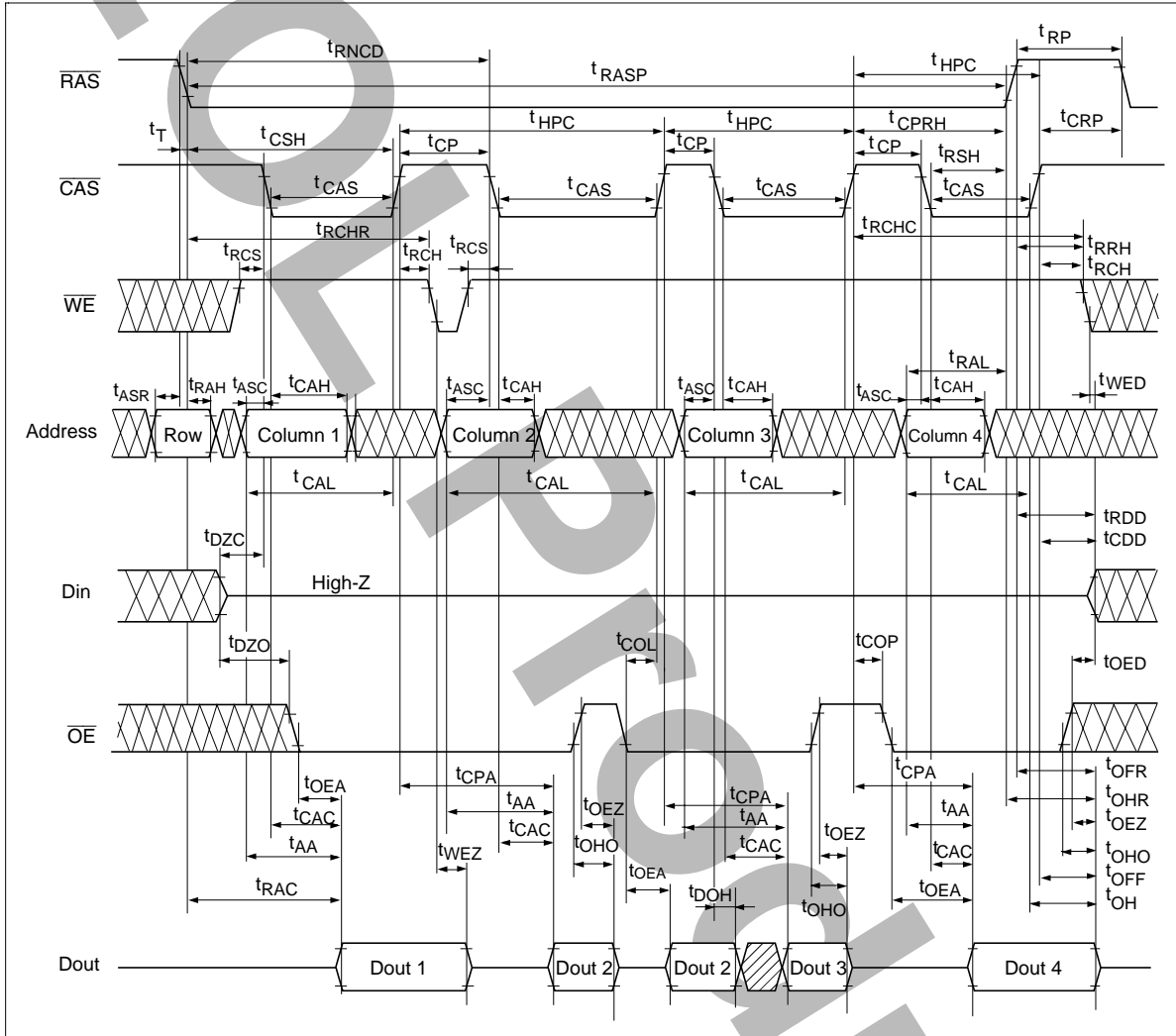


# HM5117805 Series

## Hidden Refresh Cycle

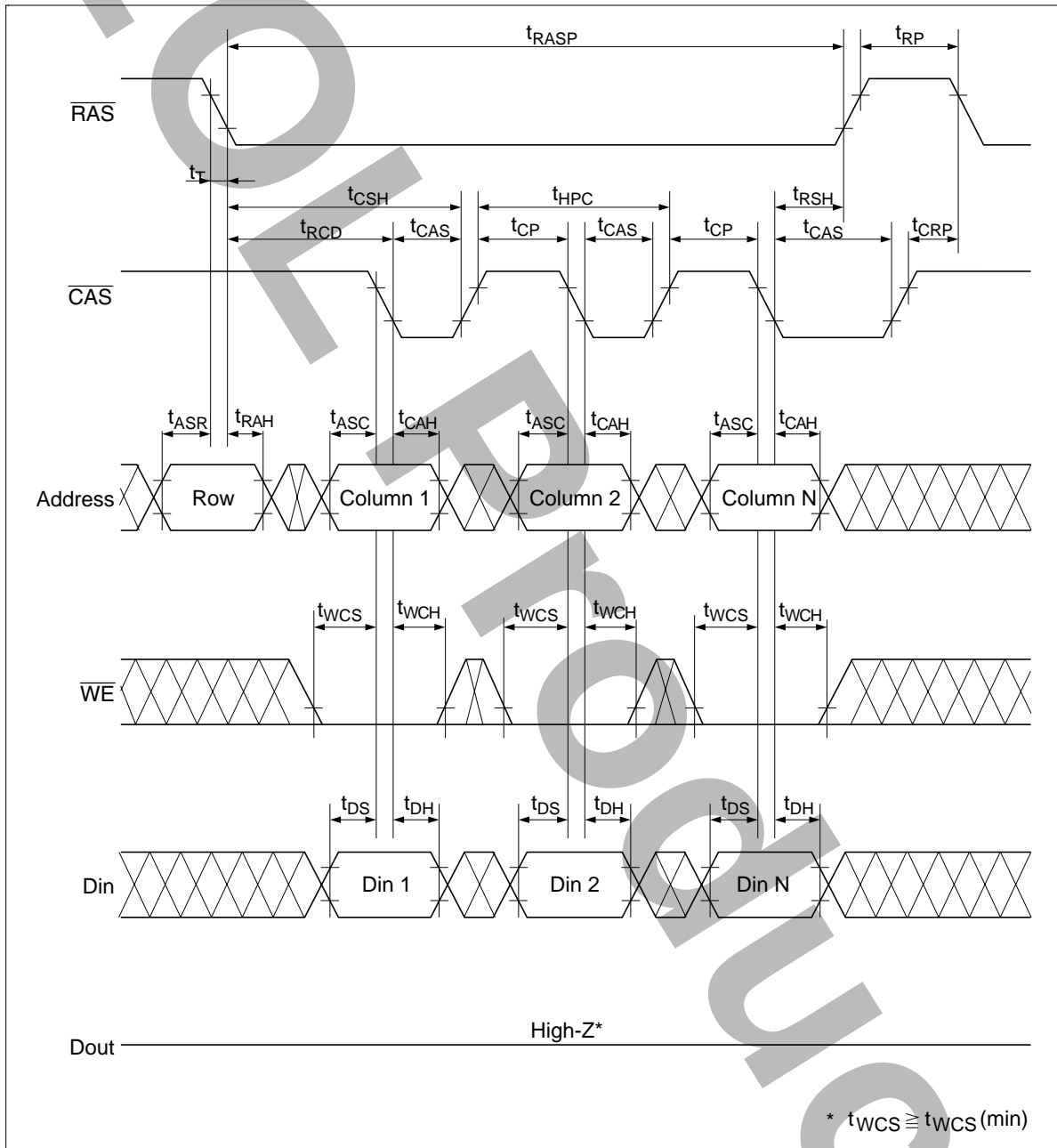


EDO Page Mode Read Cycle

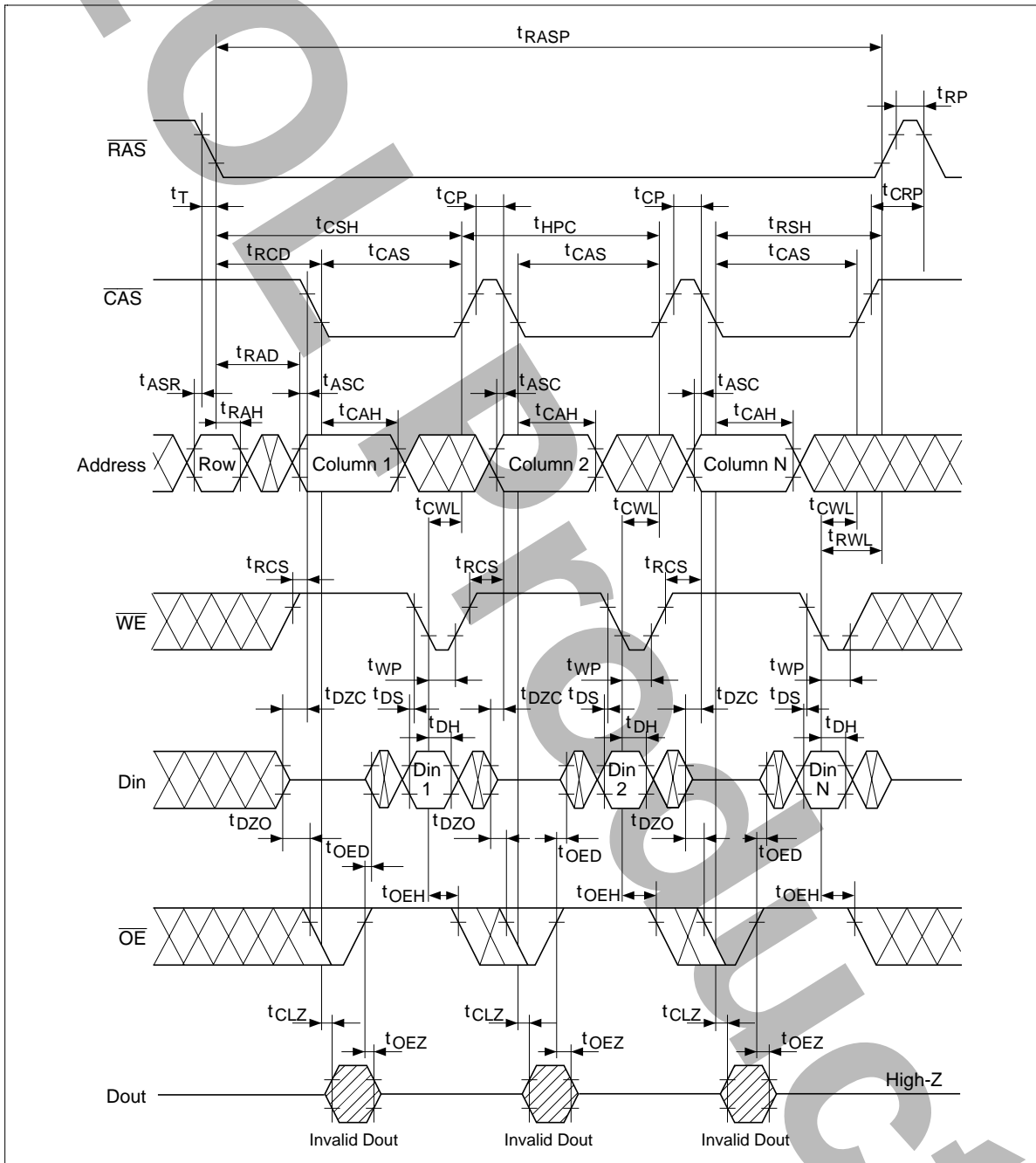


# HM5117805 Series

## EDO Page Mode Early Write Cycle

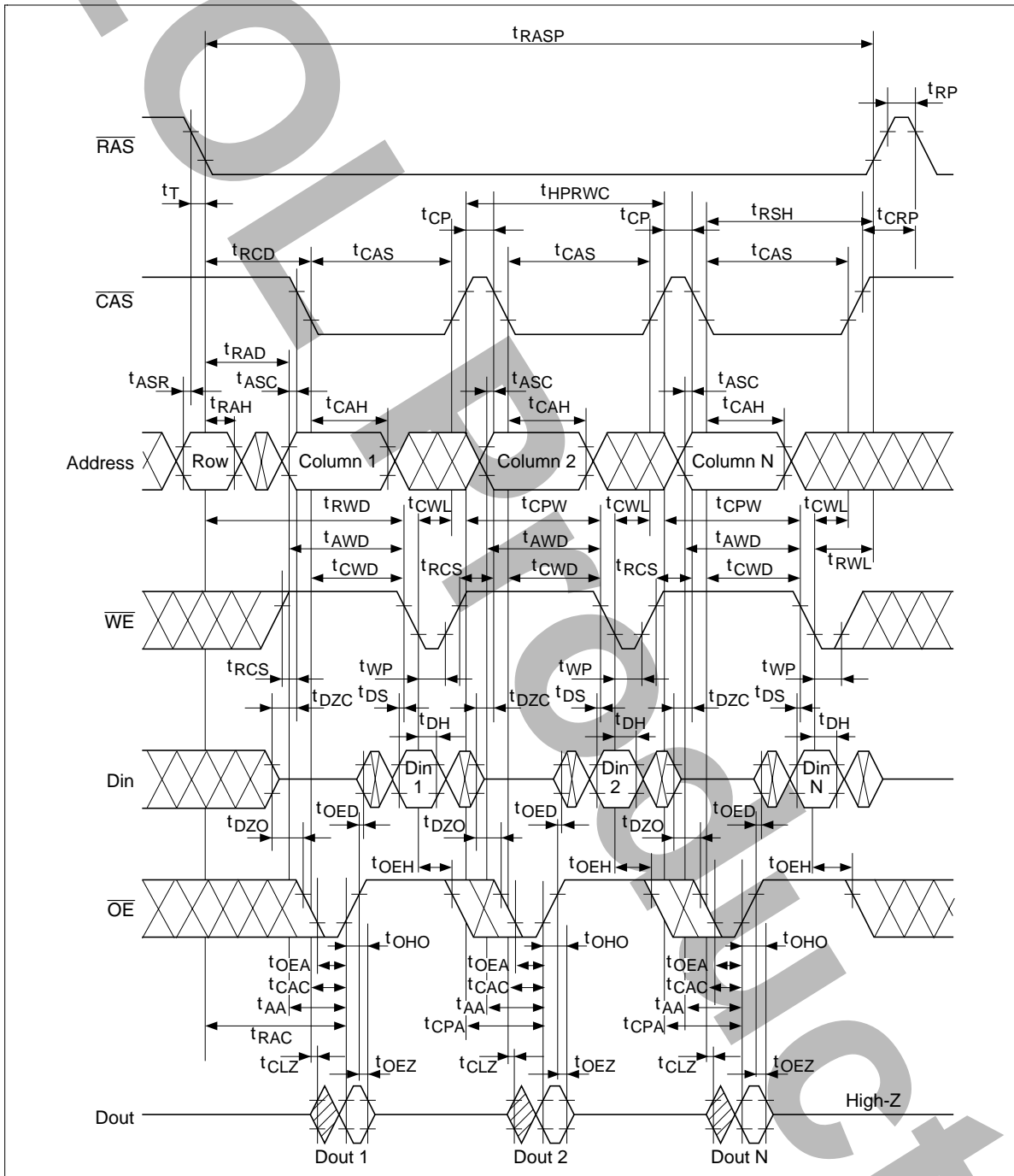


EDO Page Mode Delayed Write Cycle\*18



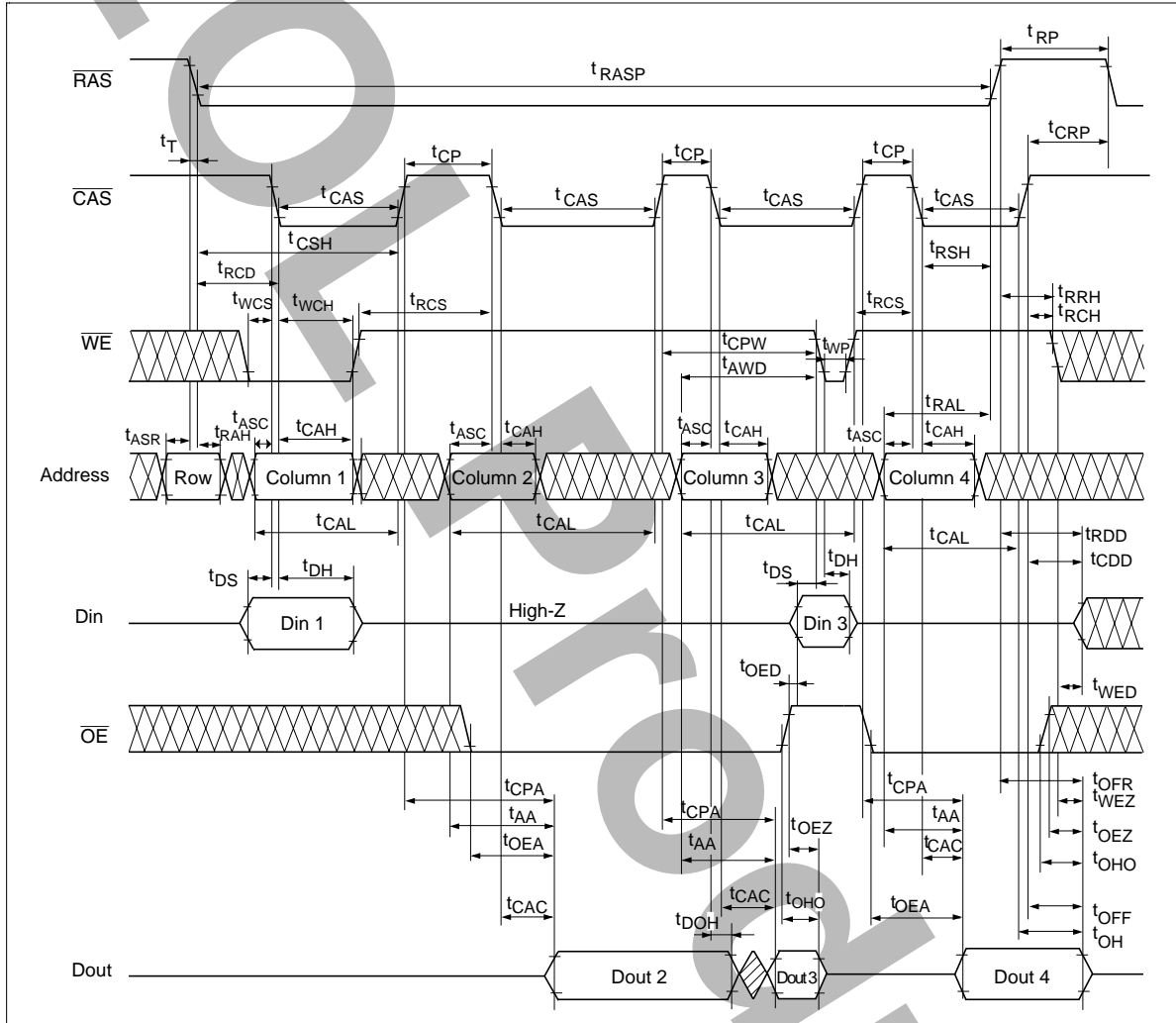
# HM5117805 Series

## EDO Page Mode Read-Modify-Write Cycle <sup>\*18</sup>



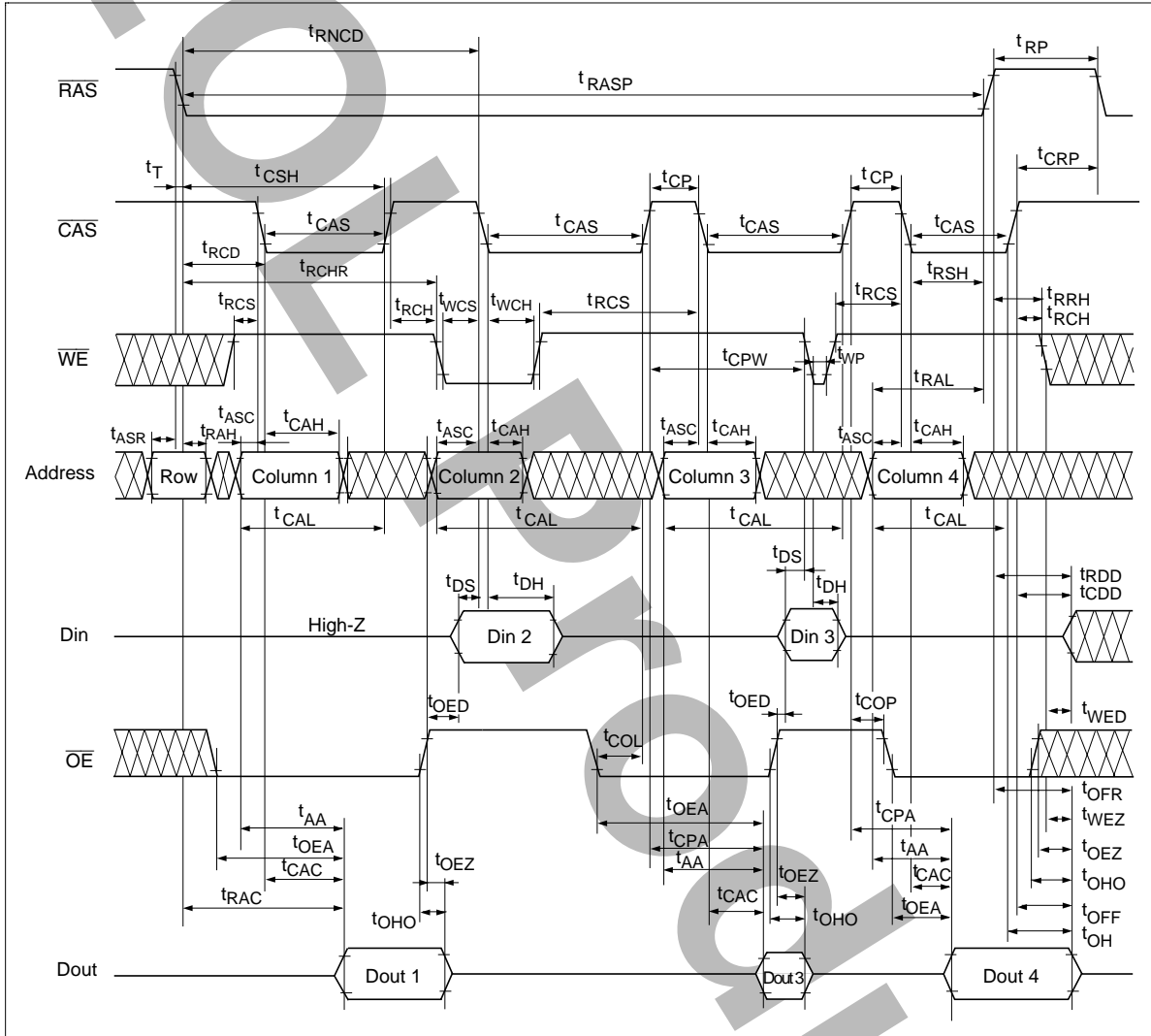


EDO Page Mode Mix Cycle (1)

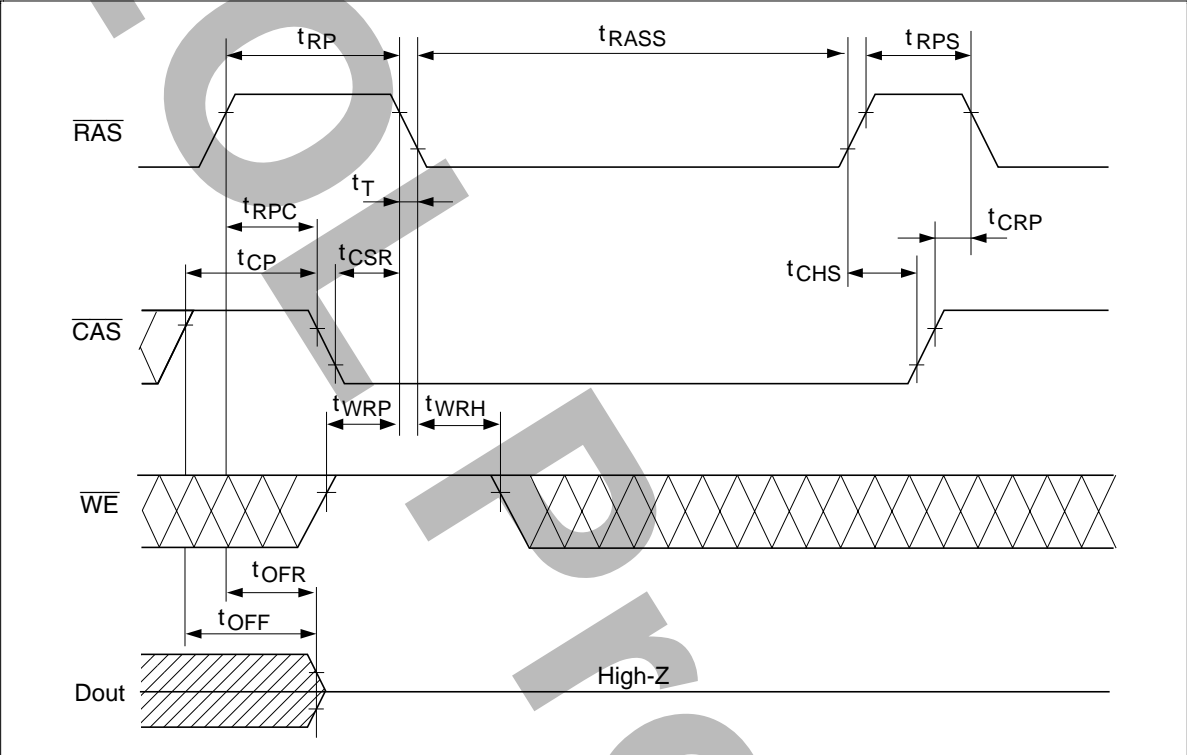


# HM5117805 Series

## EDO Page Mode Mix Cycle (2)



Self Refresh Cycle (L-version) \*21, 22, 23, 24

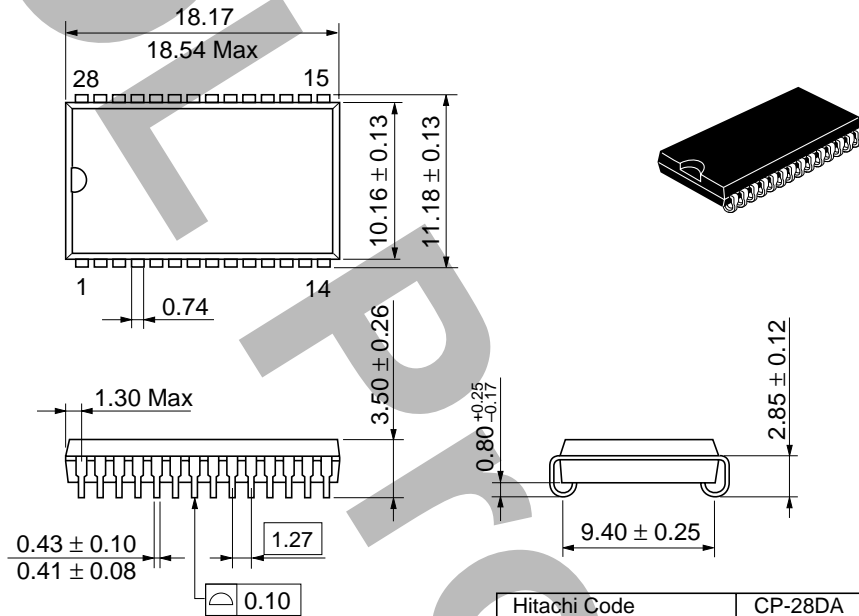


# HM5117805 Series

## Package Dimensions

HM5117805J/LJ Series (CP-28DA)

Unit: mm



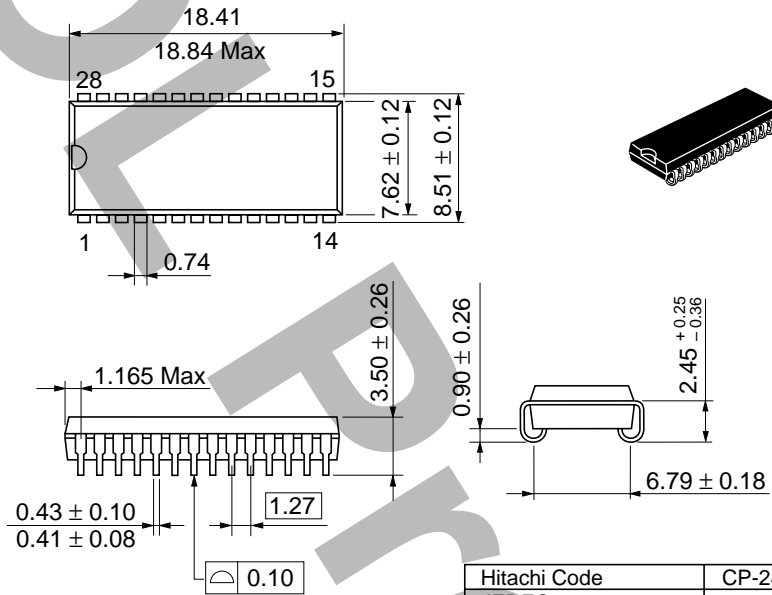
Dimension including the plating thickness  
Base material dimension

|                          |          |
|--------------------------|----------|
| Hitachi Code             | CP-28DA  |
| JEDEC                    | Conforms |
| EIAJ                     | Conforms |
| Weight (reference value) | 1.16 g   |

# HM5117805 Series

## HM5117805S/LS Series (CP-28DNA)

Unit: mm



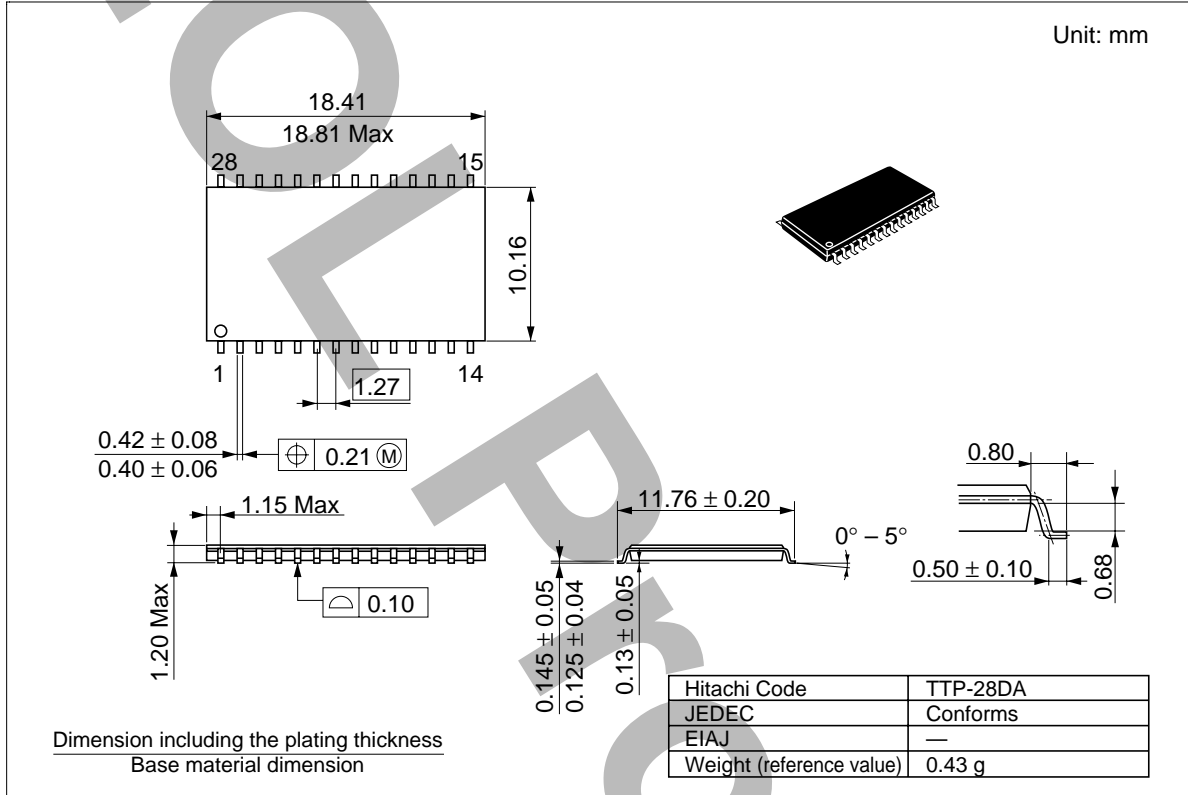
Dimension including the plating thickness  
Base material dimension

|                          |          |
|--------------------------|----------|
| Hitachi Code             | CP-28DNA |
| JEDEC                    | —        |
| EIAJ                     | —        |
| Weight (reference value) | 0.95 g   |

# HM5117805 Series

## HM5117805TT/LTT Series (TTP-28DA)

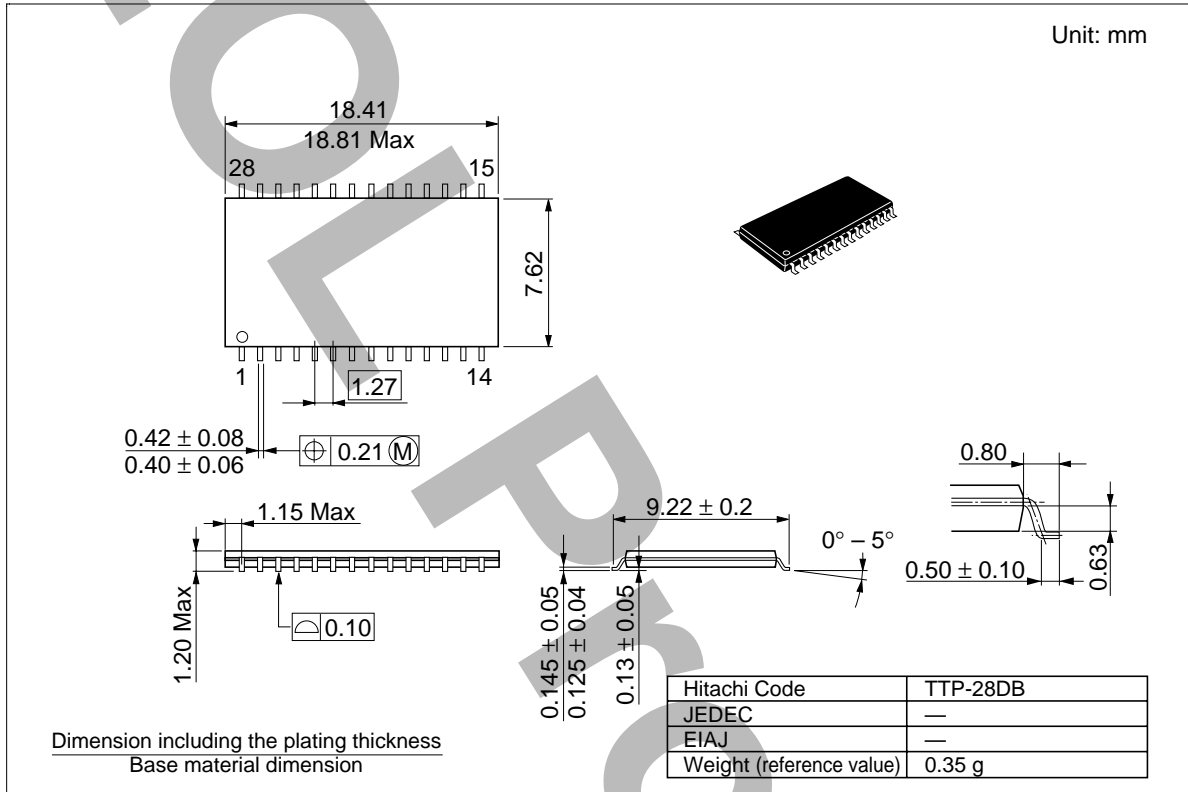
Unit: mm



# HM5117805 Series

## HM5117805TS/LTS Series (TTP-28DB)

Unit: mm



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## HM5117805 Series

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