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UM–03202–E

DT2806
User Manual

Multi-Function I/O Expansion Board for the IBM Personal Computer XT/AT

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How To Use This Manual

This manual introduces you to Data Translation's multi-function I/O expansion board, the DT2806, for the IBM Personal Computer XT/AT and compatibles. The DT2806 has three programmable counter/timers and three iSBX connectors which support up to three iSBX-compatible modules.

This manual assumes that you are familiar with counter/timer operation and the iSBX bus, and are proficient enough in software to write your own application and diagnostic programs.

Here's an overview of where information is located in this manual.

Installing and Using

Chapter 1, "**Introduction**," acquaints you with the major features of the DT2806 and lists the Data Translation accessories compatible with this product.

Chapter 2, "**Getting Started**," shows you how to jumper-configure the board, install the DT2806 in the IBM Personal Computer, and connect external devices.

Chapter 3, "**Using the DT2806**," describes the major subsystems of the DT2806 and instructs you in the basic operation of the DT2806's counter/timers.

Reference

Reference 1, "**Troubleshooting**," steps you through some difficulties you might encounter when learning how to use your data acquisition system.

Reference 2, "**Changing Jumpers**," shows you how to configure jumpers on the board to suit your environment.

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Reference 3, "**Connectors and Accessories**," describes the connectors provided for external devices and their pinouts as well as the Data Translation screw terminal panels and cables compatible with the DT2806.

Reference 4, "**Register Description**," describes the I/O registers that reside on the board and control its operations.

Reference 5, "**Specifications**," provides the technical details of the DT2806 board.

Appendixes

Appendix A, "**Example Programs**," contains listings of the example programs provided on the diskette shipped with your DT2806.

Additional Hardware and Software

The DT2806 is compatible with several Data Translation iSBX modules. It is also compatible with several commercial iSBX modules. The DT2806 hosts up to three iSBX-compatible modules to perform digital input/output functions (DTX350), digital-to-analog conversions (DTX328), and analog-to-digital conversions (DTX311 and DTX311EX).

The DT2806 is compatible with the Data Translation DT757 screw terminal panel. The DT757 supports connections to the counter/timers on the DT2806. Other screw terminal panels connect directly to the iSBX-compatible modules installed on your DT2806. Consult the specific module user manual for the compatible screw terminal panels.

PCLAB is a subroutine library callable from interpreted and compiled BASIC, C, Pascal, FORTRAN, and assembly languages. PCLAB supports the counter/timer functions of the DT2806 and read/write operations with the iSBX-compatible modules installed on the DT2806.

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Related Documentation

User manuals for the host personal computer (IBM Personal Computer XT/AT or compatible)

Software manuals for the PCDOS and BASIC software packages used with the host personal computer

IBM Technical Reference Manual, International Business Machines Corporation

PCLAB User Manual, Document Number UM-02899, Data Translation, Inc.

DTX311/311EX User Manual, Document Number UM-04670, Data Translation, Inc.

DTX328 User Manual, Document Number UM-03741, Data Translation, Inc.

DTX350 User Manual, Document Number UM-03736, Data Translation, Inc.

Where To Get Help

If you experience any problems with, or have any questions about, your DT2806 board and you do not find the solution in this manual, call Data Translation's **Technical Support Department** at:

(508) 481–3700

If you are located outside the USA, call your local distributor. The name and telephone number of your nearest distributor are listed at the back of the Data Translation catalog.

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Chapter 1



Introduction

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*Chapter 1, "**Introduction**," describes the main features of the DT2806 Multi-Function I/O Expansion Board and the compatible Data Translation accessories.*

This chapter is organized as follows:

- *About the DT2806*
- *Accessories*

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About the DT2806

The DT2806 is an I/O expansion board for the IBM Personal Computer XT/AT and compatibles. The DT2806 has three programmable counter/timers and three industry standard iSBX connectors as shown in Figure 1.

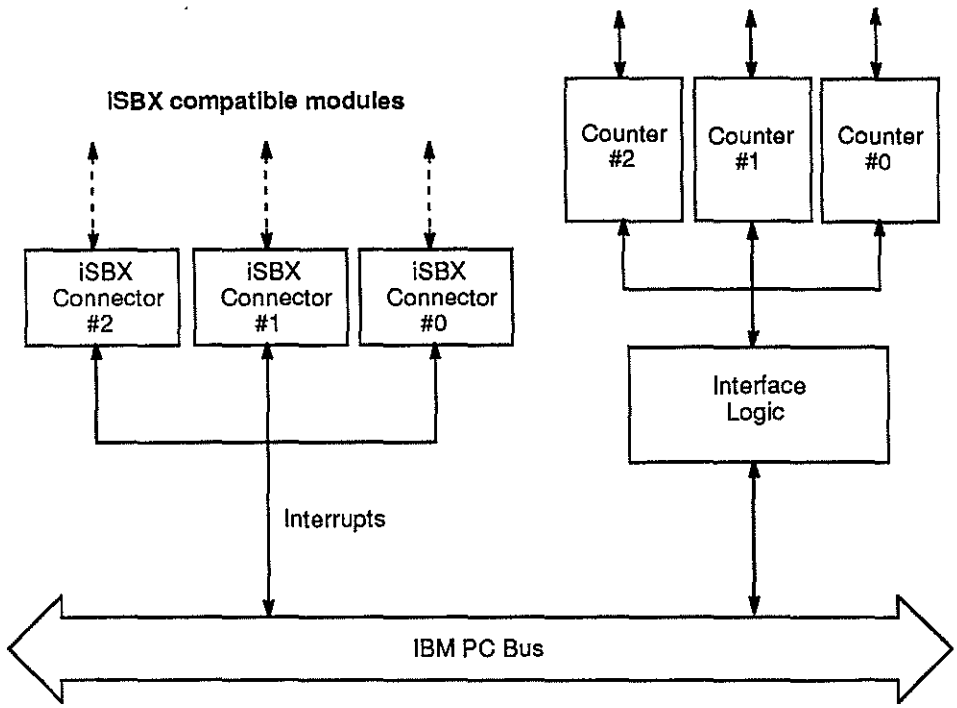


Figure 1: DT2806 Block Diagram

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Use the **counter/timers** for both internal and external clocking functions of analog and digital events, pulse counting, and software-controlled frequency generation and measurement. The counter/timers internally configure to six distinct operating modes and four different physical arrangements. Use the onboard 2MHz clock to drive the counter/timers, or use an external clock to supply the frequency input.

Full implementation of the Intel iSBX bus allows the three **iSBX connectors** to support any combination of three iSBX-compatible modules. The three iSBX connectors occupy 48 I/O-mapped locations on the host PC bus. These registers have read/write capabilities and the DT2806 handles the timing of these functions. Using iSBX modules, the DT2806 allows you to configure up to 72 channels of digital input/output, 24 D/A channels, or 80 single-ended or 40 differential analog input channels.

The DT2806 also supports **DMA** and **programmed I/O data transfers** for any iSBX-compatible module that uses these features. The DT2806 serves only to connect the DMA Request and DMA Acknowledge lines from the host PC to the iSBX connectors. The DT2806 does not have onboard DMA control.

Five interrupt lines on the IBM PC are bussed onto jumper posts on the DT2806. These **interrupts** can be user-configured either to the counter/timers or to one of the iSBX interrupt pins. Interrupt priority levels 3 through 7 are accessible, with interrupt 3 having the highest priority and interrupt 7 the lowest.

The DT2806 plugs into a single expansion slot in the IBM Personal Computer backplane. If iSBX-compatible modules are installed on the DT2806, however, the physical space of two expansion slots is required.

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Accessories

This section describes the Data Translation iSBX-compatible modules and screw terminal panels that are used in association with the DT2806.

iSBX-Compatible Modules

There are several Data Translation iSBX modules compatible with the DT2806. Table 1 lists these modules. The remainder of this section briefly describes each module listed in this table. For complete information on these modules, refer to their respective user manuals.

Table 1: iSBX-Compatible Modules

Module	Description
DTX311	16SE/8DI 12-bit analog input module
DTX311EX	48SE/24DI analog expansion for DTX311
DTX328	8 channel 12-bit analog output module
DTX344	BITBUS interface module
DTX350	24-line digital I/O module

DTX311 and DTX311EX Analog-to-Digital Modules

The DTX311 and DTX311EX A/D modules are used with the DT2806 or any iSBX-compatible host. The DTX311 module, when used alone, provides 16 single-ended (SE) or 8 differential (DI) analog inputs. The DTX311 has 12-bit resolution and a +5V output range. The DTX311 also is used in conjunction with the DTX311EX A/D expander. The DTX311EX provides an additional 48 SE or 24 DI analog inputs, the equivalent of three more DTX311 modules. *You must use the DTX311EX in conjunction with a DTX311. You cannot use it alone.*

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DTX328 Digital-to-Analog Module

The DTX328 D/A module provides 8 analog outputs having 12-bit resolution and a jumper-selectable 0 to +5V, ±5V, or 4 to 20mA output range on the DT2806 or any iSBX-compatible host.

DTX344 BITBUS Controller

The DTX344 BITBUS Controller is a double module containing an iRMX51 Distributed Control Module (DCM) core and a BITBUS connection. It can act as either a master or slave for the BITBUS network. Use one DTX344 for each BITBUS network of up to 250 nodes. The DT2806 cannot physically accommodate any other iSBX modules when the DTX344 is installed.

DTX350 Digital Input/Output Module

The DTX350 DIO module provides up to 24 lines of digital I/O, handshaking, and interrupt modes on the DT2806 or any iSBX-compatible host.

Screw Terminal Panels

There is one Data Translation screw terminal panel that is used for connecting external devices directly to the DT2806. This is the DT757 screw terminal panel. There are several other screw terminal panels used for device connection to the iSBX modules. These screw terminal panels and their connectors are described in detail in the specific module user manuals.

DT757

The DT757 is a universal screw terminal panel which provides convenient connection points for the counter/timer signals on the DT2806. It comes complete with a 3.3 foot (1m) integral cable assembly terminating in a 20-pin 3M-style header connector. For more information on the DT757 screw terminal panel, refer to Reference 3, "Connectors and Accessories," in this manual.

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Software

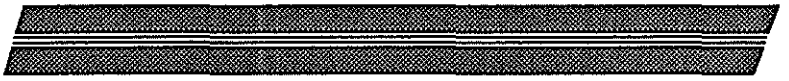
Data Translation has a subroutine library that supports the counter/timer functions of the DT2806, and read/write operations with modules installed on the DT2806's iSBX connectors. This software package is PCLAB.

PCLAB

PCLAB (SP0141) is a PCDOS-compatible software package that is used with the DT2806. PCLAB is an assembly language library of subroutines callable from interpreted and compiled BASIC, C, FORTRAN, Pascal, and assembly language.

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Chapter 2



Getting Started

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*Chapter 2, "**Getting Started**," provides step-by-step instructions for unpacking the DT2806 board, installing it in your computer, and connecting devices to the counter/timers.*

This chapter is organized as follows:

- *Unpacking*
- *Installing the DT2806*

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Unpacking

Before you begin installing your DT2806 board, make sure you have received the following items that are shipped with the DT2806:

- DT2806 multi-function I/O expansion board
- *DT2806 User Manual*
- DT2806 diskette
- Black plastic board guide
- iSBX-compatible modules – OPTIONAL

Keep the DT2806 in its protective anti-static bag until you are ready to install it. When you remove the board from the bag, hold it by the edges and do not touch the components.



Save the original packing material in the unlikely event your board requires servicing in the future.

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Installing the DT2806

Follow the steps below for installing your DT2806 and iSBX-compatible modules. These steps are described in detail on the following pages. The DT2806 is shipped ready for installation for most applications.

Step 1: Verify your board configuration

Step 2: Install the iSBX-compatible modules

Step 3: Install the board

Step 4: Connect your screw terminal panel

Step 5: Connect your peripheral devices

Step 6: Power up your system

Read the directions carefully in each step before proceeding, to minimize the chance of omitting an important step.

What You Will Need

To install the DT2806 board, you need the following equipment:

- IBM Personal Computer XT/AT or compatible
- Screw terminal panel (DT757, DT708, or other compatible panel) for connecting peripheral devices, and appropriate cables if not supplied with screw terminal panel
- Flatblade screwdriver

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Step 1: Verify Your Board Configuration

The DT2806 board is shipped to you jumper-configured for an I/O base address of 370H.

The DT2806 has several jumpers that permit connection to the PC bus signals and access up to six options (two per iSBX connector). Additional jumpers provide connections to the counter/timers, interrupt signals, and DMA lines. *The DT2806 is shipped without any jumper options selected.*

If it is necessary to change your I/O base address, or you wish to use any of the jumper options available on your DT2806, go to Reference 2, "Changing Jumpers," in this manual for complete instructions.

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Step 2: Install the iSBX-Compatible Modules

The iSBX modules mount to the DT2806 by plugging directly into any of the three female iSBX connectors on the DT2806. Complete installation instructions for the iSBX modules are contained in the user manual for each module. Figure 2 illustrates the DT2806 board.



If you are using a DTX311EX A/D expander module, you must install the DTX311 A/D module in iSBX connector J1 and install the DTX311EX module in iSBX connector J2.

If you are not installing a DTX311EX module, there are no restrictions as to the location of any of the iSBX-compatible modules.

If you are using the DTX344 module, you must install it in iSBX connector J1 or J2. The DT2806 can not physically accommodate any other iSBX module when a DTX344 is used.

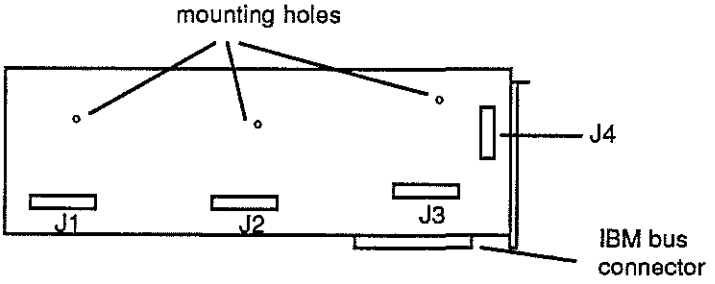


Figure 2: DT2806 Board

1. **Locate pin 1 on the module iSBX connector (P1) and align it with pin 1 of the iSBX bus connector (J1, J2, or J3) on the DT2806.**

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2. Align the iSBX module spacer with the mounting hole on the DT2806.

3. Gently press the two boards together until the iSBX connector seats.

4. Secure the iSBX module to the DT2806 by installing the 1/4 x 6/32 screw supplied with the iSBX module underneath the DT2806 at the mounting hole.

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Step 3: Install the Board

Install the DT2806 board in any available expansion slot in the IBM Personal Computer XT/AT. If you already have any iSBX-compatible modules installed, two adjacent expansion slots are necessary.

1. **Turn off the IBM Personal Computer XT/AT or compatible computer.**

2. **Turn off all accessories connected to the computer.**

3. **Unplug the system and all accessories from their wall outlets.**

4. **Disconnect all cables from the rear of the computer.**

5. **Unscrew the five cover mounting screws located on the rear panel of the computer. Figure 3 illustrates the rear view of the IBM Personal Computer AT.**

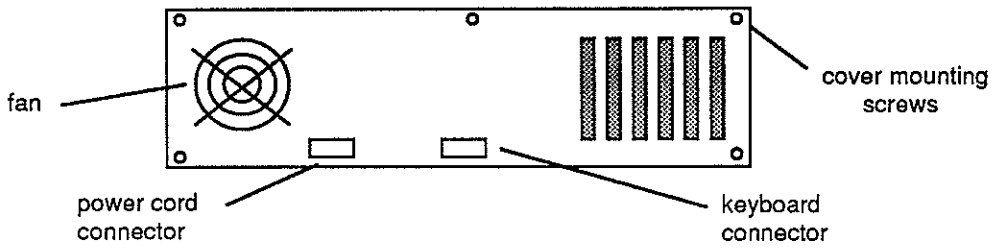


Figure 3: IBM Personal Computer AT – rear view

6. **Remove the cover by sliding it towards the front of the computer until you feel it stop, then tilt it down and off.**

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7. **Remove the slot cover present in the location selected for the DT2806 board by removing the screw and gently lifting the cover. Save the screw. Figure 4 illustates the IBM Personal Computer AT – top view.**

   If you have installed any iSBX modules on your DT2806, remove the slot cover from an adjacent expansion slot also.

   If two adjacent slots are not available, rearrange the boards in your system to provide these two slots.

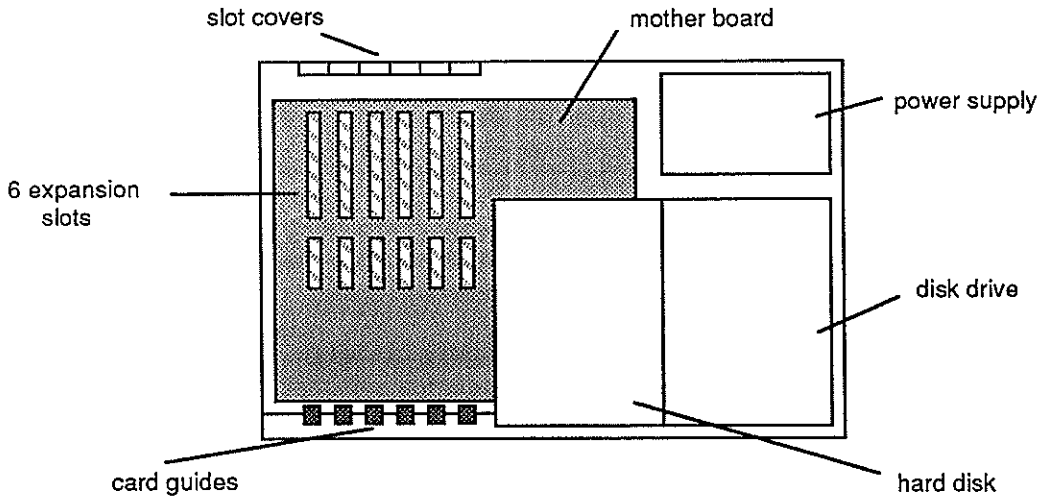


Figure 4: IBM Personal Computer AT – top view

8. **Eliminate any static charge you are carrying by touching the metal case of the computer before handling the board.**

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9. **Install the plastic board guide.**

   - Hold the plastic board guide against the card guide for the expansion slot in which the board will be installed.
   - Position the guide vertically against the inside of the computer's front plate, with the two pop-nubs facing the holes in the plate.
   - Place the tapered fronts of the pop-nubs into the holes, then press the board guide firmly against the plate. The pop-nubs will compress slightly passing through the holes, then expand to secure the guide to the plate.

10. **Pick up the DT2806 and orient it so that the rear panel connector faces the rear of the computer. (The component side of the board faces the disk drives.)**

11. **Carefully lower the board into the expansion slot using the grooves in the card cage to properly align the board in the slot. Figure 5 illustrates the DT2806 installed in the IBM Personal Computer AT.**

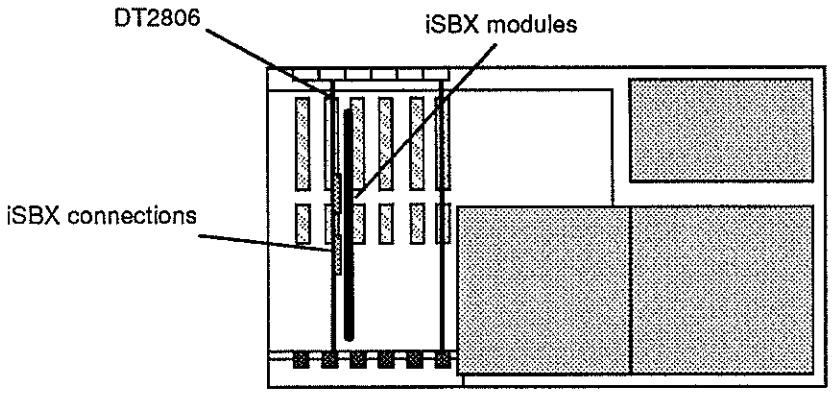


Figure 5: DT2806 Board Installed

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12. **When the bottom of the board contacts the bus connector, gently press down on the board until it "clicks" into place.**



Do not force the board. If you feel a lot of resistance, pull the board out and try again.

Don't wiggle the board from side to side when inserting it. This puts unnecessary stress on the board and could break the board connector.

---

13. **Test to see if the board is properly connected by gently lifting the board. If it stays in place, it's connected. If it exhibits no resistance, try pressing down more firmly on the board to seat it in its connector.**

14. **Secure the board in place at the rear panel of the computer using the screw removed from the slot cover.**

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Step 4: Connect Your Screw Terminal Panel

This step applies to connecting a screw terminal panel to your DT2806 board only. Refer to the installation section in the manual of the iSBX module for information on installing a screw terminal panel to that module.

If you are using a Data Translation screw terminal panel, follow the instructions below for connecting the panel to the DT2806 board.

If you are interfacing your peripheral devices to your DT2806 board via another type of device or panel, go to step 5 for device connection instructions.

1. **Turn off your computer.**

2. **Have the back of the Personal Computer facing you, or turn the main unit so that the rear panel connectors are easily accessed.**

3. **Plug the 20-pin connector on the DT757 into the mating connector on the rear of the DT2806.**

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Step 5: Connect Your Peripheral Devices

If you are using a Data Translation screw terminal panel, follow the directions for **Screw Terminal Panel – External Devices.**

If you are using another connection device, follow the directions for **Other Panel – External Devices.**

Screw Terminal Panel – External Devices

Table 2 lists the screw terminal assignments for the DT757. Refer to this table for the appropriate terminal when making your connections.

Table 2: DT757 Screw Terminal Assignments

Description	TB1	TB2	Description
Ctr/Tmr 0 clock input	1	1	Digital ground
Ctr/Tmr 1 clock input	2	2	Digital ground
Ctr/Tmr 2 clock input	3	3	Digital ground
Ctr/Tmr 0 gate input	4	4	Digital ground
Ctr/Tmr 1 gate input	5	5	Digital ground
Ctr/Tmr 2 gate input	6	6	Digital ground
Ctr/Tmr 2 output	7	7	Digital ground
Ctr/Tmr 1 output	8	8	Digital ground
Ctr/Tmr 0 output	9	9	Digital ground
Digital ground	10	10	Digital ground

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For an External Clock Input

1. **Connect the high side of the clock input to TB1 screw 1 (counter/timer 0), TB1 screw 2 (counter/timer 1), or TB1 screw 3 (counter/timer 2).**

2. **Connect the low side of the clock input to any available screw terminal on TB2.**

   Refer to Table 2 for the pin assignments.

For a Hardware-Trigger Enable Signal

1. **Connect the high side of the trigger to TB1 screw 4 (counter/timer 0), TB1 screw 5 (counter/timer 1), or TB1 screw 6 (counter/timer 2).**

2. **Connect the low side of the trigger to any available screw terminal on TB2.**

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Other Panel – External Devices

Follow these directions when you are not using a Data Translation screw terminal panel.

Table 3 lists the J4 connector pin assignments.

Table 3: J4 Connector Pin Assignments

Description	Pin	Pin	Description
Digital Ground	1	2	Counter/Timer 0 Clock Input
Digital Ground	3	4	Counter/Timer 1 Clock Input
Digital Ground	5	6	Counter/Timer 2 Clock Input
Digital Ground	7	8	Counter/Timer 0 Gate Input
Digital Ground	9	10	Counter/Timer 1 Gate Input
Digital Ground	11	12	Counter/Timer 2 Gate Input
Digital Ground	13	14	Counter/Timer 2 Output
Digital Ground	15	16	Counter/Timer 1 Output
Digital Ground	17	18	Counter/Timer 0 Output
Digital Ground	19	20	Digital Ground

For an External Clock Input

1. **Connect the high side of the clock input to the appropriate J4 pin. (Pin 2 for Counter/Timer 0, pin 4 for Counter/Timer 1, and pin 6 for Counter/Timer 2.)**

2. **Connect the low side of the clock input to any available Digital Ground pin.**

   Refer to Table 3 for the pin assignments.

For a Hardware Trigger Enable Signal

1. **Connect the high side of the trigger input to the appropriate J4 pin. (Pin 8 for Counter/Timer 0, pin 10 for Counter/Timer 1, and pin 12 for Counter/Timer 2.)**

2. **Connect the low side of the trigger input to any available Digital Ground pin.**

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Step 6: Power Up Your System

Once you are satisfied that connections are secure and made properly, arrange the components so you can work with them comfortably.

1. **Reinstall the system unit cover.**

2. **Reconnect all accessories.**

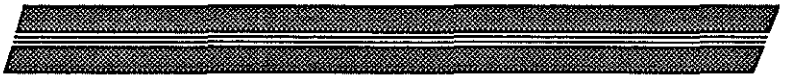
3. **Power up all accessories first.**

4. **Power up the system.**

Now that everything is set up and operational, continue with Chapter 3 to learn more about data acquisition and your DT2806 board.

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Chapter 3



Using the DT2806

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*Chapter 3, "**Using the DT2806,**" describes the major board functions in more detail and summarizes the steps necessary for programming your DT2806 board.*

This chapter is organized as follows:

- *Overview*
- *iSBX Interface*
- *Counter/Timer Subsystem*
- *Programming the Counter/Timers*
- *Basic Counter/Timer Operations*

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Overview

Control words written to the Counter/Timer Mode register and the FPLA Configuration register program the counter/timers. These registers are described in detail in Reference 4, "Register Description."

Read/write operations to the 16 addressable registers associated with each iSBX connector program the iSBX modules installed on the DT2806. iSBX module operation is covered in detail in the user manual for that module.

The DT2806 has two major subsystems:

- iSBX Interface
- Counter/Timer

These two subsystems are described in detail on the following pages.

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iSBX Interface

The DT2806 has three resident iSBX connectors that occupy 48 I/O-mapped locations on the host PC bus. Each of the three connectors has sixteen addressable registers with read/write capabilities.

The iSBX interface fully implements the iSBX specification. It supports all of the iSBX modules available from Data Translation, Intel, and other manufacturers. These iSBX modules connect to the iSBX bus via the DT2806 iSBX connectors.

There are five interrupt lines and six options (two for each iSBX connector) that can be accessed via jumpers on the DT2806. See Reference 2, "Changing Jumpers," for information on connecting these signals.

You can find additional information about the iSBX connector signals in Reference 3, "Connectors and Accessories."

iSBX module descriptions and programming information are contained in the user manual provided with those modules.

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Counter/Timer Subsystem

The **Counter/Timer** subsystem consists of three 16-bit, presettable, DOWN counter/timers. The counter/timers are fully independent and each can have a separate mode configuration, and a separate counting operation, binary or BCD. You can read the contents of each counter/timer "on the fly" without having to inhibit the clock inputs.

The counter/timer subsystem includes an 8253 field-programmable logic array (FPLA), that interfaces to a programmable interval timer and the FPLA Configuration register as shown in Figure 6. The programmable interval timer is a general purpose multi-timer consisting of three 16-bit counters, each with a count rate of up to 2MHz. The FPLA Configuration register controls the FPLA by configuring the three counter/timers into any one of four different physical arrangements.

Each counter/timer has a clock input, gate input, and output. The **clock input** to the counter/timer comes from the onboard 2MHz clock or from an external clock having a frequency between 0 and 2MHz connected to the DT2806 via the J4 connector. Writing to the appropriate gate bit in the FPLA Control register enables the **gate input** to a counter/timer via software. A TTL low signal on the appropriate pin of the J4 connector enables the gate input to a counter/timer via hardware.



In some counter/timer configurations, you are not able to access the gate and clock inputs of Counter/Timer 0 and Counter/Timer 1. Refer to the Counter/Timer Configuration section for more information.

The counter/timer output goes low or high at various times during counting depending on the mode in which the Counter/Timer subsystem is operating. The counter/timer output normally goes to the J4 connector. You can also tie it to interrupt lines 3, 4, or 5 on the PC bus using jumpers. Refer to the mode descriptions and timing diagrams for the counter/timer output states during operation.

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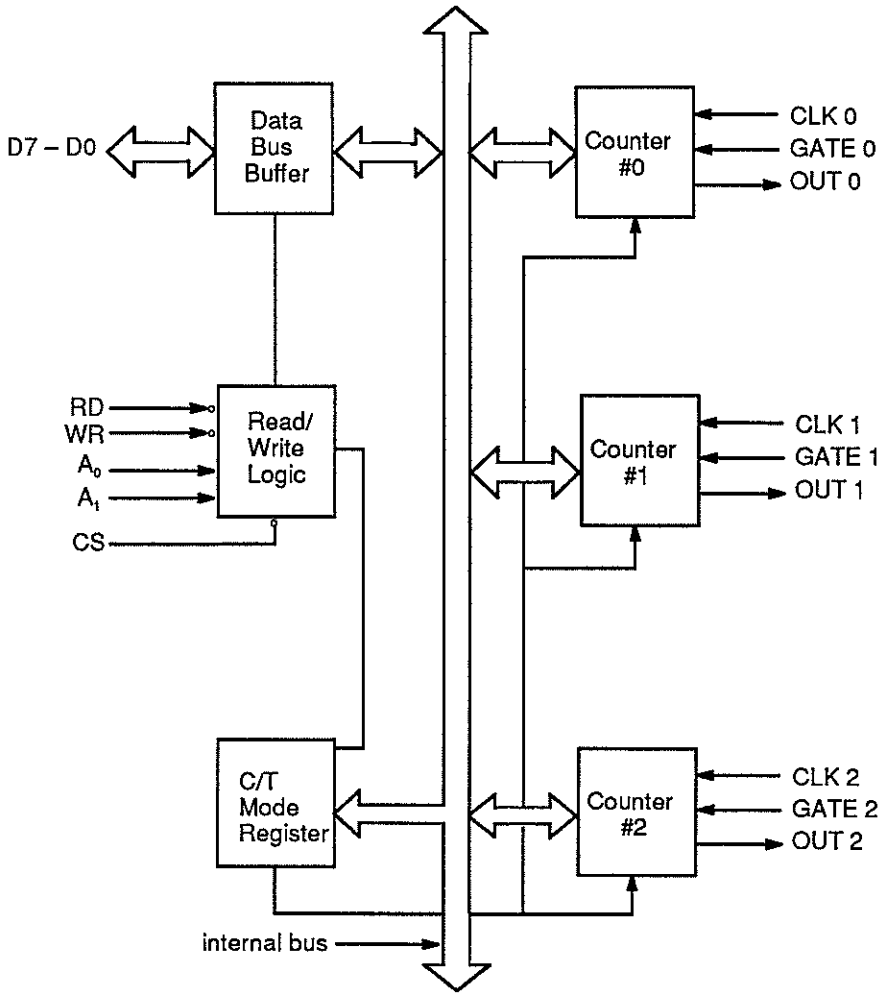


Figure 6: 8253 Counter/Timer Block Diagram

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Counter/Timer Configurations

The FPLA can arrange the three counter/timers into four different physical configurations and internally configured them for any one of six operating modes.

Writing a control word to the FPLA Configuration register selects one of four different configurations which include:

- Standard Configuration
- Delay Configuration
- Frequency Measurement Configuration
- Toggle Configuration

Standard Configuration

The **Standard configuration** sets all of the counter/timers to function independently. It gives you the choice of an internal or external clock source, internal or external gate source, and signal output destination. Figures 7 through 10 illustrate various counter/timer setups in this configuration.

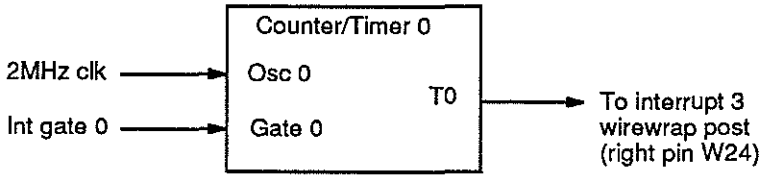


Figure 7: Internal Clock and Software Gate Counter/Timer 0 Set-Up

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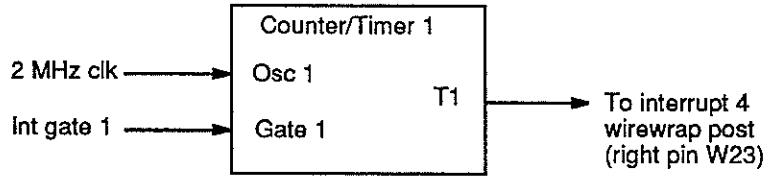


Figure 8: Internal Clock and Software Gate Counter/Timer 1 Set-Up

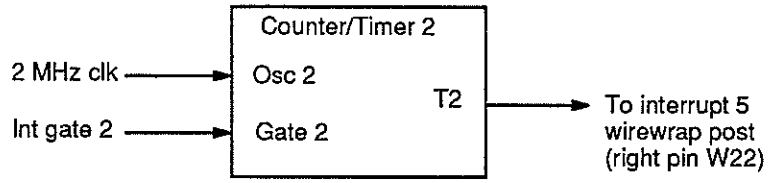


Figure 9: Internal Clock and Software Gate Counter/Timer 2 Set-Up

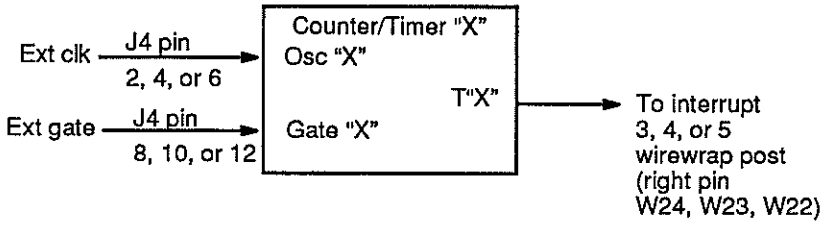


Figure 10: External Clock and Gate Counter/Timer "x" Set-Up

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Delay Configuration

Delay configuration connects the output of Counter/Timer 2 to the gate input of Counter/Timers 1 and 0. The output of Counter/Timer 1 cascades into the clock input of Counter/Timer 0. *Do not make ANY user connections to J4 connector pins 2, 8, 10, 14, or 16 when operating in this configuration.*



When the DT2806 is in any of the cascaded configurations (Delay and Frequency Measurement), you may make internal or external counter/timer connections. When internal connections are used, however, do not make any connections to the corresponding external (J4) connector pins. For example, the output of counter/Timer 0 appears both at J4 pin 18 and the right jumper post of W24. If using the J4 output, do NOT make any connection to the W24 jumper post.

The Delay configuration is designed to provide a 32-bit counter/timer for creating 32-bit software delays. Counter/Timers 2 and 0 must be set to Mode 0 (Interrupt on Terminal Count) and Counter/Timer 1 to either Mode 2 (Rate Generator) or Mode 3 (Square Wave Generator). To load the counter/timers, you must load the least significant word (or bottom 16 bits) into Counter/Timer 2. Load Counter/Timer 1 with the full count (0000H) and load Counter/Timer 0 with the most significant word minus 1, (or the top 16 bits minus 1).

You can use an internal or external clock as long as you apply it to both Counter/Timers 2 and 1. To start the delay counter, simply enable Counter/Timer 2. (Use pin 12 of the J4 connector for an external enable to Gate 2.)

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Figure 11 illustrates the Delay configuration set-up.

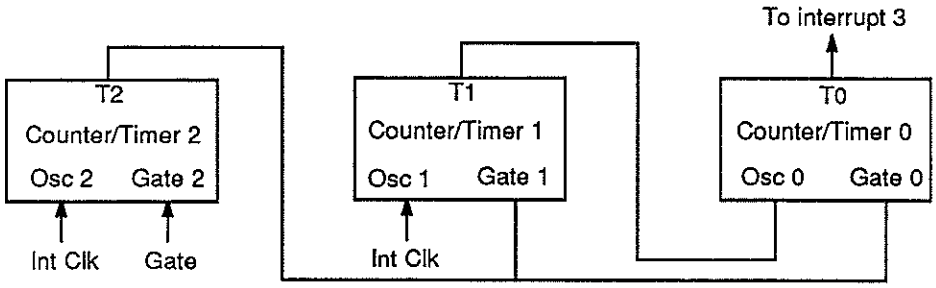


Figure 11: Delay Configuration Set-Up

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Frequency Measurement Configuration

Frequency Measurement configuration provides a method of taking frequency and pulse measurements. This configuration compares an unknown count against a known count over a set sample period. The ratio of the known count to the unknown count gives the frequency in Hertz.

$$\text{Frequency (Hz)} = \frac{\text{count loaded} - \text{count read of C/T 2}}{[\text{count loaded} - \text{count read of C/T 1 and 0}] \times 5 \times 10^{-7}\ \text{sec}}$$

You must set Counter/Timers 2 and 0 to Mode 0 (Interrupt on Terminal Count) and Counter/Timer 1 to either Mode 2 (Rate Generator) or Mode 3 (Square Wave Generator). The output of Counter/Timer 1 connects to the clock input of Counter/Timer 0. Counter/Timer 2 is used as the unknown frequency counter. Attach the unknown frequency to pin 6 of the J4 connector and reference it to digital ground on pin 7. You need not make any external connections. You may use an external clock for Counter/Timer 1, but that clock input must be precise and very stable or its use in this configuration will not be effective. Other inputs may be internal or external, but do not make any connections to the external output pin of Counter/Timer 1 (pin 16 of the J4 connector).

Load each counter with the full count (0000H). The first decrement will be to FFFF. When the counter cycles back to 0000, the count has completed.

When everything is set up, use either the FPLA or your connections at J4 to gate all three counters at the same time. If a counter should overflow, the DT2806 will generate an interrupt, indicating that a shorter sample time is needed. For pulse counting, simply gate Counter/Timer 1 with the pulse.



Remember: If you use an external gate input, all counters initiate low.

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Figure 12 illustrates the Frequency Measurement configuration set-up.

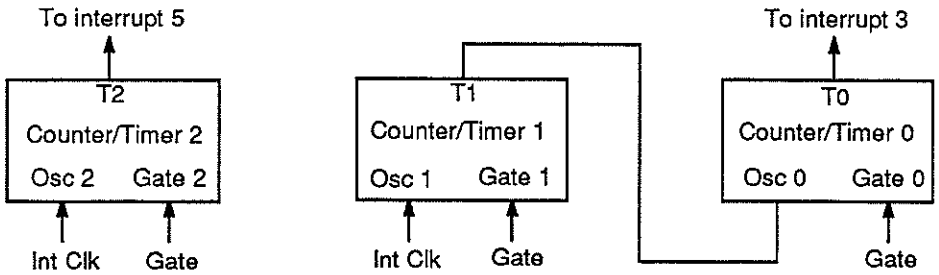


Figure 12: Frequency Measurement Configuration Set-Up

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Toggle Configuration

Toggle configuration clocks data into the counter/timers. To load one of the counters, write the count to a holding register internal to the 8253 FPLA counter/timer. Writing first a "1," and then a "0" to the FPLA Configuration register sends a pulse (low to high then high to low) on the respective clock line that loads the count into the actual counter/timer register.

The clock lines can be toggled one at a time or in any combination. For example, an F8H written to the FPLA Configuration register sets all the clock inputs to "1." C0H clears all clock inputs. The data toggles into all three counters. Use the Toggle configuration to strobe the data into the counter/timer registers in the 8253 counter/timer. Do not make any connections to the external clock inputs EXCLK0, EXCLK1, and EXCLK2 on J4 when using the Toggle configuration.

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Counter/Timer Modes

The counter/timers can operate in six different modes: Mode 0 through Mode 5. Select these modes via bits 3, 2, and 1 of the Counter/Timer Mode register as described in Reference 4, "Register Description."

The counter/timer output is always indeterminate until you set the operating mode; then, depending upon the mode selected, the output may remain low or go high to accomplish the specific purposes defined by that mode.

Table 4 illustrates the effect of the gate input on the counter/timer. The remainder of this section describes each of the modes in detail.

Table 4: Gate Operations Summary

Modes	Signal Status		
	Low or Going Low	Rising	High
0	Disables counting	———	Enables counting
1	———	1) Initiates counting 2) Resets output after next clock	———
2	1) Disables counting 2) Sets output immediately high	1) Reloads counter 2) Initiates counting	Enables counting
3	1) Disables counting 2) Sets output immediately high	1) Reloads counter 2) Initiates counting	Enables counting
4	Disables counting	———	Enables counting
5	———	Initiates counting	———

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Mode 0: Interrupt on Terminal Count

Mode 0 creates the capability for a system interrupt. Use it in any application that requires the output to change state upon terminal count. Select this mode for an individual counter/timer or for any number of them.

Mode 0 affects the counter/timers as follows:

- The output goes low after the Mode Set operation.
- Once the count is loaded into the selected count register, the output remains low and the counter starts counting.
- When terminal count is reached, the output goes high and remains high until the selected count register is reloaded with a mode or with a new count.
- The counter continues to decrement after the terminal count has been reached.
- Writing to the counter/timer register during counting results in a cessation of the current count when the first byte is written, and the beginning of a new count when the second byte is written.

Figure 13 shows events 1 and 2 in a Mode 0 timing diagram.

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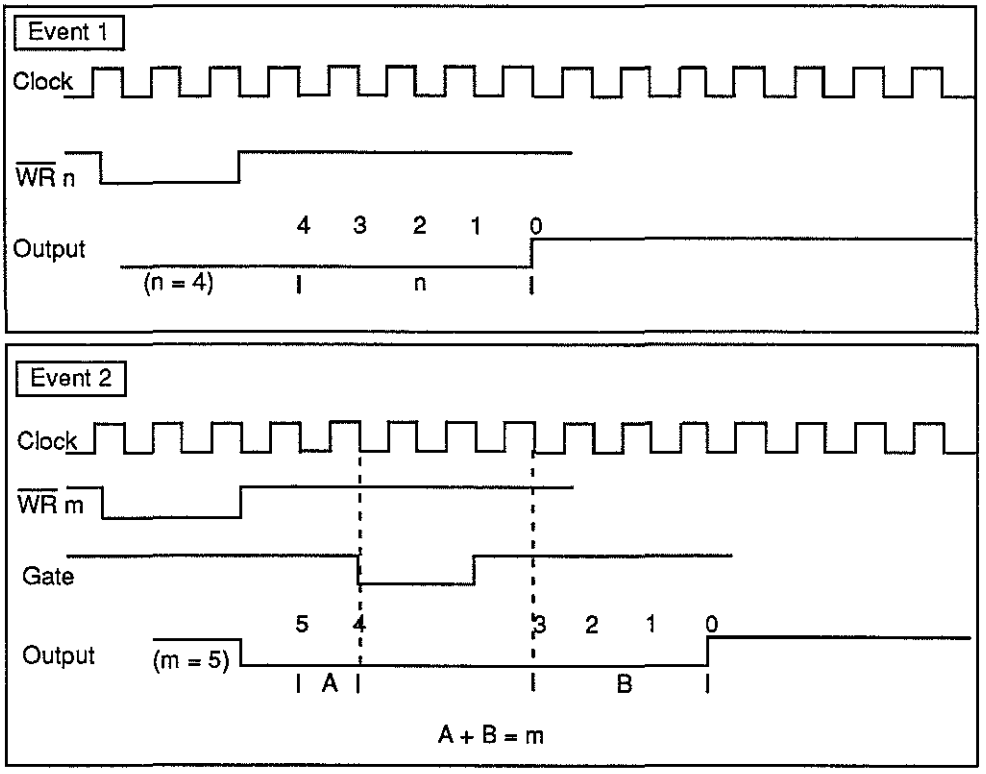


Figure 13: Mode 0 Timing Diagram – Events 1 and 2

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Mode 1: Programmable One-Shot

Mode 1 allows the counter/timers to be clocked for a programmable one-shot. See the Mode 1 timing diagram for events 1 and 2 in Figure 14.

The counter/timers are affected as follows:

- The output goes low on the count following the falling edge of the gate input.
- The output goes high on the terminal count.
- If a new count value is loaded while the output is low, it does not affect the duration of the one-shot pulse until the succeeding gate.
- You may read the current count at any time without affecting the one-shot pulse.
- The one-shot is retriggerable; hence, the output remains low for the full count after the falling edge of any gate input.

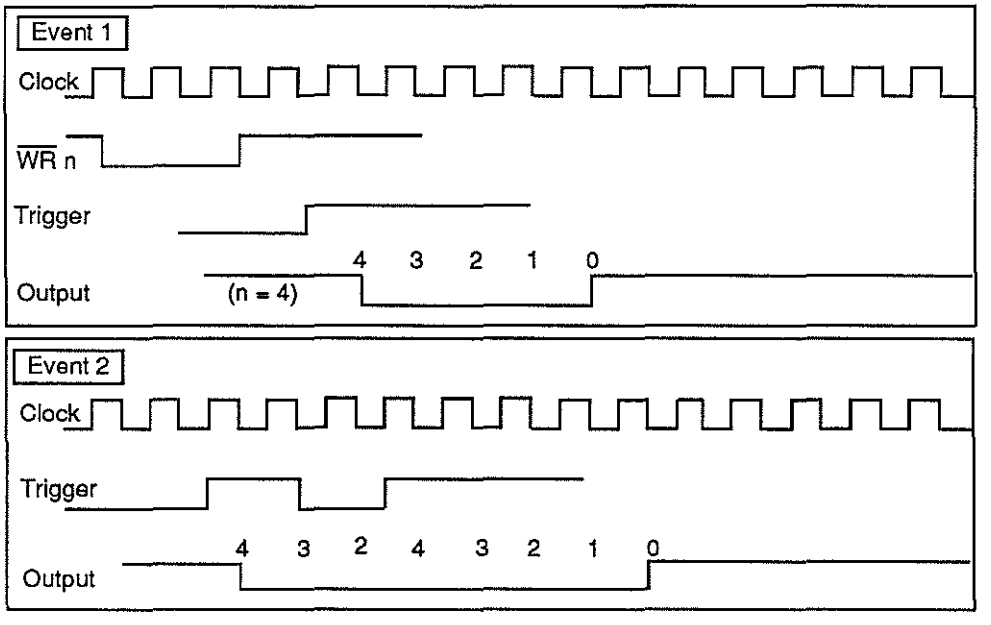


Figure 14: Mode 1 Timing Diagram – Events 1 and 2

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Mode 2: Rate Generator

Mode 2 is a "divide-by-n" counter. This mode affects the counter/timers as follows:

- The output is low for one period of the input clock.
- The period from one output pulse to the next is determined by the number of input counts in the count register.
- If the counter/timer register is reloaded between output pulses, the present period is not affected, but the subsequent period will reflect the new value.
- When the gate input is high, it forces the output high. When the gate input goes low, the counter starts from the initial count. Thus, either a hardware- or software-enable gate input to the counter/timer can be used to synchronize the counter.
- When this mode is set, the output remains high until after the count register is loaded.

Figure 15 illustrates the Mode 2 timing diagram.

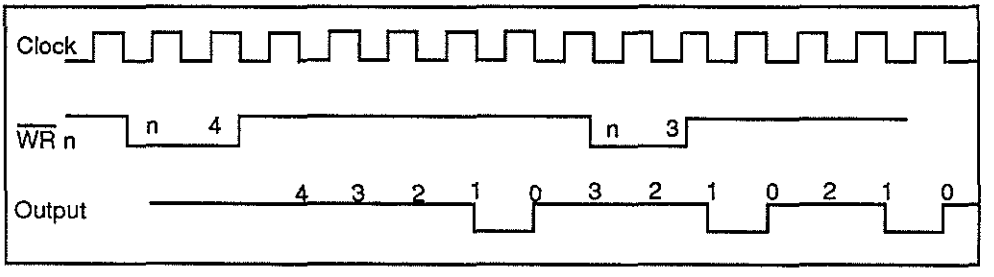


Figure 15: Mode 2 Timing Diagram

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Mode 3: Square Wave Generator

Mode 3 affects the counter/timers as follows:

- The output remains high until one half of the count has been completed (for even numbers), and goes low for the other half of the count.
- By decrementing the clock by two counts on the rising edge of each clock pulse, when the counter reaches the terminal count, the counter is reloaded with the count and the output is changed.
- When the count is odd and the output is high, the first clock pulse decrements the counter by one, and subsequent clock pulses decrement the counter by two. The output goes low and the count is reloaded.
- On the first clock pulse, the counter is decremented by three and then by two on successive pulses until timeout.

Figure 16 illustrates the Mode 3 timing diagram.

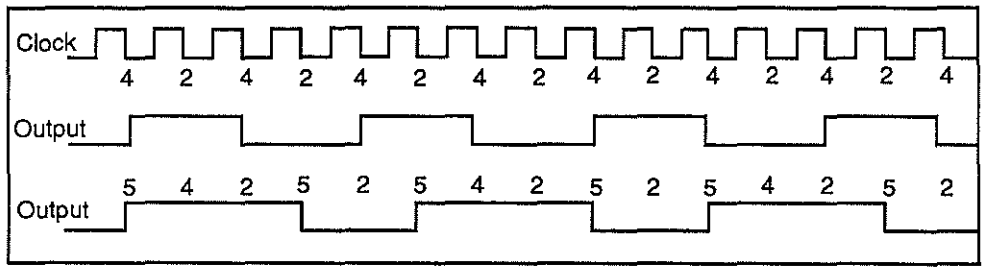


Figure 16: Mode 3 Timing Diagram

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Mode 4: Software-Triggered Strobe

Mode 4 allows the counter/timer to be used as a strobe that is implemented by software. See Figure 17 for a timing diagram of Mode 4 for events 1 and 2.

The counter/timers are affected as follows:

- After the mode is set, the output is high.
- When the count is loaded the output goes low on terminal count and then returns high on the next clock input.
- If the counter/timer is loaded while it is counting, the new count is loaded on the next clock pulse.

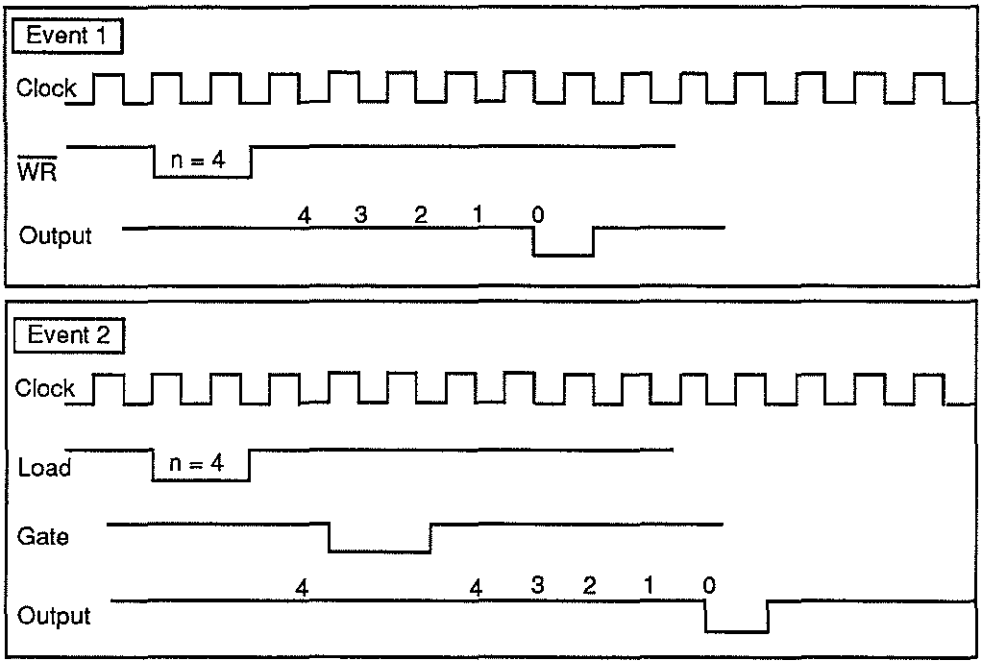


Figure 17: Mode 4 Timing Diagram – Events 1 and 2

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Mode 5: Hardware-Triggered Strobe

Mode 5 illustrated in Figure 18 allows the counter/timer to be used as a strobe that is implemented through hardware.

The counter/timers are affected as follows:

- The counter/timer starts counting after the falling edge of the gate input and goes low for one clock period when the terminal count is reached.
- The output is retriggerable; hence the output remains high for the full count after the falling edge of any gate input.

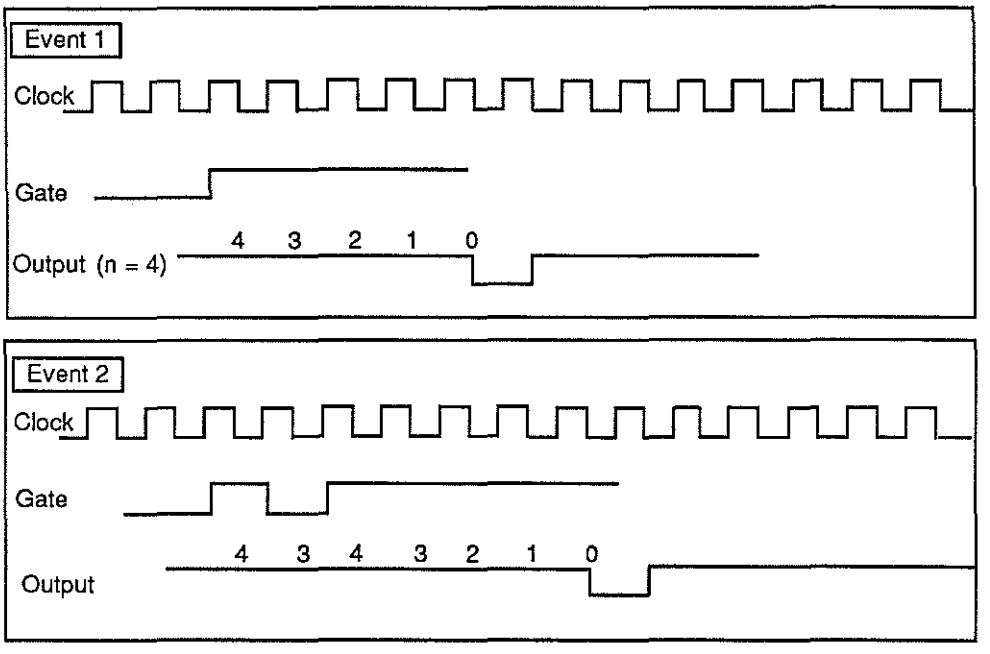


Figure 18: Mode 5 Timing Diagram – Events 1 and 2

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Programming the Counter/Timers

Writing control words to the Counter/Timer Mode and FPLA Configuration registers programs the counter/timers. The Counter/Timer Mode register sets the operating mode for each counter/timer and the FPLA Configuration register sets the physical configuration of the three counter/timers in relation to each other.



Example programs for various counter/timer operations reside on the DT2806 diskette shipped with your board. You can find the listings for these example programs in Appendix A of this manual.

Write Operations

Writing a control word and the number of count register bytes (1 or 2) prior to using that counter/timer, programs each counter/timer.

The order in which you program this information is flexible. You can write the control words for the three counter/timers in any sequence, e.g., you do not have to write Counter/Timer 0's control word first or Counter/Timer 2's control word last. The control word applies to the counter/timer determined by the value of bits 7 and 6 (Counter/Timer Select) of the Counter/Timer Mode register.

You must load the count value into the Counter/Timer registers, however, in the exact sequence specified by the Read/Load bits (bits 5 and 4) of the control word for that counter/timer. You must load the Counter/Timer register with the number of bytes specified by the Read/Load bits. You do not have to load the count value immediately following the programming of the control word. Load the count value any time after programming the control word as long as you load the correct number of bytes in the order specified.

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All counter/timers are down counters. Thus, the value loaded into the Counter/Timer register decrements. Loading all zeros results in the maximum count.

Read Operations

You read the value of the counters while counting is in progress by either of two methods:

Method 1

The first method involves simple I/O read operations. Select the counter/timer to read by setting the Counter/Timer Select bits (bits 7 and 6) in the Counter/Timer Mode register to the appropriate values.



In order to ensure a stable count reading, you must inhibit the actual operation of the selected counter/timer, either by controlling the gate input or the external logic that inhibits the clock input.

Read the two bytes from the selected counter/timer. The least significant byte (LSB) is in one byte and the most significant byte (MSB) in the other. You must read these bytes in the order determined by the Read/Load bits (bits 5 and 4) in the Counter/Timer Mode register.

You MUST complete the read operation. If two bytes are programmed to be read then you MUST read two bytes before you can write to the counter/timer again.

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Method 2

The second method involves reading the contents of the counter "on the fly." To do this, select the counter latching operation by clearing the Read/Load bits of the Counter/Mode register (bits 5 and 4). This action latches the information into a storage register. Select the counter/timer to read by setting the Counter/Timer Select bits to the appropriate values. Read the contents of the selected counter/timer. This read operation returns the contents of the storage register.

You MUST complete the read operation. If two bytes are programmed to be read then you MUST read two bytes before you can write to the counter/timer again.

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Basic Counter/Timer Operations

This section tells you how to accomplish specific counter/timer operations. It summarizes the steps necessary for programming your DT2806 to perform the following:

- Initializing the Counter/Timer
- Standard Configuration: Internal Clock and Gate; Output to Interrupt
- Standard Configuration: External Clock and Gate; Output to Interrupt
- Delay Configuration
- Frequency Measurement Configuration
- Toggle Configuration

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Initializing the Counter/Timer

1. **Write a control word to the Counter Timer Mode register (Base + C00H) to select the measurement mode.**

2. **Write the count to the appropriate Counter/Timer register in use, adhering to the Read/Load bit selection in the Counter/Timer Mode register.**

3. **Select the Toggle configuration in the FPLA Configuration register (Base + 1400H).**

4. **Clock the count into the respective counter/timer.**

5. **Set the desired operating configuration, clocking, and enabling scheme in the FPLA Configuration register.**



The count is started when the gate bit is enabled and, on the next clock pulse, the counter begins decrementing.

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Standard Configuration: Internal Clock and Gate; Output to Interrupt

1. **Clear the FPLA Configuration register (Base + 1400H).**

2. **Select Mode 0 (interrupt on terminal count), Counter/Timer 0, and the Read/Load method of loading the least significant byte first followed by the most significant byte, by writing 30H to the Counter/Timer Mode register (Base + C00H).**

3. **Write the low byte of the count value to the Counter/Timer 0 register (Base + 000H).**

4. **Write the high byte of the count value to the Counter/Timer 0 register.**

5. **Toggle the count into the Counter/Timer 0 register by first writing C8H and then C0H to the FPLA Configuration register.**

6. **Enable Counter/Timer 0 by writing 09H to the FPLA Configuration register.**

Figure 19 shows an example program written in BASIC for this configuration.

```
10    OUT   &H1770, &H00     :REM Clears the FPLA
20    OUT   &HF70, &H30      :REM Sets up Mode 0,
                                  Timer 0, Load Method 4
30    OUT   &H370, LO_BYTE   :REM Low byte of count
40    OUT   &H370, HI_BYTE   :REM High byte of count
50    OUT   &H1770, &HC8     :REM Toggle count into register
60    OUT   &H1770, &HC0     :REM Toggle count
70    OUT   &H1770, &H09     :REM Gate counter
80    END                    :REM Done INTERNAL
```

Figure 19: Example Program – Internal Clock and Gate

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Standard Configuration: External Clock and Gate; Output to Interrupt

1. **Clear the FPLA Configuration register (Base + 1400H).**

2. **Select Mode 0, Counter/Timer 0, and the Read/Load method of loading the least significant byte first followed by the most significant byte, by writing 30H to the Counter/Timer Mode register (Base + C00H).**

3. **Write the low byte of the count value to the Counter/Timer 0 register (Base + 000H).**

4. **Write the high byte of the count value to the Counter/Timer 0 register.**

5. **Toggle the count into the Counter/Timer 0 register by first writing C8H and then C0H to the FPLA Configuration register.**

6. **Enable Counter/Timer 0 by writing 00H to the FPLA Configuration register.**

Figure 20 shows an example program written in BASIC for this configuration.

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```
10    OUT   &H1770, &H00     :REM Clears the FPLA
20    OUT   &HF70, &H30      :REM Sets up Mode 0,
                                  Timer 0, Load Method 4
30    OUT   &H370, LO_BYTE   :REM Low byte of count
40    OUT   &H370, HI_BYTE   :REM High byte of count
50    OUT   &H1770, &HC8     :REM Toggle count into register
60    OUT   &H1770, &HC0     :REM Toggle count
70    OUT   &H1770, &H00     :REM Set up external clock and gate
80    REM   The external clock can be started, keep in mind that
90    REM   it will be inverted.  When ready to start the timer
100   REM   pull the EXENA0 line low and the timer will start.
110   END                    :REM Done EXTERNAL
```

Figure 20: Example Program – External Clock and Gate

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Delay Configuration

1. Clear the FPLA Configuration register (Base + 1400H).

2. Select Mode 0, Counter/Timer 2, and the Read/Load method of loading the least significant byte first followed by the most significant byte, by writing B0H to the Counter/Timer Mode register (Base + C00H).

3. Write the least significant word into the Counter/Timer 2 register (Base + 800H).

4. Select Mode 2, Counter/Timer 1, and the Read/Load method of loading the least significant byte first followed by the most significant byte, by writing 74H to the Counter/Timer Mode register.

5. Write 00H to the least significant byte of the Counter/Timer 1 register (Base + 400H).

6. Write 00H to the most significant byte of the Counter/Timer 1 register.

7. Select Mode 0, Counter/Timer 0, and the Read/Load method of loading the least significant byte first followed by the most significant byte, by writing 30H to the Counter/Timer Mode register.

8. Load the most significant word minus 1 into the Counter/Timer 0 register (Base + 000H).

9. Toggle the counts into the Counter/Timer registers by first writing F8H and then C0H to the FPLA Configuration register.

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10. Begin the Delay Configuration mode by writing 74H to the Counter/Timer Mode register.

Figure 21 shows an example program written in BASIC for this configuration.

```
10    REM   Delay Configuration
20    OUT   &H1770, &H00     :REM Clear the FPLA
30    OUT   &HF70, &HB0      :REM Set Counter/Timer 2, Mode 0
40    OUT   &HB70, &H00      :REM Load count
50    OUT   &HB70, &H24      :REM Load 2 millisecond delay
60    OUT   &HF70, &H74      :REM Set Counter/Timer 1, Mode 2
70    OUT   &H770, &H00      :REM Full count
80    OUT   &H770, &H00      :REM Full count
90    OUT   &HF70, &H30      :REM Set Mode 0, Counter/Timer 0,
                                  Method 4
100   OUT   &H370, &HF4      :REM 8 second delay
110   OUT   &H370, &H00      :REM Delay count
120   OUT   &H1770, &HF8     :REM Toggle count into register
130   OUT   &H1770, &HC0     :REM Toggle all
140   INPUT "BEGIN TEST"; A$
150   IF A$="Y" THEN GOTO 170
160   GOTO 990
170   OUT   &H1770, &H74     :REM Begin Set Delay configuration
180   REM   8 seconds later the delay is finished and
190   REM   interrupt 3 is asserted by the output of
200   REM   Timer 0
210   END
```

Figure 21: Example Program – Delay Configuration

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Frequency Measurement Configuration

1. Clear the FPLA Configuration register (Base + 1400H).

2. Select Mode 0, Counter/Timer 2, and the Read/Load method of loading the least significant byte first followed by the most significant byte, by writing B0H to the Counter/Timer Mode register (Base + C00H).

3. Load Counter/Timer 2 with a full count by writing 0H to both the least and most significant bytes in the Counter/Timer 2 register (Base + 800H).

4. Select Mode 2, Counter/Timer 1, and the Read/Load method of loading the least significant byte first followed by the most significant byte, by writing 74H to the Counter/Timer Mode register.

5. Load Counter/Timer 1 with a full count by writing 0H to both the least and most significant bytes in the Counter/Timer 1 register (Base + 400H).

6. Select Mode 0, Counter/Timer 0, and the Read/Load method of loading the least significant byte first followed by the most significant byte, by writing 30H to the Counter/Timer Mode register.

7. Load a full count (0H) into the Counter/Timer 0 register (Base + 000H).

8. Toggle the counts into the Counter/Timer registers by first writing F8H and then C0H to the FPLA Configuration register.

9. Begin the Frequency Measurement Configuration mode by writing 97H to the FPLA Configuration register.

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Figure 22 shows an example program written in BASIC for this configuration.

```
10   REM  Frequency Measurement Configuration
20   OUT  &H1770, &H00    :REM Clear the FPLA
30   OUT  &HF70, &HB0     :REM Set Counter/Timer 2, Mode 0
40   OUT  &HB70, &H00     :REM Load full count
50   OUT  &HB70, &H00     :REM Load full count
60   OUT  &HF70, &H74     :REM Set Counter/Timer 1, Mode 2
70   OUT  &H770, &H00     :REM Full count
80   OUT  &H770, &H00     :REM Full count
90   OUT  &HF70, &H30     :REM Set Mode 0, Counter/Timer 0,
                               Method 4
100  OUT  &H370, &H00     :REM Full count
110  OUT  &H370, &H00     :REM Full count
120  OUT  &H1770, &HF8    :REM Toggle count into registers
130  OUT  &H1770, &HC0    :REM Toggle all
140  A=INP (&H370)        :REM Check data
150  B=INP (&H370)        :REM Check data
160  C=INP (&H770)        :REM Check data
170  D=INP (&H770)        :REM Check data
180  E=INP (&HB70)        :REM Check data
190  F=INP (&HB70)        :REM Check data
200  IF A=B=C=D=E=F THEN GOTO 220
210  GOTO 380
220  INPUT "BEGIN FREQUENCY MEASUREMENT TEST (1=YES)";R
230  OUT  &H1770, &H97    :REM Go
240  FOR W=1 TO 2000
250  NEXT W
260  OUT  &H1770, &H00    ;REM Stop for 2 second sample
270  A=INP (&H370)        :REM Read data
280  B=INP (&H370)        :REM Read data
290  C=INP (&H770)        :REM Read data
300  D=INP (&H770)        :REM Read data
310  E=INP (&HB70)        :REM Read data
320  F=INP (&HB70)        :REM Read data
330  KNOW=2^32-(((2^8*B)+A)*2^16)+((2^8*D)+C)
340  MEAS=2^16-((2^8*F)+E)
350  FREQ=(MEAS/(KNOW*0.0000005))
360  IF FREQ<1000 THEN GOTO 380
370  PRINT "FREQUENCY TEST OK"
                          : GOTO 390
380  PRINT "ERROR FREQUENCY TEST"
390  END
```

Figure 22: Example Program – Frequency Measurement Configuration

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Toggle Configuration

1. Select Mode 0, Counter/Timer 0, and the Read/Load method of loading the least significant byte first followed by the most significant byte, by writing 30H to the Counter/Timer Mode register (Base + C00H).

2. Write the low byte of the count value to the Counter/Timer 0 register (Base + 000H).

3. Write the high byte of the count value to the Counter/Timer 0 register.

4. Select Mode 0, Counter/Timer 1, and the Read/Load method of loading the least significant byte first followed by the most significant byte, by writing 70H to the Counter/Timer Mode register (Base + C00H).

5. Write the low byte of the count value to the Counter/Timer 1 register (Base + 400H).

6. Write the high byte of the count value to the Counter/Timer 1 register.

7. Select Mode 0, Counter/Timer 2, and the Read/Load method of loading the least significant byte first followed by the most significant byte, by writing B0H to the Counter/Timer Mode register (Base + C00H).

8. Write the low byte of the count value to the Counter/Timer 2 register (Base + 800H).

9. Write the high byte of the count value to the Counter/Timer 2 register.

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10. Toggle the count into the registers by first writing F8H and then C0H to the FPLA Configuration register.

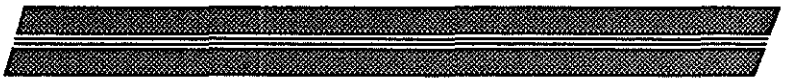
Figure 23 shows an example program written in BASIC for this configuration.

```
10    OUT   &HF70, &H30      :REM Sets up Mode 0, Counter/Timer 0,
                                  Load method 4
20    OUT   &H370, LO_BYTE   :REM Low byte of count
30    OUT   &H370, HI_BYTE   :REM High byte of count
40    OUT   &HF70, &H70      :REM Sets up Mode 0, Counter/Timer 1,
                                  Load method 4
50    OUT   &H770, LO_BYTE   :REM Low byte of count
60    OUT   &H770, HI_BYTE   :REM High byte of count
70    OUT   &HF70, &HB0      :REM Sets up Mode 0, Counter/Timer 2,
                                  Load method 4
80    OUT   &HB70, LO_BYTE   :REM Low byte of count
90    OUT   &HB70, HI_BYTE   :REM High byte of count
100   OUT   &H1770, &HF8     :REM Toggle counts into registers
110   OUT   &H1770, &HC0     :REM Toggle
120   END                    :REM Done Counter Load
```

Figure 23: Example Program – Toggle Configuration

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Reference 1



Troubleshooting

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*Reference 1, "**Troubleshooting**," describes some of the problems commonly encountered when the DT2806 board is first used and suggests steps you may take to correct them.*

This reference chapter is organized as follows:

- *General Checklist*
- *Specific Problems*
- *Service and Support*

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General Checklist

Go through the following checklist when troubleshooting the DT2806 board to help you isolate your problem.

1. **Verify that the factory-settings for the board are adequate for your system.**

   Refer to Reference 2, "Changing Jumpers," for the factory-configured settings and alternative values.

2. **Check the +5V power supply on the board. It must be between +4.75 and +5.25 volts for the board to work properly.**

3. **Make sure the DT2806 is firmly seated in its expansion slot.**

4. **Verify that all cables associated with the board are firmly connected.**

5. **Check that components on the board are not making contact with an adjacent board.**

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Specific Problems

The following details specific problems that may occur and suggests possible causes and solutions.

1. **No board response.**

   - Verify that the board is fully seated in the bus connector.

     Test to see if the board is properly connected by gently pulling the board. If it stays in place, it's connected. If the board exhibits no resistance, it is not seated in its connector. Try pressing more firmly on the board to seat it in its connector.

   - If there is still no response after trying above, call Data Translation for assistance.

2. **Power supply etch has blown.**

   The power supply etches of the DT2806 are fused using an etch-neck-down technique. This means that the supply etches are bussed in heavy 50 mil etch, except in the fused area where they are reduced to thinner etch. The location of the supply etches is directly above the connector fingers on the solder side of the DT2806.

   - If one of the etches blows due to power supply overloading, install a fuse in the holes provided. Refer to Table 5 for the recommended fuse values.

Table 5: Supply Etch Fuse Values

Etch Voltage	Fuse Value	Fuse Label	Recommended Fuse Number (Littelfuse) 265/266
+12 Volts	1.5 amp	F1	26X .125
–12 Volts	250 mA	F2	26X .125
+5 Volts	3.0 amp	F3	26X .062

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Service and Support

To help you get the best performance from your Data Translation product, the Technical Support staff is available to provide prompt, reliable assistance. If you are located outside the USA, you local distributor can provide assistance. The name and address of your nearest distributor are listed at the back of the Data Translation catalog.

Please be prepared to answer the following questions when you call for technical support. This information helps us identify specific system and configuration related problems.

- What is the serial number of the product?
- What operating system are you using?
- What other boards, modules, or applications are installed in your system?
- How much RAM do you have?
- What size hard disk are you using?
- How fast is your CPU?
- How fast is your host bus?
- If you are on a network, what type of network are you using and approximately how many users are on the network?
- If example programs or diagnostics were shipped with your product, have you run them? What were the results?
- Have you verified that all your connections are secure and are made properly?
- Have you isolated the source of your problem: input or output device, board or module, software?
- What is your jumper configuration?

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In addition, if it appears your problem is software-related, specify whether or not it has occurred more than once and, if possible, document the sequence of steps that caused the problem. This information helps us to reproduce the problem in-house.

If you require technical assistance, call the **Technical Support Department** at:

(508) 481–3700

If Your DT2806 Needs Factory Service

If factory service is necessary:

1. **Call the Customer Service Department using the telephone number listed above and obtain a Return Material Authorization (RMA) number.**

   All return shipments to Data Translation must be marked with the RMA number in order to ensure proper processing.

2. **Package the board as follows:**

   - Wrap the board in an electrically conductive plastic material, handling it with ground protection. *A static discharge can destroy board components.*
   - Pack the board in its original shipping container, if available and in good condition; or use any secure shipping container.

3. **Return the board to the following address, making sure the RMA number is visible on the outside of the box.**

   Customer Service Dept.
   Data Translation, Inc.
   100 Locke Drive
   Marlboro, MA 01752–1192

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Reference 2

Changing Jumpers

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*Reference 2, "**Changing Jumpers**," describes the jumper-selectable parameters on the DT2806 board.*

This reference chapter is organized as follows:

- *Jumper Summary*
- *I/O Base Address Selection*
- *Interrupt and Option Selection*
- *DMA Request/Acknowledge Selection*

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Jumper Summary

Your DT2806 board has jumper settings that you can change if necessary. In most instances you can use the factory-configured jumper settings on the board. If your operating environment requires alternative settings, however, you must change the appropriate jumpers on the board before installing it.

The jumpers on the DT2806 permit connection to the PC bus signals and access up to six available options (two per iSBX connector). They also provide connections to the counter/timers, interrupt signals, and DMA lines.

The DT2806 has three jumper-selectable functions:

- I/O Base Address selection
- Interrupt and Option selection
- DMA Request/Acknowledge selection

Table 6 summarizes the user-configurable DT2806 jumpers.

Table 7 summarizes the base address jumpers.

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Table 6: Jumper Summary

Left Post Signal	Jumper Pair/Post	Right Post Signal
T0	W24	+IRQ3
T1	W23	+IRQ4
T2	W22	+IRQ5
–DACK3	W21	Data transceivers
–DACK2	W20	Data transceivers
–DACK1	W19	Data transceivers
+DRQ3	W18	+CDRQTH on J3
–DACK3	W17	–CDACKL on J3
COPT1	W16 [1]	
COPT0	W15 [1]	
+IRQ7	W14	CINTR0H on J3
+IRQ7	W13	CINTR1H on J3
+DRQ2	W12	+BDRQTH on J2
–DACK2	W11	–BDACKL on J2
BOPT1	W10 [1]	
BOPT0	W9 [1]	
+IRQ5	W8	BINTR0H on J2
+IRQ6	W7	BINTR1H on J2
+DRQ1	W6	+ADRQTH on J1
–DACK1	W5	–ADACKL on J1
AOPT1	W4 [1]	
AOPT0	W3 [1]	
+IRQ3	W2	AINTR0H on J1
+IRQ4	W1	AINTR1H on J1

[1] Single jumper post.

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Table 7: I/O Base Address Jumper Summary

Jumper	Description
W32	Bit 0 of base address
W31	Bit 1 of base address
W30	Bit 2 of base address
W29	Bit 3 of base address
W28	Bit 4 of base address
W27	Bit 5 of base address
W26	Bit 6 of base address
W25	Bit 7 of base address

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Jumper Locations

Jumpers are labeled with an uppercase "W" followed by a number. These jumper labels are silkscreened on the component side of the board. Figure 24 illustrates the locations of the jumpers on the DT2806 board.

You can find the jumpers in two locations on the DT2806. Forty-two wirewrap posts, labeled W1 through W24, are located on the left edge of the component side of the board. This jumper matrix contains all of the interrupt, option, and DMA Request/Acknowledge jumpers. The left-most pins make connection to the PC bus signals. The right-most pins make connection to the iSBX connectors and the board logic. The single pins in this matrix represent connections to the six options available, two for each of the three iSBX connectors.

A second set of jumper pairs, labeled W25 through W32, is located near the bus connector P1. These jumpers are associated with the DT2806 I/O base address selection.

How to Install Jumpers



Make any changes to the jumper configuration before you install the board in your system. If you need to change the jumper settings after the board is installed, however, you must first turn off your Personal Computer, open the main unit, and remove the board. After changing the jumper settings, replace the board and start up again.

All of the jumper posts are in pairs with the exception of the option pins, which are not paired. Standard jumper plugs are used for parallel-pair jumpering. If the posts to be jumpered are not parallel, the jumpers must be wirewrapped.

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Parallel Pairs

Install parallel pair jumpers by inserting a standard jumper plug between the wirewrap posts at the designated location.

Wirewrapping

Install a wirewrap jumper by connecting a wire to each of the wirewrap posts representing the desired jumper-selectable option.

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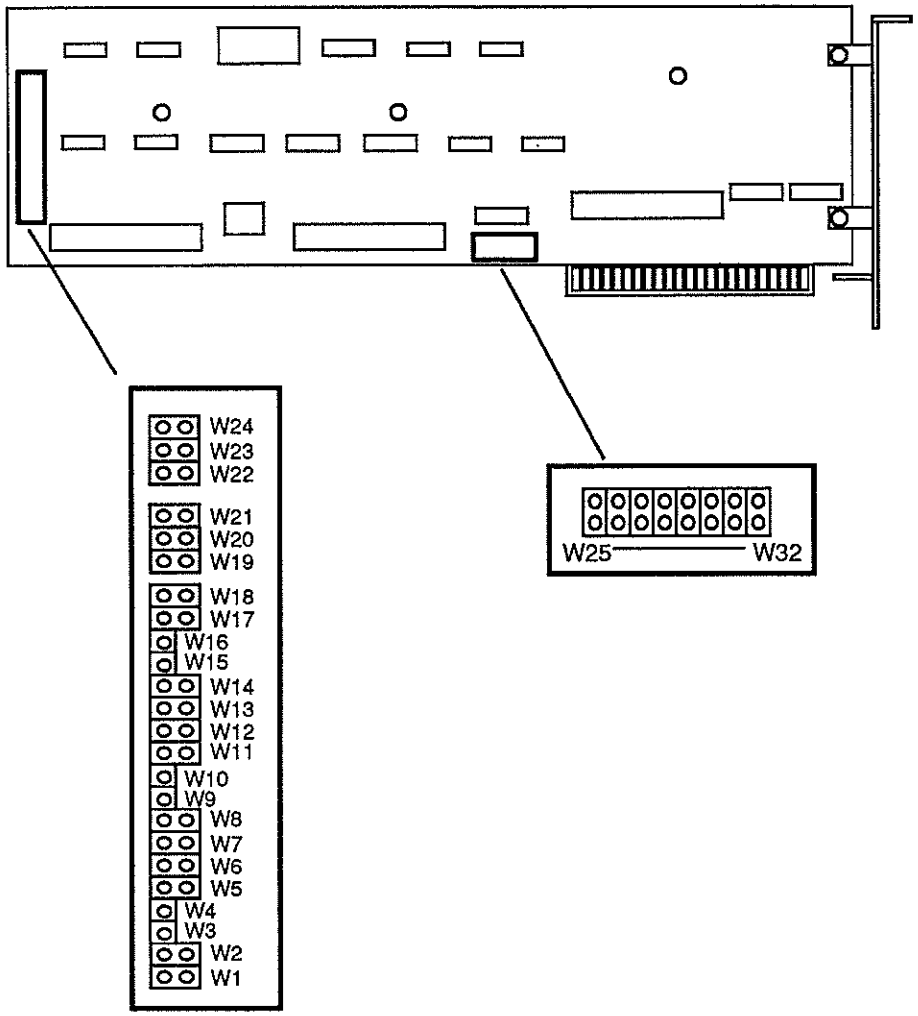


Figure 24: DT2806 Jumper Locations

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I/O Base Address Selection

The **I/O Base Address** is the lowest I/O address used by the DT2806 board. The DT2806 board uses sixty-four (64) 8-bit registers in the I/O address space of the IBM Personal Computer. Five of these registers control the operations of the DT2806, 48 registers are allocated for the iSBX connectors, and 11 registers are not used. See Reference 4, "Register Description," for complete information on these registers.

There are eight jumpers for the selection of the I/O Base Address. These jumpers are labeled **W25**, **W26**, **W27**, **W28**, **W29**, **W30**, **W31**, and **W32**. These jumpers affect the lower eight bits (0 to 7) of the 20-bit address bus of the IBM Personal Computer. Figure 25 illustrates the 20-bit address. Installing a jumper sets a "0" for that bit. Removing a jumper sets a "1."

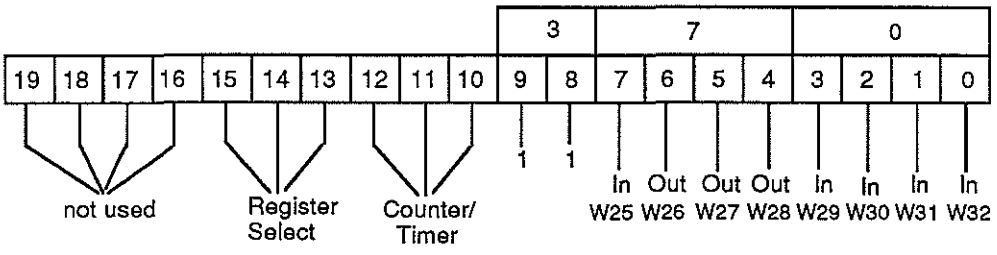


Figure 25: 20-Bit Address

You may change the base address of the DT2806 from the factory configuration as long as the new address does not conflict with the addresses used by other boards in the system, or with any of the reserved addresses on the DT2806.

The DT2806 is shipped to you preconfigured for an I/O base address of 370H.

To Change Jumper Settings:

Install or remove jumper plugs at jumper locations W25 through W32 as necessary to achieve the new setting.

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Interrupt and Option Selection

The interrupt and option jumpers allow the interrupt signals and other user options to pass between the PC bus and the iSBX connectors, and between the counter/timers and the PC bus.

Interrupts

Several jumpers on the DT2806 connect the iSBX connectors and counter/timers with the IBM PC's interrupt lines (3 through 7). The following jumper pairs select an interrupt line for each of the iSBX connectors:

- **W1** and **W2** for J1
- **W7** and **W8** for J2
- **W13** and **W14** for J3



W13 and W14 share access to the same interrupt signal (+IRQ7) as shown in Table 6. Interrupt line 7 will not function properly if both these jumpers are connected at the same time.

The following jumpers select an interrupt line for each of the counter/timers:

- **W22** for counter/timer 2
- **W23** for counter/timer 1
- **W24** for counter/timer 0

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The interrupt priorities relate to the interrupt line numbers as follows. These priorities are arranged in order from highest to lowest:

Interrupt line 3 = priority 1 (highest)
Interrupt line 4 = priority 2
Interrupt line 5 = priority 3
Interrupt line 6 = priority 4
Interrupt line 7 = priority 5 (lowest)

Table 8 lists the possible interrupt line selections for the iSBX connectors and the counter/timers. This table refers to parallel-pair jumper selections only. If your jumper selections are not on parallel posts, refer to Table 6 to determine the appropriate jumper post selections.

Table 8: Interrupt Configuration

Interrupt Priority	Interrupt Request [1]	Jumpers	
		W2	**W24**
1 1	3 to J1 3 to T0	In Out	Out In
		W1	**W23**
2 2	4 to J1 4 to T1	In Out	Out In
		W8	**W22**
3 3	5 to J2 5 to T2	In Out	Out In
		W7	
4	6 to J2	In	
		W13	**W14**
5 5	7 to J3 7 to J3	In Out	Out In

[1] Connect only one jumper to an interrupt request line; i.e. interrupt request 3 may not be connected to both the J1 iSBX connector (J1) and counter/timer 0 (T0)

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The DT2806 board is shipped with no interrupt lines selected.

To Change Jumper Settings:

1. **Install or remove jumper plugs at the jumper locations outlined in Table 8 as necessary to make the appropriate interrupt selection.**

Options

The DT2806 has six options (two for each iSBX connector) that you access via the single post jumpers (W3, W4, W9, W10, W15, and W16). Wirewrap these single post jumpers to any other jumper pins in the W1 to W24 jumper matrix to tailor your DT2806 to your application.

These single post jumpers have the following assignment:

- **W3** and **W4** for J1
- **W9** and **W10** for J2
- **W15** and **W16** for J3.

The DT2806 board is shipped with no option lines selected.

To Change Jumper Settings:

Install a wire between the single-post jumper and the desired jumper post in the W1 to W24 jumper matrix (refer to Table 6) as necessary to make the appropriate option selection.

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DMA Request/Acknowledge Selection

The DT2806 provides access to the DMA channels 1, 2, and 3 at the PC bus via several jumpers. There are three types of DMA jumpers: **DMA Request** and **DMA Acknowledge** jumpers that make connections to the iSBX connectors; and **DMA Acknowledge** jumpers that connect to the data bus transceivers. In order to use the DMA channel, you must install all three jumpers relative to that channel. *You may implement DMA ONLY if the iSBX accessory module has DMA capabilities.*



The DT2806 may not use a DMA channel currently in use by another product in the system. Consult the technical reference manuals for your computer and any other peripherals or board-level options you are using to determine whether other DMA channels are in use. For example, the IBM PC/AT typically uses DMA channel 2 for the system disk drives. The IBM PC/XT typically uses DMA channel 3 for controlling the hard disk.

The DMA Request jumper pairs are **W6** (J1), **W12** (J2), and **W18** (J3). The DMA Acknowledge jumper pairs for the iSBX connectors are **W5** (J1), **W11** (J2), and **W17** (J3). The DMA Acknowledge jumper pairs for the data bus transceivers are **W19**, **W20**, and **W21**.

You must install jumpers for the three jumper pairs relative to a channel. For example, to use DMA channel 2, install jumpers at the jumper pairs **W11**, **W12**, and **W20**. These jumpers select the DMA Request and DMA Acknowledge lines for channel 2.

If your application requires connection from the DMA channel at the PC bus to a non-corresponding iSBX connector (i.e., from the J1 iSBX connector to DMA Request channel 3 on the PC bus), connect the left post of the jumper pair corresponding to the PC bus DMA channel to the right post of the jumper pair corresponding to the iSBX connector (i.e., left pin of W18 to right pin of W6).

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Tables 9 and 10 illustrate the DMA Request and DMA Acknowledge line jumper selections for each channel. These tables refer to parallel-pair jumper selections only. If your jumper selections are not on parallel posts, refer to Table 6 to determine the appropriate jumper post selections.

Table 9: DMA Request Jumper Selections

iSBX Connector	DMA Request Channel	Jumpers		
		W6	W12	W18
J1	1	In	Out	Out
J2	2	Out	In	Out
J3	3	Out	Out	In

Table 10: DMA Acknowledge Jumper Selections

iSBX Connector	DMA Request Channel	Jumpers					
		W5	W11	W17	W19	W20	W21
J1	1	In	Out	Out	In	Out	Out
J2	2	Out	In	Out	Out	In	Out
J3	3	Out	Out	In	Out	Out	In

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Reference 3

Connectors and Accessories

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*Reference 3, "**Connectors and Accessories**," describes the connectors on the DT2806 boards and lists their pinouts, and also discusses the compatible Data Translation screw terminal panels.*

This reference chapter is organized as follows:

- *Connectors*
- *DT757 Screw Terminal Panel*

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Connectors

The DT2806 board has five connectors labeled P1, J1, J2, J3, and J4 as shown in Figure 26.

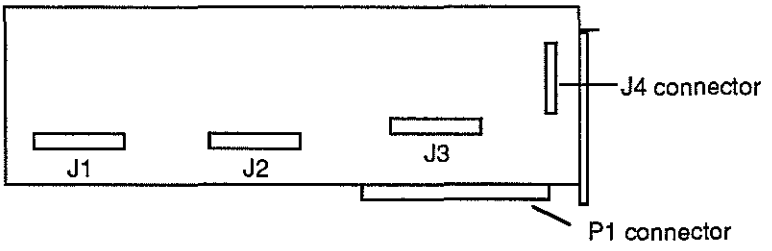


Figure 26: DT2806 Board Connectors

P1 , located on the bottom of the board, connects the DT2806 to the IBM Personal Computer backplane. This connection is made automatically when the board is installed.

J1, **J2**, and **J3**, located on the surface of the DT2806, are iSBX connectors used for accessory module attachment.

J4, located at the rear of the board, interfaces external devices with the DT2806.

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P1: IBM Personal Computer Bus Connector

The IBM Personal Computer XT/AT interfaces with the DT2806 board via the connector **P1** shown in Figure 27. The IBM Personal Computer bus connections to the DT2806 board are made automatically when the board is installed.

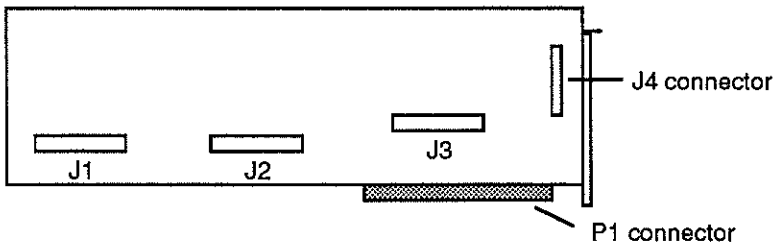


Figure 27: DT2806 Board P1 Connector

P1 is a 62-pin edge connector that carries all the data and control signals between the host computer and the DT2806. Table 11 lists the pin assignments and signal descriptions for P1.

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Table 11: P1 Pin Assignments

IBM PC Pin Label	Mnemonic	Signal Description
A1	RESERVED	Not used
A2	+D7	Data bit 7 (MSB)
A3	+D6	Data bit 6
A4	+D5	Data bit 5
A5	+D4	Data bit 4
A6	+D3	Data bit 3
A7	+D2	Data bit 2
A8	+D1	Data bit 1
A9	+D0	Data bit 0 (LSB)
A10	+I/O CH RDY	I/O channel ready
A11	+AEN	Address enable
A12	RESERVED	Not used
A13	RESERVED	Not used
A14	RESERVED	Not used
A15	RESERVED	Not used
A16	+A15	Address bit 15
A17	+A14	Address bit 14
A18	+A13	Address bit 13
A19	+A12	Address bit 12
A20	+A11	Address bit 11
A21	+A10	Address bit 10
A22	+A9	Address bit 9
A23	+A8	Address bit 8
A24	+A7	Address bit 7
A25	+A6	Address bit 6
A26	+A5	Address bit 5
A27	+A4	Address bit 4
A28	+A3	Address bit 3
A29	+A2	Address bit 2
A30	+A1	Address bit 1
A31	+A0	Address bit 0

(continued)

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Table 11: P1 Pin Assignments (continued)

IBM PC Pin Label	Mnemonic	Signal Description
B1	GND	Ground
B2	+RESET DRV	Reset driver
B3	+5VDC	+5 Volt power
B4	RESERVED	Not used
B5	RESERVED	Not used
B6	+DRQ2	DMA request 2
B7	–12VDC	–12 Volt power
B8	RESERVED	Not used
B9	+12VDC	+12 Volt power
B10	GND	Ground
B11	RESERVED	Not used
B12	RESERVED	Not used
B13	–IOW	I/O Write command
B14	–IOR	I/O Read command
B15	–DACK3	DMA acknowledge 3
B16	+DRQ3	DMA request 3
B17	–DACK1	DMA acknowledge 1
B18	+DRQ1	DMA request 1
B19	RESERVED	Not used
B20	RESERVED	Not used
B21	+IRQ7	Interrupt request 7
B22	+IRQ6	Interrupt request 6
B23	+IRQ5	Interrupt request 5
B24	+IRQ4	Interrupt request 4
B25	+IRQ3	Interrupt request 3
B26	+IRQ2	Interrupt request 2
B27	+T/C	Terminal count
B28	RESERVED	Not used
B29	+5VDC	+5 Volt power
B30	RESERVED	Not used
B31	GND	Ground

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J1, J2, and J3: iSBX Connectors

Connectors **J1**, **J2**, and **J3** are 36-pin iSBX connectors on the DT2806, that handle the parallel I/O communication between the iSBX modules and the DT2806 host. These connectors are shown in Figure 28.

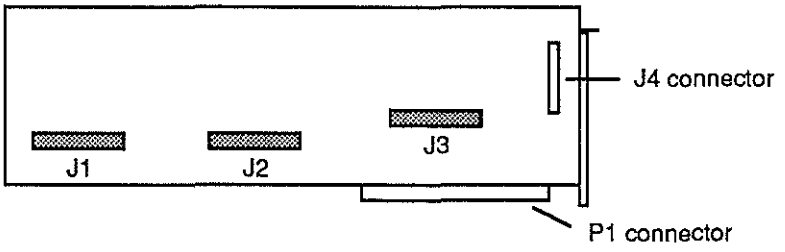


Figure 28: DT2806 Board iSBX Connectors

Table 12 lists the iSBX bus signals brought out to the iSBX connectors.

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Table 12: iSBX Bus Signals

Description	Mnemonic	Pin	Pin	Mnemonic	Description
+12 Volts	+12V	1	2	–12V	–12 Volts
Analog ground	AGND	3	4	+5V	+5 Volts
Reset	RESETH	5	6	CLK	iSBX module clock
Address 2	AB2	7	8	MPSTL	Module present
Address 1	AB1	9	10	RESRVD	Not used
Address 0	AB0	11	12	INTR1H	Interrupt 1
IO Write command	WRITEL	13	14	INTR0H	Interrupt 0
IO Read command	READL	15	16	WAITL	iSBX module wait
Digital ground	DGND	17	18	+5V	+5 Volts
Data bit 7	DB7	19	20	CS1L	Chip Select 1
Data bit 6	DB6	21	22	CS0L	Chip Select 0
Data bit 5	DB5	23	24	RESRVD	Not used
Data bit 4	DB4	25	26	TDMA	Terminate DMA
Data bit 3	DB3	27	28	OPT1	Option 1
Data bit 2	DB2	29	30	OPT0	Option 0
Data bit 1	DB1	31	32	DACKL	DMA acknowledge
Data bit 0	DB0	33	34	DRQTH	DMA request
Digital ground	DGND	35	36	+5V	+5 Volts

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J4: External Device Connector

All user connections to the counter/timers on the DT2806 board interface with the board via connector **J4** shown in Figure 29.

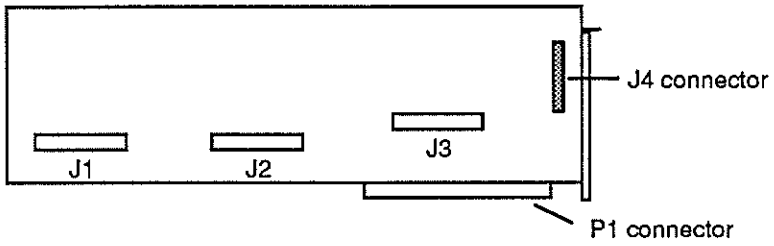


Figure 29: DT2806 Board J4 Connector

J4 is a 20-pin 3M keyed connector. Table 13 lists the pin assignment for J4.

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Table 13: J4 Pin Assignments

Pin	Signal Description
1	Digital ground
2	Clock/Timer 0 clock input
3	Digital ground
4	Clock/Timer 1 clock input
5	Digital ground
6	Clock/Timer 2 clock input
7	Digital ground
8	Clock/Timer 0 gate input
9	Digital ground
10	Clock/Timer 1 gate input
11	Digital ground
12	Clock/Timer 2 gate input
13	Digital ground
14	Clock/Timer 2 output
15	Digital ground
16	Clock/Timer 1 output
17	Digital ground
18	Clock/Timer 0 output
19	Digital ground
20	Digital ground



All external clock signals are inverted by the DT2806, and all external enables clock on the rising edge (relative to the J4 connector). When an internal enable is used, or if the output of one or more counter/timers are jumpered to interrupts, do NOT use the corresponding external enable connections on the J4 connector pins.

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DT757 Screw Terminal Panel

The DT757 is a universal screw terminal panel which provides convenient connection points to the counter/timers on the DT2806 board. The panel comes with an integral cable assembly terminating in a 20-pin 3M-style header connector.

Pin Functions

Each terminal screw on the DT757 screw terminal panel connects to a pin on the J4 connector of the DT2806. The odd-numbered pin functions are brought out to TB2. The even-numbered pin functions to TB1. The terminal screws are attached to two barrier strips, **TB1** (bottom) and **TB2** (top), on the panel. Table 14 shows the assignments of the terminal screws to the pins on the DT2806 J4 connector.

Table 14: DT757 Terminal Screw Assignments

Description	TB1	TB2	Description
Ctr/Tmr 0 clock input	1	1	Digital ground
Ctr/Tmr 1 clock input	2	2	Digital ground
Ctr/Tmr 2 clock input	3	3	Digital ground
Ctr/Tmr 0 gate input	4	4	Digital ground
Ctr/Tmr 1 gate input	5	5	Digital ground
Ctr/Tmr 2 gate input	6	6	Digital ground
Ctr/Tmr 2 output	7	7	Digital ground
Ctr/Tmr 1 output	8	8	Digital ground
Ctr/Tmr 0 output	9	9	Digital ground
Digital ground	10	10	Digital ground

To use any of the counter/timers with the DT757, connect the high side of the input to the appropriate terminal on TB1. Connect the low side of the input to any available terminal on TB2.

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Screw Terminal Panel Specifications

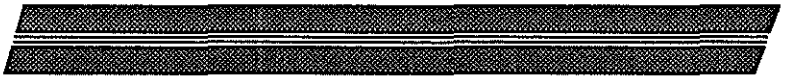
Typical @ +25°C and rated voltage unless otherwise specified.

DT757

Board size	4.5"H x 3.0"W x 1.3"D (11.4 cm x 7.6 cm x 3.3 cm)
Weight	3 ounces (85 g)
Screw Terminal	20 barrier strip connections: two sections having 10 connections each
Barrier strip screw	
Size	6-32 screws
Material	high tensile copper alloy
Barrier strip material	BASF 6.6 polyamide (Ultramid A3K)
Wire size	28 to 14 AWG
Connector	20-pin, 3M No. 3493-2003 male header
Cable assembly (included)	20-conductor flat ribbon cable, 3.3 feet (1 meter) No. 3493 connector on the DT2806 board end and No. 3421 connector on the DT757 end
Mounting	Four 1/4" mounting holes with center 1/4" from each corner
Temperature range	–25 to +85°C (–13 to +185°F)
Relative humidity	To 95% non-condensing

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Reference 4



Register Description

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*Reference 4, "**Register Description**," describes the DT2806 registers, bit functions, and addresses.*

This reference chapter is organized as follows:

- *Register Summary*
- *Counter/Timer Mode Register*
- *Counter/Timer 0 Register*
- *Counter/Timer 1 Register*
- *Counter/Timer 2 Register*
- *FPLA Configuration Register*

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Register Summary

Sixty-four register addresses are mapped on the DT2806 board. Five of these registers control the operations of the DT2806 counter/timers. Forty-eight of these registers are associated with the three iSBX connectors. Eleven of these registers are not used.

Table 15 lists the DT2806 registers controlling the counter/timers and their functions and addresses. These registers are described in detail in the following sections.

Table 15: DT2806 Counter/Timer Registers

Register	Address	Function	Access
Counter/Timer Mode [1]	I/O Base + C00	Controls the operational mode of each of the counter/timers	Write
Counter/Timer 0	I/O Base + 000	Counter/Timer 0	R/W
Counter/Timer 1	I/O Base + 400	Counter/Timer 1	R/W
Counter/Timer 2	I/O Base + 800	Counter/Timer 2	R/W
FPLA Configuration	I/O Base + 1400	Sets the connection configuration from one counter/timer to another	R/W

[1] This register must be programmed with a configuration for each counter/timer, otherwise the counter/timer operation is undefined.

A complete register summary is found in Table 16. Only the addresses for the options included in any attached modules are valid. All other addresses are ignored when written to, but will return random (invalid) information when read back.

The iSBX module physically occupying the J1 connector is addressed as iSBX A; a module in the J2 connector is iSBX B and a module in the J3 connector is iSBX C.

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Table 16: DT2806 Register Summary

Register	Address	Access
Counter/Timer 0	Base + 000	Read/Write
Counter/Timer 1	Base + 400	Read/Write
Counter/Timer 2	Base + 800	Read/Write
Counter/Timer Mode	Base + C00	Write Only
Reserved	Base + 1000	not used
FPLA Configuration	Base + 1400	Read/Write
Reserved	Base + 1800	not used
Reserved	Base + 1C00	not used
Reserved	Base + 2000	not used
Reserved	Base + 2400	not used
Reserved	Base + 2800	not used
Reserved	Base + 2C00	not used
Reserved	Base + 3000	not used
Reserved	Base + 3400	not used
Reserved	Base + 3800	not used
Reserved	Base + 3C00	not used
iSBX A CS0 Register 0	Base + 4000	Read/Write
iSBX A CS0 Register 1	Base + 4400	Read/Write
iSBX A CS0 Register 2	Base + 4800	Read/Write
iSBX A CS0 Register 3	Base + 4C00	Read/Write
iSBX A CS0 Register 4	Base + 5000	Read/Write
iSBX A CS0 Register 5	Base + 5400	Read/Write
iSBX A CS0 Register 6	Base + 5800	Read/Write
iSBX A CS0 Register 7	Base + 5C00	Read/Write
iSBX A CS1 Register 0	Base + 6000	Read/Write
iSBX A CS1 Register 1	Base + 6400	Read/Write
iSBX A CS1 Register 2	Base + 6800	Read/Write
iSBX A CS1 Register 3	Base + 6C00	Read/Write
iSBX A CS1 Register 4	Base + 7000	Read/Write
iSBX A CS1 Register 5	Base + 7400	Read/Write
iSBX A CS1 Register 6	Base + 7800	Read/Write
iSBX A CS1 Register 7	Base + 7C00	Read/Write

(continued)

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Table 16: DT2806 Register Summary (continued)

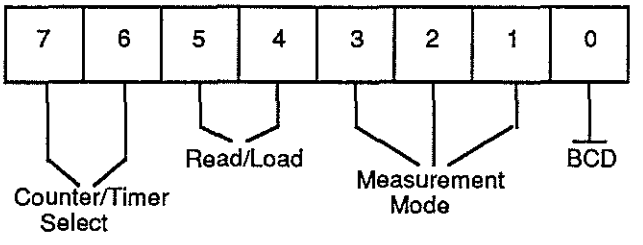
Register	Address	Access
iSBX B CS0 Register 0	Base + 8000	Read/Write
iSBX B CS0 Register 1	Base + 8400	Read/Write
iSBX B CS0 Register 2	Base + 8800	Read/Write
iSBX B CS0 Register 3	Base + 8C00	Read/Write
iSBX B CS0 Register 4	Base + 9000	Read/Write
iSBX B CS0 Register 5	Base + 9400	Read/Write
iSBX B CS0 Register 6	Base + 9800	Read/Write
iSBX B CS0 Register 7	Base + 9C00	Read/Write
iSBX B CS1 Register 0	Base + A000	Read/Write
iSBX B CS1 Register 1	Base + A400	Read/Write
iSBX B CS1 Register 2	Base + A800	Read/Write
iSBX B CS1 Register 3	Base + AC00	Read/Write
iSBX B CS1 Register 4	Base + B000	Read/Write
iSBX B CS1 Register 5	Base + B400	Read/Write
iSBX B CS1 Register 6	Base + B800	Read/Write
iSBX B CS1 Register 7	Base + BC00	Read/Write
iSBX C CS0 Register 0	Base + C000	Read/Write
iSBX C CS0 Register 1	Base + C400	Read/Write
iSBX C CS0 Reigster 2	Base + C800	Read/Write
iSBX C CS0 Register 3	Base + CC00	Read/Write
iSBX C CS0 Register 4	Base + D000	Read/Write
iSBX C CS0 Register 5	Base + D400	Read/Write
iSBX C CS0 Register 6	Base + D800	Read/Write
iSBX C CS0 Register 7	Base + DC00	Read/Write
iSBX C CS1 Register 0	Base + E000	Read/Write
iSBX C CS1 Register 1	Base + E400	Read/Write
iSBX C CS1 Register 2	Base + E800	Read/Write
iSBX C CS1 Register 3	Base + EC00	Read/Write
iSBX C CS1 Register 4	Base + F000	Read/Write
iSBX C CS1 Register 5	Base + F400	Read/Write
iSBX C CS1 Register 6	Base + F800	Read/Write
iSBX C CS1 Register 7	Base + FC00	Read/Write

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Counter/Timer Mode Register

Address: I/O Base + C00 ***Access: Write Only***

The Counter/Timer Mode register is a write-only register that contains the mode word used to specify the operating modes of the individual counter/timers. You must write a mode (control) word to the Counter/Timer Mode register for each counter/timer in order to specify the loading, sequence, operation mode, and selection of binary or BCD counting. Without this initialization, the operation of the counter/timer is undefined.



Bits 7 and 6: Counter/Timer Select

Selects the counter/timer being programmed. Table 17 illustrates how these bits select each counter/timer.

Table 17: Counter/Timer Selection

Description	Bit 7	Bit 6
Counter/Timer 0	0	0
Counter/Timer 1	0	1
Counter/Timer 2	1	0

READ: Irrelevant

WRITE: Refer to Table 17

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Bits 5 and 4: Read/Load

Indicates the number and order of the bytes loaded or read to the counter/timer. Table 18 illustrates how these bits are used to select the bytes. Refer to Chapter 3, "Using the DT2806," for complete information on reading the counter/timer.

Table 18: Read/Load Bit Selection

Description	Bit 5	Bit 4
Counter latching operation	0	0
Read/Load most significant byte only	0	1
Read/Load least significant byte only	1	0
Read/Load least significant byte first followed by the most significant byte	1	1

READ: Irrelevant

WRITE: Refer to Table 18

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Bits 3 through 1: Measurement Mode

Selects one of the six measurement modes in which the counter/timer is used. Table 19 illustrates the measurement mode selections. Refer to Chapter 3, "Using the DT2806," for a complete description of each of these modes.

Table 19: Measurement Mode Selection

Mode	Bit 3	Bit 2	Bit 1
Mode 0: Interrupt on Terminal Count	0	0	0
Mode 1: Programmable One-Shot	0	0	1
Mode 2: Rate Generator	0	1	0
Mode 3: Square Wave Generator	0	1	1
Mode 4: Software-Triggered Strobe	1	0	0
Mode 5: Hardware-Triggered Strobe	1	0	1

READ: Irrelevant

WRITE: Refer to Table 19

Bit 0: BCD

Indicates whether the counter/timer will count binary or BCD. When this bit is clear, the counter/timer counts in binary. If this bit is set, the counter/timer counts up to four decades in BCD.

READ: Irrelevant

WRITE: 0 = binary
1 = BCD

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Counter/Timer 0 Register

Address: I/O Base + 000 ***Access: Read/Write***

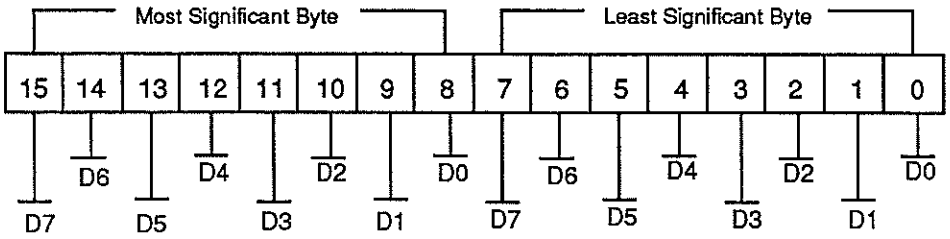
Counter/Timer 0 consists of a presettable down-counter with read/write access, which you may load with a full count of 0000. Writing the count value (one or two bytes, depending on the mode selected by the Read/Load bits in the Counter/Timer Mode register) loads Counter/Timer 0, and this is followed by a falling edge of the clock, then a rising edge. When counting from 0000, the counter/timer decrements in hexadecimal to FFFF. When it recycles back to 0000, the terminal count has been reached.

The contents of Counter/Timer 0 are indeterminate on power-up. Reading the contents of Counter/Timer 0 after it is loaded returns either the count placed in it (if it has not yet begun counting) or whatever value it has decremented to at the time it is read. Reading it prior to the second edge will yield invalid data. You may access the least or most significant byte of the counter/timer independently or in sequence.

Counter/Timer 0 can operate in either binary or BCD. Counter/Timer 0 has a clock and gate input and an output. The mode selected in the Counter/Timer Mode register (bits 3 – 1: Measurement Mode) defines the output operation. Loading all zeros into the counter/timer results in the maximum count (2^{16} in binary, 10^4 in BCD).

You can use Counter/Timer 0 as a fully independent unit. The FPLA can configure it for control either through hardware (J4 connection) or software. Software control involves an input connection from Counter/Timer 1. Hardware control involves jumpering the output to a system interrupt line. Refer to the Counter/Timer operating configurations discussed in Chapter 3, "Using the DT2806," for complete information on the mode configurations.

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Bits 15 through 8: Most Significant Byte

Most significant byte of the counter/timer value: the Read/Load bits of the Counter/Timer Mode register determine when you read or write this byte.

You may read each byte of this register independently or in sequence. You may also read this byte while counting is in progress. If two bytes are programmed into the counter/timer, then you must read both bytes before you can write to the counter/timer again.

READ: Current Counter/Timer value
(each byte is read separately)

WRITE: Counter/Timer 0 count value
(each byte is written separately)

Bits 7 through 0: Least Significant Byte

Least significant byte of the counter/timer value: the Read/Load bits of the Counter/Timer Mode register determine when you read or write this byte.

READ: Current Counter/Timer value
(each byte is read separately)

WRITE: Counter/Timer 0 count value
(each byte is written separately)

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Counter/Timer 1 Register

Address: I/O Base + 400 ***Access: Read/Write***

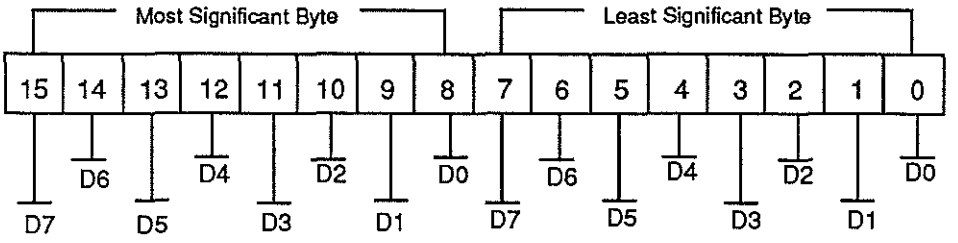
Counter/Timer 1 consists of a presettable down-counter with read/write access, which you may load with a full count of 0000. Writing the count value (one or two bytes, depending on the mode selected by the Read/Load bits in the Counter/Timer Mode register) loads Counter/Timer 1, and this is followed by a falling edge of the clock, then a rising edge. When counting from 0000, the counter/timer decrements in hexadecimal to FFFF. When it recycles back to 0000, the terminal count has been reached.

The contents of Counter/Timer 1 are indeterminate on power-up. Reading the contents of Counter/Timer 1 after it is loaded returns either the count placed in it (if it has not yet begun counting) or whatever value it has decremented to at the time it is read. Reading it prior to the second edge will yield invalid data. You may access the least or most significant byte of the counter/timer independently or in sequence.

Counter/Timer 1 can operate in either binary or BCD. Counter/Timer 1 has a clock and gate input and an output. The mode selected in the Counter/Timer Mode register defines the output operation. Loading all zeros into the counter/timer results in the maximum count (2^{16} in binary, 10^4 in BCD).

You can use Counter/Timer 1 as a fully independent unit. The FPLA can configure it for control either through hardware (J4 connection) or software. A software interconnection option includes input connection from Counter/Timer 2 and output connection to Counter/Timer 0. Refer to the Counter/Timer operating configurations discussed in Chapter 3, "Using the DT2806," for complete information on the mode configurations.

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Bits 15 through 8: Most Significant Byte

Most significant byte of the counter/timer value: the Read/Load bits of the Counter/Timer Mode register determine when you read or write to this bit.

You may access each byte of this register independently or in sequence. You can also read this counter/timer value while counting is in progress. If two bytes are programmed into the counter/timer, then you must read both bytes before you can write to the counter/timer again.

READ: Current Counter/Timer value
(each byte is read separately)

WRITE: Counter/Timer 1 count value
(each byte is written separately)

Bits 7 through 0: Least Significant Byte

Least significant byte of the counter/timer value: the Read/Load bits of the Counter/Timer Mode register determine when you read or write to this bit.

READ: Current Counter/Timer value
(each byte is read separately)

WRITE: Counter/Timer 1 count value
(each byte is written separately)

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Counter/Timer 2 Register

Address: I/O Base + 800 ***Access: Read/Write***

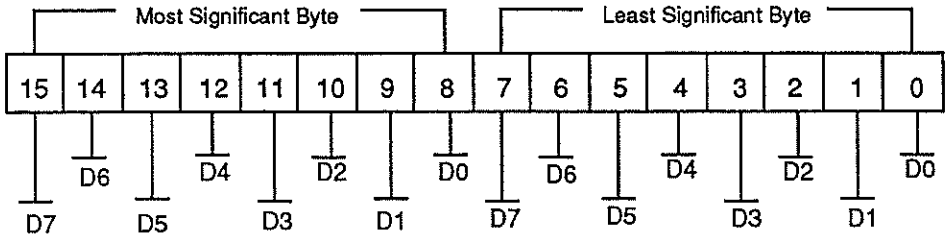
Counter/Timer 2 consists of a presettable down-counter with read/write access, which you may load with a full count of 0000. Writing the count value (one or two bytes, depending on the mode selected by the Read/Load bits in the Counter/Timer Mode register) loads Counter/Timer 2, and this is followed by a falling edge of the clock, then a rising edge. When counting from 0000, the counter/timer decrements in hexadecimal to FFFF. When it recycles back to 0000, the terminal count has been reached.

The contents of Counter/Timer 2 are indeterminate on power-up. Reading the contents of Counter/Timer 2 after it is loaded returns either the count placed in it (if it has not yet begun counting) or whatever value it has decremented to at the time it is read. Reading it prior to the second edge will yield invalid data. You may access the least or most significant byte of the counter/timer independently or in sequence.

Counter/Timer 2 can operate in either binary or BCD. Counter/Timer 2 has a clock and gate input and an output. The mode selected in the Counter/Timer Mode register defines the output operation. Loading all zeros into the counter/timer results in the maximum count (2^{16} in binary, 10^4 in BCD).

You can use Counter/Timer 2 as a fully independent unit. The FPLA can configure it for control either through hardware (J4 connection) or software. A software interconnection option includes output connection to the input of Counter/Timers 0 and 1. Refer to the Counter/Timer operating configurations discussed in Chapter 3, "Using the DT2806," for complete information on the mode configurations.

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Bits 15 through 8: Most Significant Byte

Most significant byte of the counter/timer value: the Read/Load bits of the Counter/Timer Mode register determine when you read or write this byte.

You may read each byte of this register independently or in sequence. You may also read this byte while counting is in progress. If two bytes are programmed into the counter/timer, then you must read both bytes before you can write to the counter/timer again.

READ: Current Counter/Timer value
(each byte is read separately)

WRITE: Counter/Timer 2 count value
(each byte is written separately)

Bits 7 through 0: Least Significant Byte

Least significant byte of the counter/timer value: the Read/Load bits of the Counter/Timer Mode register determine when you read or write this byte.

READ: Current Counter/Timer value
(each byte is read separately)

WRITE: Counter/Timer 2 count value
(each byte is written separately)

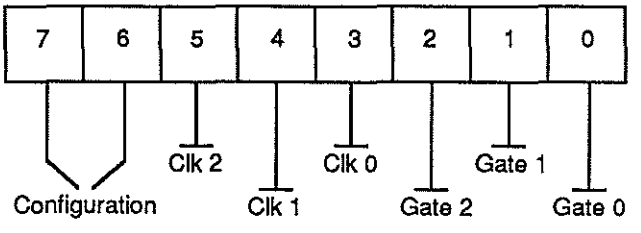
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FPLA Configuration Register

Address: I/O Base + 1400 ***Access: Read/Write***

The FPLA Configuration register defines the functions for each counter/timer. The four basic functions of the FPLA Configuration register are:

- **Internal or external clocking.** Internal clocking uses the onboard 2MHz clock. External clocking uses an external clock signal input via the J4 connector.
- **Software-enabled gating (internal).** Initiates a count command to the counter/timer when the appropriate gate bit is written to in this register.
- **Hardware-enabled gating (external).** Initiates a count command to the counter/timer when a TTL low signal is received on the appropriate J4 pin.
- **FPLA configuration.** Selects one of four possible configurations: Standard Configuration, Delay Configuration, Frequency Measurement Configuration, and Toggle Configuration.



Once the FPLA Configuration register is initialized and the enable (internal or external) sets the gate bit, the count begins decrementing on the next clock pulse.

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Bits 7 and 6: Configuration

Selects one of four FPLA configurations. Table 20 illustrates how these bits select the four configurations.

Table 20: FPLA Configuration Selection

Configuration	Bit 7	Bit 6
Standard Configuration	0	0
Delay Configuration	0	1
Frequency Measurement	1	0
Toggle Configuration	1	1

READ: Currently selected configuration

WRITE: Refer to Table 20

Bit 5: Clk 2

Enables an internal or external clocking input for Counter/Timer 2. When this bit is clear, the 2MHz internal clock provides the clock input of Counter/Timer 2. When this bit is set, an external clock connected to J4 provides the clock input to Counter/Timer 2. The rising edge of the external clock decrements the counter/timer. This is true for all configurations except the Toggle Configuration which loads the counter/timer registers. In the Toggle Configuration, if this bit is "1," the clock input of Counter/Timer 2 is "1," and if it is "0," the clock input of Counter/Timer 2 is "0."

READ: Currently selected clocking input for Counter/Timer 2

WRITE: 0 = internal clocking input
1 = external clocking input

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Bit 4: Clk 1

Enables an internal or external clocking input for Counter/Timer 1. When this bit is clear, the 2MHz internal clock provides the clock input of Counter/Timer 1. When this bit is set, an external clock connected to J4 provides the clock input to Counter/Timer 1. The rising edge of the external clock decrements the counter/timer. This is true for all configurations except the Toggle Configuration which loads the counter/timer registers. In the Toggle Configuration, if this bit is "1," the clock input of Counter/Timer 1 is "1," and if it is "0," the clock input of Counter/Timer 1 is "0."

READ: Currently selected clocking input for Counter/Timer 1

WRITE: 0 = internal clocking input
1 = external clocking input

Bit 3: Clk 0

Enables an internal or external clocking input for Counter/Timer 0. When this bit is clear, the 2MHz internal clock provides the clock input of Counter/Timer 0. When this bit is set, an external clock connected to J4 provides the clock input to Counter/Timer 0. The rising edge of the external clock decrements the counter/timer. This is true for all configurations except the Toggle Configuration which is used to load the counter/timer registers. In the Toggle Configuration, if this bit is "1," the clock input of Counter/Timer 0 is "1," and if it is "0," the clock input of Counter/Timer 0 is "0."

READ: Currently selected clocking input for Counter/Timer 0

WRITE: 0 = internal clocking input
1 = external clocking input

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The J4 connector gate pins retain access to gate 0, gate 1, and gate 2, whether they are enabled internally or not.

Bit 2: Gate 2

Determines whether Counter/Timer 2 is enabled via software or hardware. When this bit is clear software-enabled gating is in effect, and writing a count command to Counter/Timer 2 initiates counting. When this bit is set hardware-enabled gating is in effect, and TTL low signal on pin 12 of J4 initiates Counter/Timer 2. The operational mode selected (bits 3, 2, and 1 in the Counter/Timer Mode register), determines whether you can access this gate. Each of the FPLA configurations (bits 7 and 6 of this register) affects this bit differently as shown below:

- Standard Configuration: you control this gate
- Delay Configuration: you control this gate
- Frequency Measurement: you control this gate
- Toggle Configuration: this gate is ignored

READ: Currently selected gate for Counter/Timer 2

WRITE: 0 = software-enabled gating
1 = hardware-enabled gating

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Bit 1: Gate 1

Determines whether Counter/Timer 1 is enabled via software or hardware. When this bit is clear software-enabled gating is in effect, and writing a count command to Counter/Timer 1 initiates counting. When this bit is set hardware-enabled gating is in effect, and TTL low signal on pin 10 of J4 initiates Counter/Timer 1. The operational mode selected (bits 3, 2, and 1 in the Counter/Timer Mode register), determines whether you can access this gate. Each of the FPLA configurations (bits 7 and 6 of this register) affects this bit differently as shown below:

- Standard Configuration: you control this gate
- Delay Configuration: the output of Counter/Timer 2 enables this gate
- Frequency Measurement: you control this gate
- Toggle Configuration: this gate is ignored

READ: Currently selected gate for Counter/Timer 1

WRITE: 0 = software-enabled gating
1 = hardware-enabled gating

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Bit 0: Gate 0

Determines whether Counter/Timer 0 is enabled via software or hardware. When this bit is clear software-enabled gating is in effect, and writing a count command to Counter/Timer 0 initiates counting. When this bit is set hardware-enabled gating is in effect, and TTL low signal on pin 8 of J4 initiates Counter/Timer 0. The operational mode selected (bits 3, 2, and 1 in the Counter/Timer Mode register), determines whether you can access this gate. Each of the FPLA configurations (bits 7 and 6 of this register) affects this bit differently as shown below:

- Standard Configuration: you control this gate
- Delay Configuration: the output of Counter/Timer 2 enables this gate
- Frequency Measurement: the output of Counter/Timer 1 enables this gate
- Toggle Configuration: this gate is ignored

READ: Currently selected gate to Counter/Timer 0

WRITE: 0 = software-enabled gating
1 = hardware-enabled gating

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Reference 5



Specifications

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*Reference 5, "**Specifications,**" lists the technical details for the DT2806 board.*

This reference chapter is organized as follows:

- *Counter/Timer Subsystem*
- *Clock*
- *Enable*
- *iSBX Bus*
- *PC Bus Interface*
- *Power Requirements*
- *Physical/Environmental*

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The DT2806 specifications are typical @ +25°C and rated voltage unless otherwise specified.

Counter/Timer Subsystem

Number of counter/timers	3
Control lines	
Input Enables	ENA0, ENA1, ENA2
Input Clocks	CLK0, CLK1, CLK2
Output Lines	OUT0, OUT1, OUT2
Control line capacity	1 LSTTL load
Drive capability of output lines	3 LSTTL loads, 1 TTL
Maximum count per counter/timer	16 bits
Functions	Standard decrement counter 32-bit delay counter Frequency/pulse comparator
Fanout	3 LSTTL

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Clock

Internal clock frequency	2MHz ± 0.1% (maximum)
Logic family	TTL
External clock frequency range	0 to 2MHz
Minimum pulse width	
clock high	230ns
clock low	150ns
Input type	Negative edge sensitive; clocks on rising edge
Logic high input voltage	2.0V minimum
Logic low input voltage	0.8V maximum
Logic low input current	± 10µA

Enable

Minimum pulse width	
enable high	150ns
enable low	100ns
Input type	Clocks on externally falling edge
Logic high input voltage	2.0V minimum
Logic low input voltage	0.8V maximum
Logic low input current	–150µA maximum
Logic high input current	+50µA maximum

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iSBX Bus

iSBX bus compatibility	compatible with iSBX bus standards
Number of iSBX connectors	3
Number of DMA lines	3, jumper-configurable to the following:
DMA request lines	+DRQ1, +DRQ2, +DRQ3
DMA acknowledge lines	–DACK1, –DACK2, –DACK3
Number of interrupts	2 per connector, jumper-configurable
Interrupt lines	INTR0H, INTR1H

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PC Bus Interface

Compatible bus	IBM Personal Computer XT/AT
Interface type	I/O mapped, 16-bits decoded
Bus loading	1 LSTTL load
Number of I/O locations occupied	64, (1 of 10-bit decode)
Base address	370H, jumper-configurable in increments of 1 hex
Bus interrupt lines	6, jumper-configurable to the following: +IRQ3, +IRQ4, +IRQ5, +IRQ6, +IRQ7
Data path	16 bits
Bus DMA lines	3, jumper-configurable to the following:
DMA request lines	ADRQTH, BDRQTH, CDRQTH
DMA acknowledge lines	–DACK1, –DACK2, –DACK3
Input data lines	D0, D1, D2, D3, D4, D5, D6, D7
Input address lines	A0 through A15
Input control lines	IOR, IOW, DRQ1–3, DACK1–3, IRQ3–7, T/C, IOCHRDY, RESET
Logic Sense/Level (IBM PC)	
Read/Write	Negative edge sensitive
Enable	Negative level sensitive
Reset	Positive level sensitive
Data	Positive level logic
Address	Positive level logic
Logic family	LSTTL
Logic load	presents 3 LSTTL loads
Data throughput	1MHz
Threshold Voltages	
Logic high input voltage	2.0V minimum
Logic low input voltage	0.8V maximum
Logic high input current	0.1mA @ 5.5V maximum 20 mA @ 2.0V (current at threshold voltage)
Logic low input current	–0.4mA maximum

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Power Requirements

DT2806 alone: +5V (only) ±10%, @ 100mA max, 86mA typ

DT2806 with accessory iSBX modules

+5V	± 10%, @ 3.0A max
+12V	± 5%, @ 1.5A max
–12V	± 10%, @ 250mA max

Table 21: Required Voltage/Amperage per Attached Module

Board Type	Voltage Draw		
	+5V	+12V	–12V
DT2806	100mA	Not used	Not used
DTX350	320mA	Not used	Not used
DTX311	45mA	30mA	50mA
DTX311EX	5mA	30mA	12mA
DTX328	120mA	50mA	60mA
DTX328 [1]	120mA	220mA	60mA
DT709-Y	250mA	30mA	30mA
DT756-Y	250mA	30mA	30mA

[1] DTX328 in current loop mode. The IBM Personal Computer XT/AT power supply does not support the use of three DTX328s all running in current loop mode. Current draw can cause the power supply protection circuit to shut off. Three of these modules can be running in voltage out mode ONLY.

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Physical/Environmental

Board size	13.5"H x 4.5"W x 0.56"D (34.3 cm x 11.4 cm x 1.4 cm)



0.56"D (1.4cm) board alone;
1.13"D (2.9cm) with iSBX modules installed

Weight	14.5 ounces (411 g)
Operating temperature range	0 to +70°C (+32 to +158 °F)
Storage temperature range	–25 to +85 °C (–13 to +185 °F)
Relative humidity	0 to 90%, non-condensing

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Appendix A



Example Programs

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This appendix contains a listing of each of the BASIC example programs provided on the diskette shipped with your DT2806. These example programs cover the following operations:

- *Programmable Delay*
- *Frequency Measurement*
- *Event Counter*
- *Programmable One-Shot*
- *Square Wave Generator*
- *Software-Triggered Strobe*
- *Hardware-Triggered Strobe*

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Programmable Delay

```
'
'                A Programmable Delay
'
' Using the 2 MHz internal clocks, a programmable delay is produced
' across the Counter/Timers.  All 3 Counter/Timers are used to produce
' a 32-bit counter/timer.  Attach the oscilloscope's leads to pins J2-17
' (Digital Ground) and J2-18 (Counter/Timer 0 Output) of the DT708.  The
' DT2806 board is factory configured for this example.
'

'.....CONSTANT SECTION.....

    FPLA = &H1770
    CTMODE = &HF70
    CT2 = &HB70
    CT1 = &H770
    CT0 = &H370

BEGIN:  SCREEN 0: COLOR 13, 4: CLS

    LOCATE 4, 31, 0
    FOR I = 1 TO 20
      PRINT CHR$(210);
    NEXT I

    LOCATE 5, 32, 0: PRINT "Programmable Delay"

    LOCATE 6, 31, 0
    FOR I = 1 TO 20
      PRINT CHR$(208);
    NEXT I

    LOCATE 10, 25: COLOR 7, 4
    INPUT "Length of delay [1s - 600s(10min)"; A%


    'THE FORMULAS BELOW TAKE THE "LENGTH OF DELAY" VALUE AND
    'MULTIPLIES IT BY A VALUE WHICH IS EQUAL TO ONE SECOND AND
    'THIS PRODUCES THE VALUE THAT IS TO BE LOADED INTO THE
    'COUNTER/TIMER 2 AND 0.  THE FORMULAS BELOW ARE
    'CALCULATING THE VALUE OF THE MOST SIGNIFICANT AND LEAST
    'SIGNIFICANT BYTES THAT ARE TO BE LOADED INT0 COUNTER/TIMER
    '2 AND 0.
```


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```
    CALC& = A% * 2000000
    IF (CALC& >= 2 ^ 24) THEN
      MTMP0! = CALC& / 2 ^ 24
      MSBCT0 = INT(MTMP0!)
      LTMP0! = ((MTMP0! - INT(MTMP0!)) * 2 ^ 24) / 2 ^ 16
      LSBCT0 = INT(LTMP0!)
      MTMP2! = ((LTMP0! - INT(LTMP0!)) * 2 ^ 16) / 2 ^ 8
      MSBCT2 = INT(MTMP2!)
      LSBCT2 = INT(((MTMP2! - INT(MTMP2!)) * 2 ^ 8))
    END IF

    IF (CALC& >= 2 ^ 16) AND (CALC& < 2 ^ 24) THEN
      TEMP0! = CALC& / 2 ^ 16
      MSBCT0 = 0
      LSBCT0 = INT(TEMP0!)
      TEMP2! = ((TEMP0! - INT(TEMP0!)) * 2 ^ 16) / 2 ^ 8
      MSBCT2 = INT(TEMP2!)
      LSBCT2 = INT(((TEMP2! - INT(TEMP2!)) * 2 ^ 8))
    END IF

    OUT FPLA, &H0                 'CLEARS THE FPLA

    OUT CTMODE, &HB0              'SETS T2, MODE 0
    OUT CT2, LSBCT2               'USER ENTERED COUNT FOR THE
    OUT CT2, MSBCT2               'TIME OF THE DELAY.

    OUT CTMODE, &H74              'SETS T1, MODE 2
    OUT CT1, &H0                  'FULL COUNT (0000H) AT 1ST DECREMENT
    OUT CT1, &H0                  'BECOMES (FFFFH).  ONCE COUNT REACHES
                                  '0000H, COUNT IS COMPLETE.

    OUT CTMODE, &H30              'SETS T0, MODE 0
    OUT CT0, LSBCT0               'USER ENTERED COUNT FOR THE
    OUT CT0, MSBCT0               'TIME OF THE DELAY.

    OUT FPLA, &HF8                'TOGGLES COUNT INTO C/T 2, 1, 0
    OUT FPLA, &HC0                'TOGGLES ALL

    OUT FPLA, &H74                'START PROCESS, SET DELAY MODE

    LOCATE 23, 25: COLOR 0, 4
    INPUT "Would you like to continue [Y/N]"; A$
    IF (A$ = "Y" OR A$ = "y") THEN
      GOTO BEGIN
    END IF

END
```


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Frequency Measurement

```
'
'                    Frequency Measurement
'
' Using a function generator, send a frequency across Counter/Timer 2.
' The J4 connector pin assignments for Counter/Timer 2 are pins J2–5(Digital
' Ground) and J2–6(Counter/Timer 2 Clock Input). The J4 connector is
' connected to the J2 connector of the DT708 or the J1 connector of the
' DT757. The DT2806 is factory configured for this example.
'

'.............CONSTANT SECTION.....................

    FPLA = &H1770                   'FPLA REGISTER
    CTMODE = &HF70                  'COUNTER/TIMER MODE REGISTER
    CT0 = &H370                     'COUNTER/TIMER 0
    CT1 = &H770                     'COUNTER/TIMER 1
    CT2 = &HB70                     'COUNTER/TIMER 2

BEGIN:  SCREEN 0: COLOR 13, 1: CLS

    LOCATE 4, 27, 0
    FOR I = 1 TO 23
            PRINT CHR$(210);
    NEXT I

    LOCATE 5, 28
    PRINT "Frequency Measurement"

    LOCATE 6, 27, 0
    FOR I = 1 TO 23
            PRINT CHR$(208);
    NEXT I

    OUT FPLA, &H0                   'CLEARS THE FPLA

    OUT CTMODE, &HB0                'SETS C/T 2, MODE 0
    OUT CT2, &H0                    'LOADING WITH A FULL COUNT (0000H).
    OUT CT2, &H0                    'THE 1ST DECREMENT WILL BE FFFF.  WHEN
                                    'COUNTER HAS CYCLED BACK TO 0000, THE
                                    'COUNT HAS COMPLETED.

    OUT CTMODE, &H74                'SETS C/T 1, MODE 2
    OUT CT1, &H0                    'SAME AS C/T 2
    OUT CT1, &H0
```


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```
    OUT CTMODE, &H30            'SETS C/T 0, MODE 0
    OUT CT0, &H0                'SAME AS C/T 2
    OUT CT0, &H0

    OUT FPLA, &HF8              'COUNT IS TOGGLED INTO C/T 2, C/T 1,
    OUT FPLA, &HC0              'AND C/T 0.

    A& = INP(CT0)               'LEAST SIGNIFICANT BYTE OF C/T 0
    B& = INP(CT0)               'MOST SIGNIFICANT BYTE OF C/T 0
    C& = INP(CT1)               'LEAST SIGNIFICANT BYTE OF C/T 1
    D& = INP(CT1)               'MOST SIGNIFICANT BYTE OF C/T 1
    E& = INP(CT2)               'LEAST SIGNIFICANT BYTE OF C/T 2
    F& = INP(CT2)               'MOST SIGNIFICANT BYTE OF C/T 2

    'EACH COUNTER/TIMER IS READ AND ITS VALUE SHOULD BE 0000H.  IF ALL
    'THE COUNTER/TIMERS AREN'T EQUAL TO 0000H THEN THE PROGRAM LOOPS
    'BACK TO THE LOADING SECTION.  THE "IF" STATEMENT BELOW PERFORMS
    'THIS TASK.

    IF A& = B& = C& = D& = E& = F& THEN GOTO START
    GOTO BEGIN

START:

    OUT FPLA, &H97              'STARTS THE PROCESS, FREQUENCY
                                'MEASUREMENT CONFIG., C/T 1 IS ENABLED
                                'FOR THE 2MHz INTERNAL CLOCK, ALL
                                'GATES ARE SET.

    FOR W = 1 TO 2000           'STOP FOR 2 SECOND SAMPLE (TIMING LOOP)
    NEXT W
    OUT FPLA, &H0               'SETS UP EXTERNAL CLOCKING AND GATING

    'READING DATA FROM C/T 2, C/T 1, AND C/T 0 FOR COMPUTING THE UNKNOWN
    'COUNT, THE KNOWN COUNT, AND THE FREQUENCY.

    A& = INP(CT0)               'LEAST SIGNIFICANT BYTE OF C/T 0
    B& = INP(CT0)               'MOST SIGNIFICANT BYTE OF C/T 0
    C& = INP(CT1)               'LEAST SIGNIFICANT BYTE OF C/T 1
    D& = INP(CT1)               'MOST SIGNIFICANT BYTE OF C/T 1
    E& = INP(CT2)               'LEAST SIGNIFICANT BYTE OF C/T 2
    F& = INP(CT2)               'MOST SIGNIFICANT BYTE OF C/T 2

    'THE FORMULAS BELOW COMPUTE THE UNKNOWN FREQUENCY THAT'S
    'PRODUCED BY THE FUNCTION GENERATOR.  IN THE FORMULA "KNOW&",
    'COUNTER/TIMERS 0 AND 1 MAKE UP A 32-BIT COUNTER.  MULTIPLYING B& BY
    '2^8 AND ADDING A& AND MULTIPLYING THIS EXPRESSION BY 2^16 PRODUCES
```


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```
    'THE DECIMAL VALUE OF THE UPPER 16-BITS.  MULTIPLYING D& BY 2^8 AND
    'ADDING C& MAKES UP THE LOWER 16-BITS.  ADDING THESE 2 EXPRESSIONS
    'TOGETHER PRODUCES THE COUNT OF THE 32-BIT COUNTER.  SUBTRACTING
    'THIS VALUE FROM 2^32 PRODUCES THE KNOWN COUNT.  IN THE FORMULA
    '"UNKNOWN&", COUNTER/TIMER 2 PRODUCES THE UNKNOWN COUNT.  IN THE
    'FORMULA "FREQ!", THE UNKNOWN COUNT DIVIDED BY THE KNOWN COUNT
    'TIMES 0.0000005 PRODUCES THE UNKNOWN FREQUENCY.


    KNOW& = 2 ^ 32 - (((2 ^ 8 * B&) + A&) * 2 ^ 16) + ((2 ^ 8 * D&) + C&)
    UNKNOWN& = 2 ^ 16 - ((2 ^ 8 * F&) + E&)
    FREQ! = (UNKNOWN& / (KNOW& * .0000005))

    COLOR 3, 1
    LOCATE 10, 25: PRINT "The Known Count is "; KNOW&
    LOCATE 12, 25: PRINT "The Unknown Count is "; UNKNOWN&
    LOCATE 14, 25: PRINT "The Frequency is "; FREQ!

    LOCATE 23, 23: COLOR 0, 1: INPUT "Would you like to continue [Y/N]"; A$
    IF (A$ = "Y" OR A$ = "y") THEN
            GOTO BEGIN
    END IF
END
```


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Event Counter

```
'
'                An Event Counter
'
' Using a function generator, send a frequency across Counter/Timer 1.
' The J4 connector pin assignments for Counter/Timer 1 are pins J2-3(Digital
' Ground) and J2-4(Counter/Timer 1 Clock Input). The J4 connector is
' connected to the J2 connector of the DT708 or the J1 connector of the
' DT757. The DT2806 board is factory configured.
'
' The "seconds" displayed is used as a timer for the user to choose the
' duration for the event counting. If you let the timer run for 5 seconds
' and a 1 kHz signal is inputted into Counter/Timer 1 then the events counted
' will be 5000.

'.............CONSTANT SECTION.....................

    FPLA = &H1770                   'FPLA REGISTER
    CTMODE = &HF70                  'COUNTER/TIMER MODE REGISTER
    CT1 = &H770                     'COUNTER/TIMER 1

BEGIN:  SCREEN 0: COLOR 13, 0
    CLS

    LOCATE 4, 29
    FOR I = 1 TO 15
            PRINT CHR$(210);
    NEXT I

    LOCATE 5, 30
    PRINT "Event Counter"

    LOCATE 6, 29, 0
    FOR I = 1 TO 15
            PRINT CHR$(208);
    NEXT I

    COLOR 11, 0
    LOCATE 10, 29
    PRINT "Hit <+> to Stop"


    OUT FPLA, &H0                   'CLEARS THE FPLA


    OUT CTMODE, &H40                'SETS C/T 1, LATCH, MODE DON'T CARE
```


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```
OUT CT1, &H0                    'LOADING WITH A FULL COUNT (0000H). THE
OUT CT1, &H0                    '1ST DECREMENT WILL BE FFFF.  WHEN
                                'COUNTER HAS CYCLED BACK TO 0000, THE
                                'COUNT HAS COMPLETED.

OUT FPLA, &HD0                  'COUNT IS TOGGLED INTO COUNTER/TIMER 1
OUT FPLA, &HC0                  'TOGGLE


OUT FPLA, &H82                  'START THE PROCESS

LOCATE 13, 33, 0
COLOR 1, 0
PRINT "SECONDS"

DO                              'THIS IS A TIMING LOOP
 T$ = TIME$
 LOCATE 14, 35, 0
 COLOR 7, 0
 PRINT RIGHT$(T$, 2)
LOOP UNTIL INKEY$ = "+"

OUT FPLA, &H0                   'SETS UP EXTERNAL CLOCKING AND GATING

C& = INP(CT1)                   'READING DATA FOR COMPUTING THE
D& = INP(CT1)                   'COUNTED EVENTS

COUNT2& = (2 ^ 16 – ((D& * 256) + C&))  'D& IS THE MOST SIGNIFICANT
                                'BYTE AND C& IS THE LEAST SIGNIFICANT
                                'BYTE.  MUTLIPLYING D& BY 256 PRODUCES
                                'THE DECIMAL VALUE OF THE MOST
                                'SIGNIFICANT BYTE.  ADDING C& TO D&
                                'PRODUCES THE DECIMAL VALUE OF
                                'COUNTER/TIMER 1. SUBTRACTING C/T 1's
                                'DECIMAL VALUE FROM 2^16 (65536)
                                'PRODUCES THE COUNTED EVENTS.

COLOR 4, 0
LOCATE 18, 26: PRINT COUNT2&; " Events Counted"

LOCATE 23, 22: COLOR 7, 0
INPUT "Would you like to continue [Y/N]"; A$
IF (A$ = "Y" OR A$ = "y") THEN
  GOTO BEGIN
END IF

END
```


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Programmable One-Shot

```
'
'                One-Shot
'
' Using the 2MHz internal clock, a one-shot is produced across Counter/Timer
' 2.  Connect an oscilloscope's leads to pins J2-13 (Digital Ground) and
' J2-14 (Counter/Timer 2 Output) of the DT708.  The DT2806 board is factory
' configured for this program.
'

'.....CONSTANT SECTION.....

    FPLA = &H1770                   'FPLA REGISTER
    CTMODE = &HF70                  'COUNTER/TIMER MODE REGISTER
    CT2 = &HB70                     'COUNTER/TIMER 2 REGISTER

BEGIN:  SCREEN 0: COLOR 13, 4: CLS

    LOCATE 4, 33, 0
    FOR I = 1 TO 13
            PRINT CHR$(210);
    NEXT I

    LOCATE 5, 35
    PRINT "One-Shot"

    LOCATE 6, 33, 0
    FOR I = 1 TO 13
            PRINT CHR$(208);
    NEXT I

    OUT FPLA, &H0                   'CLEARS THE FPLA
    OUT CTMODE, &HB2                'SETS C/T 2, MODE 1
    OUT CT2, &HAA                   'LOADING A COUNT VALUE INTO
    OUT CT2, &H0                    'COUNTER/TIMER 2


    FOR W = 1 TO 2000               'USED AS A DELAY SO THE ONE-SHOT CAN
    NEXT W                          'BE VIEWED.

    OUT FPLA, &H20                  'START THE PROCESS, INTERNAL 2MHz
                                    'CLOCK ENABLED FOR C/T 2.
    OUT FPLA, &H24                  'ENABLES C/T 2 AND ITS GATE
```


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```
    LOCATE 23, 25: COLOR 0, 4:
    INPUT "Would you like to continue [Y/N]"; A$
    IF (A$ = "Y" OR A$ = "y") THEN
            GOTO BEGIN
    END IF
END
```


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Square Wave Generator

```
'
'                SQUARE WAVE GENERATOR
'
' Using the 2MHz internal clock, a square wave is produced across
' Counter/Timer 0.  Connect an oscilloscope's leads to pins J2–17(Digital
' Ground) and J2–18(Counter/Timer 0 Output) of the DT708.  The DT2806
' board is factory configured for this program.

'.....CONSTANT SECTION.....

    FPLA = &H1770                   'FPLA REGISTER
    CTMODE = &HF70                  'COUNTER/TIMER MODE REGISTER
    CT0 = &H370                     'COUNTER/TIMER 0
    EXP1 = 2 ^ 16
    EXP2 = 2 ^ 8

BEGIN:  SCREEN 0: COLOR 13, 1

    CLS

    LOCATE 4, 29, 0
    FOR I = 1 TO 23
            PRINT CHR$(210);
    NEXT I

    LOCATE 5, 30, 0
    PRINT "Square Wave Generator"

    LOCATE 6, 29, 0
    FOR I = 1 TO 23
            PRINT CHR$(208);
    NEXT I

'THE FORMULAS BELOW COMPUTE THE FREQUENCY AND COUNT.  THE
'COUNT IS THE VALUE THAT WILL BE LOADED INTO COUNTER/TIMER 0
'AND A SQUARE WAVE WILL BE GENERATED USING THIS INFORMATION.

    FOR N = 0 TO 7
            COMP&(N, 0) = 16000 / 2 ^ N
            COMP&(N, 1) = COMP&(N, 0) / 2 ^ (7 – (N * 2))
    NEXT N
```


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```
DO
        LOCATE 10, 32: COLOR 6, 1: PRINT "Enter a frequency :"
        LOCATE 11, 32: PRINT "  0.  125 Hertz"
        LOCATE 12, 32: PRINT "  1.  250 Hertz"
        LOCATE 13, 32: PRINT "  2.  500 Hertz"
        LOCATE 14, 32: PRINT "  3. 1000 Hertz"
        LOCATE 15, 32: PRINT "  4. 2000 Hertz"
        LOCATE 16, 32: PRINT "  5. 4000 Hertz"
        LOCATE 17, 32: PRINT "  6. 8000 Hertz"
        LOCATE 18, 32: PRINT "  7. 16000 Hertz"
        LOCATE 19, 32: PRINT "  8. Exit Program."
        LOCATE 20, 32: COLOR 0, 1: INPUT "Enter a Selection "; A%


        CALC& = COMP&(A%, 0)


        'THE FORMULAS BELOW ARE CALCULATING THE VALUE OF THE MOST
        'SIGNIFICANT AND LEAST SIGNIFICANT BYTES THAT ARE TO BE
        'LOADED INT0 COUNTER/TIMER 0.

        TEMP! = CALC& / EXP2
        MSBCT0 = INT(TEMP!)
        LSBCT0 = INT(((TEMP! – INT(TEMP!)) * EXP2))

        OUT FPLA, &H0           'CLEARS THE FPLA

        OUT CTMODE, &H36        'SETS C/T 0, MODE 3
        OUT CT0, LSBCT0         'THE USER ENTERS THE COUNT HE/SHE
        OUT CT0, MSBCT0         'DESIRES.

        OUT FPLA, &HC8          'TOGGLES COUNT INTO COUNTER/TIMER 0
        OUT FPLA, &HC0

        OUT FPLA, &H9           'START THE PROCESS, C/T 0 IS ENABLED
                                'FOR THE INTERNAL 2 MHz CLOCK

    LOOP UNTIL (A% = 8)

FINISH:
        OUT CTMODE, &H30        'SETS C/T 0, MODE 0
        OUT CT0, &H0            'LOADING WITH A FULL COUNT (OOOOH).
        OUT CT0, &H0
        OUT FPLA, &H9           'STOPS THE SQUARE WAVE
END
```


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Software-Triggered Strobe

```
'
'               Software Triggered Strobe
'
' Using the 2MHz internal clock, a software triggered strobe is produced
' across  Counter/Timer 1.  Connect an oscilloscope leads to pins J2–15
' (Digital Ground) and J2–16 (Counter/Timer 1 Output) of the DT708.  A
' loop is being used so that the software triggered strobe can be viewed.
' The DT2806 is factory configured for this program.
'

'.....CONSTANT SECTION.....

    FPLA = &H1770
    CTMODE = &HF70
    CT1 = &H770

    SCREEN 0: COLOR 13, 1
    CLS

    LOCATE 4, 24, 0
    FOR I = 1 TO 29
            PRINT CHR$(210);
    NEXT I

    LOCATE 5, 26
    PRINT "Software Triggered Strobe"

    LOCATE 6, 24, 0
    FOR I = 1 TO 29
            PRINT CHR$(208);
    NEXT I

    LOCATE 15, 30, 0: COLOR 0, 1
    PRINT "HIT <+> TO STOP"

BEGIN:
    DO
            OUT FPLA, &H0           'CLEARS THE FPLA

            OUT CTMODE, &H78        'SETS C/T 1, MODE 4
            OUT CT1, &HAA           'COUNT TO BE LOADED INTO COUNTER/
            OUT CT1, &H0            'TIMER 0
```


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```
            OUT FPLA, &HFF          'TOGGLE COUNT INTO REGISTER
            OUT FPLA, &HC0          'TOGGLE COUNT


            OUT FPLA, &H12          'ENABLES COUNTER/TIMER 1 FOR 2MHz
                                    'INTERNAL CLOCK AND GATE

    LOOP UNTIL INKEY$ = "+"
    LOCATE 23, 25: COLOR 0, 1
    INPUT "Would you like to continue [Y/N]"; A$

    IF (A$ = "Y" OR A$ = "y") THEN
            GOTO BEGIN
    END IF

END
```


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Hardware-Triggered Strobe

```
'
'               Hardware Triggered Strobe
'
' A hardware triggered strobe is produced across Counter/Timer 0.  Connect
' an oscilloscope's leads to pins J2–17 (Digital Ground) and J2–18 (Counter/
' Timer 0 Output) of the DT708.  Also connect a function generator to pins
' J2–7 (Digital Ground) and J2–8 (Counter/Timer 0 Gate Input) of the DT708.
' Set the function generator to Gate Mode.  The DT2806 board is factory
' configured for this program.

'.....CONSTANT SECTION.....

    FPLA = &H1770                   'FPLA REGISTER
    CTMODE = &HF70                  'COUNTER/TIMER MODE REGISTER
    CT0 = &H370                     'COUNTER/TIMER 0 REGISTER

BEGIN:  SCREEN 0: COLOR 13, 0
    CLS

    LOCATE 4, 24
    FOR I = 1 TO 29
            PRINT CHR$(210);
    NEXT I

    LOCATE 5, 26
    PRINT "Hardware Triggered Strobe"

    LOCATE 6, 24, 0
    FOR I = 1 TO 29
            PRINT CHR$(208);
    NEXT I

    COLOR 11, 0
    LOCATE 12, 30
    PRINT "Hit <+> to Stop"

    DO
            OUT FPLA, &H0           'CLEARS THE FPLA

            OUT CTMODE, &H3A        'SETS C/T 0, MODE 5
            OUT CT0, &H10           'COUNT TO BE LOADED INTO COUNTER/
            OUT CT0, &H0            'TIMER 0.
```


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```
            OUT FPLA, &HC8          'TOGGLES THE COUNT INTO THE
            OUT FPLA, &HC0          'COUNTER/TIMER.


            OUT FPLA, &H8           'START THE PROCESS,ENABLES C/T 0
                                    'FOR THE 2MHz INTERNAL CLOCK.
            OUT FPLA, &H0           'FOR EXTERNAL GATING
    LOOP UNTIL INKEY$ = "+"

    LOCATE 23, 23: COLOR 7, 0
    INPUT "Would you like to continue [Y/N]"; A$

    IF (A$ = "Y" OR A$ = "y") THEN
            GOTO BEGIN
    END IF
END
```


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