

7210-TQFP-R

IEEE 488.2 Controller chip – drop-in replacement for NEC μ PD7210

7210-TQFP-R

- RoHS-compliant
- Pin-compatible with NEC μ PD7210
- Software-compatible with NEC μ PD7210
- Low power consumption
- Meets all IEEE 488.2 requirements:
 - Bus line monitoring
 - Preferred implementation of requesting service
 - Sends no messages when there are no listeners
- Performs all IEEE 488.1 interface functions SH1, AH1, T5 or TE5, L3 or LE3, SR1, RL1, PP1, PP2, DC1, DT1, C1, C2, C3, C4, C5
- Reduces driver overhead
- Does not lose a data byte if ATN is asserted while transmitting data
- Static interrupt status bits that do not clear when read
- Programmable data transfer rate
- (T1 delays of 350 ns, 500 ns, 1.1 μ s, and 2 μ s)
- Automatic EOS and/or NL message detection
- Direct memory access (DMA)
- Automatically processes IEEE 488 commands and reads undefined commands
- Programmable compatible with bus transceivers (T1, National Semiconductor, Motorola, and Intel)
- TTL-compatible CMOS device
- Programmable clock rate up to 20 MHz

Overview

Measurement Computing Corporation's 7210-TQFP-R is a 44-pin DIP drop-in replacement part for the NEC μ PD7210. The 7210-TQFP-R is 100% register-compatible and pin-compatible with the NEC μ PD7210 on power up. The 7210-TQFP-R performs all of the interface functions defined by the ANSI/IEEE Standard 488.1-1987, and it meets the additional requirements and recommendations of ANSI/IEEE Standard 488.2-1987. The 7210-TQFP-R performs complete IEEE 488 talker, listener, and controller functions.

On power up, the 7210-TQFP-R contains the complete register set of the NEC μ PD7210, but can perform complete IEEE 488.2 controller functions through software.

If you are an instrument developer, you can take advantage of IEEE 488.2 with minimal software modifications, yet keep the 44-pin hardware configuration. The default clock input is 8 MHz, but increased performance is available from the 7210-TQFP-R through software-selectable input values up to 20 MHz.

If you are an IEEE 488 instrument manufacturer looking for alternatives to existing NEC μ PD7210 chip suppliers or planning to upgrade your designs to IEEE 488.2 without hardware changes, consider using the 7210-TQFP-R. Because the 7210-TQFP-R accepts faster clock inputs, performance increases without many firmware changes.

General

The 7210-TQFP-R manages the IEEE 488 bus. You program the IEEE 488 bus by writing control words into the appropriate registers. CPU-readable status registers supply operational feedback. The 7210-TQFP-R mode determines the function of these registers. When in 7210 mode, the registers resemble the μ PD7210 register set with additional registers that supply extra functionality and IEEE 488.2 compatibility. In this mode, the 7210-TQFP-R is completely pin-compatible with the NEC μ PD7210. Figure 1 shows the key components of the 7210-TQFP-R.

RoHS Compliance

The 7210-TQFP-R is available from MCC as a RoHS-compliant chip. The chip is marked with an e3 inside an ellipse to indicate a matte pure tin finish on the leads, in accordance with the marking recommendations defined in JEDEC JESD97.

The RoHS-compliant 7210-TQFP-R meets industry requirements for baking and maximum solder reflow temperature. The baking requirements are outlined in JEDEC J-STD-033. MCC recommends using the solder reflow profile as shown in IPC/JEDEC J-STD-020C with a peak temperature of 260 °C, the maximum temperature they can withstand.

Ordering Information

| RoHS-compliant chip | MCC Part number |
|---------------------|-----------------|
| 44-pin TQFP package | 7210-TQFP-R |

Go to mccdaq.com/GPIB/IEEE-488.2_Controller_Chips/7210-TQFP-R to order the chip, or call us at (508) 946-5100.

Block Diagram

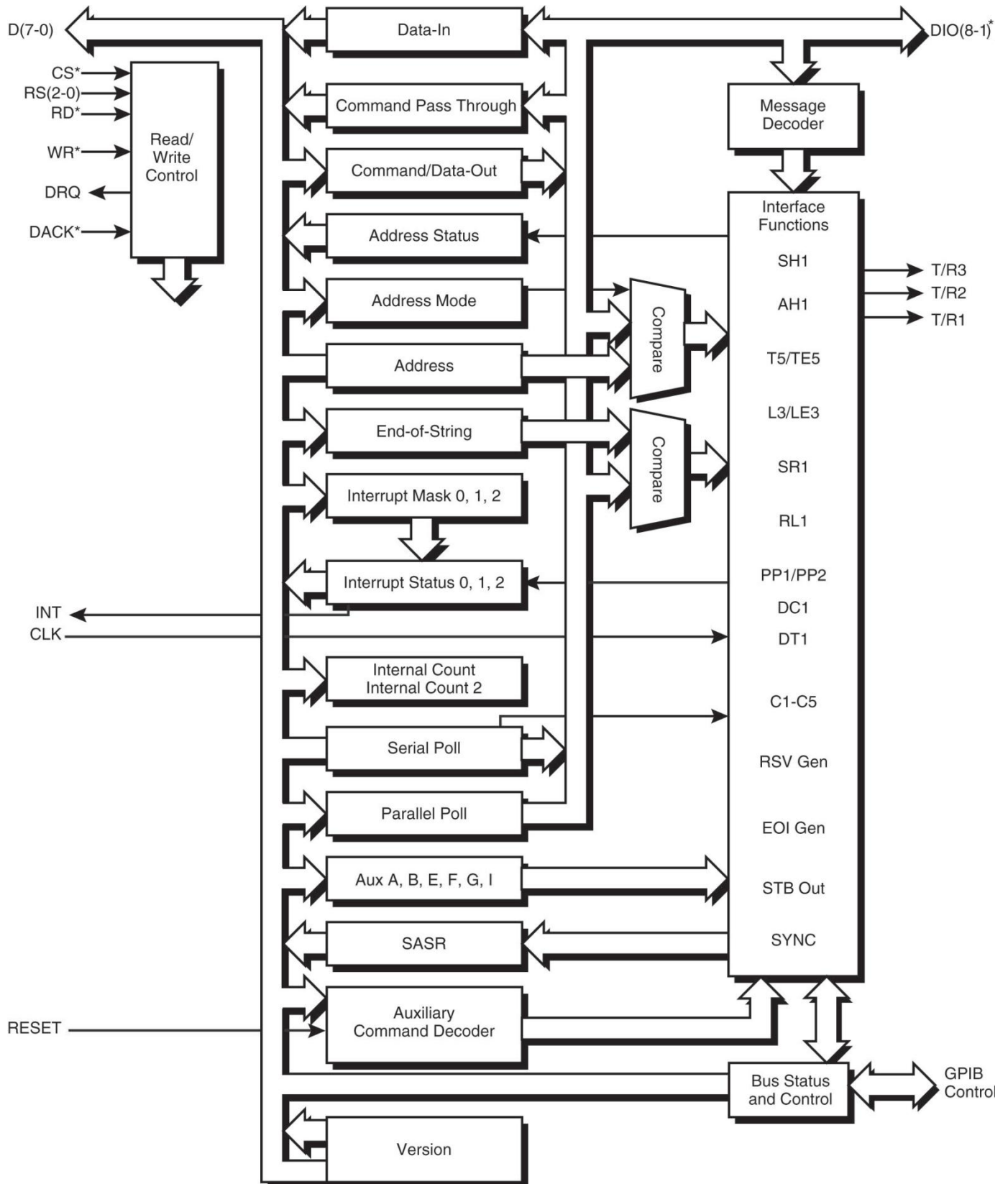


Figure 1. 7210-TQFP-R block diagram

Pin Descriptions

The following table describes the 7210-TQFP-R pins.

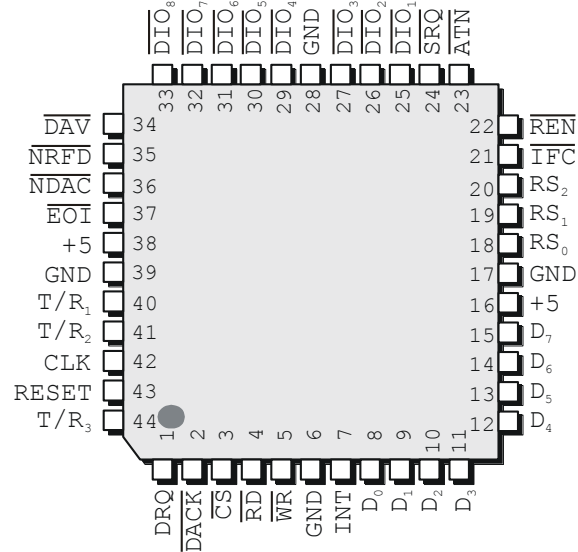


Figure 2. 7210-TQFP-R pin configuration

Pin Identification

Table 1. 7210-TQFP-R pin configuration

| Pin # | Mnemonic | I/O | Description |
|---------------|---|-----|---|
| 1 | DRQ | O | DMA Request. Requests data transfer. Becomes low on input of DMA acknowledge signal DACK. |
| 2 | $\overline{\text{DACK}}$ | I | DMA Acknowledge. (Active low) Signal connects the computer system data bus to the data register of the 7210-TQFP-R. |
| 3 | $\overline{\text{CS}}$ | I | Chip Select. (Active low) Enables access to the register selected by RS ₀ -RS ₂ (read or write operation). |
| 4 | $\overline{\text{RD}}$ | I | Read. (Active low) Places contents of read register specified RS ₀ -RS ₂ on D ₀ -D ₇ (computer bus). |
| 5 | $\overline{\text{WR}}$ | I | Write. (Active low) Writes data on D ₀ -D ₇ into the write register specified by RS ₀ -RS ₂ . |
| 6, 17, 28, 39 | GND | | Ground |
| 7 | INT | O | Interrupt Request. (Active high/low) Becomes active due to any 1 of 13 internal interrupt conditions (unmasked). Active state software configurable. Active high on chip reset. |
| 8-15 | D ₀ -D ₇ | I/O | Data Bus. 8-bit bidirectional data bus for interface to the computer system. |
| 16, 38 | +5 (V _{CC}) | I/O | +5 VDC ($\pm 5\%$) |
| 18-20 | RS ₀ -RS ₂ | I | Register Select. These lines select one of eight read (write) registers during a read (write) operation. |
| 21 | $\overline{\text{IFC}}$ | I/O | Interface Clear. Control line used for clearing the interface functions. |
| 22 | $\overline{\text{REN}}$ | I/O | Remote Enable. Control line used to enable remote operation of the devices. |
| 23 | $\overline{\text{ATN}}$ | I/O | Attention. Control line which indicates whether data on DIO lines is an interface message or device dependent message. |
| 24 | $\overline{\text{SRQ}}$ | I/O | Service Request. Control line used to request service from the controller. |
| 25-33 | $\overline{\text{DIO}}_1$ - $\overline{\text{DIO}}_8$ | I/O | Data Input/Output. 8-bit bi-directional bus for transfer of message. |
| 34 | $\overline{\text{DAV}}$ | I/O | Data Valid. Handshake line indicating that data on DIO lines is valid. |
| 35 | $\overline{\text{NRFD}}$ | I/O | Ready for Data. Handshake line indicating that device is ready for data. |
| 36 | $\overline{\text{NDAC}}$ | I/O | Data Accepted. Handshake line indicating completion of message reception. |
| 37 | $\overline{\text{EOI}}$ | I/O | End or Identity. Control line used to indicate the end of multiple byte transfer sequence or to execute a parallel polling in conjunction with ATN. |
| 40 | T/R ₁ | O | Transmit/Receive Control. Input/output control signal for the GPIB bus transceivers. |
| 41 | T/R ₂ | O | Transmit/Receive Control. The values of T/R ₂ and T/R ₃ are determined by the values of the Address Mode register bits TRM1, and TRM0. |
| 42 | CLK | I | Clock. 1 MHz to 20 MHz reference clock for generating the state change prohibit times T ₁ , T ₆ , T ₇ , T ₉ specified in IEEE Standard 488.2-1992. |
| 43 | RESET | I | Reset. Resets the 7210-TQFP-R to an idle state when high (active high). |
| 44 | T/R ₃ | O | Transmit/Receive Control. See T/R ₂ (pin 41). |

Mechanical Data

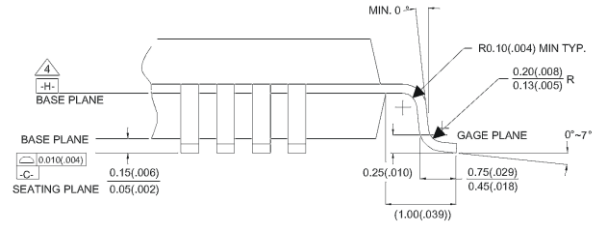
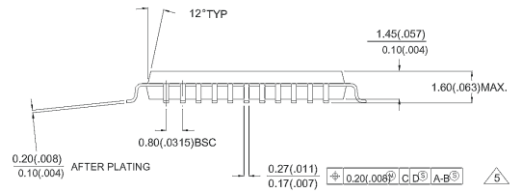
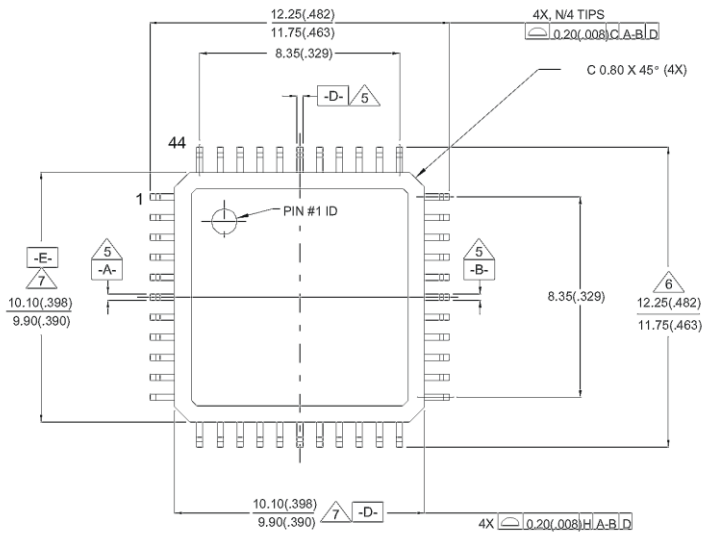


Figure 3. Package outline

Notes:

- Package dimensions shown are from a specific supplier and are for reference only. Package dimensions conform to JEDEC MO-136-BG.
- Controlling dimensions are in millimeters, with inches shown in parentheses.
- Dimensions and tolerance specifications per ANSI Y 14.5-1982.
- Datum plane "H" is located at the mold plating line, and is coincident with where the lead exits the plastic body at the bottom of the plating line.
- Datums "A-B" and "D" are to be determined at datum plane "H".
- Dimension to be determined at the seating plane "C."
- These dimensions are to be determined at datum plane "H". Dimensions D and E do not include mold protrusion. The allowable protrusion is 0.25 mm (.010") per side.
- Lead width does not include Dambar protrusion. The allowable Dambar protrusion shall be 0.08 mm/0.003" total in excess of this.
Dimensions at maximum material condition.

7210 Mode Registers

In 7210 mode, the 7210-TQFP-R registers include all of the NEC μ PD7210 registers plus two types of additional registers – extra auxiliary registers and paged-in registers. You write the extra auxiliary registers in the same way as standard μ PD7210 auxiliary registers. Upon issuing an auxiliary page-in command, the paged-in registers appear at the same offsets as existing μ PD7210 registers. At the end of the next CPU access, the chip pages out the paged-in registers. The following table lists the registers in the 7210 mode register set.

7210 Register Set

| Register | Page-In | A(2-0) | WR* | RD* | CS* | DACK* |
|---|---------|--------|-----|-----|-----|-------|
| | | | | | | |
| Data-in | U | 0 0 0 | 1 | 0 | 0 | 1 |
| Data-in | X | X X X | 1 | 0 | X | 0 |
| Command/data-out | U | 0 0 0 | 0 | 1 | 0 | 1 |
| Command/data-out | X | X X X | 0 | 1 | X | 0 |
| Interrupt status ¹ | U | 0 0 1 | 1 | 0 | 0 | 1 |
| Interrupt mask ¹ | U | 0 0 1 | 0 | 1 | 0 | 1 |
| Interrupt status ² | U | 0 1 0 | 1 | 0 | 0 | 1 |
| Interrupt mask ² | U | 0 1 0 | 0 | 1 | 0 | 1 |
| Serial poll status | N | 0 1 1 | 1 | 0 | 0 | 1 |
| Serial poll mode | N | 0 1 1 | 0 | 1 | 0 | 1 |
| Version | P | 0 1 1 | 1 | 0 | 0 | 1 |
| Initial counter ² | P | 0 1 1 | 0 | 1 | 0 | 1 |
| Address status | U | 1 0 0 | 1 | 0 | 0 | 1 |
| Address mode | U | 1 0 0 | 0 | 1 | 0 | 1 |
| Command pass through | N | 1 0 1 | 1 | 0 | 0 | 1 |
| Auxiliary mode | U | 1 0 1 | 0 | 1 | 0 | 1 |
| Source/acceptor status [†] | P | 1 0 1 | 1 | 0 | 0 | 1 |
| Address 0 | N | 1 1 0 | 1 | 0 | 0 | 1 |
| Address | N | 1 1 0 | 0 | 1 | 0 | 1 |
| Interrupt status 0 [†] | P | 1 1 0 | 1 | 0 | 0 | 1 |
| Interrupt mask 0 [†] | P | 1 1 0 | 0 | 1 | 0 | 1 |
| Address [†] | N | 1 1 1 | 1 | 0 | 0 | 1 |
| End-of-string | N | 1 1 1 | 0 | 1 | 0 | 1 |
| Bus status [†] | P | 1 1 1 | 1 | 0 | 0 | 1 |
| Bus control [†] | P | 1 1 1 | 0 | 1 | 0 | 1 |
| Notes for the Page-In column: | | | | | | |
| U = The page-in auxiliary command does not affect the register. | | | | | | |
| N = The register offset is always valid except for immediately after a page-in auxiliary command. | | | | | | |
| P = The register is valid only immediately after a page-in auxiliary command. | | | | | | |
| The [†] symbol indicates features that are not available in the μ PD7210, such as register and auxiliary commands. | | | | | | |

DC Characteristics

| Parameter | Symbol | Limits | | Unit | Test Conditions |
|--|--------|--------|------|---------------|-----------------------|
| | | Min | Max | | |
| Voltage input low | VIL | -0.5 | +0.8 | V | |
| Voltage input high | VIH | +2.0 | VCC | V | |
| Voltage output low | VOL | 0 | 0.4 | V | |
| Voltage output high | VOH | +2.4 | VCC | V | |
| Input/output leakage current | | -10 | +10 | μ A | w/o internal pull-up |
| Input/output leakage current | | -200 | +200 | μ A | with internal pull-up |
| Supply Current | | | 45 | mA | |
| Output current low (all pins except T/R ₁) | IOL | 2 | | mA | VOL=0.4 V |
| T/R ₁ | IOL | 4 | | mA | VOL=0.4 V |
| Input current low/high | IIL | | -0.5 | mA | |
| Output current high | IOH | -1 | mA | V0H=VCC-0.5 V | |
| Supply voltage | VCC | 4.75 | 5.25 | V | |

Capacitance

TA₀ to 70 °C; V_{cc}= 5 V \pm 5%

| Parameter | Symbol | Limits | | Unit | Test Conditions |
|--------------------|--------|--------|-----|------|-----------------|
| | | Min | Max | | |
| Input capacitance | Cin | | 10 | pF | |
| Output capacitance | Cout | | 10 | pF | |
| I/O capacitance | CI/O | | 10 | pF | |

Absolute Maximum Ratings

| Property | Test Conditions |
|-----------------------------|------------------|
| Supply voltage, VCC | -0.5 to +6.0 V |
| Input voltage, VI | -0.5 to VCC +0.5 |
| Operating temperature, TOPR | 0 to +70 °C |
| Storage temperature, TSTG | -40 to +125 °C |

Caution: Exposing the device to stresses above those listed could cause permanent damage. The device is not meant to be operated under conditions outside the operational limits. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

AC Characteristics

TA0 to 70 °C; Vcc= 5 V ±5%

| Parameter | Sym. | Limits | | Unit | Test Conditions |
|--|----------|--------|-----|------|-----------------|
| | | Min | Max | | |
| Address hold from $\overline{RD} \uparrow$ $\overline{WR} \uparrow$ | t_{AH} | 0 | | ns | |
| Address setup to $\overline{RD} \downarrow$ $\overline{WR} \downarrow$ | t_{AS} | 0 | | ns | |
| Data float from $\overline{RD} \uparrow$ | t_{DF} | | 25 | ns | |
| Data delay from $\overline{RD} \downarrow$ | t_{DR} | | 80 | ns | DACK=0 |
| DRQ unassertion | t_{DU} | | 25 | ns | |
| Data delay from $\overline{RD} \downarrow$ | t_{RD} | 85 | ns | CS=0 | |
| RD recovery width | t_{RR} | 120 | | ns | |
| RD pulse width | t_{RW} | 85 | | ns | |
| Data setup to $\overline{WR} \uparrow$ | t_{WS} | 60 | | ns | |
| Data hold from $\overline{WR} \uparrow$ | t_{WH} | 0 | | ns | |

Timing Waveforms

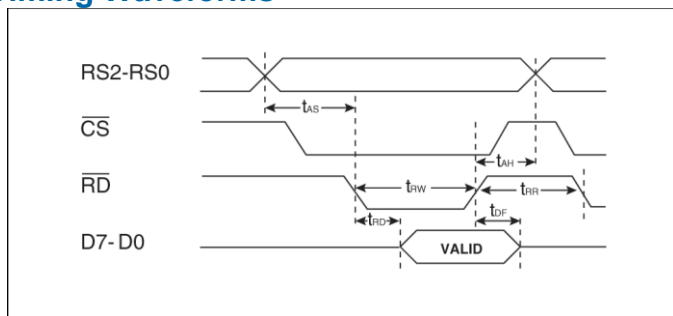


Figure 4. CPU Read

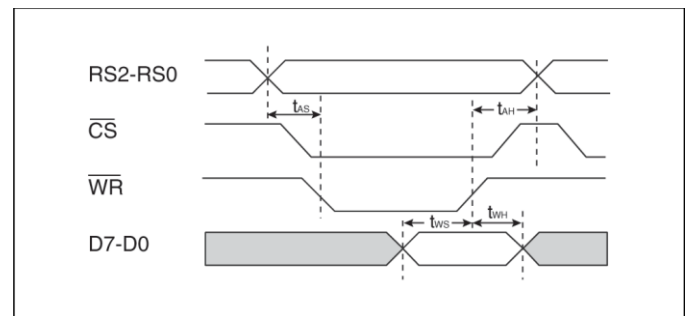


Figure 6. CPU Write

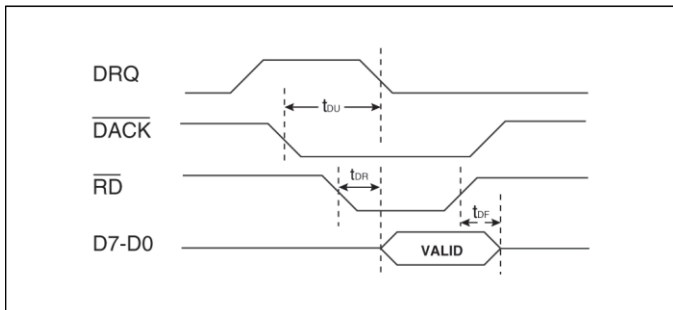


Figure 5. DMA Read

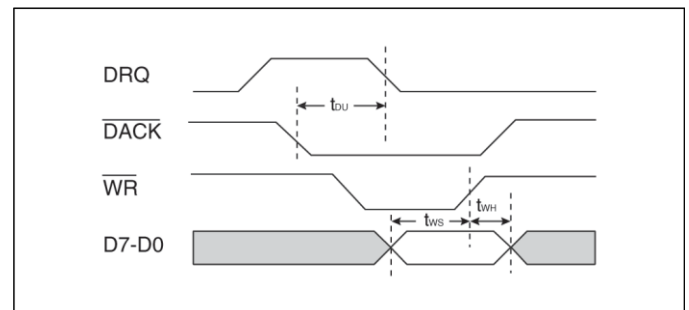


Figure 7. DMA Write

Source Handshake

| Parameter | Sym. | Limits | | Test Conditions |
|--|----------|--------|-------|---|
| | | Min | Max | |
| $\overline{NDAC} \uparrow$ to $\overline{DAV} \uparrow$ | t_{ND} | | 40 | |
| $\overline{NDAC} \uparrow$ to $\overline{INT} \uparrow$ or $\overline{DRQ} \uparrow$ | t_{NI} | | 40 | INT (DO IE Bit = 1) DRQ (DMAO Bit = 1) |
| $\overline{WR} \uparrow$ to $\overline{DAV} \downarrow$ | t_{WD} | 2,000 | 2,125 | 2 μ s T1 (8 MHz, 50% duty) |
| $\overline{WR} \uparrow$ to $\overline{DAV} \downarrow$ | t_{WD} | 1,125 | 1,250 | 1.1 μ s T1 (8 MHz, 50% duty) |
| $\overline{WR} \uparrow$ to $\overline{DAV} \downarrow$ | t_{WD} | 500 | 625 | 500 ns T1 (8 MHz, 50% duty) |
| $\overline{WR} \uparrow$ to $\overline{DAV} \downarrow$ | t_{WD} | 375 | 500 | 350 ns T1 (8 MHz, 50% duty) |

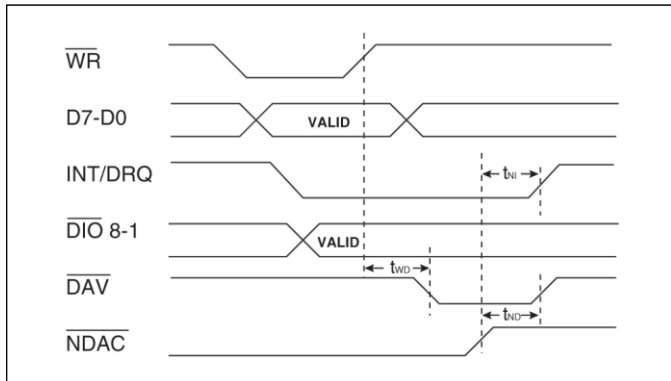


Figure 8. Source Handshake

Acceptor Handshake

| Parameter | Sym. | Limits | | Test Conditions |
|---|----------|--------|-----|--|
| | | Min | Max | |
| $\overline{DAV} \downarrow$ to $\overline{NDAC} \uparrow$ | t_{DD} | | 225 | 8 MHz, 50% duty |
| $\overline{DAV} \uparrow$ to $\overline{NDAC} \downarrow$ | t_{DD} | | 20 | |
| $\overline{DAV} \downarrow$ to $\overline{INT} \uparrow$ or $\overline{DRQ} \uparrow$ | t_{NI} | | 116 | INT (DIIE Bit = 1) DRQ (DMAI Bit = 1) |
| $\overline{DAV} \downarrow$ to $\overline{NRFD} \downarrow$ | t_{DR} | | 25 | |
| $\overline{RD} \uparrow$ to $\overline{NRFD} \uparrow$ | t_{NR} | | 30 | Read of DIR, not in Holdoff state |

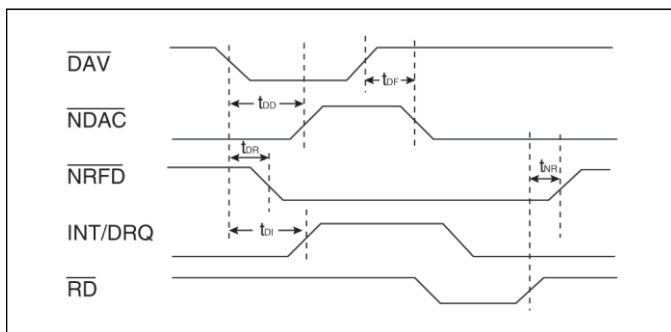


Figure 9. Acceptor Handshake

Response to ATN

| Parameter | Sym. | Limits | | Test Conditions |
|---|----------------|--------|-----|----------------------------|
| | | Min | Max | |
| $\overline{ATN} \uparrow$ to $\overline{NRFD} \downarrow$ | $t_{\Delta F}$ | | 35 | Acceptor handshake Holdoff |
| $\overline{ATN} \downarrow$ to $\overline{NDAC} \downarrow$ | t_{AN} | | 35 | AIDS \rightarrow ANRS |
| $\overline{ATN} \downarrow$ to $\overline{TE} \downarrow$ | t_{AT} | | 30 | TACS \rightarrow TADS |

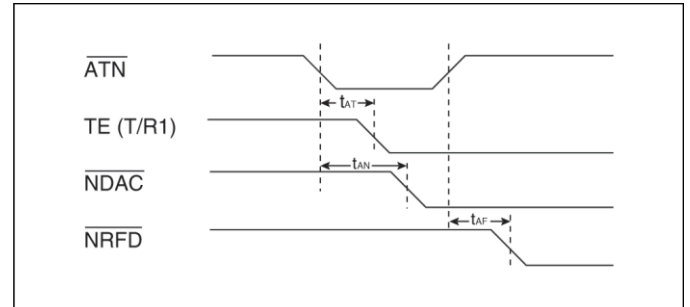


Figure 10. Response to ATN

Parallel Poll

| Parameter | Sym. | Limits | | Test Conditions |
|---|----------|--------|-----|----------------------------|
| | | Min | Max | |
| $\overline{EOI} \downarrow$ to \overline{DIO} valid | t_{FD} | | 90 | PPSS \triangleright PPAS |
| $\overline{EOI} \downarrow$ to $\overline{TE} \uparrow$ | t_{ET} | | 25 | PPSS \triangleright PPAS |
| $\overline{EOI} \uparrow$ to $\overline{TE} \downarrow$ | t_{TE} | | 25 | PPAS \triangleright PPSS |

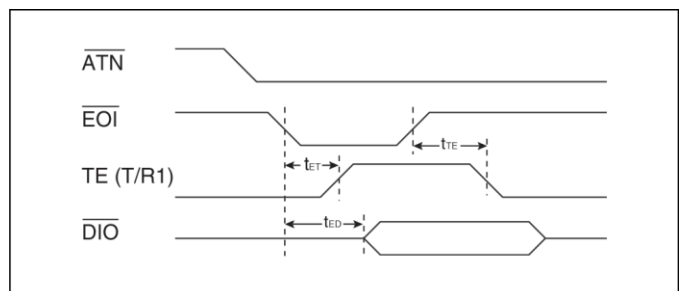


Figure 11. Parallel Poll

Typical System

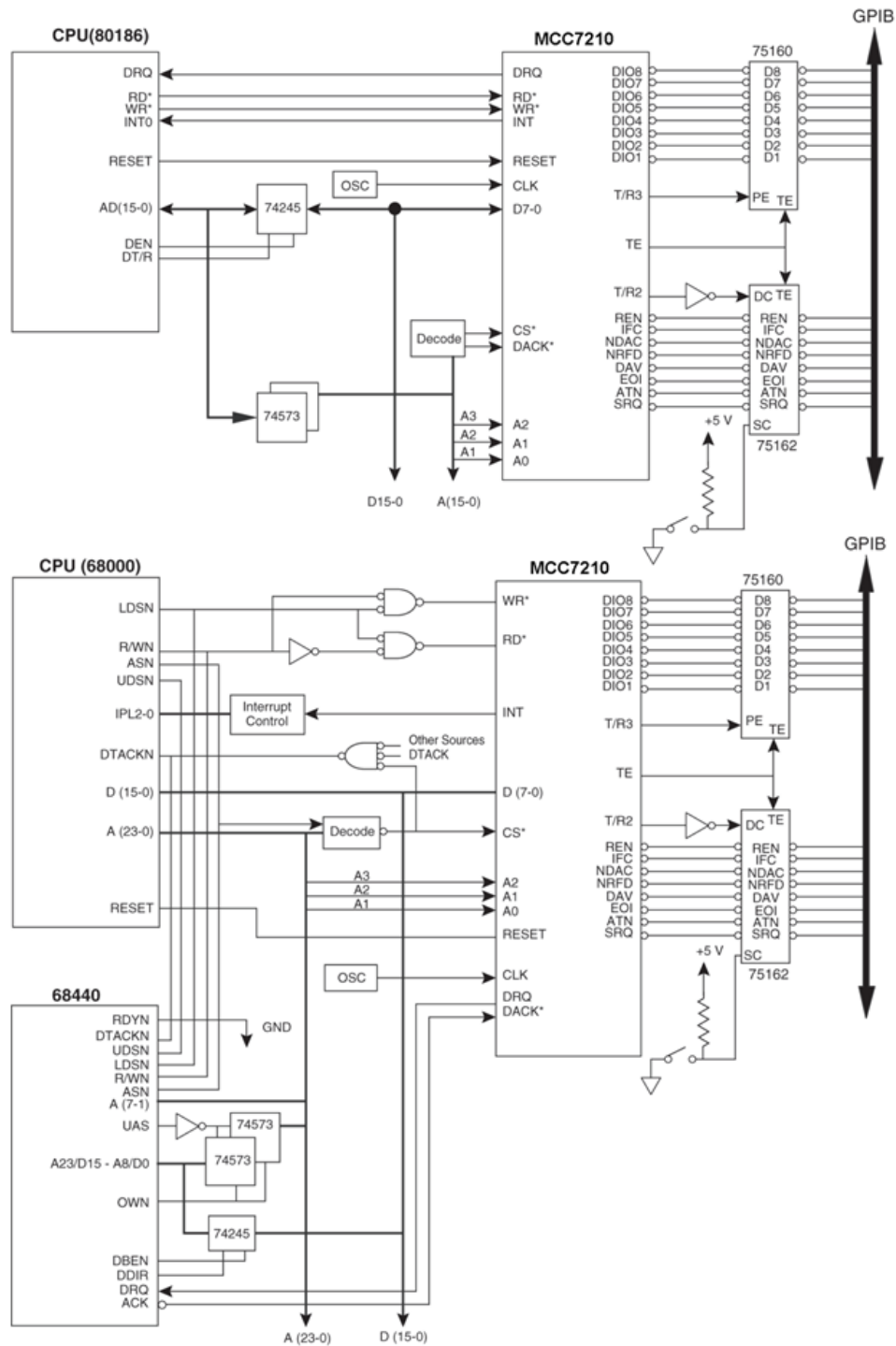


Figure 12. Typical CPU System with the 7210-TQFP-R

How to Contact us

Contact us by phone, fax, or email if you need assistance in developing the interface to your particular system. Our engineering staff will work with you to ensure that your 7210-TQFP-R interface is simple, efficient and allows access to all chip features.

- Phone: 508-946-5100 and follow the instructions for reaching Tech Support.
- Fax: 508-946-9500 to the attention of Tech Support
- Email: techsupport@mccdaq.com

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