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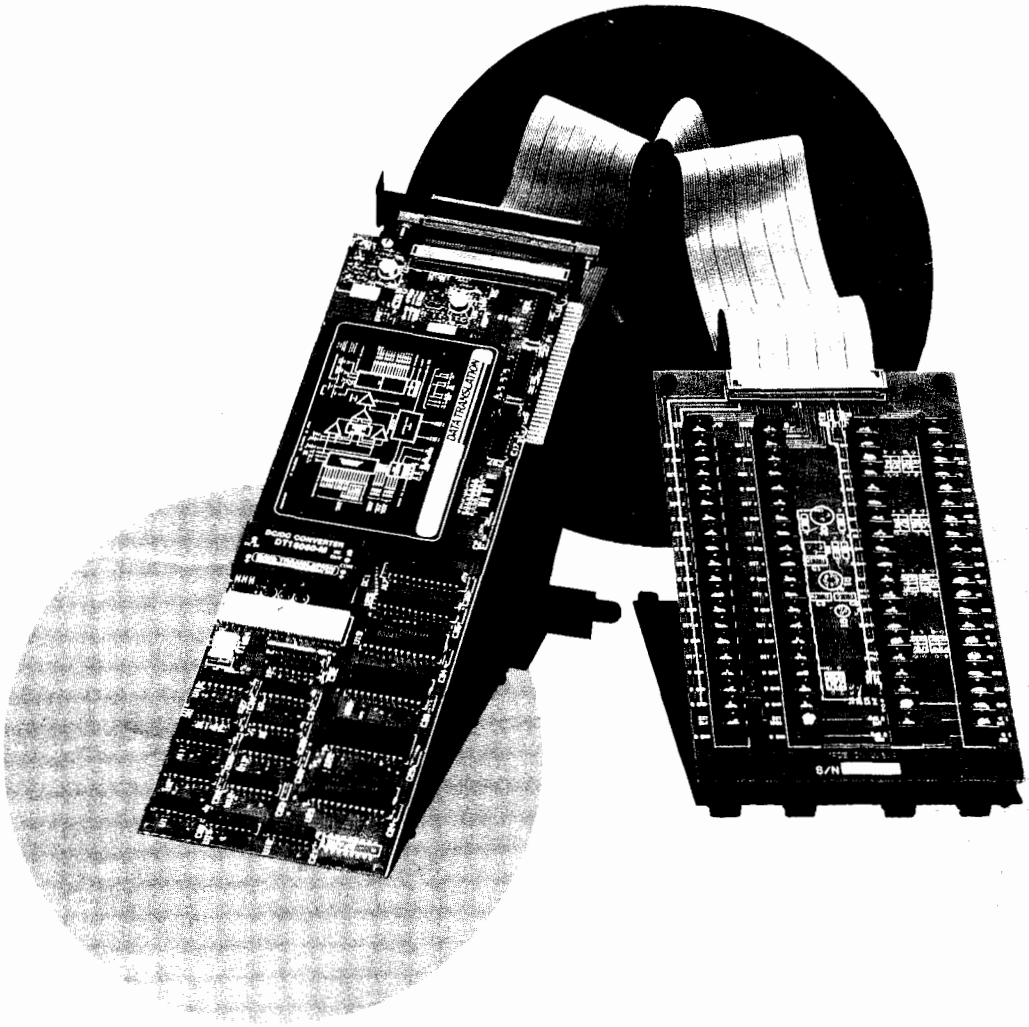
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Data Acquisition & Control for the IBM PC



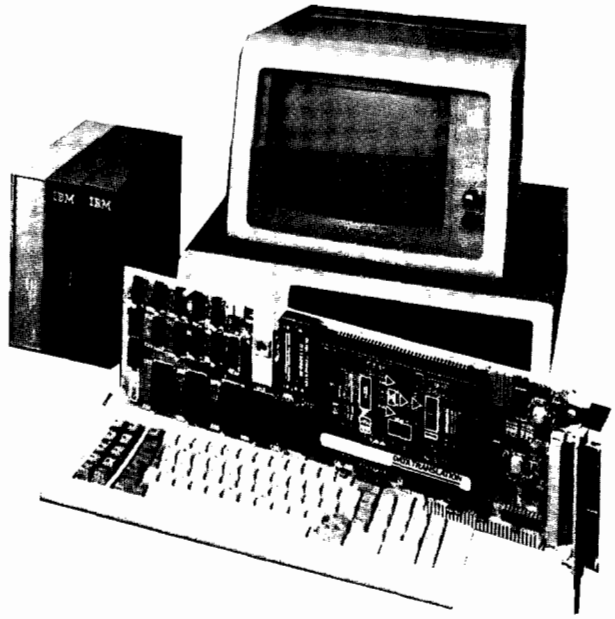
DATA TRANSLATION

A/D inputs	16SE/8DI	16SE/8DI	8DI	up to 80	16SE	4SE**
A/D resolution	12-bits 16-bits	12-bits	12-bits 16-bits	12 bits	10-bits	12 bits
prog gain	1,2,4,8	1,2,4,8	1,10,100,500	1, 10, 100, 1000	— —	— —
A/D throughput	13,700 sps 2,500 sps (16-bit)	27,500 sps	13,700 sps 2,500 sps (16-bit)	20,000 sps	3300 sps	27,500 sps
D/A channels	2	2	2	up to 24	2	2
D/A resolution	12-bits	12-bits	12-bits	12-bits	8-bits	12-bits
D/A throughput	16,000 sps	33,000 sps	16,000 sps	— —	10,000sps	33,000 sps
Digital I/O	16 lines	16 lines	16 lines	up to 72	16 lines	16 lines
DMA	yes	yes	yes	yes	yes	yes
progrm clock	yes	yes	yes	yes	yes	yes
microprocessor	yes	yes	yes	no	yes	yes
PCLAB support	yes	yes	yes	yes	yes	yes
PCTHERM support	yes	yes	yes	no	yes	yes
screw panels	DT707 DT752 DT708	DT707 DT752 DT708	DT707-T DT752 DT708	DT708	DT707 DT752 DT708	DT707 DT752 DT708

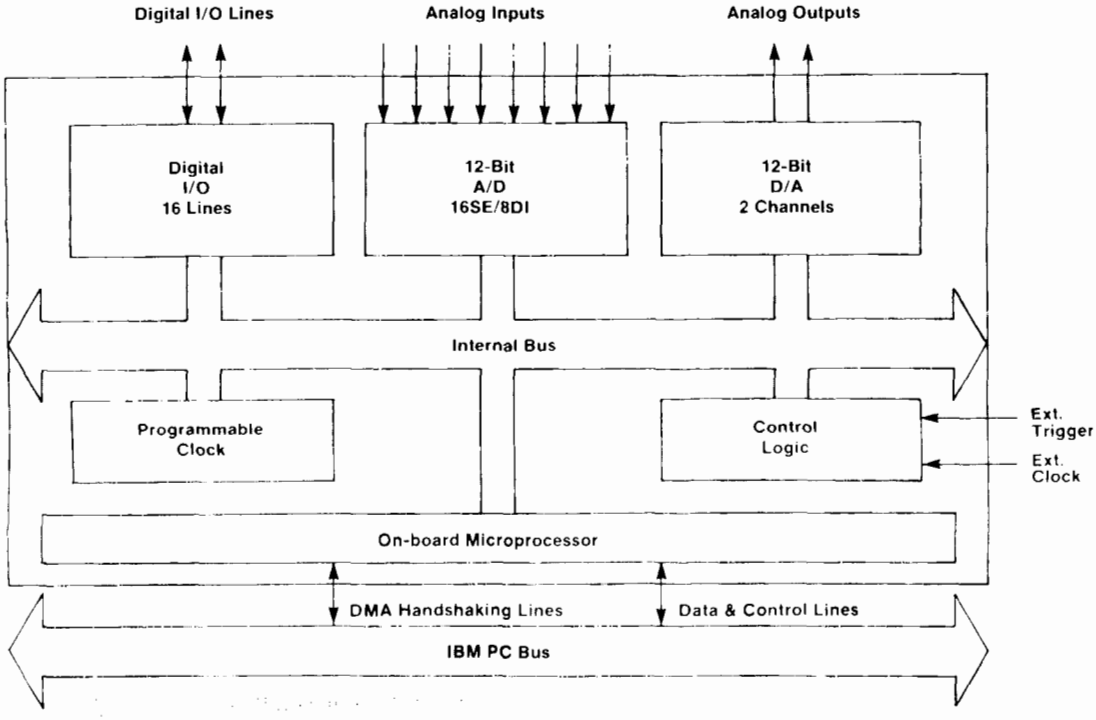
**simultaneous sample and hold

DATA TRANSLATION

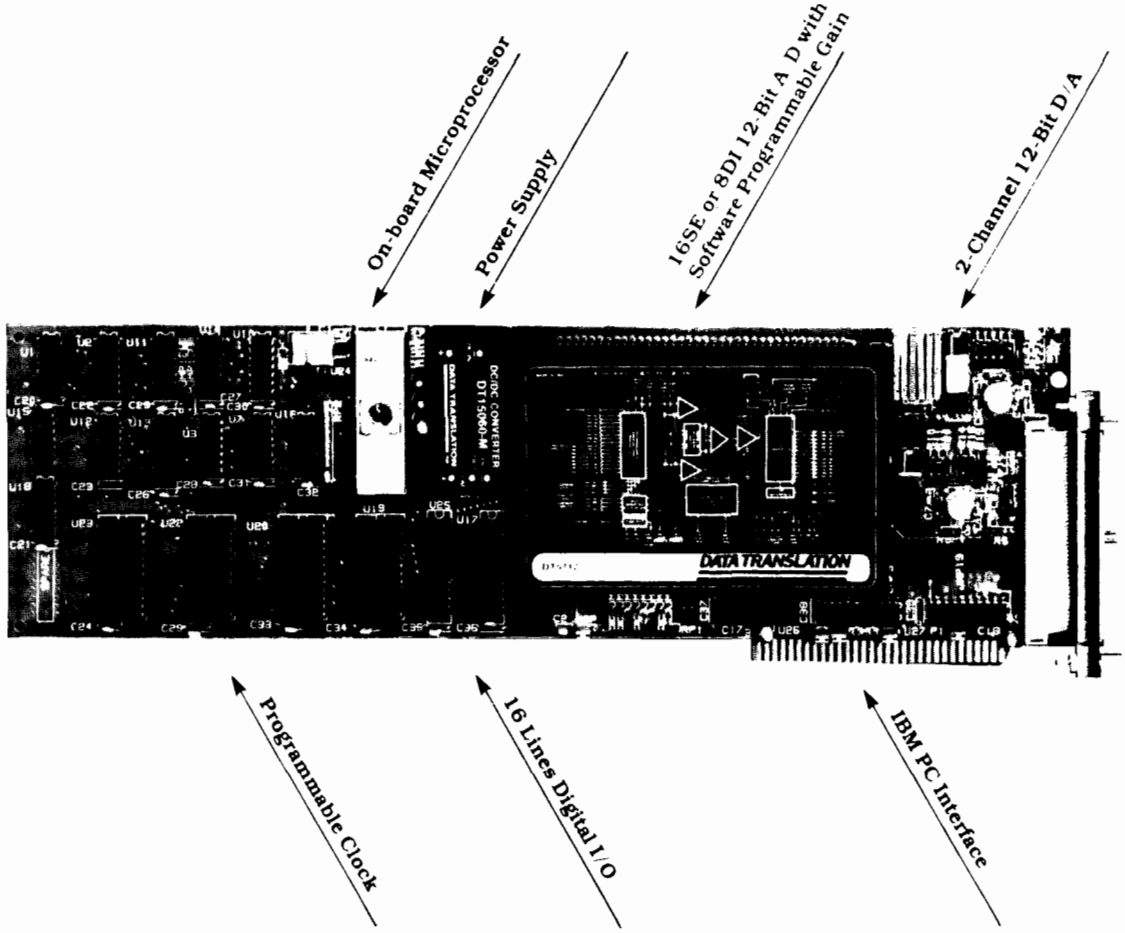
- Multifunction I/O boards provide analog inputs with programmable gain, analog outputs,digital I/O, DMA, programmable clock.
- High level (DT2801) or low level (DT2805) analog inputs available with 12 or 16-bit resolution; throughput rates up to 27,500 samples per second.
- Low cost single board with 16 channel 10-bit A/D, 2 channels 8-bit D/A, 16 lines of digital I/O, and programmable clock (DT2808).
- Simultaneous measurement and control board (DT2818).
- Up to 24 12-bit analog outputs, or up to 72 lines of digital I/O with three iSBX™ connectors (DT2806)
- On-board microprocessor offloads host IBM CPU; microcoded commands make programming easy.
- Multiple DT2801 Series boards plug directly into any of the IBM PC, PC/XT, or PC/AT expansion slots.
- Easy connection to optional Screw Terminal and Signal Conditioning Panels. Thermocouple cold-junction compensation available.
- Optional subroutine libraries and application software packages.
- Shipped with comprehensive User Manual, and sample BASIC programs on floppy diskette.



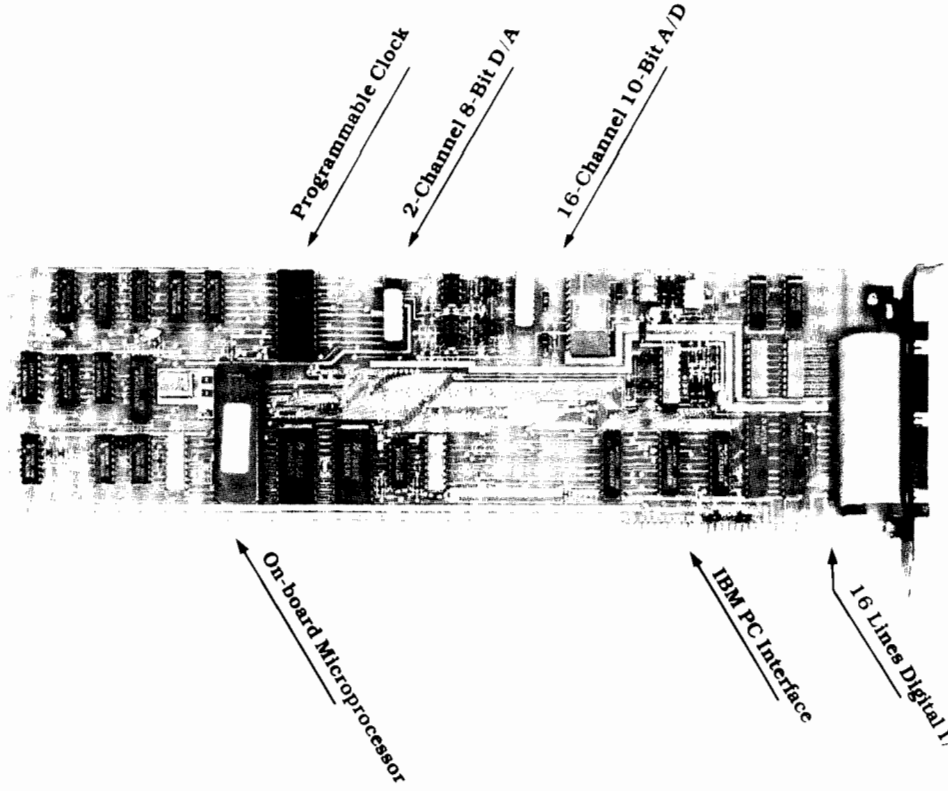
iSBX™ is a trademark of Intel Corp.



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The DT2801 and DT2805 are complete, single board data acqusition systems for the IBM PC.



The DT2808 is a low cost, single board data acquisition system for the IBM PC.

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DESCRIPTION

The DT2801 Series boards provide a wide range of low cost, high performance analog and digital I/O functions for the IBM PC, PC/XT, PC/AT, and compatibles. Including eight, software compatible boards, the DT2801 Series single-board subsystems provide full data acquisition and control capabilities.

DT2801

The DT2801 includes a high level, 12-bit analog to digital (A/D) converter system for 16 single-ended or 8 differential analog input channels. Software selectable gains of 1, 2, 4 and 8 allow the user to accommodate a range of input signal levels. 0 to 20mA current loop inputs can be accommodated using off-board current shunts (these are installed on the optional DT707 screw terminal panel). Included on the DT2801 are two digital to analog (D/A) converters with 12-bit resolution which can be operated independently or changed simultaneously. In addition, the DT2801 features two 8-line digital I/O ports which may be used separately, to read or write 8-bit data, or changed simultaneously, for 12 or 16-bit data. An on-board programmable clock is included as a pacer clock for Block mode A/D or D/A conversions.

DT2805

The DT2805 includes a low level, wide range 12-bit analog to digital (A/D) converter system for 8 differential input channels. A programmable gain amplifier provides software selectable gains of 1, 10, 100 and 500, which allow the user to accommodate a 20mV to 10V full scale range of input signal levels. The DT2805 also includes two 12-bit digital to analog (D/A) converters which may be used independently or changed simultaneously. Like the DT2801, two 8-line digital I/O channels and an internal programmable clock for A/D or D/A triggering are standard.

High Resolution Options

The DT2801 and DT2805 are also available with 16-bit analog input resolution on 8 differential channels. 16-bit A/D resolution allows incoming signals to be resolved to 1 part in 65,536 versus 1 part in 4096 for 12-bit devices. See SPECIFICATIONS for complete details.

High Throughput Option

The DT2801 is also available in a high speed version, the DT2801-A, which offers both higher A/D and D/A throughput. See SPECIFICATIONS for complete details.

DT2806

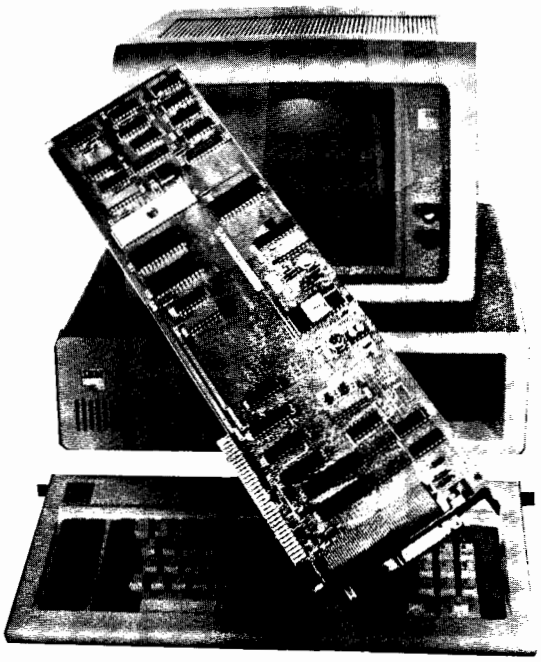
The DT2806 base board includes three programmable counter/timers and three iSBX connectors. The counter/timers are used for internal clocking of analog or digital events and can be used for external timing control.

A full implementation of the iSBX bus, the three iSBX connectors on-board the DT2806 support DMA and programmed I/O operations, as well as full interrupt capability. These iSBX connectors can be used to interface with any iSBX compatible modules, including those available from Data Translation.

DT2808

The DT2808 is a very low cost, multifunction data acquisition system compatible with the IBM Personal Computer. Analog input, analog output, and digital I/O functions are provided on a single printed circuit board.

The DT2808 includes a high level 10-bit A/D converter system for 16 single-ended analog input channels, as well as two 8-bit D/A converters which can be operated independently or changed simultaneously. In addition, the DT2808 features two 8-line digital I/O ports which may be used separately, to read or write 8-bit data, or changed simultaneously, for up to 16-bit data transfers. An on-board programmable clock is included as a pacer clock for multiple A/D or D/A conversions.



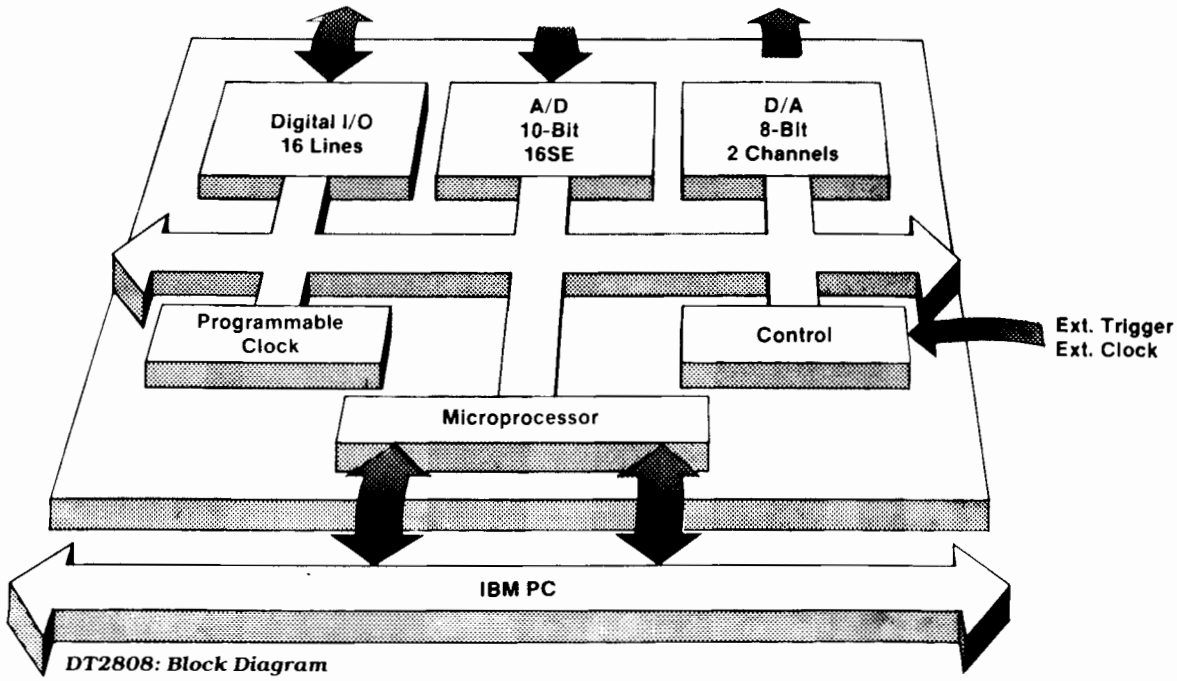
The DT2808 brings low cost analog and digital I/O functions to the IBM Personal Computer. This single board peripheral fits in one of the host computer's expansion slots.

DT2818

The DT2818 is a multifunction data acquisition board for the IBM Personal Computer, providing simultaneous sample and hold analog inputs and simultaneous analog output capabilities, as well as digital I/O and clock functions. The DT2818 allows the user to take a snapshot of up to 4 high level analog input channels, freezing their values within a ±5 nanosecond aperture uncertainty. Subsequent analog to digital conversions can occur at up to 27,500 samples per second.

The DT2818 includes a 12-bit simultaneous analog to digital (A/D) converter system for 4 single-ended analog input channels. Two 12-bit digital to analog (D/A) converters can be operated simultaneously or changed independently, depending on user requirements. In addition, the DT2818 features two 8-line digital I/O ports which may be used separately, to read or write 8-bit data, or changed simultaneously, for up to 16-bit data transfers. An on-board programmable clock is included as a pacer clock for simultaneous A/D scans or multiple D/A conversions.

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DT2808: Block Diagram

On-Board Microprocessor

All DT2801 Series boards are designed around an on-board microprocessor which acts as the interface between the I/O board and the IBM PC. The microprocessor controls all on-board operations and simplifies program control by the host IBM PC. Routine tasks, such as analog-to-digital converter sequencing and error checking are carried out by the I/O board's on-board microprocessor, and need not be handled by the IBM PC CPU. At the same time, circuitry is simplified to allow the analog and digital I/O board to plug into a single expansion slot of the personal computer.

On-Board Programmable Clock

An on-board programmable clock is used to initiate repetitive data conversion events on the DT2801 Series boards. The DT2801, DT2805, and DT2808 internal clock is programmable for periods ranging from 5 microseconds to 0.1638 seconds, in 2.5 microsecond increments, and can be used for internal clocking of A/D and D/A conversions. The clock on-board the DT2801-A and DT2818 is programmable for periods of 2.5 microseconds to 0.0819 seconds, in 1.25 microsecond increments.

In cases where the user requires a precise clock period which is not a multiple of 2.5 microseconds, an external clock can be used in place of the on-board clock.

Another control feature of the DT2801 Series boards is the external trigger. An external trigger is a user-supplied pulse used to specify the exact time at which an A/D, D/A, or digital I/O command begins execution. An external trigger input allows the user to synchronize an I/O event with an external event by deferring command execution until an external trigger pulse is received.

An on-board DC/DC power converter (except DT2808) generates all needed supply voltages from the +5 volts provided on the IBM PC and provides high noise isolation from the computer system's power supplies.

Ease of Programming

The DT2801 Series boards can be programmed in any language that can access the I/O registers of the IBM PC. Microcoding within the on-board controller greatly simplifies user access to the board's functions.

The DT2801 Series boards are easily programmed from the IBM Personal Computer's interpreted or compiled BASIC languages. By using only three of the personal computer's BASIC commands: INP (read), OUT (write) and WAIT, the user has access to all of the board functions, including A/D and D/A conversions, digital I/O and Direct Memory Access (DMA) data transfers. The comprehensive user manual includes sample programs for BASIC programmers as well as detailed instructions for programming the DT2801 Series boards.

Software Subroutine Packages

Also available for use with the DT2801 Series boards are PCLAB and PCTHERM, libraries of CALLable macro-routines. PCLAB and PCTHERM are complete real-time software packages designed to allow the user to manipulate all the analog I/O, digital I/O, and clock functions of the DT2801 Series boards by simply CALLing specific routine names (see below for more complete details). With PCLAB and PCTHERM, user programming of the control registers is not required.

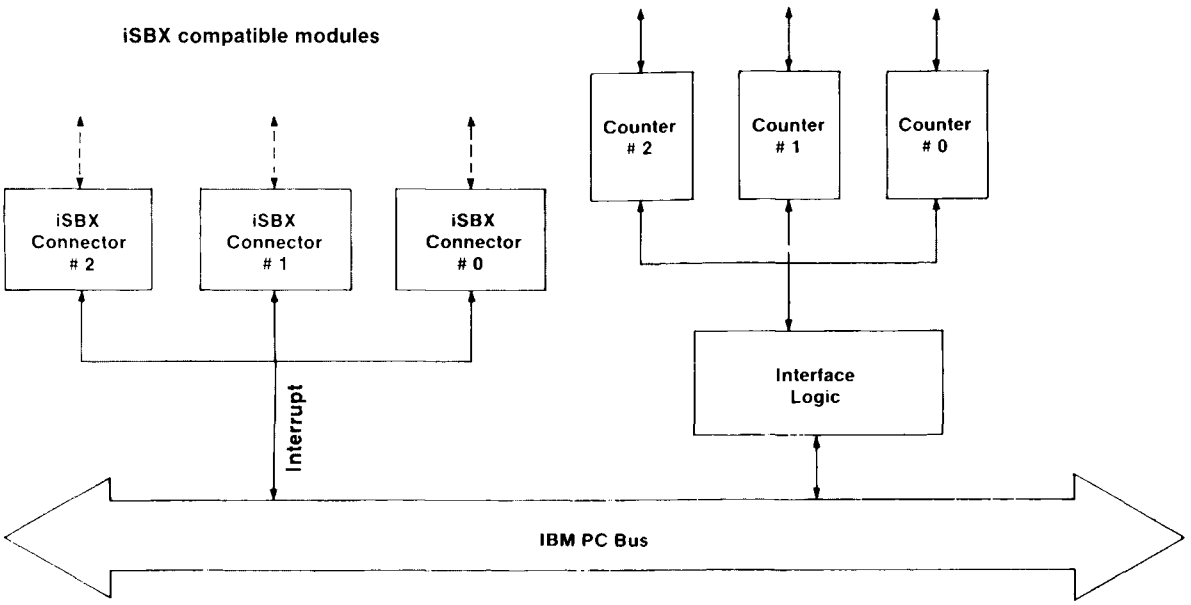
Screw Terminal Panels

Four screw terminal and signal conditioning panels are optionally available for use with the DT2801 Series boards. The DT707 table-top panel provides ease of connection, via screw terminals, for all analog and digital signals, as well as trigger inputs, to the I/O boards. The DT707 includes an integral one meter long flat ribbon cable for direct connection to the DT2801 Series boards and can be configured with a thermocouple cold junction compensation option (see below for detailed description). For 0 to 20mA current inputs, the DT707 provides blank pads to accommodate user-supplied current shunt resistors.

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The DT708 Screw Terminal Panel also provides easy connection via screw terminals for all analog and digital signals to the DT2801 Series boards. A 19 inch rack-mountable panel, the DT708 includes one 20-pin connector and two 50-pin connectors. One DT708 panel provides connections for two DT2801 Series analog and digital I/O boards or one DT2806 multifunction I/O board.

The DT752 is a screw terminal panel for the analog outputs, digital I/O, and clock signals of the DT2801 and includes a 20-pin connection for the analog input signals. The analog input connection on the DT752 allows the DT2801 to be used with the non-isolated DT709 and the isolated DT6700 series of signal conditioning panels. When used with the DT709, up to 16 differential inputs to the DT2801 may be protected to 100V. The DT6700 series provides ±1500V transient and ±250V common mode isolation of the DT2801 analog inputs. See the specific data sheets for further details.



DT2806: Block Diagram

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PRINCIPLES OF OPERATION

An on-board 8-bit microprocessor acts as the interface to the IBM PC Bus. All analog and digital I/O operations are controlled by the four 8-bit I/O locations of the microprocessor: the Command Register, the Status Register, the Data In and the Data Out Registers. These registers appear at two consecutive addresses in the IBM PC's I/O address space, i.e. the Command and Status Registers have the same address, and the Data In and Data Out Registers have the same address. The DT2801 Series boards' base addresses are jumper selectable to any even address within the IBM PC's 10-bit I/O address space.

Bytes written to the Command Register cause the on-board microprocessor to begin execution of a large number of commands controlling the A/D, D/A, and digital I/O subsystems. Execution of certain commands can be deferred until triggered by an external trigger signal. Bytes read from the Status Register contain flags used to signal errors, data register status, and completion of commands.

In addition to the error bits in the Status Register, there are 16 internal error bits which indicate exactly which errors have occurred. These error bits can be accessed using the READ ERROR REGISTER command and cleared using the CLEAR ERROR command.

The Data In and Data Out Registers are used to transfer all data to and from the DT2801 Series boards.

DMA handshaking lines allow the board to request DMA service from the IBM PC DMA controller.

Register Name	Register Function	Register Address
Data In Register	Receives data, command parameters from the host PC	Base (Write only)
Data Out Register	Contains data, error information from the board	Base (Read only)
Command Register	Receives command byte from the host PC	Base + 1 (Write only)
Status Register	Contains status byte from the board	Base + 1 (Read only)

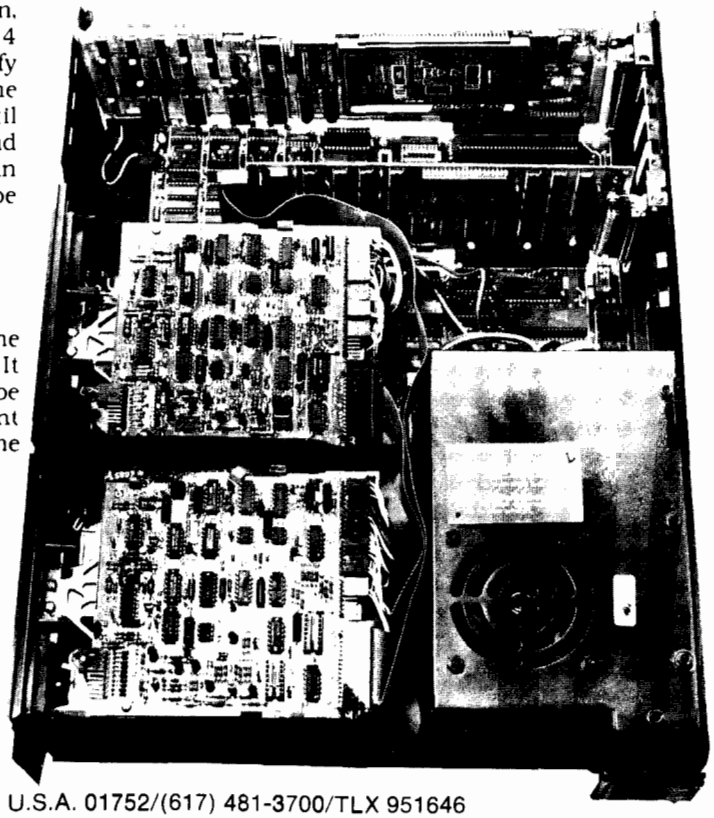
COMMAND REGISTER (BASE address + 1, write only)

The Command Register is a write-only register located at the base address + 1 of the DT2801 Series boards.

Bytes written to the Command Register enable the on-board microprocessor to execute the many commands which control A/D, D/A, digital I/O, clock, error detection, and reset functions. The command modifiers (bits 4 through 7) and OPCODE in the command bytes specify the exact operations to be executed by the board. The execution of any command may be deferred until triggered by an external trigger pulse. If a new command is issued while an old command is still running, an error bit will be flagged and the old command will be abandoned.

STATUS REGISTER (BASE ADDRESS + 1, read only)

The Status Register is a read-only register located at the base address + 1 of the DT2801 Series boards. It consists of five status flags. The Status Register can be read at any time and the flags will reflect the current state of the interface board, signalling errors and the completion of commands.



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COMMAND REGISTER FORMAT

7	6	5	4	3 2 1 0
EXT TRIGGER	**EXT CLK**	**CONTINUOUS**	**DMA**	**OPCODE**

BIT #	NAME	DESCRIPTION
7	EXTERNAL TRIGGER	When the external trigger bit is set, complete execution of some commands is deferred until a trigger pulse occurs on the external trigger line. After the trigger pulse, execution of the command will continue to completion.
6	EXTERNAL CLOCK	When the external clock bit is set, clock pulses occurring on the external clock input will be used to clock changes in input and output lines during block mode commands.
5	CONTINUOUS	The continuous mode, set by the continuous bit, enables A/D and D/A conversions to occur without interruption in Standard Block Operation or Block Operation with DMA operating modes until stopped by the STOP command or by the occurrence of an error.
4	DMA	Sets the DMA (Direct Memory Access) mode for A/D and D/A conversions, enabling direct transfers of data to and from memory to occur during block mode commands.
3-0	OPCODE	The OPCODE specifies the command to be executed.

STATUS REGISTER FORMAT

7	6	5	4	3	2	1	0
ERROR	**"0"**	**"0"**	**"0"**	**COMMAND**	**READY**	**DIF**	**DOR**

BIT #	NAME	DESCRIPTION
7	COMPOSITE ERROR	When set, the Composite Error flag indicates that an error has occurred; the READ ERROR REGISTER command should be issued and the internal Error Register should be read and decoded to find out exactly what type of error has occurred.
6,5,4	"0"	Value always reads as zero.
3	COMMAND	When set, the Command flag indicates that the last byte written to the DT2801 or DT2805 was a command written to the Command Register. When clear, the last byte written was data or a command parameter, written to the Data In Register.
2	READY	When set, the Ready flag indicates that the DT2801 or DT2805 is ready to begin execution of a new command; when clear, the Ready flag indicates that the I/O board is currently busy executing a command.
1	DATA IN FULL	The Data In Full flag indicates that the last command, command parameter or data byte written to the interface has not yet been stored. If new data is written when the Data In Full flag is set, the new information will overwrite the last command or data byte. The Data In Full flag must always be checked before the Data In Register is addressed to ensure that information written earlier is not lost. Undefined operations will otherwise result.
0	DATA OUT READY	The Data Out Ready flag indicates that data or error information is available in the Data Out Register. This bit should always be checked before reading data to ensure that the data present in the Data Out Register resulted from the current command.

DATA IN AND DATA OUT REGISTERS (BASE address)

The data registers are located at the base address of the interface board: the Data In Register is write-only, and the Data Out Register is read-only.

The Data In and Data Out Registers are used to transfer all data, command parameters, and error flag information between the IBM Personal Computer and the DT2801 Series boards.

DMA handshaking lines are available on the I/O boards and, when used with the DMA controller in the IBM Personal Computer, can be used to transfer data directly between the DT2801 Series board and the host computer's memory.

Data or command parameters must be written to the Data In Register as required by each operating sequence. If the Data In Register is written to when no command is running, a Data Where Command Expected Error occurs. If more data is written than the operating sequence requires, data will remain in the Data In Register until the command finishes execution, then the Data Where Command Expected Error will occur.

Data must be read from the Data Out Register as required by each operating sequence. In addition, the Data Out Register should be cleared of data with a read whenever a command is terminated due to an error or due to an additional write to the Command Register. The board will not return to the READY state if data remains in the Data Out Register.

DATA REGISTER FORMAT

DATA BYTE 1 (8-, 12-, 16-bit transfers)

7	6	5	4	3	2	1	0
D7	D6	D5	D4	D3	D2	D1	D0
							(LSB)

DATA BYTE 2 (12-bit transfers)

7	6	5	4	3	2	1	0
"0"	"0"	"0"	"0"	D11	D10	D9	D8
				(MSB)			

DATA BYTE 2 (16-bit transfers)

7	6	5	4	3	2	1	0
D15	D14	D13	D12	D11	D10	D9	D8
(MSB)							

8-bit data is transferred to and from the data registers in a single byte. 12-bit and 16-bit data written to (read from) the data register is divided into two consecutive bytes. 12-bit data must be right-justified within a 16-bit word to ensure that all meaningful information is contained in the lower 12 bits. When writing to or reading from the data registers, the lower byte, the least significant byte, is transferred first, followed by the upper byte.

ERROR REGISTER

The Error Register is an internal 16-bit register used to flag various types of errors that may occur. It can be read using the READ ERROR REGISTER command and it can be cleared using either the RESET command or the CLEAR ERROR command.

ERROR REGISTER FORMAT

ERROR BYTE 1

7	6	5	4	3	2	1	0
ERR7	ERR6	ERR5	ERR4	ERR3	ERR2	ERR1	ERR0

ERROR BYTE 2

7	6	5	4	3	2	1	0
ERR15	ERR14	ERR13	ERR12	ERR11	ERR10	ERR9	ERR8

ERROR COMMANDS

ERR0	Reserved
ERR1	Command Overwrite Error
ERR2	Clock Set Error
ERR3	DIO Select Error
ERR4	DIO Set Error
ERR5	DAC Select Error
ERR6	DAC Clock Error
ERR7	DAC# Conversions Value Error
ERR8	A/D Channel Error
ERR9	A/D Gain Error
ERR10	A/D Clock Error
ERR11	A/D Multiplexer Error
ERR12	A/D # Conversions Value Error
ERR13	Data Where Command Expected Error
ERR14	Reserved
ERR15	Reserved

OPERATING MODES

The DT2801 Series boards have two operating modes for controlling A/D, D/A, and digital I/O operations, as well as clock, error, and reset functions: Single Operation and Block Operation. Single Operation commands accomplish a single event when they are run.

Block Operation commands accomplish multiple data conversions when they are implemented. READ A/D and WRITE D/A are Block Operation commands. Depending on how the user sets the continuous and DMA bits of the command byte, four different Block Operation modes are available.

The operating modes determine the amount of analog or digital data the board processes with a single command, and whether the data transfers occur in programmed I/O (PIO) or DMA modes.

Single Operation

Block Commands
- Standard Block Operation
- Continuous Block Operation
- Block Operation with DMA
- Continuous Block Operation with DMA

Single Operation (A/D, D/A, Digital I/O)

Single Operation is the easiest means for accomplishing a single A/D, D/A, or digital I/O conversion. No set up command procedures are involved.

The Single Operation operating mode must always be triggered; the internal, software trigger will be generated by default if no other trigger is specified. Some of the commands will also run with an external trigger (TEST, SET DIGITAL PORT FOR INPUT, SET DIGITAL PORT FOR OUTPUT, READ DIGITAL INPUT IMMEDIATE, WRITE DIGITAL OUTPUT IMMEDIATE, READ A/D IMMEDIATE, WRITE D/A IMMEDIATE).

Block Commands (A/D, D/A)

Block commands are an easy way to program multiple analog I/O operations. The READ A/D and WRITE D/A commands can be used in any of four operating modes, depending on the setting of the Continuous and DMA bits of the Command byte.

The SET A/D PARAMETERS and SET D/A PARAMETERS commands must be executed before a READ A/D or WRITE D/A. These commands allow the user to set data conversion parameters once for many subsequent Block mode data conversions. SET A/D PARAMETERS determines the number of conversions, the gain, and the starting and ending channel numbers. SET D/A PARAMETERS specifies DAC Select and the number of conversions.

Block Operation READ/WRITE commands must use the on-board clock or be externally clocked. All commands are started by either an internal or external trigger. The default trigger is an internal, software trigger generated by the DT2801 Series board.

1. Standard Block Operation

In Standard Block Operation, the DT2801 Series boards will perform a data conversion each time an internal or external clock pulse occurs. The user program must poll the DT2801 Series board to determine when the command has completed. Hence Standard Block Operations performed, for example, under the BASIC interpreter will be slow.

In this mode, the user must specify the number of data conversions required, the A/D channel(s) and DAC(s) on which data conversion will occur, and (for A/D conversions only) the input gain setting.

2. Continuous Block Operation

Continuous Block Operation is similar to Standard Block Operation, except that the data conversion operation will continue on the channels specified until the command is halted by a STOP command, or by an error.

In Continuous Block Operation the user must specify only the channel(s) on which data conversion will occur, and (for A/D conversions only) the input gain setting.

3. Block Operation with Direct Memory Access

Block Operation with DMA is identical to Standard Block Operation, except that it allows the DT2801 Series board to transfer data directly to and from the personal computer's memory without intervention from the host CPU. This results in a higher throughput of data than is generally possible without DMA. Block Operation with DMA can be implemented under the interpreted or compiled BASIC of the IBM Personal Computer.

When written to the Command Register, the READ/WRITE WITH DMA command byte initiates a block of clocked A/D or D/A reads/writes on the channel(s) previously specified by the SET A/D PARAMETERS OR SET D/A PARAMETERS commands. A DMA request is issued by the interface board after each byte of data is ready; the IBM PC DMA controller must be programmed to respond to these requests.

As in Standard Block Operation mode, the user must specify the number of data conversions required, the A/D and D/A channel(s) on which data conversion will occur and (for A/D conversions only) the input gain setting.

4. Continuous Block Operation with DMA

Continuous Block Operation with DMA is identical to the Continuous Block Operation mode, except that it allows the DT2801 Series board to transfer data directly to and from the personal computer's memory without intervention from the host CPU. This results in a higher throughput of data than is generally possible without DMA.

As in Continuous Block Operation mode, the user must specify only the channel(s) on which data conversion will occur, and (for A/D conversions only) the input gain setting.

SUMMARY OF ANALOG AND DIGITAL I/O COMMANDS

COMMAND BYTE (first 4 bits = 4-bit command modifiers; last 4 bits = 4-bit opcode)	OPERATING MODE		COMMAND DESCRIPTION
	SINGLE	BLOCK	
			General Commands
00000000	X		RESET
00000001	X		CLEAR ERROR
00000010	X		READ ERROR REGISTER
00000011	X		SET INTERNAL CLOCK PERIOD
00001111	X		STOP
00001011	X		TEST
			Digital I/O Commands
00000100	X		SET DIGITAL PORT FOR INPUT
10000100	X		SET DIGITAL PORT FOR INPUT, TRIGGER
00000101	X		SET DIGITAL PORT FOR OUTPUT
10000101	X		SET DIGITAL PORT FOR OUTPUT, TRIGGER
00000110	X		READ DIGITAL INPUT IMMEDIATE
10000110	X		READ DIGITAL INPUT IMMEDIATE, TRIGGER
00000111	X		WRITE DIGITAL OUTPUT IMMEDIATE
10000111	X		WRITE DIGITAL OUTPUT IMMEDIATE, TRIGGER
			D/A Commands
00001000	X		WRITE D/A IMMEDIATE
10001000	X		WRITE D/A IMMEDIATE, TRIGGER
00001001		X	SET D/A PARAMETERS
00001010		X	WRITE D/A
00101010		X	WRITE D/A, CONTINUOUS MODE
01001010		X	WRITE D/A, EXT CLK
01101010		X	WRITE D/A, EXT CLK, CONTINUOUS MODE
10001010		X	WRITE D/A, TRIGGER
10101010		X	WRITE D/A, TRIGGER, CONTINUOUS MODE
11001010		X	WRITE D/A, EXT CLK, TRIGGER
11101010		X	WRITE D/A, EXT CLK, TRIGGER, CONTINUOUS MODE
00011010		X	WRITE D/A, DMA
00111010		X	WRITE D/A, DMA, CONTINUOUS MODE
01011010		X	WRITE D/A, DMA, EXT CLK
01111010		X	WRITE D/A, DMA, EXT CLK, CONTINUOUS MODE
10011010		X	WRITE D/A, DMA, TRIGGER
10111010		X	WRITE D/A, DMA, TRIGGER, CONTINUOUS MODE
11011010		X	WRITE D/A, DMA, EXT CLK, TRIGGER
11111010		X	WRITE D/A, DMA, EXT CLK, TRIGGER, CONTINUOUS MODE
			A/D Commands
00001100	X		READ A/D IMMEDIATE
10001100	X		READ A/D IMMEDIATE, TRIGGER
00001101		X	SET A/D PARAMETERS
00001110		X	READ A/D
00101110		X	READ A/D CONTINUOUS MODE
01001110		X	READ A/D, EXT CLK
01101110		X	READ A/D, EXT CLK, CONTINUOUS MODE
10001110		X	READ A/D, TRIGGER
10101110		X	READ A/D, TRIGGER, CONTINUOUS MODE
11001110		X	READ A/D, EXT CLK, TRIGGER
11101110		X	READ A/D, EXT CLK, TRIGGER, CONTINUOUS MODE
00011110		X	READ A/D, DMA
10011110		X	READ A/D, DMA, EXT CLK
00111110		X	READ A/D, DMA, CONTINUOUS MODE
10111110		X	READ A/D, DMA, EXT CLK, CONTINUOUS MODE
01011110		X	READ A/D, DMA, TRIGGER
01111110		X	READ A/D, DMA, TRIGGER, CONTINUOUS MODE
11011110		X	READ A/D, DMA, EXT CLK, TRIGGER
11111110		X	READ A/D, DMA, EXT CLK, TRIGGER, CONTINUOUS MODE

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EXAMPLE I/O OPERATING SEQUENCE

Many DT2801 Series commands require that bytes containing data or command parameters be written to the I/O board's Data In Register before the command can run. The DT2801 Series user manual contains operating sequences for each command. The operating sequences outline all the steps required to make the command operate. A typical operating sequence for the command READ A/D IMMEDIATE follows.

READ A/D IMMEDIATE performs a single A/D conversion at the analog input gain, specified in the second step, and on the channel specified in the third step. Two bytes of data are written out, the A/D low byte and the A/D high byte. READ A/D IMMEDIATE can use either an internal software trigger or an external trigger to start the I/O event.

1. Check Status Register for set READY flag, clear ERROR flag, then write command word to Command Register.
2. Check Status Register for clear DATA IN FULL flag, then write A/D gain to Data In Register.
3. Check Status Register for clear DATA IN FULL flag, then write A/D channel number to Data In Register.
4. If no external trigger, the DT2801 Series board issues a software trigger.
5. If external trigger:
   a. Wait at least 1ms.
   b. Issue external trigger.
6. A/D conversion occurs.
7. Check Status Register for set DATA OUT READY flag or set READY flag, then read converted A/D data, low byte from Data Out Register.
8. Check Status Register for set DATA OUT READY flag or set READY flag, then read converted A/D data, high byte from Data Out Register.
9. Check Status Register for set READY flag, clear ERROR flag to indicate successful command completion.

EXAMPLE PROGRAM

The following BASIC example program causes the high level, DT2801 to make a single A/D conversion, then converts the A/D reading to voltage and prints the voltage value out. This A/D conversion can be done on any channel, at any one of the four legal gains for the DT2801 (1,2,4,8) or at a gain of 1 for the DT2805.

```
10        '' READ A/D IMMEDIATE command example.
20        ''
30        '' Define constants.
40        ''
50        DEFINT A-Z
60        BASE.ADDRESS      = &H2EC
70        COMMAND.REGISTER  = BASE.ADDRESS + 1
80        STATUS.REGISTER   = BASE.ADDRESS + 1
90        DATA.REGISTER     = BASE.ADDRESS
100       COMMAND.WAIT      = &H4
110       WRITE.WAIT        = &H2
120       READ.WAIT         = &H5
130       ''
140       CCLEAR            = &H1
150       CADIN             = &HC
160       CSTOP             = &HF
200       ''
210       '' Stop and clear the DT2801.
220       ''
230       OUT COMMAND.REGISTER, CSTOP
240       TEMP = INP(DATA.REGISTER)
250       WAIT STATUS.REGISTER, COMMAND.WAIT
260       OUT COMMAND.REGISTER, CCLEAR
1000      ''
1010      '' Get the desired A/D channel and gain parameters from user.
1020      ''
1030      PRINT "ADGAIN (FOR GAINS OF 1,2,4, OR 8, TYPE 0,1,2 OR 3)";
1040      INPUT ADGAIN
1050      IF ADGAIN < 0 THEN GOTO 1030
1060      IF ADGAIN > 3 THEN GOTO 1030
1070      ''
1080      INPUT "A/D CHANNEL (0-15 SE, 0-7 DI)":ADCHANNEL
1090      IF ADCHANNEL < 0 THEN GOTO 1080
1100      IF ADCHANNEL > 15 THEN GOTO 1080
1110      ''
1120      '' Wait until the DT2801 READY flag is set, then write the
1130      '' READ A/D IMMEDIATE command byte to the Command Register.
1140      ''
```

```
1150            WAIT STATUS.REGISTER, COMMAND.WAIT
1160            OUT COMMAND.REGISTER, CADIN
1170    '
1180    '       Wait until the DT2801 DATA IN FULL flag is clear, then write
1190    '       the A/D gain byte to the DT2801 Data In Register.
1200    '
1210            WAIT STATUS.REGISTER, WRITE.WAIT, WRITE.WAIT
1220            OUT DATA.REGISTER, ADGAIN
1230    '
1240    '       Wait until the DT2801 DATA IN FULL flag is clear, then write
1250    '       the A/D channel byte to the DT2801 Data In Register.
1260    '
1270            WAIT STATUS.REGISTER,   WRITE.WAIT, WRITE.WAIT
1280            OUT DATA.REGISTER, ADCHANNEL
1290    '
1300    '       Read two bytes of A/D data from the Data Out Register, waiting
1310    '       for a set DATA OUT READY (or READY) flag before each read, and
1320    '       combine the two bytes into one word.
1330    '
1340            WAIT STATUS.REGISTER, READ.WAIT
1350            LOW = INP(DATA.REGISTER)
1360            WAIT STATUS.REGISTER, READ.WAIT
1370            HIGH = INP(DATA.REGISTER)
1380            DATA.VALUE# = HIGH * 256 + LOW
1390    '
1400    '       Wait until the DT2801 READY flag is set, indicating command
1410    '       completion, then check the Status Register ERROR flag.
1420    '
1430            WAIT STATUS.REGISTER, COMMAND.WAIT
1440            STATUS = INP(STATUS.REGISTER)
1450            IF (STATUS AND &H80) THEN GOTO 2000
1460    '
1470    '       Calculate and print the A/D reading in volts.
1480    '
1490            GAIN = 2 ^ ADGAIN
1500            FACTOR# = (10 / 4096) / GAIN
1510            UNI.VOLTS# = DATA.VALUE# * FACTOR#
1520            BI.VOLTS# = UNI.VOLTS# * 2 - (10 / GAIN)
1530    '
1540            PRINT
1550            PRINT "VALUE IF UNIPOLAR IS ";
1560            PRINT USING "###.###";UNI.VOLTS#;
1570            PRINT "      VOLTS"
1580            PRINT
1590            PRINT "VALUE IF BIPOLAR IS ";
1600            PRINT USING "###.###";BI.VOLTS#;
1610            PRINT "      VOLTS"
1620            PRINT
1630    '
1640            END
2000    '
2010    '       Error.
2020    '
2030            PRINT
2040            PRINT "ERROR"
2050            PRINT
2060    '
2070            END
```

SIMULTANEOUS SAMPLE AND HOLD OPERATION

The DT2818 was designed to operate efficiently and easily. When scanning multiple input channels, initially all sample and hold circuits are in the sample (track) mode and are tracking the input signal. Whenever a clock signal (internal or external) is detected, all sample and hold circuits are simultaneously switched into the hold mode and the input channel values are frozen within a ±5 nanosecond window. After scanning all channels, the sample and hold circuits are switched back to track mode. The next occurrence of a clock signal will cause this cycle to be repeated.

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EXAMPLE I/O OPERATING SEQUENCE

The following is a typical operating sequence for reading a scan of three simultaneously sampled input channels.

The READ A/D command initiates a scan of clocked A/D conversions on the three channels specified in a previous SET A/D PARAMETERS command. Two bytes of data are written out for each channel, the A/D low byte and the A/D high byte. READ A/D can use either an internal software trigger or an external trigger to start the I/O event and can be run in continuous or non-continuous modes.

1. Perform a SET A/D PARAMETERS operating sequence defining the A/D gain to be equal to one; the A/D scan is specified to start on channel 0 and end on channel 2 (total of 3 channels scanned).
2. If no external clock, set clock with SET INTERNAL CLOCK PERIOD command.
3. If external clock:

   A. Connect external clock to pin 50 of the J1 connector.
4. Check Status Register, then write a READ A/D command to the Command Register.
5. If no external trigger, the DT2818 issues a software trigger.
6. If external trigger:

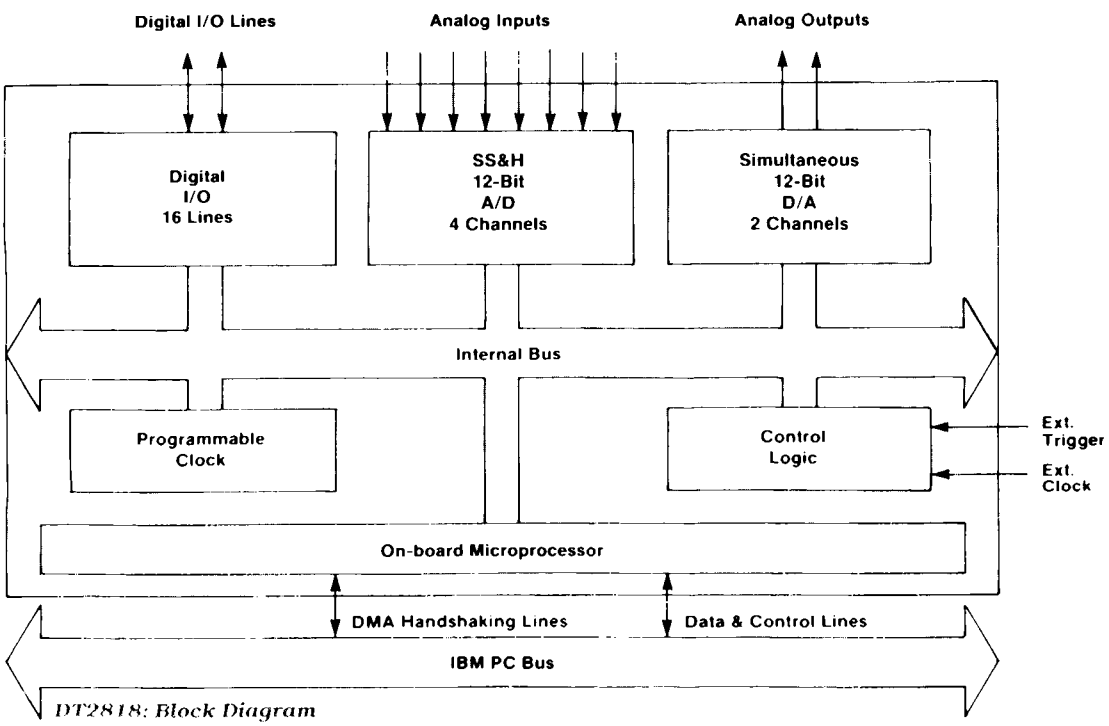
   A. Wait at least 1 millisecond.

   B. Issue external trigger.

7a. The first clock transition (from high to low) is used to synchronize the on-board circuitry with the internal or external clock.

7b. The next clock transition causes the Sample and Hold circuitry on ALL channels specified to go into HOLD mode. The first A/D channel conversion of the frozen values occurs on channel 0.

8. Check Status Register, then read the low byte of data from the first A/D conversion (channel 0) from the Data Out Register.
9. The next A/D channel conversion occurs on channel 1 after the data is read from the Data Out Register.
10. Check Status Register, then read the high byte of data from the first A/D conversion (channel 0) from the Data Out Register.
11. Check Status Register, then read the low byte of data from the second A/D conversion (channel 1) from the Data Out Register.
12. The third A/D channel conversion occurs on channel 2 after the data is read from the Data Out Register.
13. Check Status Register, then read the high byte of data from the second A/D conversion (channel 1) from the Data Out Register.
14. Check Status Register, then read the low byte of data from the third A/D conversion (channel 2) from the Data Out Register.
15. All Sample and Hold circuits are unfrozen and go back to sample (track) mode.
16. Check Status Register, then read the high byte of data from the third A/D conversion (channel 2) from the Data Out Register.
    NOTE: the high byte of data is not available until after the next clock pulse (internal or external) is issued.
17. Continuous mode:
    Events 7b through 13 continue until a STOP command is issued, or until an error occurs.



DT2818: Block Diagram

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SPECIFICATIONS

Analog Input Specifications:	DT2801	DT2805
Accuracy		
Resolution	12 bits: DT2801, DT2801-A 16 bits: DT2801/5716	12 bits: DT2805 16 bits: DT2805/5716
Programmable gain	1, 2, 4, 8	1, 10, 100, 500
Accuracy	±0.03% FSR (gain=1): 12-bit A/D ±0.05% FSR (gain=2,4,8): 12-bit A/D ±0.0075% FSR (gain=1): 16-bit A/D ±0.01% FSR (gain=2,4,8): 16-bit A/D	* ±0.04% FSR (gain=10) 12-bit A/D ±0.06% FSR (gain=100) 12-bit A/D ±0.10% FSR (gain=500) 12-bit A/D ±0.04% FSR (gain=500): 16-bit A/D
Noise	0.03% FSR RMS	*
Linearity	To within ±½ LSB	*
Gain error	Adjustable to zero	*
Offset error	Adjustable to zero	*
Temperature		
Operating Range	0 to 50°C	*
Monotonicity	0 to 50°C	*
A/D zero drift	±20μV/°C (12-bit A/D) ±12μV/°C (16-bit A/D)	* *
Amplifier zero drift	(±3μV/°C) x gain (12-bit A/D) (±2μV/°C) x gain (16-bit A/D)	* *
Gain drift	±35ppm of FSR/°C (12-bit A/D) ±15ppm of FSR/°C (16-bit A/D)	* ±20ppm of FSR/°C (16-bit A/D)
Dynamic performance		
Throughput	13,700 Hz typical(DT2801) 27,500 Hz typical(DT2801-A) 2,500 Hz typical(DT2801/5716)	2500 Hz to 13,700Hz typical 100 Hz to 2,500Hz (DT2805/5716)++
Input Specifications		
Number of channels	16 SE or 8 DI (jumper selectable on 12-bit A/D) 8 DI only (16-bit A/D)	8 DI *
Maximum input voltage without damage, power on	±30V (12-bit A/D) ±16V (16-bit A/D)	* *
Input noise	10μV RMS	*
Channel to channel input error	±10μV	*
Coding	Straight binary, offset binary (12-bit A/D) Two's complement, bipolar (16-bit A/D)	* *
Ranges		
Programmable input ranges		
bipolar	±1.25V, 2.5V, 5V, 10V	±20mV, ±100mV, ±1V, ±10V
unipolar	0 to +1.25V, 0 to +2.5V, 0 to +5V, 0 to +10V	0 to 20mV, 0 to 100mV, 0 to 1V, 0 to 10V

++ NOTE: The timing capacitor installed on the DT2805/5716 has been configured for a maximum gain of 500. In order to allow higher throughputs with the DT2805 models, this capacitor (C26) can be changed or removed.

DT2805/5716 Maximum Throughput

Maximum gain = 500,	C26 = 0.1 μF (factory installed)	100Hz
Maximum gain = 100,	C26 = 0.022 μF	700Hz
Maximum gain = 10,	C26 = NONE	2,500Hz
Maximum gain = 1,	C26 = NONE	2,500Hz

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Analog Input Specifications: DT2808

Accuracy	
Resolution	10 bits
Accuracy	±0.12% FSR
Noise	±0.12% FSR
Gain & offset errors	Adjustable to zero
Temperature	
Operating Range	0 to 50°C
A/D zero drift	±25μV/°C
Dynamic performance	
Throughput	3,000 Hz typical
Input Specifications	
Number of channels	16 single ended
Input Range	0 to 5 V
Maximum input voltage without damage, power on	±20V
Input noise	±1mV
Channel to channel input error	±10μV
Coding	Straight binary

Analog Input Specifications: DT2818

Accuracy	
Resolution	12 bits
Accuracy	±0.04% FSR
Noise	±0.2LSB RMS
Offset error, hold mode	±10mV
Thermal Characteristics	
Operating range	0 to +50°C
Zero drift	±20ppm of FSR/°C
Differential linearity drift	±3ppm of FSR/°C
Monotonicity	0 to 50°C
Dynamic Performance	
Throughput	27,500 conversions per second maximum (using READ A/D DMA command) 200 scans per second minimum (on up to 4 channels) for guaranteed accuracy
Sample & hold aperture uncertainty	±5ns across all channels
Sample & hold droop rate	0.5mV/mS
Slewing rate	5V/μS
Bandwidth	1MHz
Phase match at 50kHz	within 0.1 degree
Input Specifications	
Number of channels	4 single ended
Input ranges (jumper-selectable)	0 to +10V, ±10V
Output data codes	Straight binary, offset binary
Maximum input voltage, without damage	±(Vcc + 16) volts
Channel-to-channel offset error, hold mode	±10mV

Analog Output Specifications: DT2801, DT2805 and DT2818

Accuracy	
Resolution	12 bits
Non-linearity	0.02%
Differential linearity	±½LSB
Dynamic Performance	
Settling time to 0.01% FSR (10V step)	35μS
Settling time to 0.01% FSR (100mV step)	10μS
Slew rate	0.50V/μS
Temperature	
Operating Range	0 to +50°C
Monotonicity	0 to +50°C
Offset drift (unipolar)	±3 ppm of FSR/°C
Offset drift (bipolar)	±30 ppm of FSR/°C
Gain drift	±30 ppm of FSR/°C

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Analog Output Specifications: DT2801, DT2801 and DT2818 (Cont.)

Output Characteristics	
Range	±10V, ±5V, ±2.5V, 0 to +10V, 0 to +5V (jumper selectable)
Number of channels	2
Data Coding	Binary, offset binary
Current Output	5mA maximum
Impedance (dc)	<0.1Ω
Noise(rms)	<0.05% FSR
Capacitive loading	0.5μF
Protection	Short circuit protected
Throughput to memory	14.8kHz/channel, single channel mode (DT2801) 8kHz/channel, dual channel mode (DT2801) 29.5kHz/channel, single channel mode (DT2801-A) 16.5kHz/channel, dual channel mode (DT2801-A)

Analog Output Specifications: DT2808

Accuracy	
Resolution	8 bits
Temperature	
Operating Range	0 to +50°C
Offset drift (unipolar)	±3 ppm of FSR/°C
Offset drift (bipolar)	±30 ppm of FSR/°C
Output Characteristics	
Range	0 to +5V (unipolar), ±5V (bipolar)
Number of channels	2
Data Coding	Straight binary (unipolar) Offset binary (bipolar)
Noise	<0.05% FSR RMS
Protection	Short circuit protected
Throughput	10,000 Hz (8 bit transfer) 5,000 Hz (16 bit transfer)

Digital I/O Specifications: DT2801, DT2805, DT2808, DT2818

Digital Input Specifications	
Logic load	Presents 1 LSTTL load
Digital Output Specifications	
Fanout	Drives 37.5 LSTTL loads
High-level output voltage	2.0V minimum
Low-level output voltage	0.5V maximum
High-level output current	-15mA maximum
Low-level output current	24mA minimum
External Trigger Specifications	
Logic load	Presents 1 LSTTL load
Input type	Schmitt Trigger—edge sensitive
Minimum pulse width	200ns
External Clock Specifications	
Logic load	Presents 1 LSTTL load
Input type	Schmitt Trigger—edge sensitive
Minimum pulse width	200ns

Physical/Environmental Specifications:	**DT2801, DT2805, DT2806, DT2808, DT2818**
Dimensions (including connector)	4.5" H X 13.5" W X 1" D (11.4 X 34.3 X 2.5 cm)
Operating Temperature Range	0 to 50°C
Storage Temperature Range	-25 to 70°C
Humidity	90%, non-condensing
Power Consumption	+5V @ 1.2A typical

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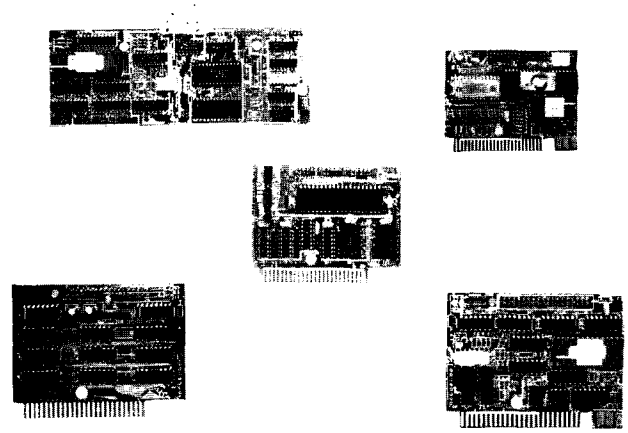
DATA TRANSLATION®

iSBX™ SERIES
MULTIFUNCTION I/O MODULES
DTX SERIES

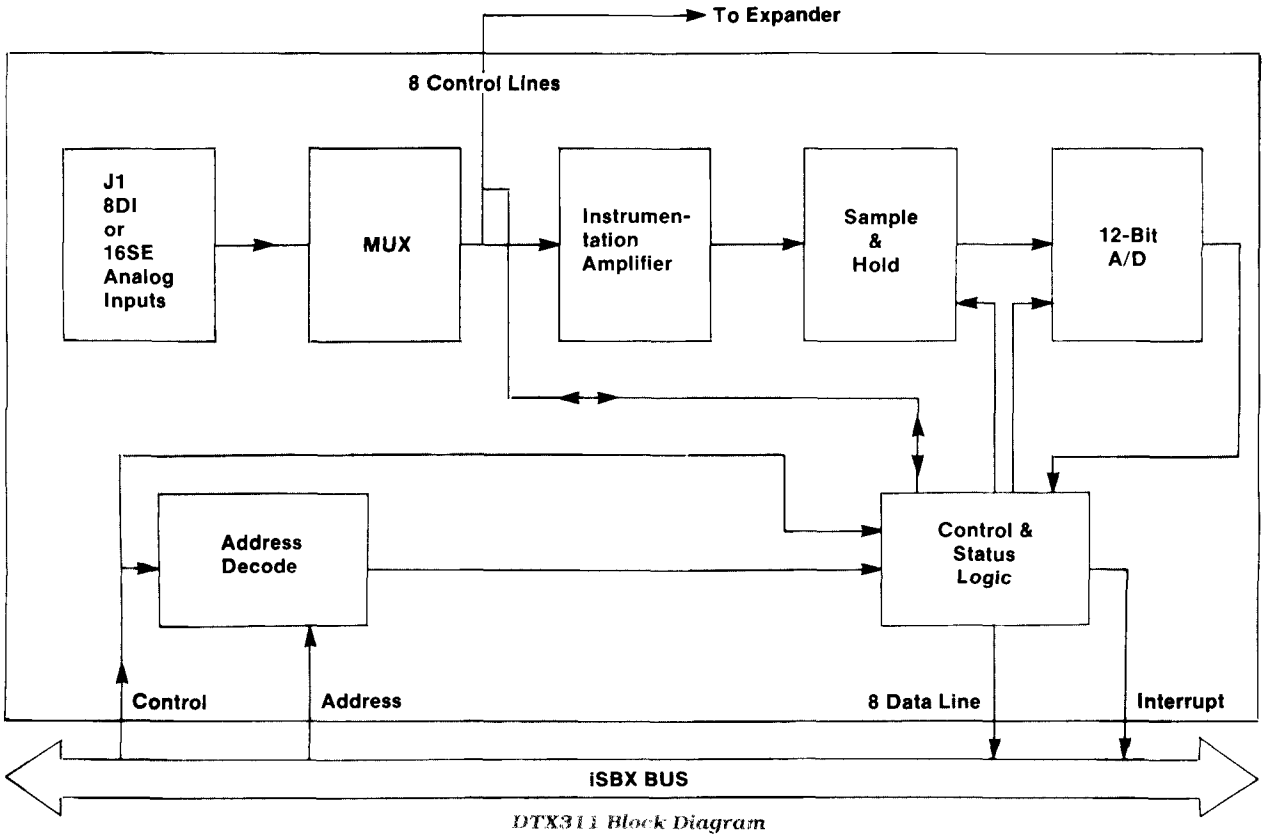
FEATURES

- **Low cost, industry standard iSBX bus compatible modules support a variety of I/O functions, including A/D, D/A and digital I/O**
- **Compatible with the DT2806 IBM ™ PC multifunction I/O mother board**
- **Compatible with the DT901 BITBUS™ multifunction interface board**
- **DTX344 BITBUS controller board on a dual size module**
- **Shipped complete with comprehensive User Manual**

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Data Translation's DTX Series offers a complete range of analog and digital I/O capabilities on iSBX compatible modules.



DTX311 Block Diagram

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DESCRIPTION

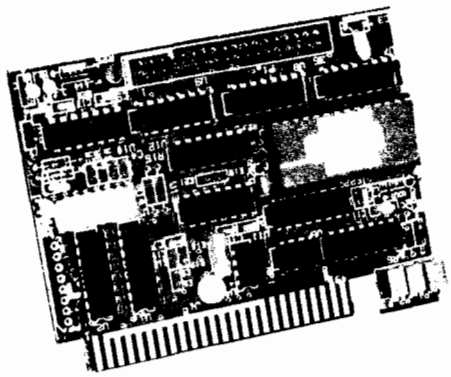
The DTX Series is a family of iSBX compatible modules. Based on the industry standard iSBX interface protocol, the DTX Series allows the user to add various I/O functions directly onto the host computer bus or remotely via plug-in modules and a mother board.

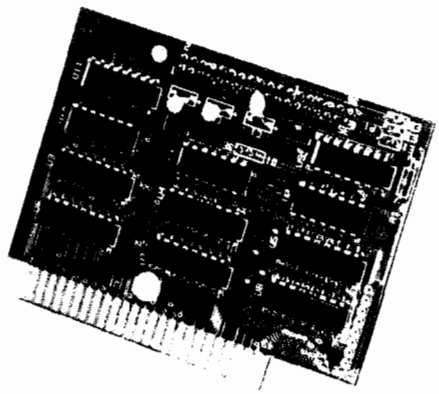
DTX modules conform to the iSBX industry standard open bus architecture. DTX series modules are compatible with the iSBX connections on the Data Translation DT2806 multifunction I/O board for the IBM PC and with the DT901 remote multifunction interface board for the Intel® BITBUS.

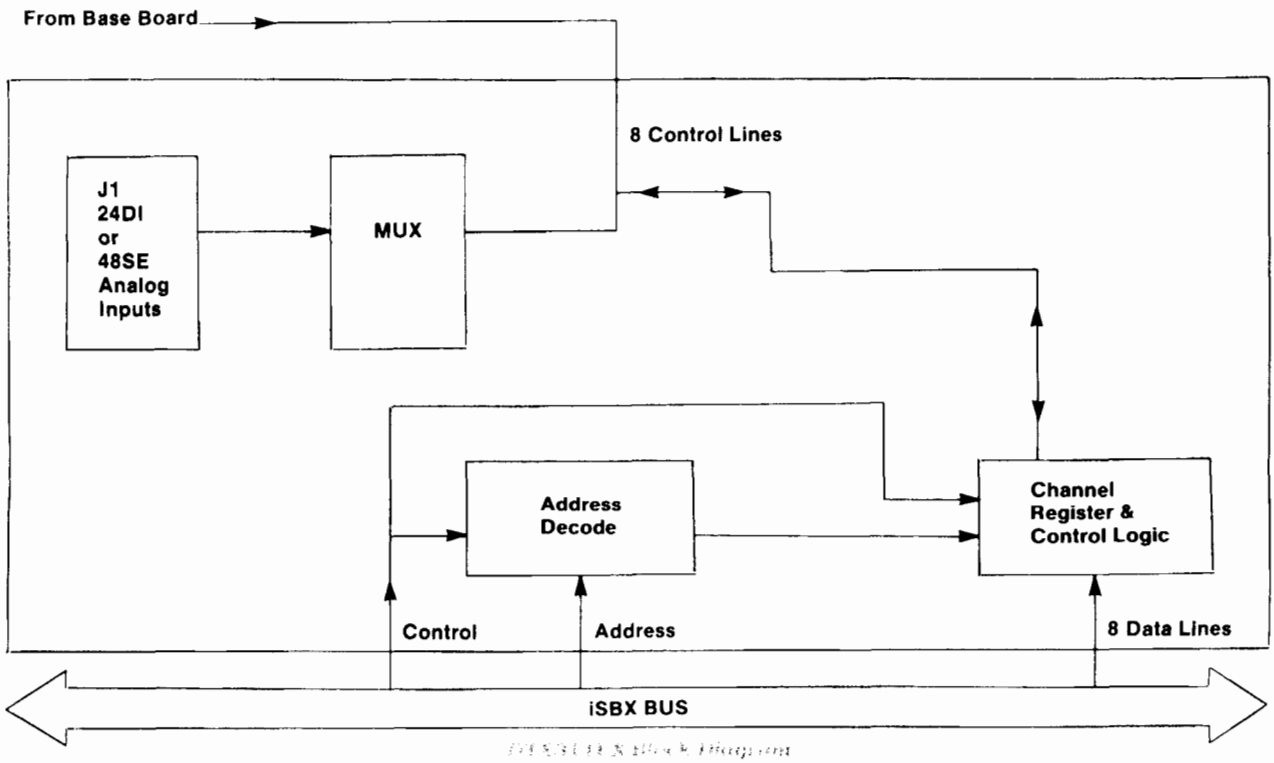
DTX311, DTX311EX Analog Input Modules

The Data Translation DTX311 analog input module provides 16SE/8DI analog input channels with 12-bit resolution and interrupt capabilities. The DTX311 is hardware and software compatible with the Intel iSBX 311 with the added features of expandability, higher accuracy, lower power, and jumper selectable gains of 1, 10, 100 and 1000.

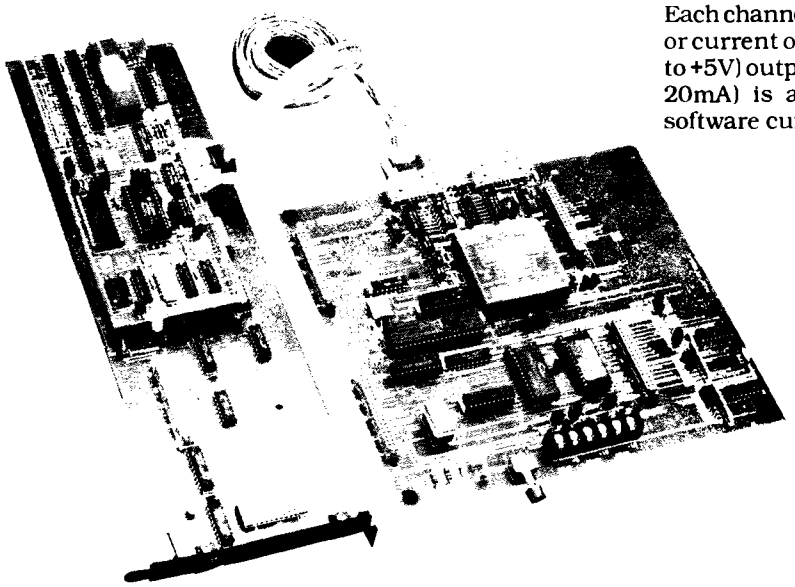
The DTX311EX expands the Data Translation DTX311 to 64SE/32DI analog input channels. The DTX311EX must plug into an iSBX connector adjacent to the base DTX311 module to receive a channel address. An EP193 is an 8-pin connection plug that connects the DTX311 base board to the DTX311EX expander board. One EP193 is shipped with every DTX311EX.



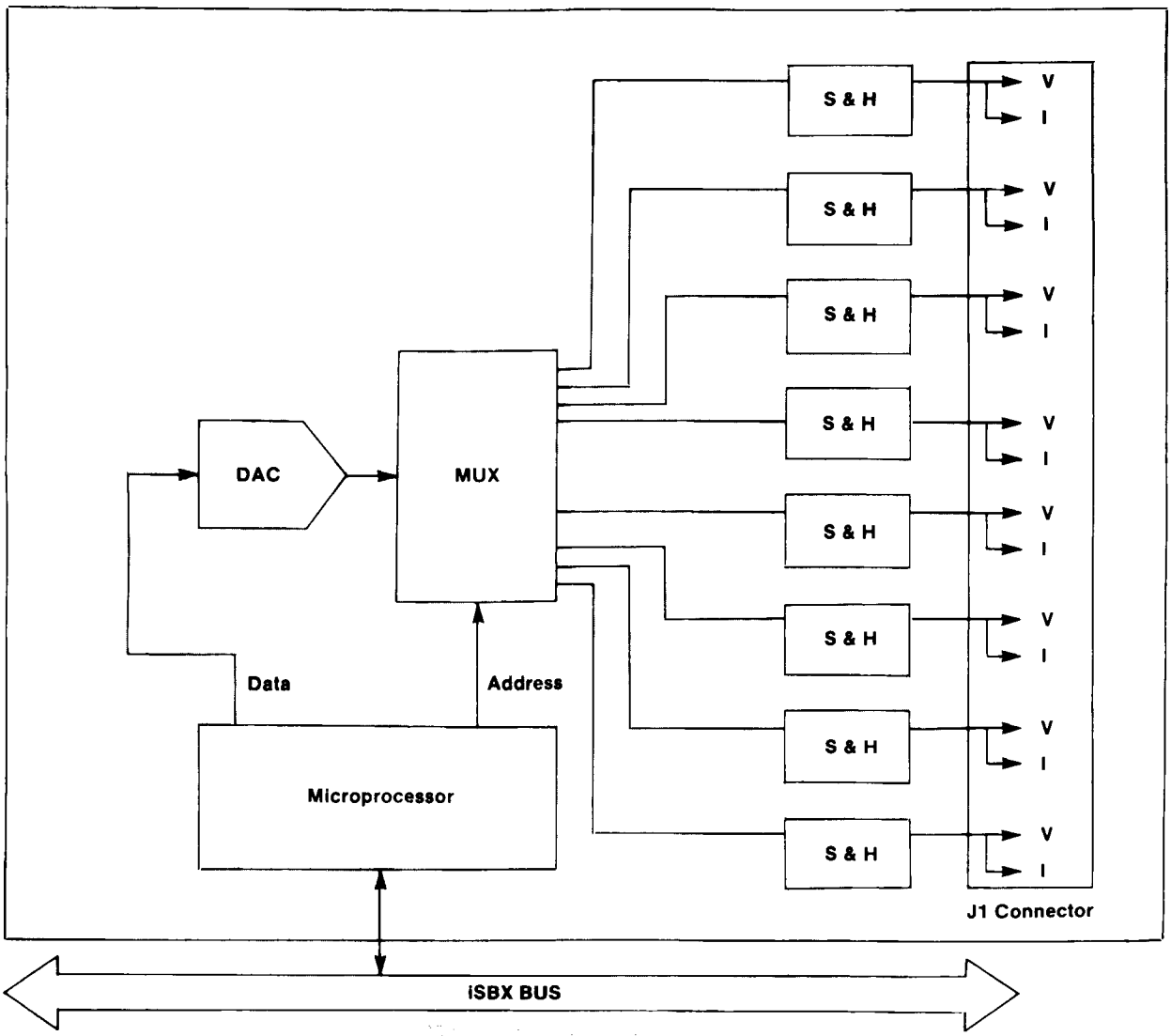




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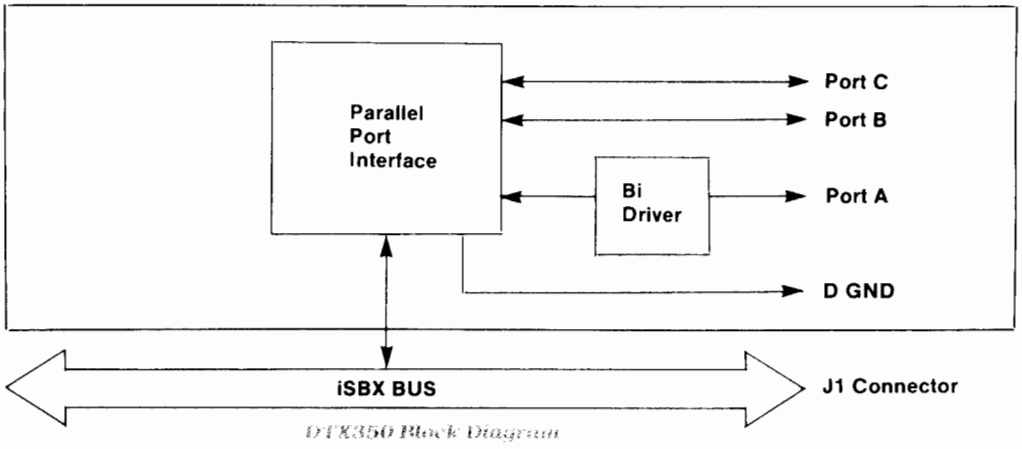
The DTX328 is an eight channel 12-bit D/A module. Each channel provides separate jumper selectable voltage or current outputs. Bipolar (-5V to +5V) and unipolar (0 to +5V) outputs are available. A current loop output (4 to 20mA) is also available with either a hardware or software current offset.



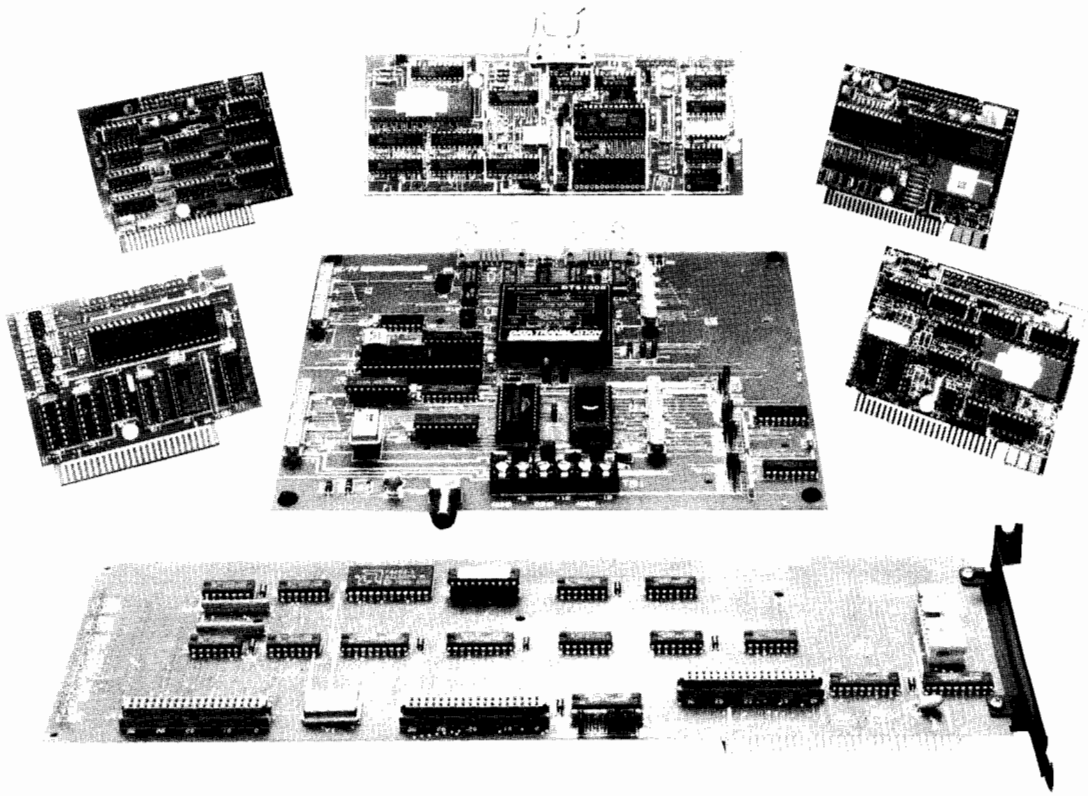
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DTX350 Digital I/O Module

The DTX350 provides 24 lines of digital I/O configured as three 8-bit programmable bidirectional parallel ports.



DTX350 Block Diagram

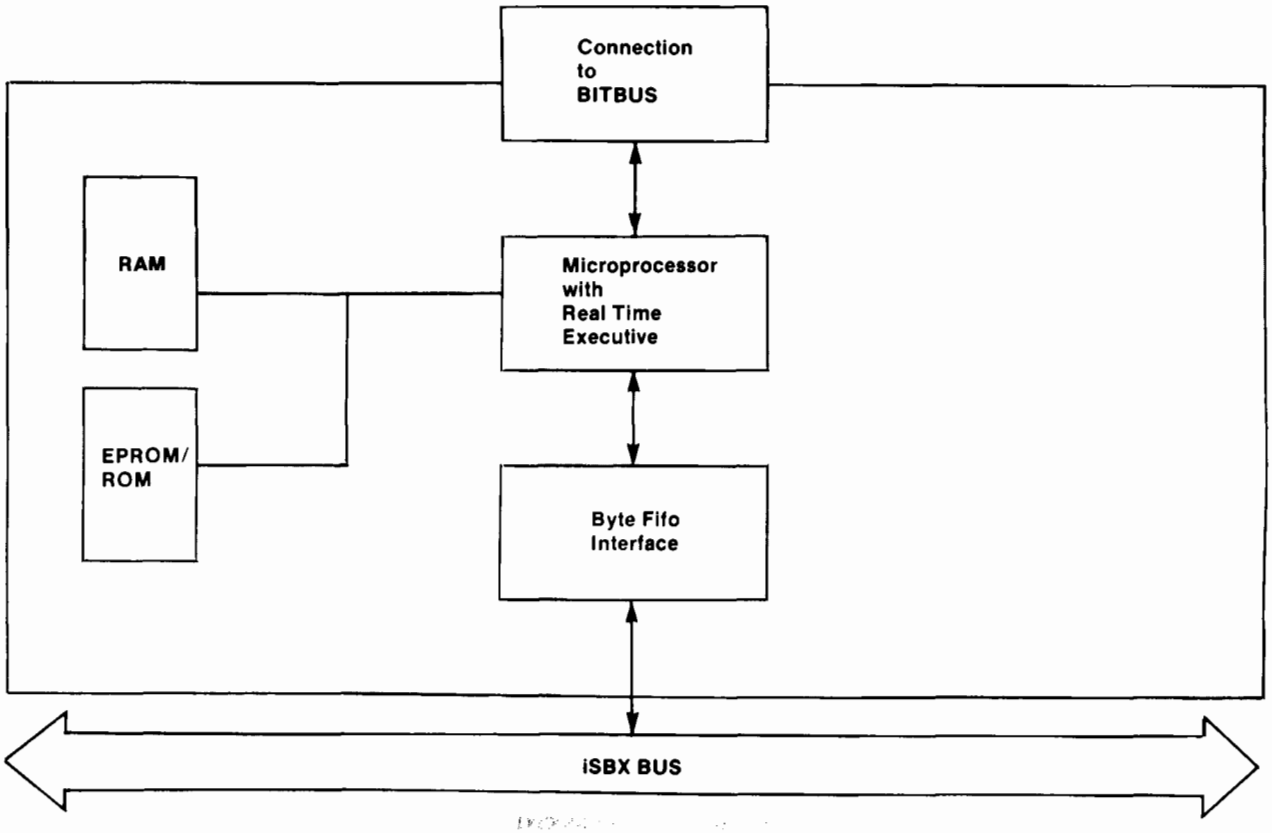


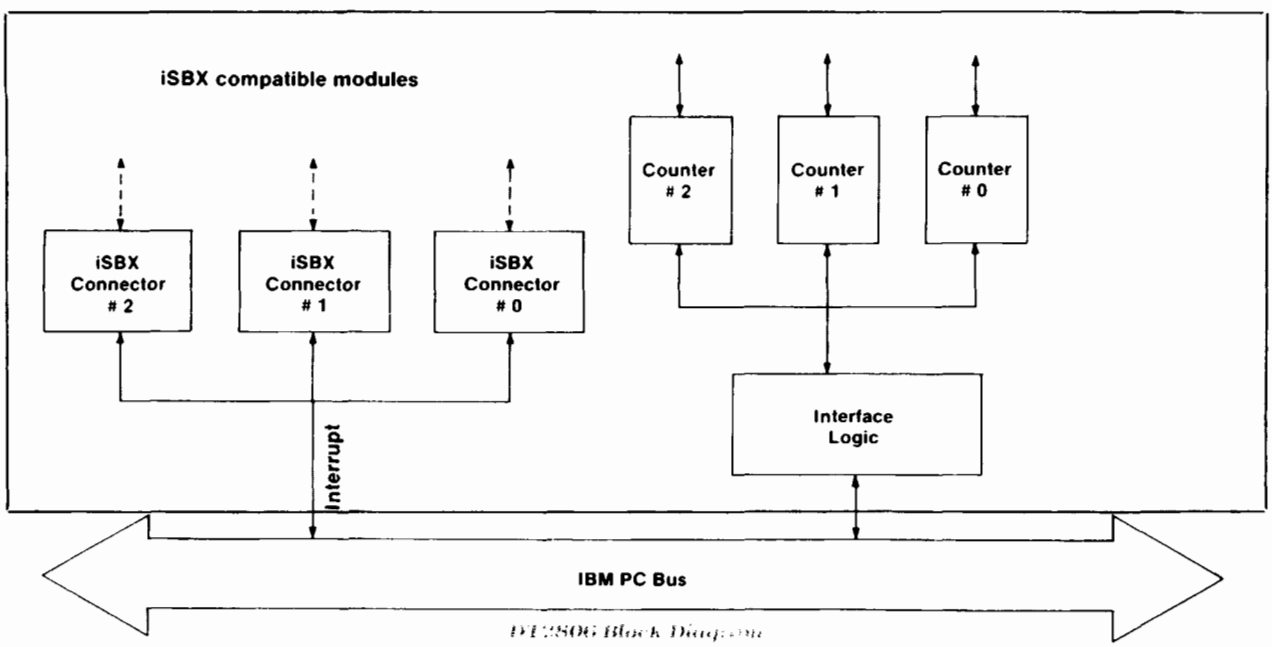
The family of Data Translation BITBUS products include (clockwise from the top) DTX344, DTX328, DTX311, DT2806, DTX350, DTX311EX, and DT901 (center).

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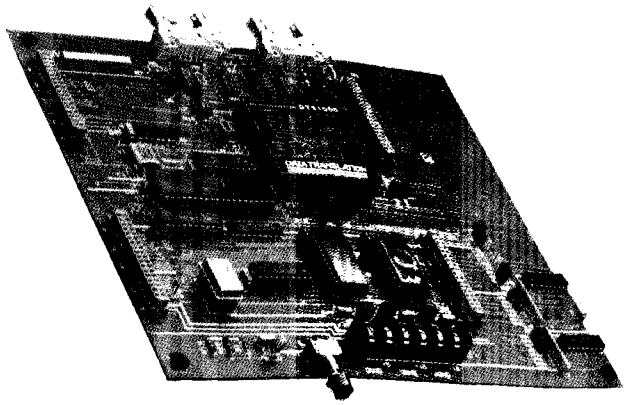
DTX344 BITBUS Interface

The DTX344 provides a connection to Intel's serial remote interconnect called the BITBUS. The DTX344 may function as the master node in the hierarchical BITBUS architecture and can control up to 250 remote nodes. The DTX344 is compatible with the Intel iSBX344.



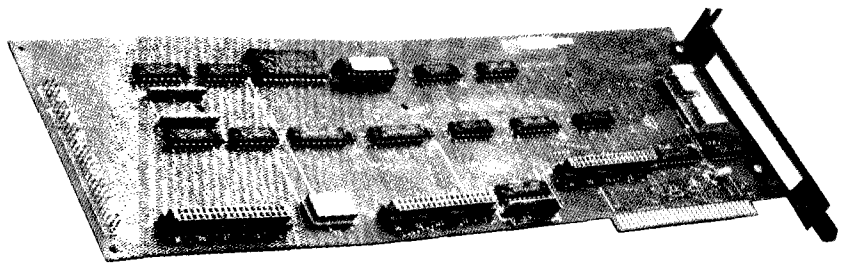


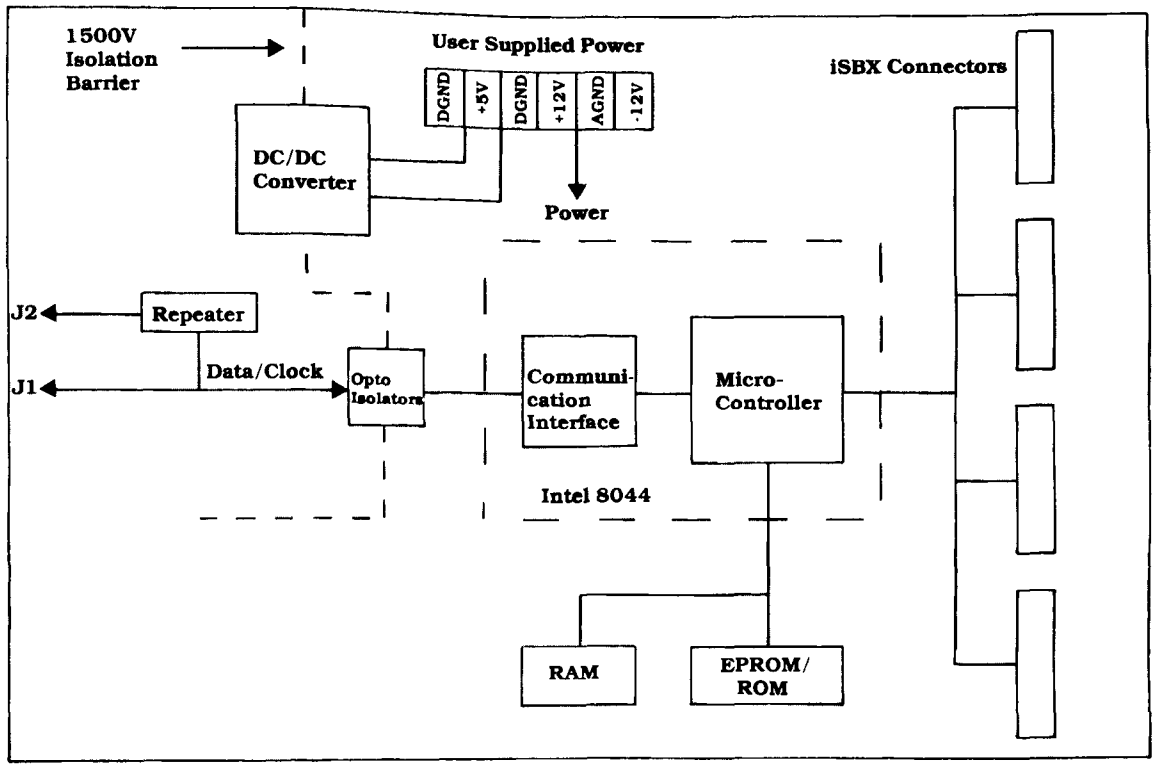
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The DT2806 base board provides three standard iSBX connections and includes three programmable counter/timers. The DT2806 plugs into one of the expansion slots in the IBM PC, PC/XT, or PC/AT. The three iSBX connectors on-board the DT2806 support DMA and programmed I/O operations, as well as full interrupt capability. The counter/timers are used for internal clocking of analog or digital events or external timing control.

The DT901 board is an intelligent real time controller and remote I/O expansion device compatible with Intel's BITBUS. The DT901 provides 4 iSBX connectors so that the user may interface DTX series I/O functions to the Intel BITBUS.





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SPECIFICATIONS

(Typical @25 degrees C, with mounted [illegible])

A/D SPECIFICATIONS (LSB's)

No. of Channels	8DI/16SE (jumper-selectable)
Resolution	12 bits
Input Ranges	0-5V, ±5V, ±2.5V (jumper-selectable)
Gain Ranges	1, 10, 100, and 1000 (jumper-selectable)
Resistor Gain Equation	G = [40000/R +1] ±20%
Inherent Quantizing Error	±½LSB
Output coding	Straight binary (unipolar) Offset binary (bipolar)
System Accuracy	.035% FSR (gain = 1) .040% FSR (gain = 10) .050% FSR (gain = 100) (CT=1000 pF) .175% FSR (gain = 1000) (CT=4700 pF)
Input Impedance	100 MΩ in parallel with 10 pF "OFF" channel 100 MΩ in parallel with 330 pF "ON" channel (1kΩ will be in series with the 330 pF, to prevent input oscillations due to capacitive loading)
Bias Current	±50nA
Common Mode Input Voltage	±7V
Max. Input Voltage w/o Damage	±32V power on ±20V power off
Input Noise	2.0μV rms
Channel To Channel Offset Voltage	±20μV
Dynamic Performance Conversion Time	50μs (20kHz) (gain = 1 to 10) CT=0 pF 70μs (14kHz) (gain = 11 to 200) CT=1000 pF 130μs (7.5kHz) (gain = 201 to 1000) CT=4700 pF
Dynamic Error	±.75 LSB for a 10V change (max.)
CMRR	70dB @ 60Hz with 1000Ω unbalanced (min.) (gain = 1)
CMRR	110dB @ 60Hz with 1000Ω unbalanced (min.) (gain = 1000)
Channel crosstalk	80dB @ 1000Hz

Physical (by [illegible])

Dimensions	3.7" H X 2.5" W X .8" D (9.4 X 7.2 X 2.0 cm)

(1.13" from mother board, when mounted in the iSBX connector)

Operating Temperature	0 to +60°C
Storage Temperature	-25° to +95°C
Relative Humidity	To 90% non-condensing
Offset TC	150 μV/°C max. (gain = 1)
Input Offset TC (multiplied by gain)	2μV/°C max.
Gain TC	32 ppm/°C max. (gain = 1) 42 ppm/°C max. (gain = 10) 62 ppm/°C max. (gain = 100) 127 ppm/°C max. (gain = 1000)
Power Requirements (max.)	+5V ±.25V @ 45mA +12V ±.6V @ 30mA -12V ±.6V @ 50mA

Additional Channels	48SE/32DI
Power Requirements (max.)	+5V ±.25V @ 5mA +12V ±.6V @ 30mA -12V ±.6V @ 12mA
Dimensions	3.7" H X 2.5" W X .8" D (9.4 X 7.2 X 2.0 cm)

(1.13" from mother board, when mounted in the iSBX connector)

Resolution	12 bits, monotonic over temperature
Nonlinearity	.01%
Differential Linearity	½LSB
Refresh 1 channel	80μs (5kHz max.)
Refresh all 8 channels	650μs (800Hz max.)
Single channel update rate	5kHz (full scale change)
Eight channel update rate	800Hz
Slew rate	0.1V/μs min.
Number of Channels	8, either voltage or current out
Voltage Ranges (jumper selectable)	0 to +5V (unipolar operation) -5V to +5V (bipolar operation)
Current Output	±5 mA max. (voltage mode)
Current Loop Range	4-20mA
Impedance	0.1Ω
DAC Throughput	1 channel operation = 5kHz 8 channel operation = 800Hz
Input coding	Straight binary (unipolar) Offset binary (bipolar)
Dimensions	3.7" H X 2.5" W X .8" D (9.4 X 7.2 X 2.0 cm)

(1.13" from mother board, when mounted in the iSBX connector)

Nominal Supply Voltages	+12 Vdc @ ±.6V -12 Vdc @ ±.6V +5 Vdc @ ±.25V
Supply Ranges	+11.4 to +12.6 Vdc -11.4 to -12.6 Vdc +4.75 to +5.25 Vdc
Operating Temperature Range	0 to +55°C
Storage Temperature	-25° to +85°C
Relative Humidity	Up to 90% non-condensing
Power Consumption	±5V @ 140mA typical ±12V @ 45mA typical (voltage mode) ±12V @ 200mA typical (current loop mode)

DIGITAL I/O SPECIFICATIONS: DTX350

Interface Compatibility	iSBX Bus and Parallel I/O
Digital Input Specifications	
Logic Load	1 TTL load
Digital Output Specifications (Port A, using 8226)	
Fanout	7 TTL loads
Logic Sense/Level	
Read/Write	Negative level sensitive
Enable	Negative edge sensitive
Reset	Positive level logic
Data and Address	Positive level sensitive
Performance Specifications	
Word Size	Data - 8 bits
I/O Capacity	24 programmable lines
Access Time*	
Read	250 ns max.
Write	300 ns max.

* Actual transfer speed is dependent upon the cycle time of the host microcomputer.

Interrupts

Interrupt requests may originate from the programmable peripheral interface or the user-specified I/O.

Physical/Environmental Specifications

Dimensions	3.7" H X 2.5" W X .8" D (9.4 X 7.2 X 2.0 cm)

(1.13" from mother board, when mounted in the iSBX connector)

Operating Temperature	+32° to +131°F (0 to +55°C)
Operating Humidity	0 to 90% (non-condensing)
Power Requirements	+5v ±10% @ 320mA

BITBUS CONTROLLER SPECIFICATIONS: DTX344

Word Size	
Instruction	8-bit
Data	8-bit
Processor Clock	12 MHz
Processor Cycle	1μs
Memory Capacity/Addressing	
iDCM Controller	64 K
Input Load	1 LSTTL load
Physical/Environmental Specifications	
Dimensions	7.5" H X 2.5" W X .4" D (19.1 X 6.4 X 1.0 cm)

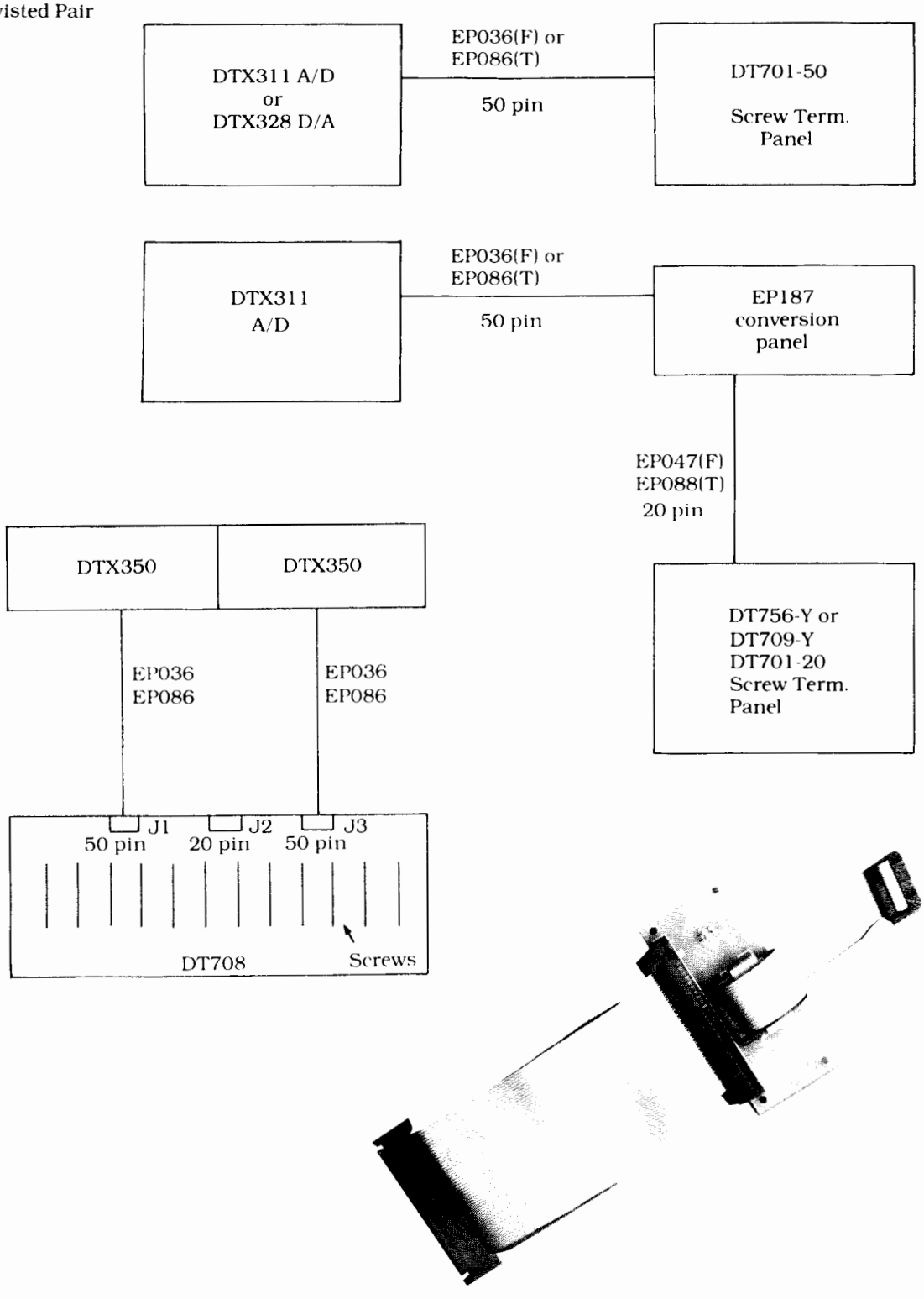
(Double-wide iSBX MULTIMODULE Form Factor)

Operating Temperature	0°C to +55°C
Humidity	90% non-condensing
Power Requirements	+5V ±5% @ .9A (memory NOT included)

System Characteristics

* Fully supported self clocked mode for 375 Kbits/sec and 62.5 Kbits/sec
* The DTX344 board constitutes one node on the BITBUS network
* Message length of 18 bytes is supported
* BITBUS Remote Access Control (RAC) function supported

(F) = Flat Ribbon
(T) = Twisted Pair



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ORDERING GUIDE

DTX MODULES

DTX311	Analog Input Module, 16SE/8DI (jumper selectable), 12-bit resolution, programmable gain (1, 10, 100, 1000) and 20 kHz throughput.
DTX311EX	Analog Input Expansion Module for DT311. Provides additional 48SE/24DI (jumper selectable) analog input channels. Each DTX311EX is shipped with an EP193 connection plug that connects the DTX311 TO THE DTX311EX.
DTX328	Analog Output Module, 8 channels, 12-bit resolution, and voltage (0-5V, +/-5V) or current (4-20mA) output.
DTX350	24-line Digital I/O Module
DTX344	Master Board for BITBUS Network. Compatible with Intel iSBX344.

MOTHER BOARDS FOR DTX MODULES

DT2806	IBM PC compatible board includes three programmable counter/ timers and three iSBX module connections.
DT901	Non-isolated remote BITBUS node with four iSBX connectors.
DT901-I	Isolated remote BITBUS node with four iSBX connectors. Opto-isolation provided on the BITBUS lines as well as a DC/DC converter to isolate the bus connections. (see DT2801 series and DT901 data sheets for additional information)

SCREW TERMINAL PANEL ACCESSORIES

DT701-50	The DT701-50 is a 19 inch rack mountable screw terminal panel for the DTX311, DTX311EX and the DTX328 with space for user supplied passive signal conditioning. ***Options:*** Add "-MA" for enclosed 19 inch rack-mounting assembly with plexiglass cover.
DT708	The DT708 is a 19 inch rack-mountable screw terminal panel. It contains one 20-pin connector for all counter/timer functions on the DT2806. The DT708 also contains two 50-pin connectors and can support up to two DTX350's. ***Options:*** Add "-MA" for enclosed 19 inch rack-mounting assembly with plexiglass cover.
DT709-Y	The DT709-Y is a signal conditioning screw terminal panel for the DTX311. It allows 16SE analog input board to interface to 16DI analog input signals, has a 35kHz low pass filter in the signal conditioning circuitry, and provides an input common mode operating range of +/-20V and transient protection to +/-100V.
DT756-Y	The DT756-Y is a signal conditioning screw terminal panel for the DTX311. It allows 16SE analog input board to interface to 16DI analog input signals. It is designed to accomodate thermocouples/bridges and low level analog signals, and gains of 100, 125, 200 and output of 0-5V. Cold junction compensation and voltage offsets are also provided.
EP187	The EP187 is a paddle board that converts the 50-pin cable that comes from the DTX311 to a 20-pin cable that is compatible with the DT701-20, DT709-Y, and DT756-Y screw terminal panels.

CABLES FOR DTX MODULES

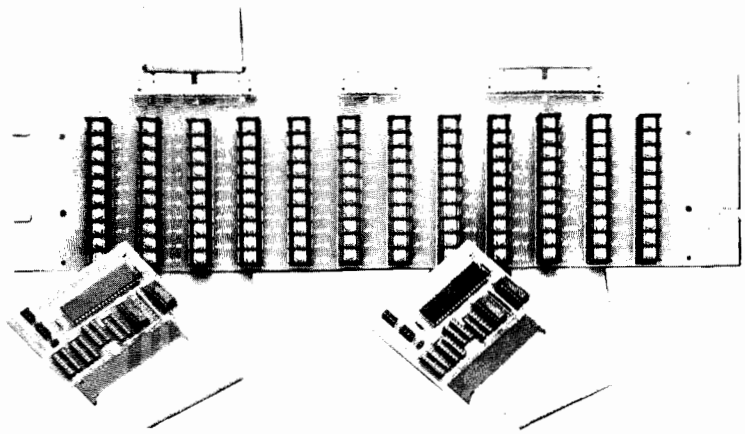
FROM	TO	CABLE
DTX311	DT701-50	EP036 flat EP086 twisted
DTX311	EP187	EP036 flat EP086 twisted
EP187	DT701-20 DT709-Y DT756-Y	EP047 flat EP088 twisted
DTX311EX	DT701-50	EP036 flat EP086 twisted
DTX311	DTX311EX	EP193 flat
DTX328	DT701-50	EP036 flat EP086 twisted
DTX350	DT708	EP036 flat EP086 twisted

DTX SCREW TERMINAL PANEL CHART

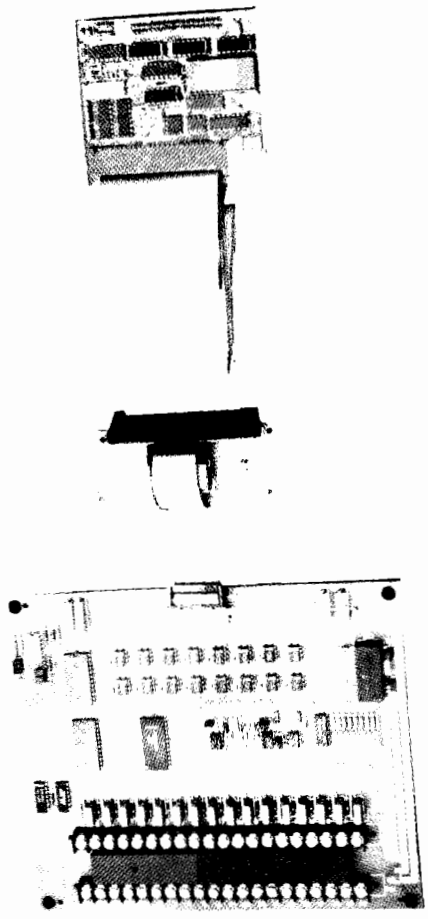
	DTX311	DTX311EX	DTX328	DTX350
DT701-50	X	X	X	
DT708				**X**
DT709-Y	X			
DT756-Y	X			

CABLES FOR DTX MODULES

EP036 50-pin 8 foot (2.5m) flat ribbon cable
EP086 50-pin 8 foot (2.5m) twisted pair cable
EP047 20-pin 8 foot (2.5m) flat ribbon cable
EP088 20-pin 8 foot (2.5m) twisted pair cable



The DTX311 is connected to a DT756-Y signal conditioning screw terminal panel via an EP187 paddle board.



The DT708 screw terminal panel can accomodate up to two DTX350 digital I/O modules.

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DATA TRANSLATION®

IBM PERSONAL COMPUTER
SUBROUTINE LIBRARY
PCLAB™

FEATURES

- **Easy to use, real-time software packages, compatible with DT2801 Series boards**
- **Subroutine libraries for control of all on-board analog and digital I/O functions; callable from BASIC (compiled or interpreted), PASCAL, FORTRAN, C, and TURBO PASCAL**
- **Shipped complete on one single-sided, double density floppy diskette, together with a comprehensive User Manual**

DESCRIPTION

PCLAB™ is a real-time software package for Data Translation's IBM PC compatible DT2801 Series analog and digital I/O system interfaces. The package consists of libraries of routines designed to be CALLed from IBM's BASIC, (Compiled & interpreted), PASCAL, FORTRAN, C, and Turbo Pascal. The PCLAB package allows the user to control all the analog and digital I/O capabilities of the interface boards through operation-specific routines which greatly simplify the programming, use, and application of the hardware interfaces. With PCLAB, direct access to the control registers is not required.

An error processing system checks for argument errors and generates an error report if any are detected. Attempts to operate the interfaces in illegal modes of operation are reported before potentially non-valid operations can be performed.

The PCLAB software library supports all the analog I/O, digital I/O, and clock functions of the DT2801 Series boards, and provides linearization tables for handling thermocouple inputs. PCLAB includes a set of stand alone data acquisition and control utilties that act as example programs by demonstrating the use of the routines.



Figure 1. PCLAB is a group of subroutines for the control of all analog I/O, digital I/O, and clock functions of the DT2801 series boards.

HARDWARE SUPPORTED

The following DT2801 Series hardware is supported by PCLAB:

DT2801
DT2801-A
DT2801/5716
DT2805
DT2805/5716
DT2806
DT2808
DT2818

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CAPABILITIES

The following table provides a description of the PCLAB subroutines which are available to support the DT2801 Series analog and digital I/O interface boards. As a convention within PCLAB, all input arguments occur first. Output arguments, where present, appear last. Input arguments are indicated graphically by a right-hand arrow (as, ——→); output arguments have a left-hand arrow (as, ←——). All variables can be assumed to have their explicit BASIC data types, that is, variable names that end with a "%" must be integers, those that end with a "S" must be strings, and those that end with "!" are single precision values.

PCLAB ROUTINES

Analog Input Routines

INPUT.ADC.VALUE (CHANNEL%, GAIN%, ANALOG.DATA.VALUE%)

Input a single analog data value from the specified channel.

INPUT.ADC.ON.TRIGGER (CHANNEL%, GAIN%, ANALOG.DATA.VALUE%)

Input a single analog value immediately after detecting an external trigger.

SETUP.ADC (TIMING.SOURCE%, START.CHAN%, END.CHAN%, GAIN%)

Setup the A/D converter operating parameters.

INPUT.ADC.SERIES (NUMBER.OF.VALUES%, ANALOG.DATA.ARRAY%)

Input a series of analog values synchronously (no DMA).

START.ADC.DMA (NUMBER.OF.VALUES%, ANALOG.DATA.ARRAY%)

Input a series of analog values asynchronously, using DMA.

CONTINUOUS.ADC.DMA (NUMBER.OF.VALUES%, ANALOG.DATA.ARRAY%)

Start continuous performance analog data collection using DMA.

TEST.ADC.DMA (COUNT.REMAINING%)

Test DMA transfer count.

WAIT.ADC.DMA Suspend program until the DMA analog transfer is completed.

STOP.ADC.DMA Stop the DMA analog conversion without waiting for completion.

Analog Output Routines

OUTPUT.DAC.VALUE (DAC.SELECT%, ANALOG.DATA.VALUE%)

Output a single D/A value from the specified channel.

OUTPUT.DAC.ON.TRIGGER (DAC.SELECT%, ANALOG DATA VALUE%)

Output a single D/A value immediately after detecting an external trigger.

SETUP.DAC (TIMING.SOURCE%, DAC.SELECT%)

Setup the D/A converter operating parameters.

OUTPUT.DAC.SERIES (NUMBER.OF.VALUES%, ANALOG.DATA.ARRAY%)

Output a series of D/A values synchronously (no DMA).

START.DAC.DMA (NUMBER.OF.VALUES%, ANALOG.DATA.ARRAY%)

Output a series of D/A values asynchronously, using DMA.

CONTINUOUS.DAC.DMA (NUMBER.OF.VALUES%, ANALOG.DATA.ARRAY%)

Start continuous performance D/A data collection using DMA.

TEST.DAC.DMA (COUNT.REMAINING%)

Test D/A DMA transfer count.

WAIT.DAC.DMA

Suspend program until the DMA D/A transfer is completed.

STOP.DAC.DMA

Stop DMA D/A conversion without waiting for completion.

Clock Routines

SET.CLOCK.DIVIDER (DIVISOR%)

Set the pacer clock; operating frequency = 400,000/ divisor%.

SET.SLOW.CLOCK (EXTRA.TICKS%)

Set the pacer clock divisor for lower frequencies.

Digital Input and Output Routines

ENABLE.FOR.OUTPUT (PORT.SELECT%)

Enable the digital port as an output port.

ENABLE.FOR.INPUT (PORT.SELECT%)

Enable the digital port for input.

OUTPUT.DIGITAL.VALUE
(PORT.SELECT%,MASK%, DIGITAL.VALUE%)

Output a digital value to the specified port.

OUTPUT.DIGITAL.ON.TRIGGER (PORT.SELECT%, MASK%, DIGITAL.VALUE%)

Output a digital value to the specified port after an external trigger.

INPUT.DIGITAL.VALUE
(PORT.SELECT%, MASK%, DIGITAL.VALUE%)

Input a digital value from the specified port.

INPUT.DIGITAL.ON.TRIGGER
(PORT.SELECT%, MASK%, DIGITAL.VALUE%)

Input a digital value from the specified port after an external trigger.

Configuration Routines

SELECT.BOARD (BOARD.NUMBER%)

Select which board is to be operated.

SET.BASE.ADDRESS (BASE.ADDRESS%)

Specify the PCLAB base address (must be even).

SET.DMA.CHANNEL (DMA.CHANNEL%)

Specify the DMA I/O channel to use either 1 or 3.

SET.ADC.CHANNELS (NUMBER.OF.CHANNELS%)

Specify the number of channels; 8 = differential, 16 = single-ended.

SET.TIMEOUT (NUMBER.OF.SECONDS%)

Specify the timeout interval before an external trigger or clock is assumed to be unavailable.

Error Processing System

SET.ERROR.CONTROL.WORD (ERROR.CONTROL.WORD%)

Set the error control word.

GET.ERROR.CODE (ERROR.CODE%)

Get the current error code.

Analog Input Routines

MEASURE.THERMOCOUPLE (TYPE%, CHANNEL%, TENTHS.DEGREE.C%, NOISE.LEVEL%)

Measure the temperature of the thermocouple.

Clock Routines

SET.CLOCK.FREQUENCY (REQUESTED.FREQUENCY, ACTUAL.FREQUENCY)

Start the pacer clock operating at the specified frequency.

SET.CLOCK.PERIOD (REQUESTED.PERIOD, ACTUAL.PERIOD)

Start the pacer clock operating at the specified period.

ESTIMATE.EXTERNAL.FREQUENCY (APPROXIMATE.FREQUENCY)

Form an estimate of the external trigger's operating frequency.

ESTIMATE.EXTERNAL.PERIOD (APPROXIMATE.PERIOD)

Form an estimate of the external trigger's operating period.

Data Manipulation Routines

ANALOG.TO.VOLTAGE (ANALOG.DATA.VALUE%, GAIN%, VOLTAGE)

Convert an analog data value into a voltage value.

VOLTAGE.TO.ANALOG (VOLTAGE, ANALOG.DATA.VALUE%)

Convert a voltage value into an analog data value.

Thermocouple Tables, Interpolation Routines

LOOKUP.THERMOCOUPLE (TYPE%, MICROVOLTS%, TENTHS.DEGREE.C%)

Look up microvolts in thermocouple tables for the specified type.

LOOKUP.HIGH.THERMOCOUPLE (TYPE%, TENS.MICROVOLTS%, TENTHS.DEGREE.C%)

Look up tens of microvolts in thermocouple tables for specified type.

Configuration Routines

SET.ADC.RANGE (LOW.VOLTAGE, HIGH.VOLTAGE)

Specify the A/D voltage range being used.

SET.DAC.RANGE (LOW.VOLTAGE, HIGH.VOLTAGE)

Specify the D/A voltage range being used.

SET.LINE.FREQUENCY (HERTZ%)

Specify the system line frequency; 50 or 60 cycles per second.

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IBM PERSONAL COMPUTER
SCREW TERMINAL PANELS
DT707/DT708/DT752

FEATURES

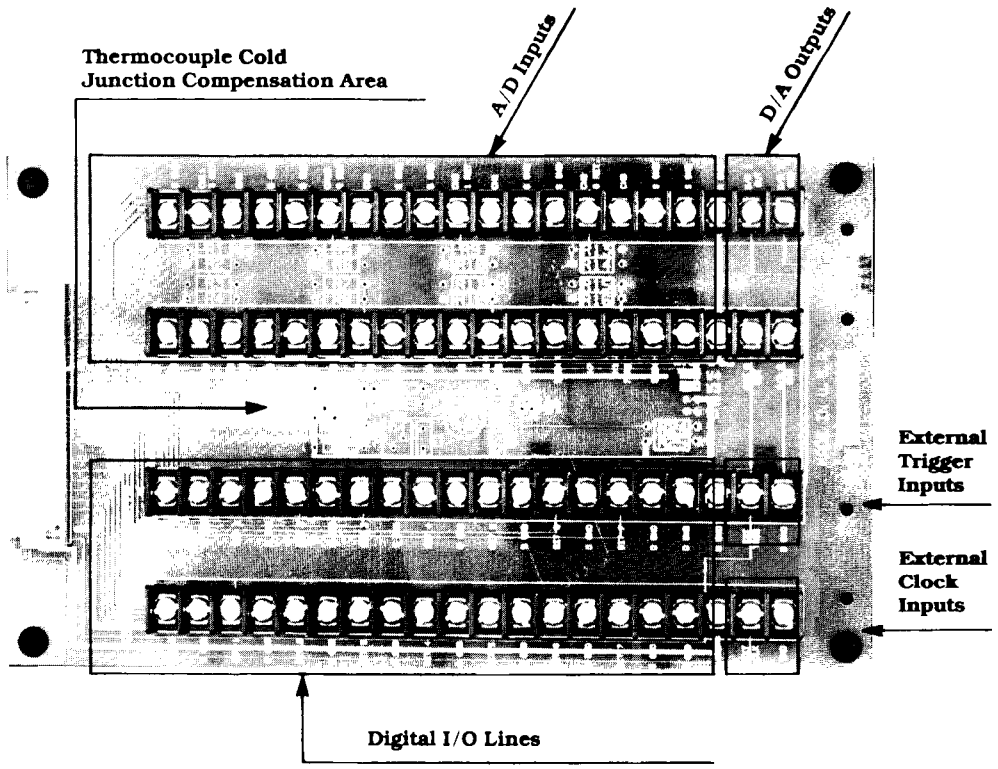
- Easy-to-use, reliable connection points for ALL DT2801 Series analog I/O, digital I/O, and clock signals
- Table-top board with standoffs and integral ribbon cable for connection to DT2801 Series boards

DT707

The DT707 is a screw terminal panel with standoffs to allow table top operation. It provides ease of connection, via 80 screw terminals, for all analog and digital I/O signals to the DT2801 Series boards. The DT707 includes an integral one meter long flat ribbon cable for direct connection to the analog I/O board.

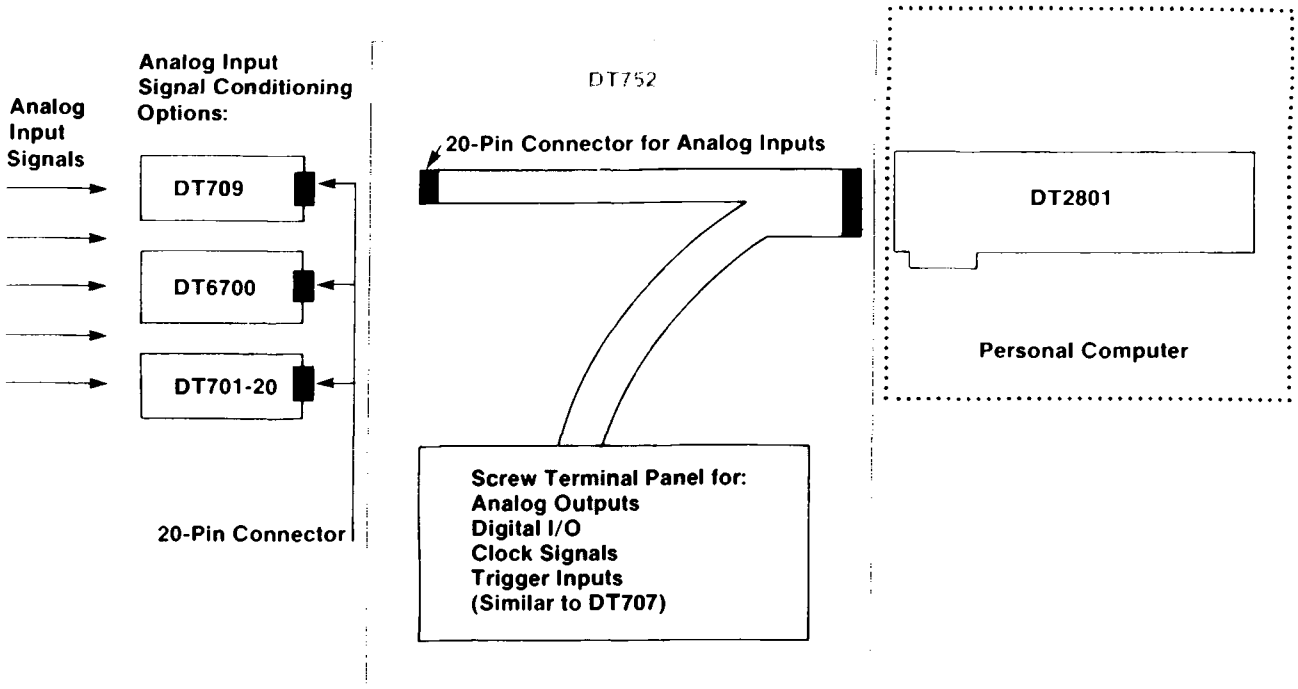
To accept any type of thermocouple input, the DT707 can be configured with the -T option, and must be used with the DT2805. The DT707-T provides a thermocouple reference cold junction compensation circuit by which users can determine the temperature of the screw terminal panel. A user-written program can then compensate for the cold-junction thermocouple formed at the DT707-T. When the cold-junction compensation circuit is calibrated, the sensor's output is 0.4mV/°C.

Provision has been made on the DT707 for current loop input operation, with a 0 to 20mA full scale input range. By installing 250 ohm current shunt resistors, the user will convert the 0 to 5V input range to a 0 to 20mA range. Current loop operation on the DT707 is compatible with the DT2801 with a programmable gain of 2.

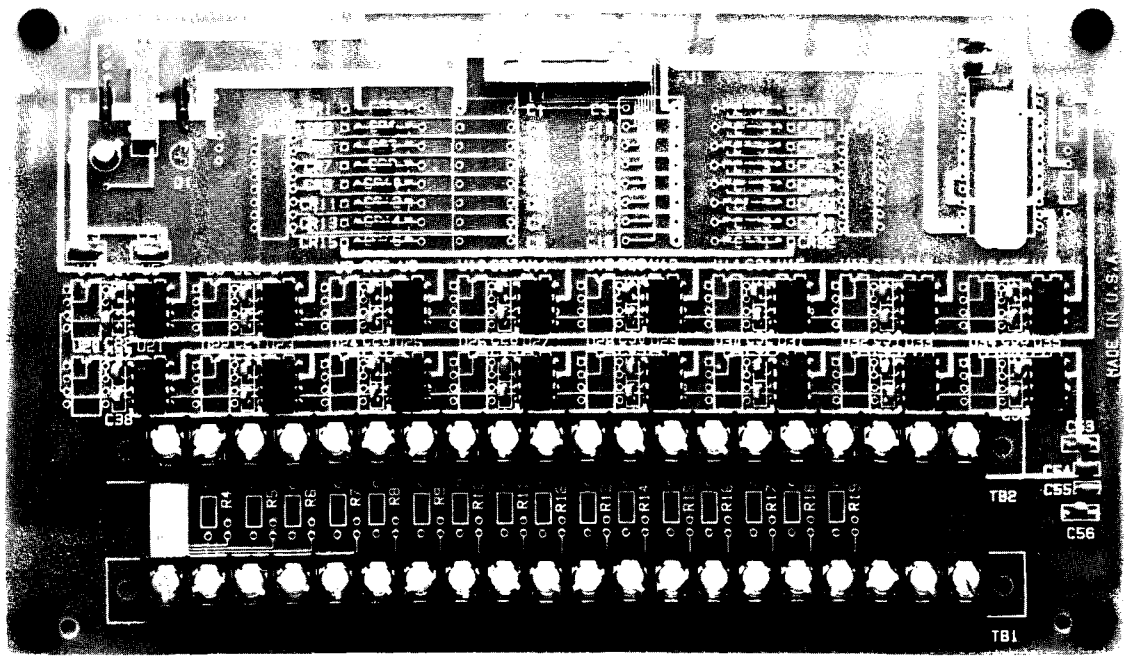


The DT707 is a companion screw terminal panel for the DT2801 or DT2805. The DT707 supports all the analog I/O, digital I/O, and clock functions of the DT2801 or DT2805 and provides for convenient connection of user input signals. Thermocouple cold junction compensation is optionally available on the DT707-T for use with the DT2805. The DT2801 can accomodate 0 to 20mA input signals via user-installed resistors on the DT707.

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The DT752 is a screw terminal panel for the analog outputs, digital I/O, and clock signals of the DT2801 and includes a 20-pin connection for the analog input signals. The DT752 is compatible with isolated and non-isolated analog input signal conditioning options.



The DT709 screw terminal/signal conditioning option allows up to 16DI inputs to be used with the DT2801. The DT709 also provides 100V of input protection.

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DT752

The DT752 is a screw terminal panel for the analog outputs, digital I/O, and clock signals of the DT2801 Series boards and includes a 20-pin connections for the analog input signals. The analog input connection on the DT752 allows the DT2801 Series boards to be used with the non-isolated DT709 and the isolated DT6700 series of signal conditioning systems. When used with the DT709, up to 16 differential inputs to the DT2801 Series boards may be protected to 100V. The DT6700 series provides ±1500V transient and ±250V common mode isolation of the DT2801 Series boards' analog inputs. See the specific data sheets for further details.

DT708

The DT708 Screw Terminal Panel provides easy connection, via screw terminals, for all analog and digital signals to the DT2806 multifunction I/O board. A 19 inch rack-mountable panel, the DT708 includes one 20-pin connector for timing functions and two 50-pin connectors for iSBX module functions. One DT708 panel provides connections for up to two iSBX modules.

DT2806 Function	DT708 Screw Terminal Connection
Programmable counter/ timers	20-pin
iSBX modules	50-pin

The DT708 Screw Terminal Panel can also be used as a 19 inch rack-mountable panel for other DT2801 Series boards. The DT708's screw terminals can be used for connection of all analog and digital I/O signals to the DT2801, DT2805, DT2808, and DT2818 via the DT708's 50-pin connector.

SPECIFICATIONS: DT707

(Typical at +25 degrees C and standard voltages, unless otherwise noted.)

GENERAL SPECIFICATIONS

Outline Dimensions:
5.20"H X 8.75"W X 0.875"D
(13.21 X 22.23 X 2.22 cm)

Weight:
12.5 ounces
(355 grams)

Screw Terminal:
The Screw Terminal panel consists of 80 barrier strip connections in four sections of 20 connections each;

Barrier Strip Screw Size:
6-32 Screws

Barrier Strip Screw Material:
Magnum

Barrier Strip Material:
Polyester, UL grade, 94V-O polypropylene

Acceptable Wire Size:
18 to 22 AWG

USER-SUPPLIED CURRENT LOOP SPECIFICATIONS

Resistor Value:
250 ohms (0 to 20mA current range)

Resistor Tolerance:
+/-.02% or better

Resistor Power Dissipation:
1/4 watt

Resistor Temperature Coefficient:
+/-15 ppm/degree Celsius or better

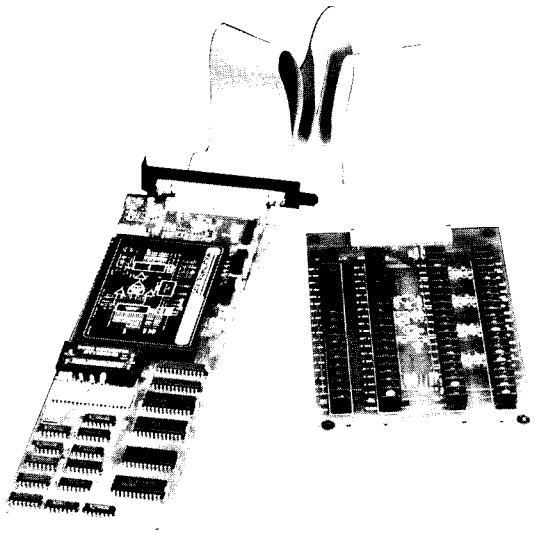
THERMOCOUPLE COLD-JUNCTION COMPENSATION CIRCUIT (DT707-T only)

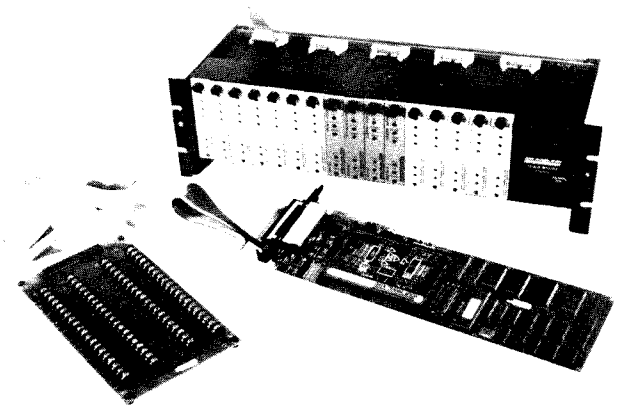
Output Impedance:
Amplifier Output 100 milliohms, 100 ohm divider

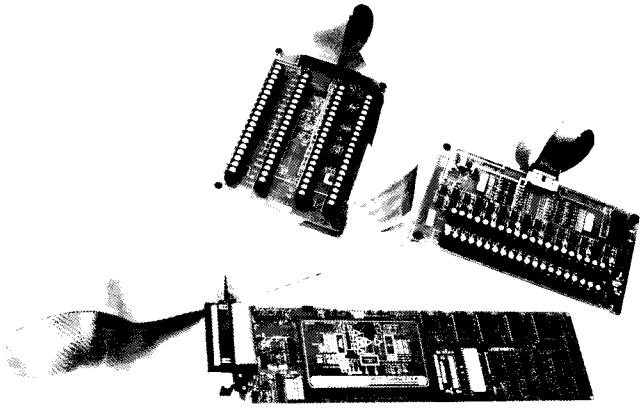
Output Voltage Equation:
Output Voltage = 0.5mV x T
where T=temperature of DT707-T board in degrees Celcius.

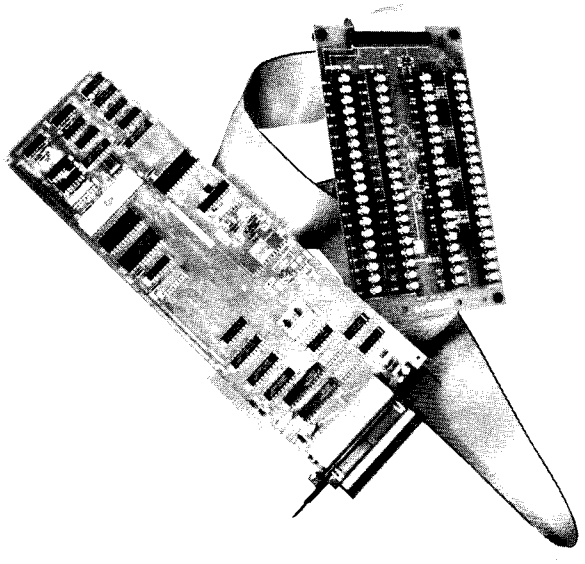
Operating Temperature Range:
0 to +50 deg.C

Power requirements:
+/- 15 volts from DT707—5.5mA (+15V), 0.5mA (-15V)









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The DT2801 board is shipped complete with a comprehensive User Manual and sample BASIC programs on floppy diskette. Standard hardware includes:

16SE/8DI (jumper selectable) high-level analog input system with 12-bit resolution
High level programmable gain (1, 2, 4, 8)
Two, 12-bit DAC's
16 lines of digital I/O
Programmable clock

The DT2805 board is shipped complete with a comprehensive User Manual and sample BASIC programs on floppy diskette. Standard hardware includes:

8DI low-level analog input system with 12-bit resolution
Low level programmable gain (1, 10, 100, 500)
Two, 12-bit DAC's
16 lines of digital I/O
Programmable clock

High Speed Option for DT2801: Add "-A" for 27.5kHz throughput

High Resolution Option for DT2801 and DT2805: Add "/5716" for 16-bit resolution (8DI channels, bipolar, only)

The DT2806 base board includes three programmable counter/timers and three iSBX module connections. The DT2806 is shipped complete with a comprehensive User Manual.

iSBX Modules:

Order for eight 12-bit analog outputs on an iSBX compatible module. Up to three modules (24 DAC's) are supported by the DT2806.

Order for 24 digital I/O lines on an iSBX compatible module. Up to three modules (72 lines) are supported by the DT2806.

The DT2808 is shipped complete with a comprehensive User Manual and sample BASIC programs on floppy diskette. Standard hardware includes:

16 single-ended analog input channels with 10-bit resolution
2 analog output channels with 8-bit resolution
16 lines of digital I/O
Programmable clock

The DT2818 is shipped complete with a comprehensive User Manual and sample BASIC programs on floppy diskette. Standard hardware includes:

4 single-ended simultaneous analog input channels with 12-bit resolution
2 12-bit analog output channels which can be operated simultaneously or independently
16 lines of digital I/O
Programmable clock

The DT707 is a screw terminal panel for all analog I/O, digital I/O, and clock functions of the DT2801, DT2805, DT2808, or DT2818 boards; complete with cable.

The DT708 is a 19 inch rack-mountable screw terminal panel for all counter/timer and iSBX functions on the DT2806. The DT708 contains one 20-pin connector and two 50-pin connectors. The necessary cabling is ordered seperately (see below).

Add "-MA" for enclosed 19 inch rack-mounting assembly with plexiglass cover.

Order 20-pin 8 ft. flat ribbon cable for connection of DT2806 counter/timers to DT708 screw terminal panel; one cable required per DT2806

Order 50-pin 8 ft. flat ribbon cable for connection of DT2806 iSBX modules to DT708; also for connection of all analog I/O, digital I/O, and clock functions of DT2801, DT2805, DT2808, or DT2818 boards to DT708 screw terminal panel

Order 50-pin 8 ft. twisted pair cable for connection of DT2806 iSBX modules to DT708 screw terminal panel

The DT752 allows several signal conditioning products to be used with the analog inputs of the DT2801, DT2805, DT2808, or DT2818; complete with cable.

Data Acquisition and Control Software

■ **Subroutine Libraries**

PCLAB Subroutine Library

Order **PCLAB** for subroutine software support for all DT2801 Series boards (DT2801, DT2801-A, DT2801/5716, DT2805, DT2805/5716, DT2806, DT2808, and DT2818). PCLAB is callable from BASIC, PASCAL, FORTRAN, and C. This library is shipped on one single-sided, double-density (320KB) floppy diskette and is complete with a comprehensive User Manual.

■ **Application Software Series ***

CHROMLAB Real-time Chromatography and Spectroscopy Software

Order **CHROMLAB** for easy-to-use, menu-driven software for chromatography and spectroscopy applications; capabilities include real-time data acquisition & display, chromatographic peak detection & integration, spectral display & manipulation, and report generation. Includes compiled BASIC and source code versions. Compatible with DT2801 or DT2805 analog and digital I/O boards. CHROMLAB is shipped complete on single-sided, double-density floppy diskettes with a comprehensive User Manual.

DT/NOTEBOOK Electronic Laboratory Notebook

Order **DT/NOTEBOOK** for easy-to-use, menu-driven software for automation and customization of real-time data acquisition, process control, and data analysis. Capabilities include automatic interface to spreadsheet packages such as Lotus 1-2-3 or Symphony and advanced curve-fitting routines. Compatible with DT2801 Series of analog and digital I/O boards. DT/NOTEBOOK is shipped complete on single-sided, double-density floppy diskettes with a comprehensive User Manual.

DT/ILS-PC 1 Signal Processing Software

Order **DT/ILS-PC 1** for easy-to-use, command-driven signal processing software. Capabilities include data scanning and manipulation, file management, waveform generation and display, statistical manipulation, digital filter design, and spectral analysis. Compatible with DT2801 Series of analog and digital I/O boards. DT/ILS-PC 1 is shipped complete on single-sided, double-density floppy diskettes with a comprehensive User Manual.

* See individual data sheets for further information.

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