

INTEGRATED CIRCUIT DEVELOPMENT
MODEL DT968C BATH CONTROLLER
COMMUNICATIONS SUPPLEMENT

This supplement contains information relating to the RS232 option for the ICD Model DT968C Bath Controller. This option allows the user to have direct access to the Controller via a standard RS232 link. Through this serial link, all of the standard functions of the Controller may be activated, tested and adjusted.

Since this unit is a Controller, it does not handle a great deal of data. Therefore, the link has been optimized to allow the user, through very simple instructions, to control and interrogate the unit.

Eleven 'key' commands allow the user to instruct the Controller to perform all of its normal operations. However, only a couple of these are actually required for computer operation. The remainder are provided, but are not often used, since these keys are utilized in programming. The serial link has direct access to the programming stack through the 'READ', 'WRITE', 'UP LOAD' and 'DOWN LOAD' commands without using 'key' commands. Utilizing these commands, the serial link can interrogate or overwrite any or all of the items in the program stack.

The basic status conditions for the Controller are accessed through 4 bytes. These bytes may be read out at any time using the 'STATUS' command.

The Controller may be hooked to any standard terminal or computer system via the DB9 connector on the back panel. The pin out follows the standard IBM DB9 configuration. Therefore, it may be wired directly to an IBM PC/AT or its equivalent. The link is fixed at 9600 baud, 8 bit, 1 stop and 1 start bit, no parity. This link only requires 3 leads to function. As viewed from the Controller, Pin 5 is the 'Signal Ground', Pin 3 is 'Receive Data' and Pin 2 is 'Transmit Data'.

The internal ACIA utilizes a full duplex interrupt driven transmission scheme. Thus, the unit may receive and transmit simultaneously, as well as continue to perform its normal functions. Therefore, the Controller may be interrogated even though it is performing its program.

The Protocol for the serial link consists of 7 basic commands:

- K - KEY
- S - STATUS
- R - READ
- W - WRITE
- D - DOWN LOAD
- U - UP LOAD
- X - CANCEL (CLEAR)

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All commands will be prefixed by one of these 7 letters. The data format is standard ASCII and all data, with the exception of the Status Bytes are BCD values. The Status Bytes are transmitted in ASCII as hexadecimal, since they contain bit information.

UP LOAD and DOWN LOAD are the only group commands. They each have a specific format and a specific number of bytes of information. They are structured to DOWN LOAD all of the programming information at one time or READ the complete programming stack. All of the rest of the commands are structured to handle the data one byte at a time.

The following is a breakdown of each of the commands and the way they are accessed. It should be noted that the format allows for the unit to be hooked directly to a dumb computer terminal. This can be very useful in checkout. The unit will echo all characters that are typed to it. When used with a terminal, this will provide the appropriate display. When used with a computer system, this will provide direct feedback of the fact that unit has accepted the data.

All commands are completed with a carriage return from the computer. With the exception on the CANCEL command (X), all commands will be acknowledged by a carriage return, line feed (\$0A,\$0D).

KEY COMMAND*****

The KEY COMMAND allows the user to instruct the Controller just as would be done by depressing the Face Panel keys. The exact operation and sequence for these keys is covered in the Controller manual. This description will simply indicate how the link may be used to send these key functions.

The command is entered as a letter followed by 2 numbers, followed by a carriage return:
K01(Return)

The 'K' indicates that this is to be a KEY command. The '01' indicates the KEY number and the 'Return' activates the command.

The following is a listing of the key numbers:

<u>KEY NUMBER</u>	<u>KEY</u>
01	DOWN
02	SAVE
03	ALARM SILENCE
04	VIEW
05	TIMER-START
06	UP
07	SETUP
08	RETURN
09	STANDBY
10	TIMER-STOP/RESET
11	DRAIN

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When a KEY command is sent, the Controller will echo each of the characters and acknowledge with a carriage return line feed, once the command is entered. If an invalid command is detected, it will simply be ignored, although it will acknowledge the fact that the command has been received.

READ COMMAND*****

The READ command is utilized to read from the Controller any of the program data. The format for the command is essentially the same as the KEY command.

R07(Return)

The 'R' indicates to the Controller that the command is to be a READ command. The next two digits indicate the information that is to be read. The carriage return indicates that the command is to be activated. The following is a listing of the data locations that may be read:

<u>DATA LOCATION</u>	<u>DESCRIPTION</u>
01	CS
02	PS
03	HI
04	LO
05	AC
06	DR
07	UNUSED
08	PA
09	CR
10	PB
11	RE
12	RA
13	UNUSED
14	UNUSED (ALWAYS 1)
15	USED
16	UNUSED
17	CD (00001=UP), (00004=DOWN)
18	PROCESS TEMPERATURE
19	TIME (TIMER COUNT)

It should be noted that while most of the values will read out directly as they appear on the unit, the Time Values will display in Minutes and Seconds, but will read out in seconds only. Therefore, the clock setpoint on the unit may be programmed for 5:00 (Minutes:Seconds). The data that is read from the unit will come out as 0300 seconds.

All data is returned in ASCII format with 4 BCD characters. When the controller displays information, such as the Proportional Band in tenths of degrees C., the data that is returned will be in tenths of degrees. For example, 10.0 degrees C. will be transmitted as 0100. The user should refer to the Controller Manual to determine the exact meaning of each of these readings.

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STATUS*****

The STATUS command is utilized to access 4 bytes of information that are utilized by the Controller to indicate its operating status. The same format as the KEY and READ commands is utilized to READ the status bytes:

S01(Return)

The 'S' indicates the activation of a STATUS command. The number indicates the status byte that is to be read out. The carriage return activates the command. The following is a listing of the available bytes:

<u>NUMBER</u>	<u>NAME</u>	<u>DESCRIPTION</u>
01	ALARM	ALARM CONDITIONS
02	MODBYT	SYSTEM MODE
03	SYSBYT	TIMER MODE
04	OUTBYT	OUTPUTS

Each of these bytes contains bits that are set internally by the control algorithms and indicate all the operating information for this system. The ALARM and MODE bytes (MODBYT) are displayed on the Controller via the ALARM and MODE LEDs. The 'System Byte' (SYSBYT) contains information about the current status of the Timer. The 'Output Byte' (OUTBYT) indicates the condition of the outputs. The following is a description of the appropriate bits that may be utilized to monitor the system functions:

<u>ALARM</u>	<u>MODBYT</u>	<u>SYSBYT</u>	<u>OUTBYT</u>
7- ---	7-NORM	7- ---	7- ---
6- ---	6-HOLD	6- ---	6- ---
5- ---	5-WARMUP	5- ---	5- ---
4-LL	4-ALARM	4- ---	4-HEAT
3-LO	3-PROG	3-TMR OVER	3- ---
2-HI	2- ---	2-PREWARN	2-DRAIN
1-SENSOR	1- ---	1- ---	1- ---
0-SYS	0- ---	0-TMR RUNNING	0- ---

The meaning for each of the ALARM and MODE LEDs is covered in the Controller Manual. The SYSTEM BYTE indicates whether the Timer is running or not, and whether it is in the OVERTIME or PREWARN modes.

The OUTPUT BYTE may contain both positive and negative logic bits. For those bits that are unmarked, a '1' indicates that the output is ON. For those bits that are marked with a not (), the outputs are on when the bit is '0'.

Also, it should be noted that many of the undefined bits are used internally and therefore may be either '1' or '0' at any given reading.

These bytes require data transmission in a hexadecimal format. The actual data is sent as an ASCII character, but its meaning is translated in hexadecimal to determine the appropriate bit pattern. For example, the ASCII transmission of \$31,\$30 would translate to a hex reading of 10,

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which would indicate for the ALARM BYTE that a low alarm condition existed.

After the carriage return, the Controller will acknowledge with a carriage return line feed and then send the two ASCII characters that indicate the hex representation for the appropriate bit pattern requested.

WRITE*****

The WRITE command allows the user to overwrite all the information in the programming stack. The single exception is the calibration value which is not accessible. It should be noted that while this information may be over written, it will not be permanently saved in the controller without first accessing the PROGRAM mode and then activating the SAVE command via the keys. If the values written are to be permanently saved in the controller's EEPROM memory, after all changes have been made, a K07 (SETUP) followed by a K02 (SAVE) must be transmitted.

If it is not desirable to have these values permanently saved, the user may simply go in and overwrite the current information for temporary use. When the system is repowered, the information that is currently stored in its EEPROM will be reinserted into the Program stack.

The following is the format for this command:
W020750

The command essentially follows the same format as all the previous commands. The 'W' indicates that it is a WRITE command, the next two characters indicate the location that is to be written to and the last four characters indicate the data value that is to be entered. Again, the data is in BCD and transmitted in an ASCII format. The example WRITE command would put 75.0 Degrees C. in the Process Setpoint.

The data locations are the same as those covered in the READ command section. However, locations 18 and 19, are READ only and may not be written to. They simply provide a Read Out for the current Process Temperature and remaining time.

UP LOAD*****

The UP LOAD command is utilized to READ all of the items in the Program Stack at one time. The following is the format for this command:
U(Return)

This is a single character command that instructs the controller to do a direct dump of the complete programming stack. The data will be transmitted as described in the READ COMMAND section with a carriage return line feed between each parameter.

DOWNLOAD*****

The DOWN LOAD command allows the user to overwrite the complete programming stack with one command. The following is the format for this command:

Dxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx(Return)

Where small 'x' is replaced by the data to be DOWN LOADED starting with data location 1 and running through data location 17.

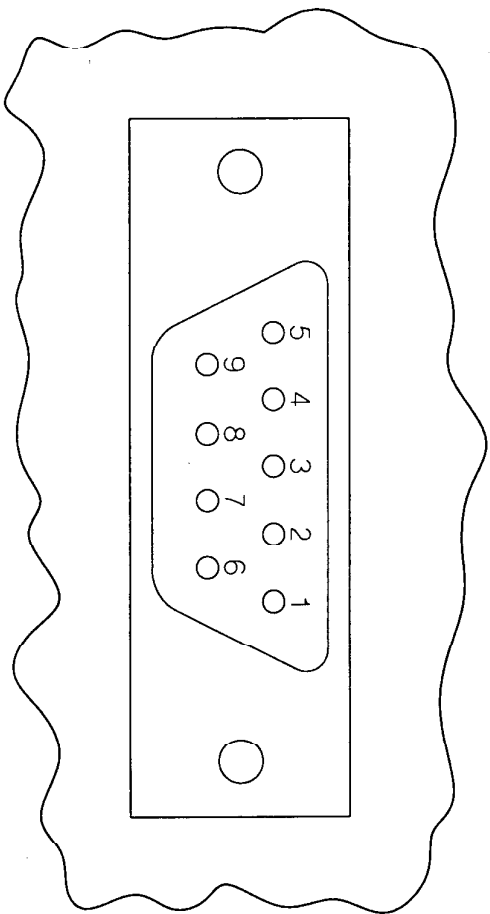
The Controller will echo each of the characters as it is transmitted to confirm that it has been correctly received.

The data locations and the appropriate descriptions are identical to the stack shown under the READ command.

CANCEL*****

The CANCEL command is simply a way to reestablish proper control, should an error occur or an incorrect command be transmitted. For the most part, an incorrect command will simply be ignored and the controller will prepare for an additional command. However, a command may be canceled midstream by transmitting an 'X' (ASCII). This command does not require a carriage return, nor will it acknowledge with a carriage return. However, it will echo an 'X' to indicate that the CANCEL command has been received.

The command may also be utilized as a clear and/or acknowledgement of the Controller being on line.



DETAIL OF FEMALE DB9 CONNECTOR

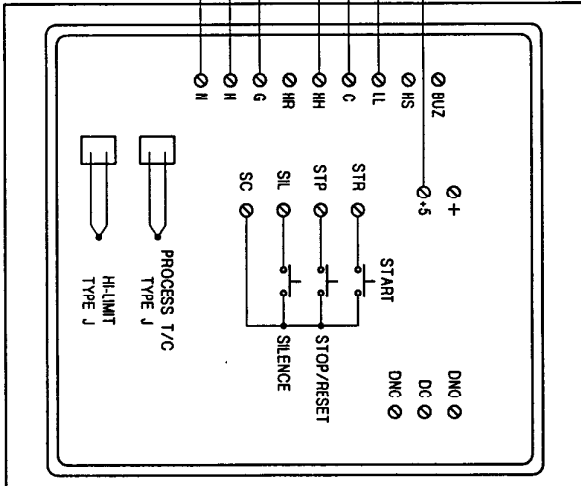
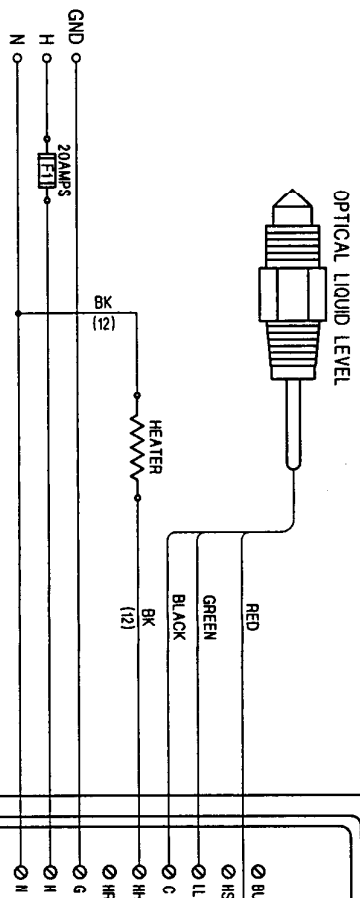
DB9 PIN OUT

- 1 _____
- 2 T x D
- 3 R x D
- 4 _____
- 5 COMMON
- 6 _____
- 7 _____
- 8 _____
- 9 _____

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<p>UNLESS OTHERWISE NOTED ALL DIMENSIONS AND TOLERANCES ARE IN INCHES (1/16" = 1.588 MM) UNLESS OTHERWISE SPECIFIED.</p>	<p>UNLESS OTHERWISE NOTED ALL DIMENSIONS ARE IN INCHES (1/16" = 1.588 MM) UNLESS OTHERWISE SPECIFIED.</p>
<p>DATE: _____</p> <p>BY: _____</p>	<p>DATE: _____</p> <p>BY: _____</p>
<p>DESIGNER: _____</p> <p>CHECKED: _____</p>	<p>DATE: _____</p> <p>BY: _____</p>
<p>ICD/HEATREPLEX</p> <p>3111 BAKER BLVD, BOSTON, MA 02108</p> <p>TEL: (617) 252-1212 FAX: (617) 252-1213</p>	
<p>CONNECTION DIAGRAM</p> <p>RS232</p> <p>DATE: 12/21/95</p>	
<p>SIZE: _____</p> <p>OF: _____</p>	<p>SCALE: _____</p> <p>DATE: _____</p>
<p>REV: _____</p> <p>DATE: _____</p>	<p>REV: _____</p> <p>DATE: _____</p>

- NOTE
1. Terminal is ungrounded.
 2. WARNING: USE OF A LIQUID LEVEL IS HIGHLY RECOMMENDED BY THE FACTORY. IF CUSTOMER DECIDES NOT TO USE L/L, A JUMPER MUST BE PLACED BETWEEN +5 & LL.

INCOMING POWER
110-120VAC
20AMPS MAX
50/60HZ, 1-PH



TEMPERATURE TIMER CONTROLLER
MODEL: DT968C

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<p>ICD/HEATFLEX</p> <p>3233 LAVER AVE., BLDG. 200 MILPITAS, CA 95026 PH: 408/957-2442 FAX: 408/957-2443</p>		<p>TITLE: LADDER DIAGRAM</p> <p>LINE: HEATER</p> <p>NO. - 120VAC</p>	
<p>DATE: 7/10/96</p> <p>REV: 00</p>	<p>SCALE: 1:16</p> <p>SHEET: 2 OF 2</p>	<p>QTY: 8</p>	<p>REV: 00</p>