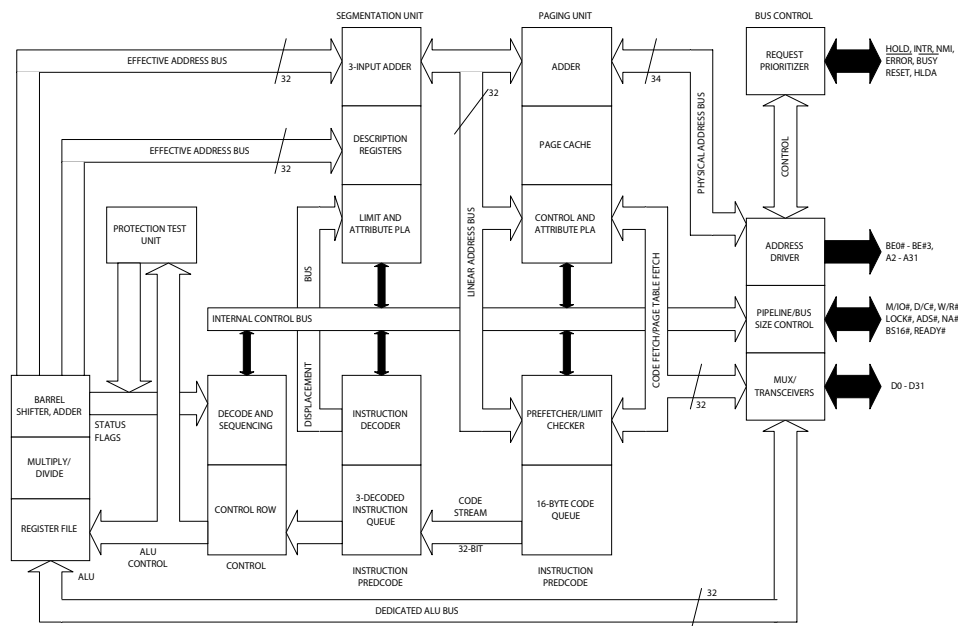
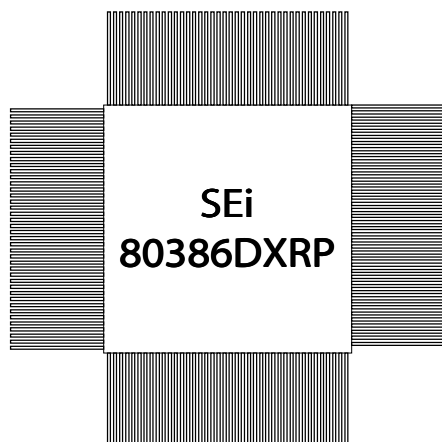


**FEATURES:**

- 32-Bit microprocessor
- RAD-PAK<sup>®</sup> radiation-hardened  
Against natural space radiation
- Total dose hardness >100 Krad (Si); dependent upon orbit
- Single event effect
  - $SEL_{TH} = 37\text{-}60 \text{ MeV/mg/cm}^2$
  - $SEU_{TH} = 3.4 \text{ MeV/mg/cm}^2$
- Package:
  - 164 Pin RAD-PAK<sup>®</sup> quad flat pack
- 8, 16, 32-Bit data types
- 8 general purpose 32-Bit registers
- Hardware debugging support
- Very large address space:
  - 4 gigabyte physical
  - 64 terabyte Virtual
  - 4 gigabyte maximum segment size
- Integrated memory management unit
  - Virtual memory support
  - Four levels of protection
  - Fully compatible with 80C286RP
- Optimized for system development
  - Pipelined instructions
  - On-chip caches support address translation
  - 32 megabytes/sec bus bandwidth

**DESCRIPTION:**

Space Electronic's 80386DXRP (RP for RAD-PAK<sup>®</sup>) high performance 32-bit microprocessor features a typical 100krad (Si) total dose tolerance; dependent upon orbit. It is designed for very high performance and multitasking operating systems. The integrated memory management and protection architecture support operating systems. The 80386DXRP allows simultaneous running of multiple operations. In addition, the 80386DXRP is capable of execution at sustained rates of between 3 and 4 million instructions per second. It offers new testability and debugging features, include a self-test and direct access to the page translation cache. The patented radiation hardened RAD-PAK<sup>®</sup> technology incorporates radiation shielding in the microcircuit package. Capable of surviving in space environment, the 80386DXRP is ideal for satellite, spacecraft, and space probe missions. It is available with packaging and screening up to Class S.


**80386DXRP PINOUT DESCRIPTION**

| PIN | SYMBOL          | PIN | SYMBOL                    | PIN | SYMBOL                    | PIN | SYMBOL          | PIN | SYMBOL          | PIN | SYMBOL          |
|-----|-----------------|-----|---------------------------|-----|---------------------------|-----|-----------------|-----|-----------------|-----|-----------------|
| 1   | A16             | 29  | NC                        | 57  | V <sub>SS</sub>           | 85  | D1              | 113 | D13             | 141 | V <sub>CC</sub> |
| 2   | A17             | 30  | NC                        | 58  | V <sub>CC</sub>           | 86  | NC              | 114 | NC              | 142 | V <sub>SS</sub> |
| 3   | A15             | 31  | V <sub>CC</sub>           | 59  | $\overline{\text{LOCK}}$  | 87  | D2              | 115 | D15             | 143 | D31             |
| 4   | A14             | 32  | V <sub>SS</sub>           | 60  | W/ $\overline{\text{R}}$  | 88  | NC              | 116 | D16             | 144 | D30             |
| 5   | A13             | 33  | NC                        | 61  | V <sub>SS</sub>           | 89  | D4              | 117 | V <sub>CC</sub> | 145 | NC              |
| 6   | A12             | 34  | V <sub>CC</sub>           | 62  | V <sub>CC</sub>           | 90  | D0              | 118 | V <sub>SS</sub> | 146 | A31             |
| 7   | A11             | 35  | V <sub>SS</sub>           | 63  | M/ $\overline{\text{IO}}$ | 91  | V <sub>CC</sub> | 119 | D18             | 147 | A30             |
| 8   | NC              | 36  | NC                        | 64  | D/ $\overline{\text{C}}$  | 92  | V <sub>SS</sub> | 120 | D17             | 148 | A29             |
| 9   | A9              | 37  | INTR                      | 65  | NC                        | 93  | D6              | 121 | D20             | 149 | A28             |
| 10  | A10             | 38  | NC                        | 66  | NC                        | 94  | D3              | 122 | V <sub>SS</sub> | 150 | V <sub>CC</sub> |
| 11  | V <sub>SS</sub> | 39  | NC                        | 67  | $\overline{\text{BE2}}$   | 95  | V <sub>SS</sub> | 123 | D22             | 151 | V <sub>SS</sub> |
| 12  | A7              | 40  | NC                        | 68  | NC                        | 96  | V <sub>CC</sub> | 124 | D19             | 152 | A27             |
| 13  | A8              | 41  | NMI                       | 69  | V <sub>CC</sub>           | 97  | D8              | 125 | NC              | 153 | A26             |
| 14  | V <sub>CC</sub> | 42  | PEREQ                     | 70  | V <sub>SS</sub>           | 98  | D5              | 126 | NC              | 154 | A25             |
| 15  | V <sub>SS</sub> | 43  | V <sub>SS</sub>           | 71  | $\overline{\text{BE0}}$   | 99  | V <sub>CC</sub> | 127 | D24             | 155 | NC              |
| 16  | A5              | 44  | V <sub>CC</sub>           | 72  | $\overline{\text{BE3}}$   | 100 | V <sub>SS</sub> | 128 | D21             | 156 | A23             |
| 17  | A6              | 45  | $\overline{\text{ERROR}}$ | 73  | NC                        | 101 | HLDA            | 129 | NC              | 157 | A24             |
| 18  | NC              | 46  | RESET                     | 74  | $\overline{\text{BE1}}$   | 102 | D7              | 130 | NC              | 158 | A21             |
| 19  | NC              | 47  | NC                        | 75  | $\overline{\text{NA}}$    | 103 | NC              | 131 | D25             | 159 | A22             |
| 20  | A3              | 48  | NC                        | 76  | NC                        | 104 | D10             | 132 | D23             | 160 | NC              |
| 21  | A4              | 49  | $\overline{\text{BUSY}}$  | 77  | NC                        | 105 | D9              | 133 | NC              | 161 | A20             |
| 22  | NC              | 50  | V <sub>CC</sub>           | 78  | $\overline{\text{BS16}}$  | 106 | NC              | 134 | NC              | 162 | A19             |
| 23  | NC              | 51  | V <sub>SS</sub>           | 79  | HOLD                      | 107 | NC              | 135 | D27             | 163 | A18             |
| 24  | A2              | 52  | V <sub>CC</sub>           | 80  | CKL2                      | 108 | D12             | 136 | D26             | 164 | NC              |
| 25  | NC              | 53  | V <sub>SS</sub>           | 81  | $\overline{\text{ADS}}$   | 109 | D11             | 137 | V <sub>CC</sub> | --  | --              |
| 26  | V <sub>CC</sub> | 54  | V <sub>CC</sub>           | 82  | NC                        | 110 | V <sub>CC</sub> | 138 | V <sub>SS</sub> | --  | --              |
| 27  | V <sub>SS</sub> | 55  | V <sub>SS</sub>           | 83  | $\overline{\text{READY}}$ | 111 | V <sub>SS</sub> | 139 | D29             | --  | --              |
| 28  | NC              | 56  | V <sub>CC</sub>           | 84  | NC                        | 112 | D14             | 140 | D28             | --  | --              |

**80386DXRP ABSOLUTE MAXIMUM RATINGS**

| PARAMETER                        | SYMBOL    | MIN  | MAX            | UNITS |
|----------------------------------|-----------|------|----------------|-------|
| Supply Voltage Respect to Ground | $V_{CC}$  | -0.5 | +6.5           | V     |
| Voltage on Other Pins            | --        | -0.5 | $V_{CC} + 0.5$ | V     |
| Operating Temperature Range      | $T_{OPR}$ | -55  | +125           | °C    |
| Storage Temperature Range        | $T_{STG}$ | -65  | +150           | °C    |

**80386DXRP RECOMMENDED OPERATING CONDITIONS**

| PARAMETER              | SYMBOL   | MIN  | MAX  | UNITS |
|------------------------|----------|------|------|-------|
| Digital Supply Voltage | $V_{CC}$ | 4.75 | 5.25 | V     |
| Temperature Range      | $T_A$    | -55  | +125 | °C    |

**80386DXRP DC ELECTRICAL CHARACTERISTICS FOR READ OPERATIONS**
 $(V_{CC} = 5V \pm 5\%, T_A = -55 \text{ TO } +125^\circ\text{C}, \text{ UNLESS OTHERWISE SPECIFIED})$ 

| PARAMETER                | TEST CONDITION                                                                                                                                                            | SYMBOL    | MIN            | MAX               | UNITS         |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|----------------|-------------------|---------------|
| Input Leakage Current    | All pins except $\overline{BS16}$ , $\overline{PEREQ}$ , $\overline{BUSY}$ , and $\overline{ERROR}$<br>$0V < V_{IN} < V_{CC}$                                             | $I_{LI}$  | -15            | +15               | $\mu\text{A}$ |
| Output Leakage Current   | $0.45V < V_{OUT} < V_{CC}$                                                                                                                                                | $I_{LO}$  | -15            | +15               | $\mu\text{A}$ |
| Input Low Voltage        | 3/                                                                                                                                                                        | $V_{IL}$  | -0.3           | 0.8               | V             |
| Input High Voltage       | 3/                                                                                                                                                                        | $V_{IH}$  | 2.0            | $V_{CC} + 0.3$    | V             |
| CLK2 Input Low Voltage   | 3/                                                                                                                                                                        | $V_{ILC}$ | -0.3           | 0.8               | V             |
| CLK2 Input High Voltage  | 3/                                                                                                                                                                        | $V_{IHC}$ | $V_{CC} - 0.8$ | $V_{CC} + 0.3$    | V             |
| Output Low Voltage       | $I_{OL} = 4 \text{ mA}$ (A2-A31, D0-D31)<br>$I_{OL} = 5 \text{ mA}$ ( $\overline{BE0}$ - $\overline{BE3}$ , W/R, D/C, M/I/O, $\overline{LOCK}$ , $\overline{ADS}$ , HLDA) | $V_{OL}$  | --             | 0.45<br>0.45      | V             |
| Output High Voltage      | $I_{OH} = -1\text{mA}$ (A2-A31, D0-D31)<br>$I_{OH} = -0.9\text{mA}$ ( $\overline{BE0}$ - $\overline{BE3}$ , W/R, D/C, M/I/O, $\overline{LOCK}$ , $\overline{ADS}$ , HLDA) | $V_{OH}$  | 2.4<br>2.4     | --                | V             |
| Power Supply Current     | CLK2 = 32MHz with 16MHz Processor<br>CLK2 = 32MHz with 20MHz Processor<br>CLK2 = 32MHz with 25MHz Processor                                                               | $I_{CC}$  | --             | 460<br>550<br>680 | mA            |
| Input Leakage Current 1/ | $\overline{PEREQ}$ Pin                                                                                                                                                    | $I_{IH}$  | --             | 200               | $\mu\text{A}$ |
| Input Leakage Current 2/ | $\overline{BS16}$ , $\overline{BUSY}$ , $\overline{ERROR}$ Pins                                                                                                           | $I_{IL}$  | --             | -400              | $\mu\text{A}$ |
| CLK2 Capacitance         | @ 1MHz 3/                                                                                                                                                                 | $C_{CLK}$ | --             | 20                | pF            |

**80386DXRP DC ELECTRICAL CHARACTERISTICS FOR READ OPERATIONS (cont)**
 $(V_{CC} = 5V \pm 5\%, T_A = -55 \text{ TO } +125^\circ\text{C, UNLESS OTHERWISE SPECIFIED})$ 

| PARAMETER                 | TEST CONDITION | SYMBOL    | MIN | MAX | UNITS |
|---------------------------|----------------|-----------|-----|-----|-------|
| Input Capacitance         | @ 1MHz 3/      | $C_{IN}$  | --  | 20  | pF    |
| Output or I/O Capacitance | @ 1MHz 3/      | $C_{OUT}$ | --  | 25  | pF    |

NOTE:

1/  $V_{IH} = 2.4V$ . PEREQ input has an internal pull-down resistor.2/  $V_{IL} = 0.45V$ . BS16, BUSY, and ERROR inputs each have an internal pull-up resistor.

3/ Guaranteed by design if not tested.

**80386DXRP AC ELECTRICAL CHARACTERISTICS**
 $(V_{CC} = 5V \pm 10\%, V_{PP} = V_{SS}, T_A = -55 \text{ TO } +125^\circ\text{C, UNLESS OTHERWISE SPECIFIED})$ 

| PARAMETER                                                           | TEST CONDITION               | SYMBOL   | MIN            | MAX               | UNITS |
|---------------------------------------------------------------------|------------------------------|----------|----------------|-------------------|-------|
| Operating Frequency<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25 | Half of CLK2 Frequency       | --       | 4<br>4<br>4    | 16<br>20<br>25    | MHz   |
| CLK2 Period<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25         | --                           | $t_1$    | 31<br>25<br>20 | 125<br>125<br>125 | ns    |
| CLK2 High Time<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25      | at 2V                        | $t_{2a}$ | 9<br>8<br>7    | --                | ns    |
| CLK2 High Time<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25      | at $(V_{CC} - 0.8V)$ 3/      | $t_{2b}$ | 5<br>5<br>4    | --                | ns    |
| CLK2 Low Time<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25       | at 2V                        | $t_{3a}$ | 9<br>8<br>7    | --                | ns    |
| CLK2 Low Time<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25       | at 0.8V 3/                   | $t_{3b}$ | 7<br>6<br>5    | --                | ns    |
| CLK2 Fall Time<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25      | $(V_{CC} - 0.8V)$ to 0.8V 3/ | $t_4$    | --             | 8<br>8<br>7       | ns    |


**80386DXRP AC ELECTRICAL CHARACTERISTICS (cont)**
 $(V_{CC} = 5V \pm 10\%, V_{PP} = V_{SS}, T_A = -55 \text{ TO } +125^\circ\text{C, UNLESS OTHERWISE SPECIFIED})$ 

| PARAMETER                                                                                                                     | TEST CONDITION                                        | SYMBOL   | MIN         | MAX            | UNITS |
|-------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|----------|-------------|----------------|-------|
| CLK2 Rise Time<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25                                                                | 0.8V to $(V_{CC} - 0.8V)$ 3/                          | $t_5$    | --          | 8<br>8<br>7    | ns    |
| A2 - A31 Valid Delay<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25                                                          | $C_L = 120\text{pF}$ ( $C_L = 50\text{pF}$ for 25MHz) | $t_6$    | 4<br>4<br>4 | 36<br>30<br>21 | ns    |
| A2 - A31 Float Delay<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25                                                          | 1/, 3/                                                | $t_7$    | 4<br>4<br>4 | 40<br>32<br>30 | ns    |
| $\overline{BE0} - \overline{BE3}$ Valid Delay<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25                                 | $C_L = 75\text{pF}$ ( $C_L = 50\text{pF}$ for 25MHz)  | $t_8$    | 4<br>4<br>4 | 36<br>30<br>24 | ns    |
| $\overline{BE0} - \overline{BE3}, \overline{LOCK}$ Float Delay<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25                | 1/, 3/                                                | $t_9$    | 4<br>4<br>4 | 40<br>32<br>30 | ns    |
| $\overline{W/R}, \overline{M/IO}, \overline{D/C}, \overline{ADS}$ Valid Delay<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25 | $C_L = 75\text{pF}$ ( $C_L = 50\text{pF}$ for 25MHz)  | $t_{10}$ | 6<br>6<br>4 | 33<br>28<br>21 | ns    |
| $\overline{W/R}, \overline{M/IO}, \overline{D/C}, \overline{ADS}$ Float Delay<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25 | 1/, 3/                                                | $t_{11}$ | 6<br>6<br>4 | 35<br>30<br>30 | ns    |
| D0 - D31 Write Data Valid Delay<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25                                               | $C_L = 120\text{pF}$ ( $C_L = 50\text{pF}$ for 25MHz) | $t_{12}$ | 4<br>4<br>7 | 48<br>38<br>27 | ns    |
| D0 - D31 Write Data Float Delay<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25                                               | 1/, 3/                                                | $t_{13}$ | 4<br>4<br>4 | 35<br>27<br>22 | ns    |
| HLDA Valid Delay<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25                                                              | $C_L = 75\text{pF}$ ( $C_L = 50\text{pF}$ for 25MHz)  | $t_{14}$ | 6<br>6<br>4 | 33<br>28<br>22 | ns    |


**80386DXRP AC ELECTRICAL CHARACTERISTICS (cont)**
 $(V_{CC} = 5V \pm 10\%, V_{PP} = V_{SS}, T_A = -55 \text{ TO } +125^\circ\text{C, UNLESS OTHERWISE SPECIFIED})$ 

| PARAMETER                                                                            | TEST CONDITIOIN | SYMBOL   | MIN            | MAX | UNITS |
|--------------------------------------------------------------------------------------|-----------------|----------|----------------|-----|-------|
| $\overline{\text{NA}}$ Setup Time<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25    | --              | $t_{15}$ | 11<br>9<br>7   | --  | ns    |
| $\overline{\text{NA}}$ Hold Time<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25     | --              | $t_{16}$ | 14<br>14<br>3  | --  | ns    |
| $\overline{\text{BS16}}$ Setup Time<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25  | --              | $t_{17}$ | 13<br>13<br>7  | --  | ns    |
| $\overline{\text{BS16}}$ Hold Time<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25   | --              | $t_{18}$ | 21<br>21<br>3  | --  | ns    |
| $\overline{\text{READY}}$ Setup Time<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25 | --              | $t_{19}$ | 21<br>12<br>9  | --  | ns    |
| $\overline{\text{READY}}$ Hold Time<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25  | --              | $t_{20}$ | 4<br>4<br>4    | --  | ns    |
| D0 - D31 Read Setup Time<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25             | --              | $t_{21}$ | 11<br>11<br>7  | --  | ns    |
| D0 -D31 Read Hold Time<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25               | --              | $t_{22}$ | 6<br>6<br>5    | --  | ns    |
| HOLD Setup Time<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25                      | --              | $t_{23}$ | 26<br>17<br>15 | --  | ns    |
| HOLD Hold Time<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25                       | --              | $t_{24}$ | 5<br>5<br>3    | --  | ns    |


**80386DXRP AC ELECTRICAL CHARACTERISTICS (cont)**
 $(V_{CC} = 5V \pm 10\%, V_{PP} = V_{SS}, T_A = -55 \text{ to } +125^\circ\text{C, UNLESS OTHERWISE SPECIFIED})$ 

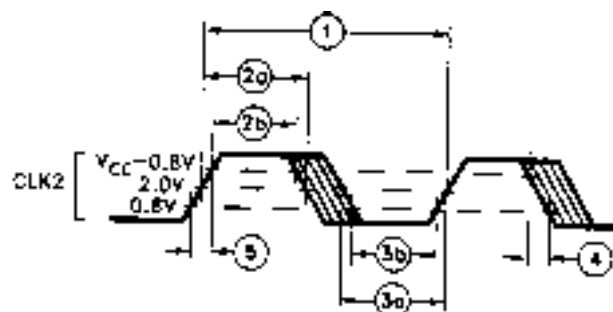
| PARAMETER                                                                                                              | TEST CONDITION | SYMBOL   | MIN           | MAX | UNITS |
|------------------------------------------------------------------------------------------------------------------------|----------------|----------|---------------|-----|-------|
| RESET Hold Time<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25                                                        | --             | $t_{26}$ | 4<br>4<br>3   | --  | ns    |
| NMI, INTR Setup Time<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25                                                   | 2/             | $t_{27}$ | 16<br>16<br>6 | --  | ns    |
| NMI, INTR Hold Time<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25                                                    | 2/             | $t_{28}$ | 16<br>16<br>6 | --  | ns    |
| PEREQ, $\overline{\text{ERROR}}$ , $\overline{\text{BUSY}}$ Setup Time<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25 | 2/             | $t_{29}$ | 16<br>14<br>6 | --  | ns    |
| PEREQ, $\overline{\text{ERROR}}$ , $\overline{\text{BUSY}}$ Hold Time<br>80386DXRP-16<br>80386DXRP-20<br>80386DXRP-25  | 2/             | $t_{30}$ | 5<br>5<br>5   | --  | ns    |

NOTE:

1/ Float condition occurs when maximum output current becomes less than  $I_{O1}$  in magnitude.

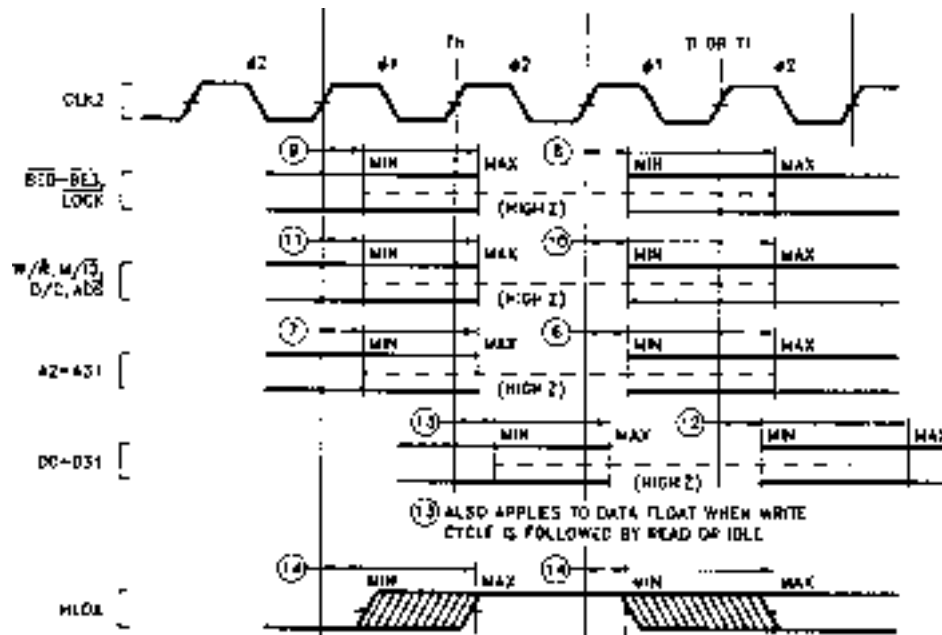
2/ These inputs are allowed to be asynchronous to CLK2. The setup and hold specifications are given for testing purposes, to assure recognition within a specific CLK2 period.

3/ Guaranteed by design if not tested.

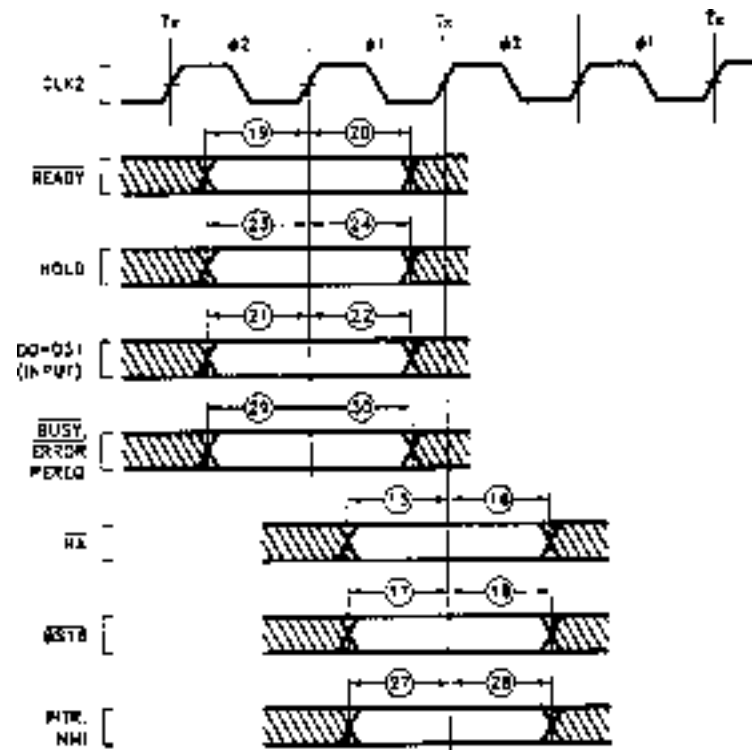
**CLK2 TIMING**




OUTPUT FLOAT DELAY AND HLDA VALID DELAY TIMING

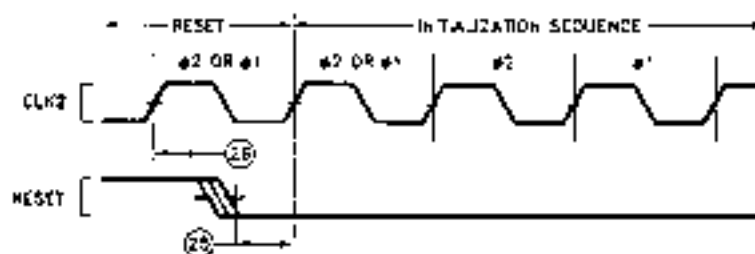


INPUT SETUP HOLD TIME





### RESET SETUP, HOLD TIMING AND INTERNAL PHASE



The second internal processor phase following RESET high-to-low transition (provided  $t_{2L}$  and  $t_{2H}$  are met) is #2

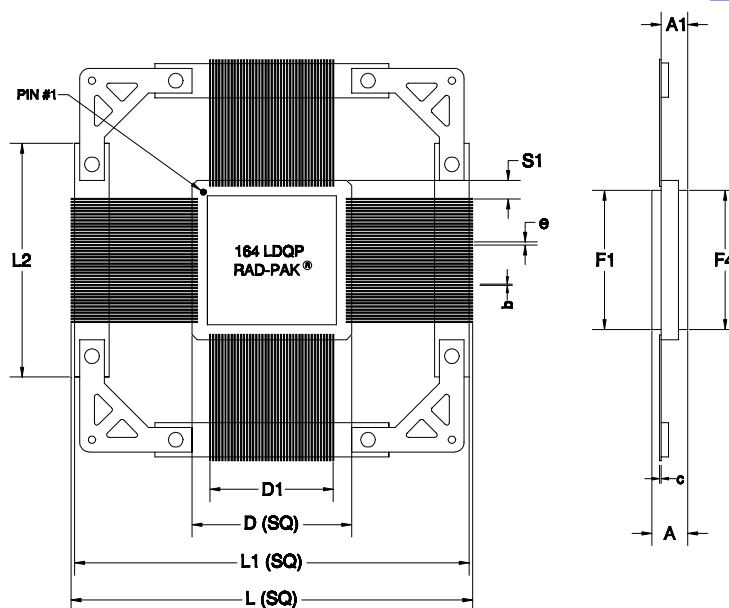
The information in this data sheet is believed to be reliable. However, Space Electronics assumes no liability for the use of this information. Use shall be entirely at the user's own risk. Prices and specifications are subject to change without notice.

No patent rights or licenses to any circuits described in this data sheet are implied or granted to any third party.

Space Electronics' products are not designed or intended for use in devices or systems intended for surgical implants or applications used to support or sustain life, or in

any other application in which the failure of the Space Electronics product could create a situation in which personal injury or death might occur. Space Electronics assumes no liability for damages, including consequential or incidental damages, arising out of the use of its products in such applications.

Space Electronics products are protected under the US patent: 5,635,754. Other patents may be pending or applied for.


**164 PIN RAD-PAK® QUAD FLAT PACKAGE**

| SYMBOL | DIMENSION |       |       |
|--------|-----------|-------|-------|
|        | MIN       | NOM   | MAX   |
| A      | 0.118     | 0.132 | 0.146 |
| b      | 0.007     | 0.008 | 0.013 |
| c      | 0.004     | 0.006 | 0.009 |
| D      | 1.138     | 1.150 | 1.167 |
| D1     | 1.000 BSC |       |       |
| e      | 0.025 BSC |       |       |
| S1     | 0.013     | 0.071 | --    |
| F1     | 0.890     | 0.895 | 0.900 |
| F4     | 0.880     | 0.890 | 0.899 |
| L      | 2.500     | 2.520 | 2.540 |
| L1     | 2.485     | 2.500 | 2.505 |
| L2     | 1.690     | 1.700 | 1.710 |
| A1     | 0.078     | 0.090 | 0.102 |
| N      | 164       |       |       |

Q164-01

NOTE: ALL DIMENSIONS IN INCHES