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Universal Control Network | UCN

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for Industrial Automation

# Honeywell



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## Basic Controller TDC 3000

## Specification and Technical Data

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### Introduction

The Honeywell TDC 3000 Basic Controller consists of a microprocessor-based card file (model CB120) providing multifunctional process control, and a dedicated terminal panel for process signal interconnection. The controller is configured by the user to provide precision automatic control for 8 independent or cascaded control loops. A reserve controller capability is available in the Basic Controller Model CB121.

### Functional Description

The Basic Controller (Figure 1) is equivalent to eight conventional multi-mode multi-functional controllers. The electronics are packaged in a single card file and the process interconnection is terminated at the printed wire terminal panel.

Eight sets of process signals, hardwired to the terminal panel, are interrogated individually by the controller file, and a customer-selected equation or algorithm is applied to each. This action results in eight discrete analog output control signals which are routed back to the terminal panel for distribution to the respective control elements.

The process input signals, a code relating the selected algorithm, and the resultant output signals are stored digitally in designated controller file areas referred to as computational slots. A slot, therefore, contains the required data necessary for controller action.

Algorithms are pre-defined and are resident in the controller file. They contain a mathematical expression in which the process variable (PV), set point (SP) and time (t) are the variables in the equation, and the resultant is the control output (C), where:

$$C = f(PV, SP, t)$$

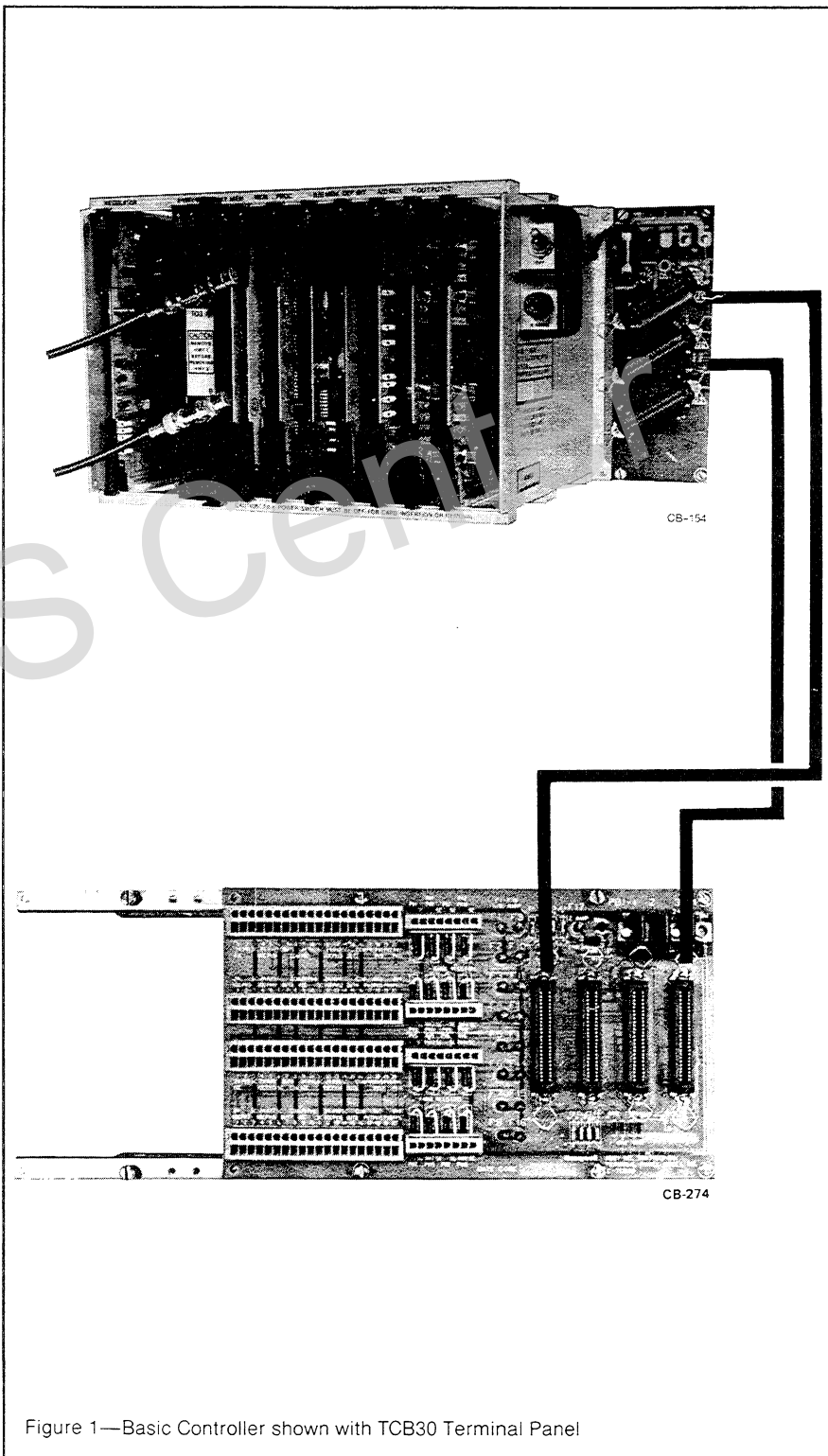


Figure 1—Basic Controller shown with TCB30 Terminal Panel

There are 28 resident algorithms, including 10 variations of 3-mode control which provide proportional, integral and derivative action. The remaining 18 include control algorithms and auxiliary functions such as multiplication/division, square root extraction, lead/lag and override signal selection. One of the 28 is selected during controller file configuration for each of the 8 computational slots. Figure 2 is a symbolic representation of the 8 slots which store configuration and process data and which perform all controller action.

Data words depicting the applicable constants, direct or reverse actuation, output indication, limits and alarms are entered and stored during the configuration procedure for each of the 8 slots. The 8 sets of data words are independently acted upon by the microprocessor resulting in eight discrete control actions.

A limit alarm is available for each slot that will activate when the customer-selected PV or deviation limits are exceeded. The PV alarm is triggered when the absolute value of the PV input exceeds its predetermined limit. The alarm type and limit are also entered during the configuration procedure.

A continuous self diagnosis is performed 3 times per second by the controller file on its major hardware and firmware components. A subsequent failure detection will cause the slot outputs to be fixed at their last value and the file to be placed in the non-operating reset mode.

### Controller Types

Two Basic Controller types are available, the CB120 and the CB121. These controllers are identical with one exception in the system security area.

*CB120* contains a core memory printed wire board which retains restart information for a stalled or powered down controller file. Configuration and operating data for each of the eight slots is stored in the controller's non-volatile core memory. It is constantly updated during normal operation, and its integrity is maintained during a system failure or power loss. This data along with a resident restart program is used to restore each of the 8 loops to a restart condition as determined at configuration. The controller is restarted by the operator who enters a restart command from the operator interface.

*CB121* contains a Complementary Metal Oxide Semiconductor (CMOS) memory in place of the core memory as used in the CB120 model. This CMOS memory is a component of the failsafe Uninterrupted Automatic Control System (UAC). This system facilitates the automatic substitution of a reserve

controller file for the failed or powered down primary controller.

The operating data stored in the CMOS memory of a failed primary controller is immediately transferred to the CMOS memory of the reserve controller, should a primary failure occur.

A restart command is automatically issued to the reserve controller and process control is resumed. The entire

switch-in operation is completed within one second.

No functional differences exist between the CB120 and the CB121 models other than those just described. Additionally, primary and reserve controller files of the UAC system are identical without exception.

See "Security" for additional UAC details.

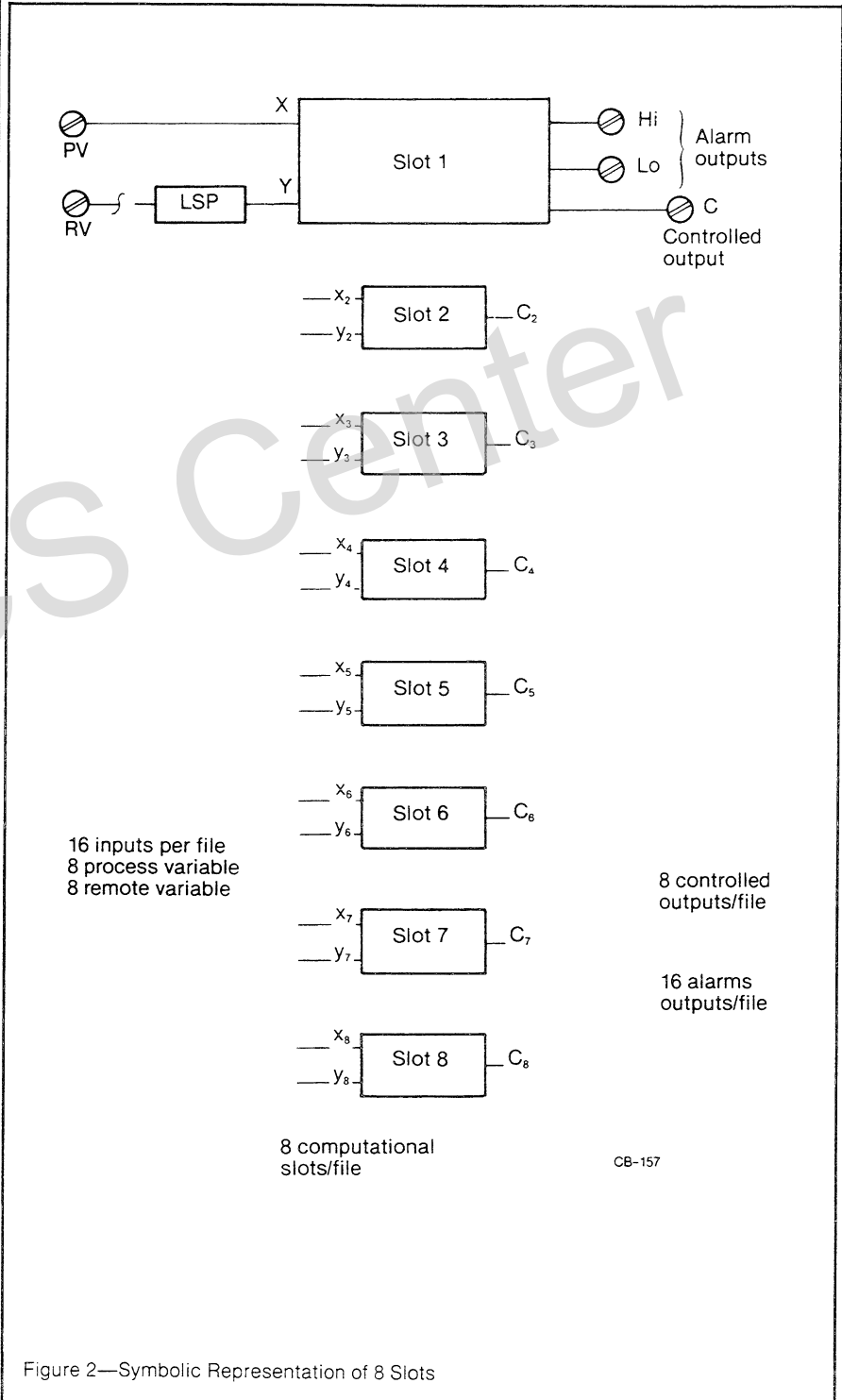


Figure 2—Symbolic Representation of 8 Slots

### Controller Interface

The interface between the process and the Controller, exists at the printed wire terminal panel (C-TCB20, C-TCB21, or C-TCB30). Input wires from field sensors and output wires to final control elements are connected at terminal strips as indicated in Figure 3 and 4. Terminals 10 and 11 on C-TCB20 and C-TCB21 also may be used for low and high alarm wiring, while terminals 12 and 13 provide outputs for left and right indicator lamps (LIL and RIL) on Analog Displays. Terminal panel C-TCB30 does not provide for alarm or indicator lamp outputs. However, it can accommodate alarm functions if used in conjunction with terminal panel TPM01 or TPM02.

On TCB20 or TCB21, each one of the eight terminal strips is devoted to only one of the eight slots of a BASIC Controller. On TCB30, each one of four terminal strips accommodates two of the eight slots. When TPM01 or TPM02 is used, each one of four terminal strips provides for up to four slots, therefore each TPM01 or TPM02 can accommodate two Basic Controllers. The signals at the terminal strips are connected internally.

### Operator

Operator interfaces to the Controller file and the process are the Operator Station, a Data Entry Panel (DEP) if used, and Analog Displays which can be used only with Terminal Panel TCB20 or TCB21. Terminal Panel TCB30 does not provide connections for Analog Displays.

The Operator Station enables the operator to monitor a single point (on a detail display) or several points (on a group display) on the CRT screen. It also permits him to manipulate parameters, such as setpoint, for one point at a time, from a position remote from the Controller file and the process.

The Data Entry Panel is an optional device. In addition to keys for data entry, it contains digital displays and indicator lamps that permit the operator to configure, operate, and monitor the Controller. By adding Slot Selector modules to it, the DEP can be used to supervise up to 16 Controller files (128 control loops). The DEP presents two primary digital displays for a given slot, the Process Variable (PV), and the selected variable. Pressing the DEP HOLD key places a Controller file in the Loop Manual control mode, where the output of each slot is held at the value it has when the DEP HOLD key was pressed.

The DEP connects to the Controller file by 50-conductor cables with a maximum length of 200 feet.

Analog Displays provide indications and manual manipulation of outputs only.

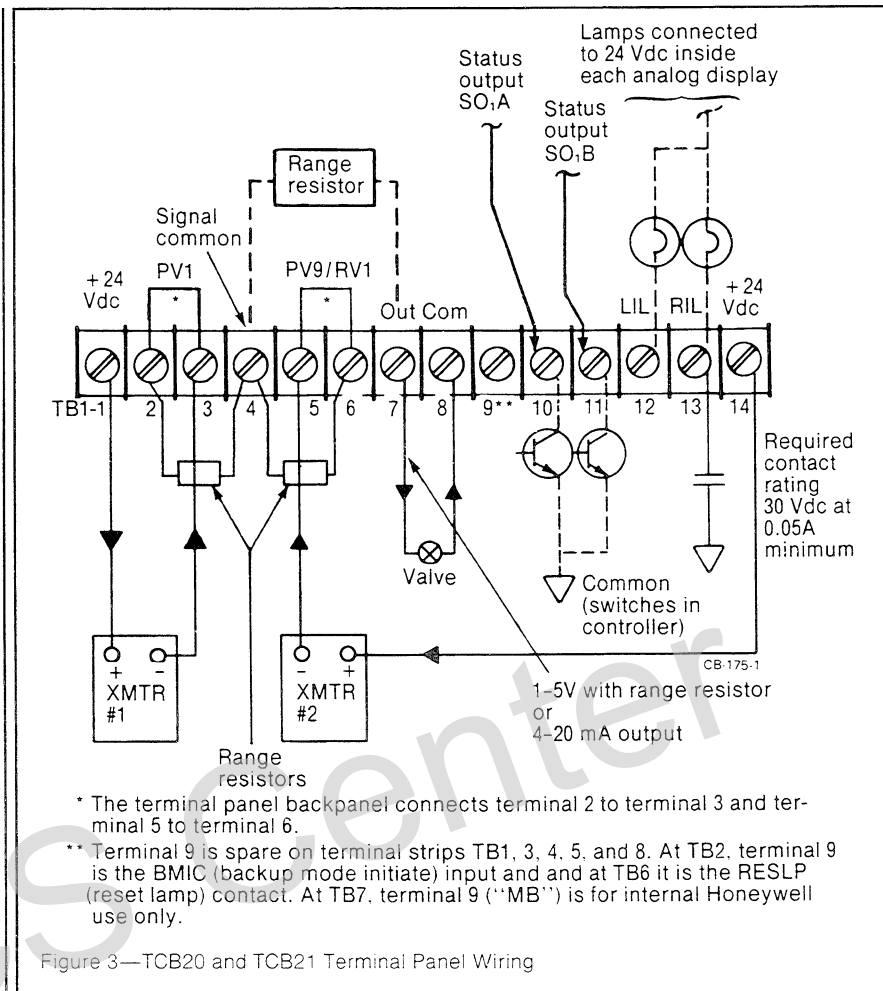


Figure 3—TCB20 and TCB21 Terminal Panel Wiring

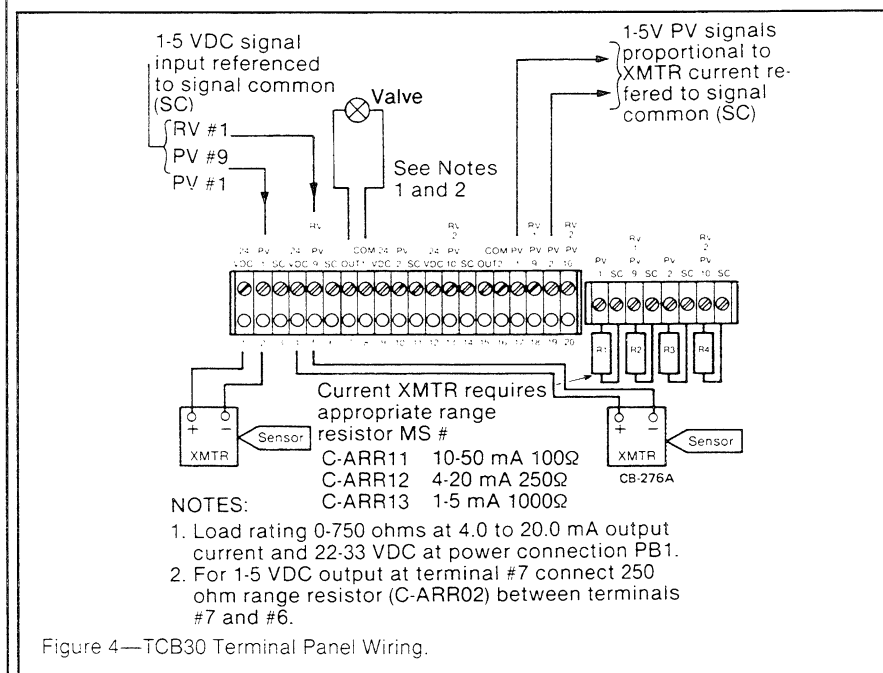


Figure 4—TCB30 Terminal Panel Wiring.

They include PV, set point (SP), and output indicators, with SP and output control levers. With the Controller file in the

Loop Manual mode. Analog Displays permit the operator to change the valve output, and to observe the change.

**Options Interface**

A system interface option is available to the controller file which allows communications through a Data Hiway. It consists of two plug-in printed wire cards, and provides a redundant coaxial cable interconnection to Hiway devices. The second cable automatically resumes communications should the primary cable become inoperative.

The Data Hiway is the interconnecting link between all Hiway based system components including operator stations or host computer.

**Trending**

A second controller file option is the Trend Memory card which provides the trending and hourly averages (logging) function for each of the 8 loops. It is a single plug-in printed wire card and is used in conjunction with the TDC 3000 Operator Station and the Data Hiway interface option. The card is loaded via the Hiway with a program, to continuously store information about each of the 8 slots for retrieval via the Hiway, as history. The stored information consists of sixty 20-second averages; one hundred and eighty 1-minute averages; sixty 3-minute averages; two hundred

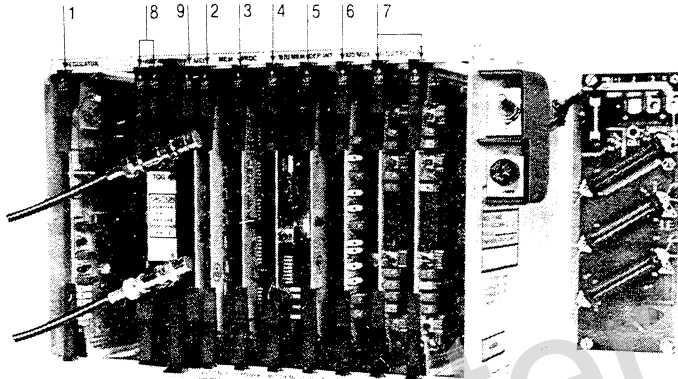
and forty 6-minute averages; sixty 12-minute averages; and 72 1-hour averages for the PV (X input) and RV of each slot.

**Physical Characteristics**

**Card File**

The controller files are designed to ac-

cept seven standard and four optional printed wire (PW) cards (Figure 5). Each card file consists of a card cage, guides, connectors and an integral printed wire backplane through which all signal paths are completed. 50-pin female connectors provide for external connection of the data entry panel and the terminal panel. Connec-



- |                       |   |                               |
|-----------------------|---|-------------------------------|
| 1. Regulator          | 4. Core Memory (CB020) or CMOS Memory (CB021) | 7. Output                     |
| 2. Solid State Memory | 5. DEP Interface (optional)                   | 8. Hiway Interface (optional) |
| 3. Processor          | 6. A/D Multiplexer                            | 9. Trend Memory (optional)    |

Figure 5—Card Locations

\*Optional—must be ordered when the Data Entry Panel (DEP) is used

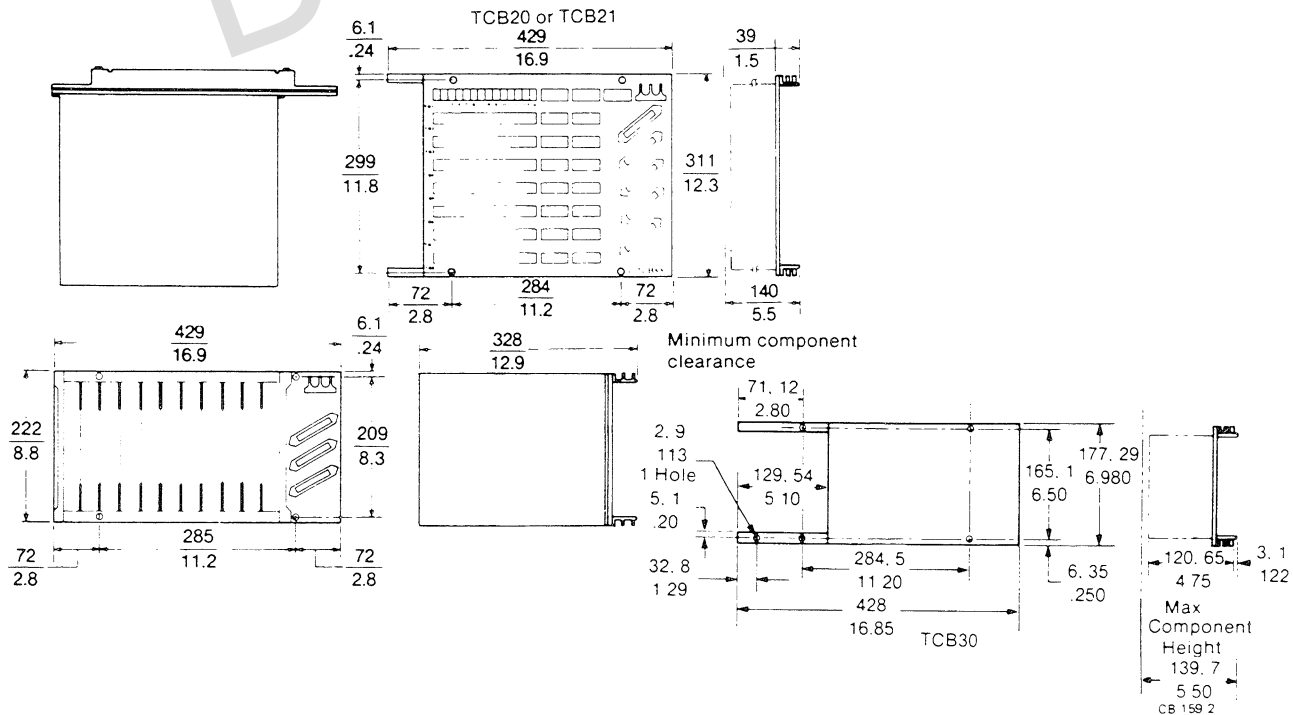


Figure 6—Outline and Dimension Drawings for Card File and Terminal Panels

tion to power, ground and signal common is completed via connection to a power bus.

An LED indicator (DS1) on the backplane denotes the availability of power to the backplane from the power distribution bus bars.

**Mounting**

The Basic Controller file is designed to fasten to a set of mounting hardware which includes the power bus system. The mounting hardware fits any standard Electronics Industries Association (EIA) 19 inch enclosure. [Adapters are available to fit 24 inch enclosures]. Outline and dimension drawings for the card file and terminal panels are shown in Figure 6.

**Indicators**

There are a minimum of 8 LED indicators provided in the Basic Controller file. These are located on the edge of the printed wire cards and on the backplane. Two additional LED's are located on the optional cards, and a final LED on the CMOS memory card, when used.

See Table 1 for location and function of each.

**Local Switch Controls**

A power on-off switch is mounted to the card cage of the controller file. This switch interrupts the 24 Vdc source to the regulator card and should be utilized whenever a PW card is removed or inserted.

The core and CMOS memory cards each contain a protect-enable switch. These memories are continuously updated with controller file data when the switch is in the enable position. Data in memory is retained at its current state and not updated when the switch is placed in the protect position.

An alternate CPU restart capability is provided at the controller file. The restart command can be initiated by placing a short circuit between a pair of test pins labeled (TP-1) on the CPU card.

**Signal Termination**

All analog field input/output (I/O) signals terminate at the Controller's terminal panel. Panel TCB20 or TCB21 or the more compact TCB30 (Figure 7) has screw terminal connections for each terminal strip's analog input and output signals (see Figures 3 and 4). The Terminal Panels provide for 16 process variable (PV) input signals, including screw terminals for range resistors if required, to match a variety of standard input and output ranges. (Duplicate PV input screws provide space for range resistors.) Eight analog output signals dedicated to slots 1 through 8, emanate from 4-20 mA drive circuit. On TCB20 or TCB21, one output emanates from each of eight terminal strips: on

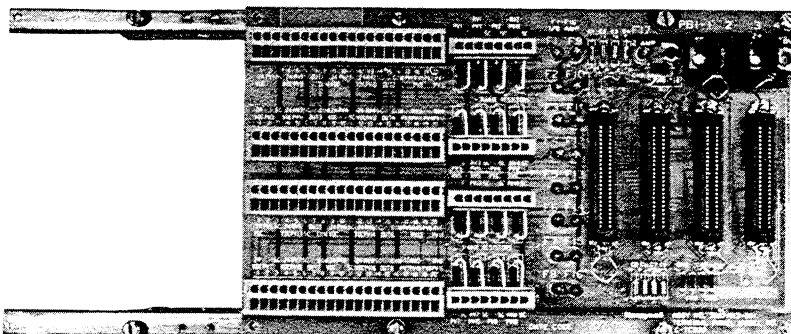


Figure 7—TCB30 Terminal Panel

**TABLE 1 LED's**

| Location                        | Designation | Normal Condition                         | Indicates   |
|---------------------------------|-------------|--|---|
| Upper Right Corner of Backplane | DS1         | Lit                                      | 24 Vdc on backplane.  |
| Processor Board                 | DS1         | Lit                                      | Processor is running, watchdog timer has not timed out.   |
| Core Memory (Controller CB120)  | Busy        | Flashing (brightly)<br>Flashing (dimmer) | Core memory is being updated (core switch is in "normal" position).<br>Core memory is being protected (core switch is in "protect" position). |
| DEP Interface Board*            | DS1         | Flashing                                 | Data transmission between DEP and Controller.   |
| Output Board(s)                 | DS1         | Lit                                      | 24 Vdc on Output Board.   |
| Regulator Board                 | DS1         | Lit                                      | Presence of + 12, - 12, + 5, and + 24 Vdc.  |
|                                 | DS2         | Lit                                      | 24Vdc to input fuse of Regulator Board. (Blown fuse does not turn off LED DS2.)   |
| Hiway Board                     | TOG         | Not Lit                                  | DDC or Supervisory Control OK.  |
|                                 |             | Lit                                      | Time out gate has timed out. (Always lit without DDC).  |
| Trend Memory (optional)         | DS1         | Flashing                                 | Trend Memory program running.   |
| CMOS Memory (Controller CB121)  | Busy        | Flashing                                 | CMOS Memory receiving data update (CMOS switch is not in "protect" position).   |

**NOTE:** There are no LED's on Solid State Memory or A/D Muiltplexer boards.  
\*Optional — must be ordered when the Data Entry Panel (DEP) is used.

TCB30, two outputs emanate from each terminal strip. Figure 3 and 4 show two independent +24-volt supply terminals for each slot, along with corresponding fuses, for external relays or transmitter modules. These drive signals connect via the terminal strip, to a final control element such as a valve.

Fuses F1 through F16 (125 mA) protect the 24-volt line to the field transmitters. Two independently fused 24-volt power sources are provided, one for each possible PV input. A 2-ampere fuse, F17 protects mainly the Analog Display power branch. An LED connected across the 24-volt line and located in the upper right corner next to the barrier strip, indicates the presence of power.

NOTE: Terminal Panel TCB21 is the only one that is directly connected at all input terminals. Therefore, in the event of a short-circuit, the power-limiting resistors can safely dissipate the full 24 volts, and a metal conduit is therefore not required.

The Backup Mode Initiate signal (BMI) causes computer algorithms to shed to the back up mode when grounded and the Reset Lamp contact (RESLP) stops operating. Both signals are available at the terminal panel.

**Interconnecting Cable**

The primary interconnection between all Basic Controller file related TDC 3000 elements (terminal panel, Data Entry Panel and Analog Displays) are made via 50-conductor cables having a maximum length of 60 m (200 feet).

**Operation**

**Configuration**

The TDC 3000 Basic Controller is designed to have a minimum number of fixed parameters in order to provide maximum flexibility. The control parameters of each slot therefore must be placed into operation. The selection of control parameters is implemented through a simplified procedure called configuration, a function performed by a series of key strokes at the operator interface. Four 4-bit words are entered for each slot; see Controller Configuration Card (Figure 8).

Parameters selected for each computational slot are input type, source and

conditioning, control or auxiliary algorithm and direct or reverse control action. The "A" equation, giving full response to set point change involving gain, integral and derivative action; and the "B" equation which responds to a set point change with integral action only. Also selected are the alarm and display types, output indication and

restart mode. The completion of the configuration procedure results in a link between the analog-to-digital converter and each of the 8 slots, with an algorithm selected to perform a specific control function for each slot. See *Controller Configuration Technical Data* CB-10-04

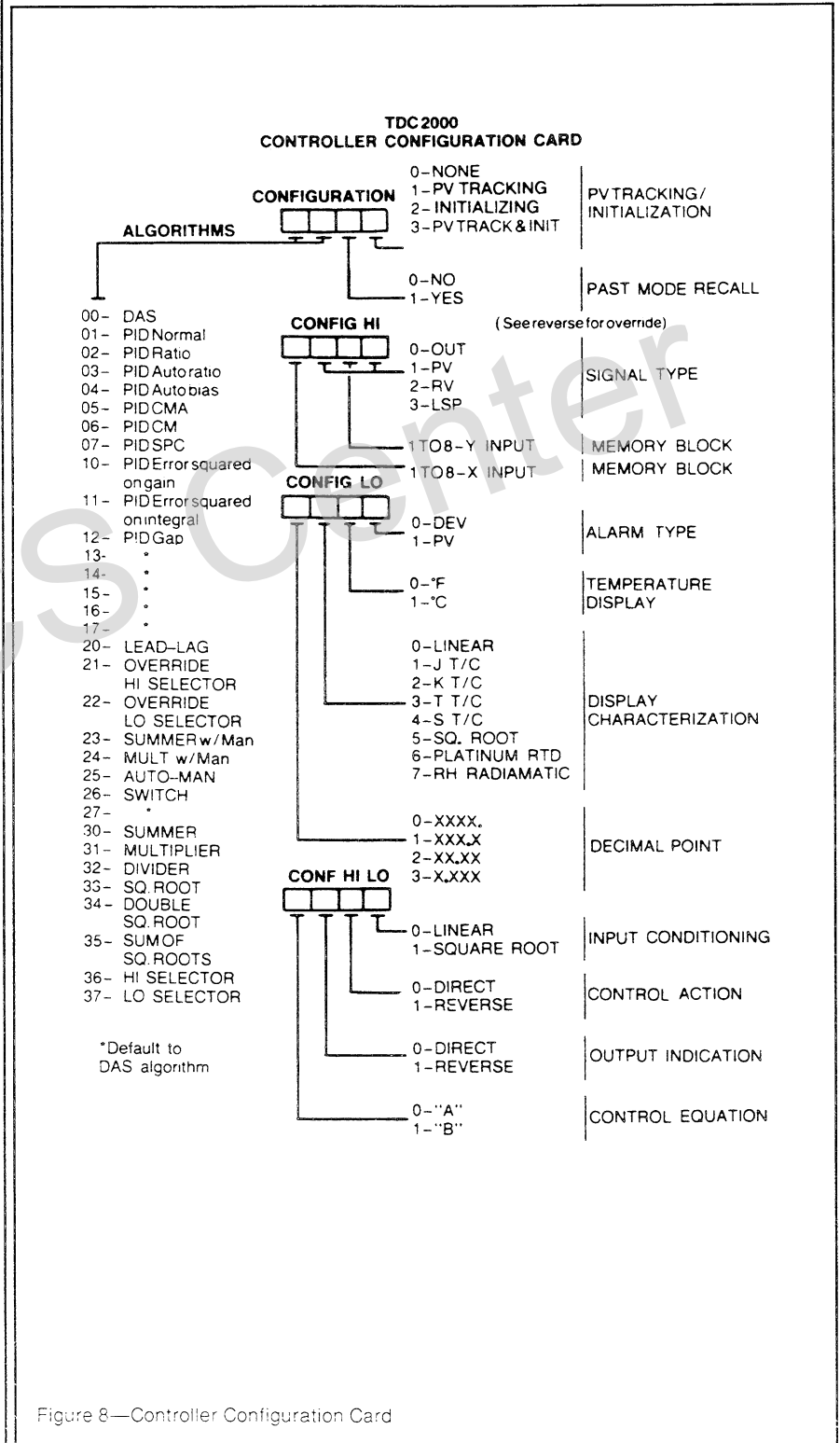


Figure 8—Controller Configuration Card

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