CHAPTER 6

EQUIPMENT MODIFICATIONS

Section I. INSTRUMENTATION AND CONTROLS

6-1. General

Existing local control system equipment will be shown to include modifications required for interfacing with an EMCS. Except for existing time clocks, the existing local loop control system must remain and perform as originally designed. It will be necessary to indicate replacement of controllers to provide capability for remote control point adjustment. The local loop controls will be interfaced so they will operate in a predetermined manner upon EMCS failure. New sensors dedicated for EMCS use will be shown a new rather than reusing existing sensors. When interfacing the field equipment, all existing indicating devices such as gauges and thermometers will be shown as remaining in service.

6-2. Controllers

a. Existing local control systems using, controller, and actuator require a controller with CPA port for remote control point adjustment. This will necessitate the replacement of the existing controller without CPA by a new controller with CPA. The CPA port will be reset from an analog output.

b. Single input CPA controller. Single input CPA controllers permit remote .hanging of control points by varying the CPA port value. The CPA port value variation must be plus or minus 10 percent of primary sensor span. The controller must include an adjustable setpoint, adjustable gain (proportional band) with field selectable direct or reverse acting action. The controller inputs and outputs must have internal or external gauges for calibration of input and output signals.

c. Two input controllers. Two input controllers permit remote changing of control points by varying the second port input value Effect of the secondary sensor span. The controller must include an adjustable setpoint, adjustable gain (proportional band) with field selectable direct or reverse acting action. The controller inputs and outputs must have internal or external gauges for calibration of input and output signals.

6-3. Controller interfaces

a. Typical controller interfaces are shown in figures 6-1 through 6-8.

b. Figure 6-1 shows a two-position pneumatic override and incorporates a three-way solenoid to switch the signal to a predetermined EMCS signal. The EMCS control signal value depends on the operation required and the equipment being controlled. The existing control signal will operate the device being controlled during FID/MUX failure. The I/O summary tables (chapter 4) require definition of the failure mode during FID/MUX failure. The electrical equivalent to the two-position pnuematic override is accomplished with a relay with Form C contacts.

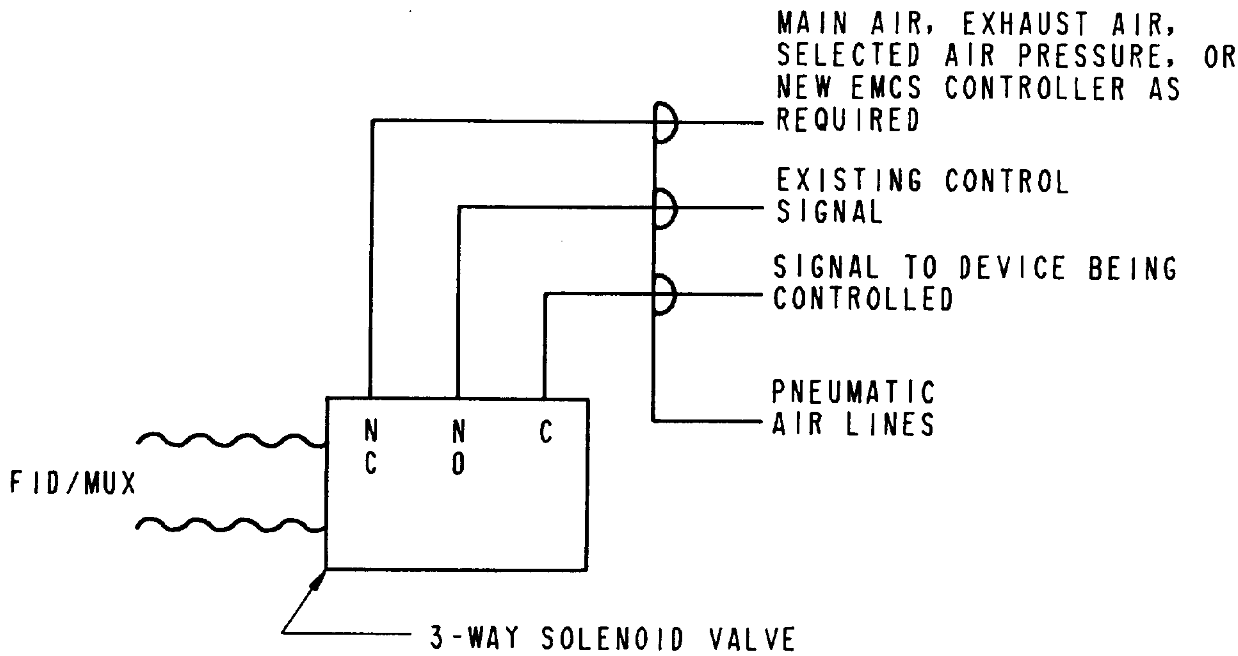

Figure 6-1. Two-position pneumatic override.

c. Figure 6-2 shows a three mode pneumatic override control which incorporates two 3-way solenoids controlled from the FID/MUX electrical output. The operation of the solenoids allows either for the dampers to be under local control of the mixed air controller or for override to allow for 100 percent outside air supply or minimum outside air supply.

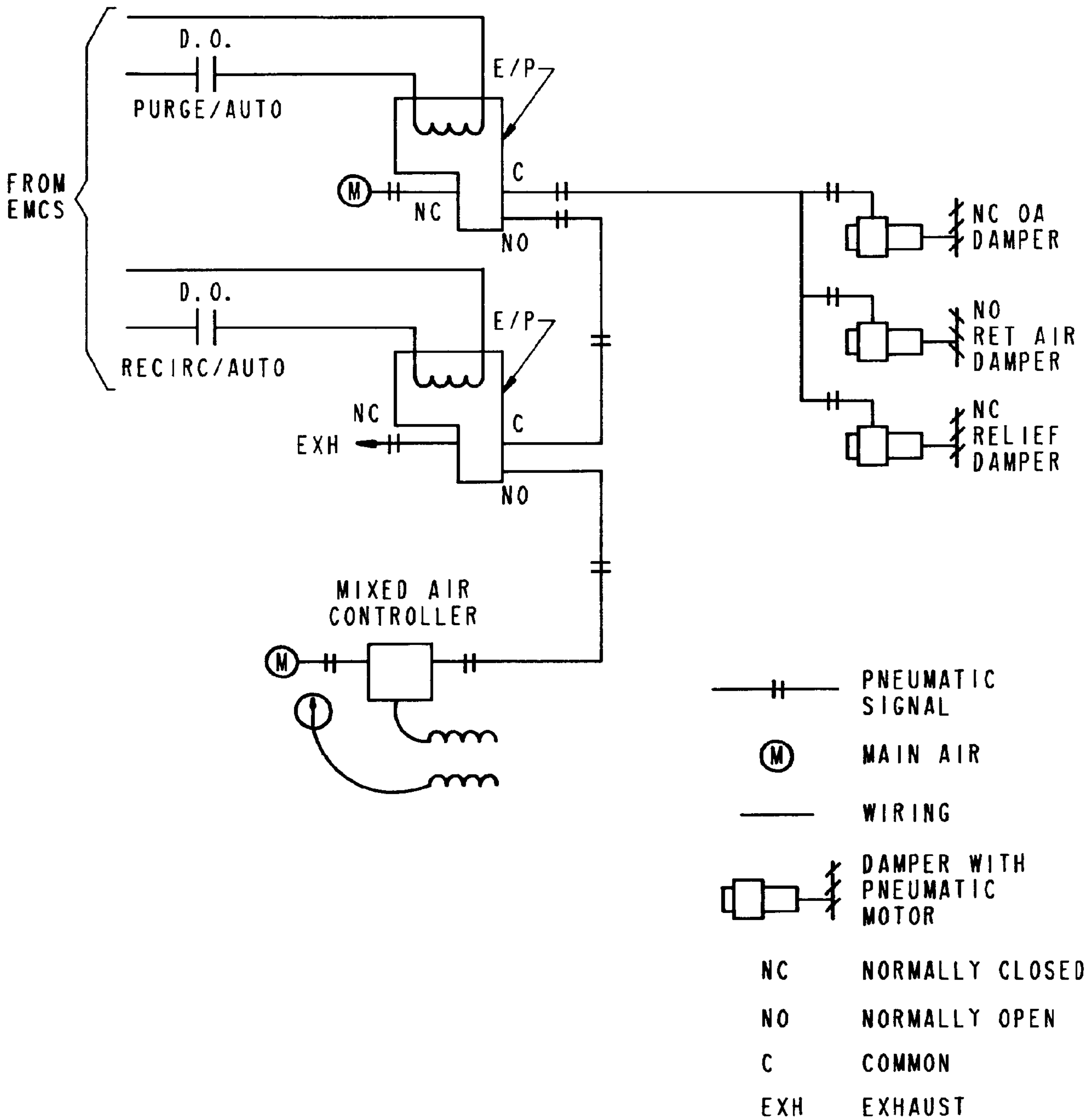

Figure 6-2. Three-mode damper control.

d. Transducers are used for changing pneumatic signals to electric signals, and vice versa or to change a current signal to a voltage signal. Transducers are used in conjunction with sensors and controllers Figure 6-3 shows an electric to pneumatic transducer used to convert FID/MUX electrical output signals to pneumatic signal inputs to a local pneumatic control loop. Figure 6-4 shows a pneumatic to electric transducer used to convert local loop pneumatic signals to electric signal inputs to the FID/MUX.

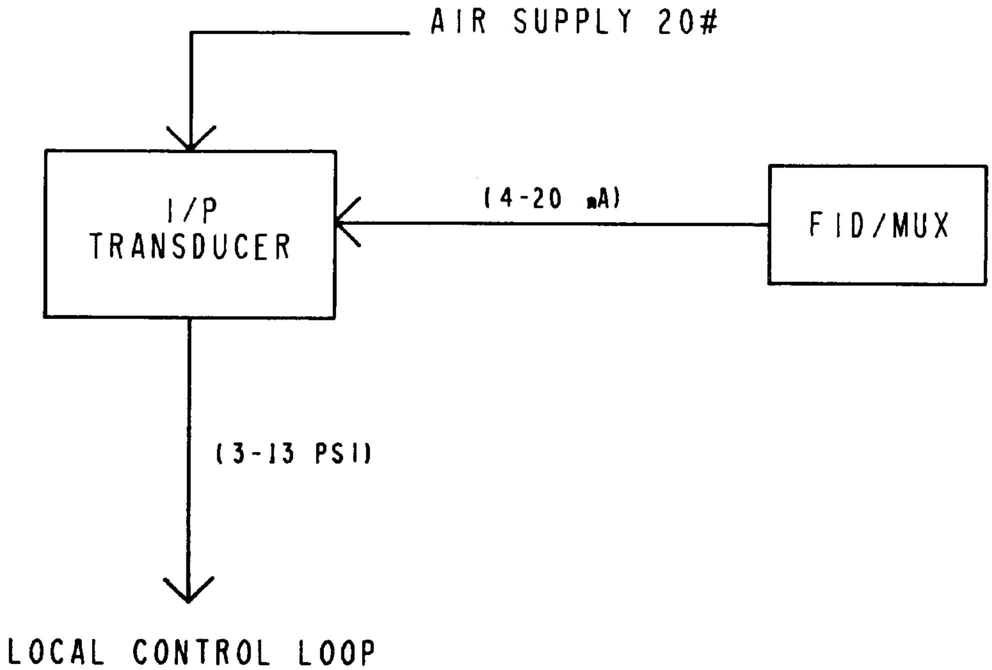

Figure 6-3. Electric to pneumatic transducer.

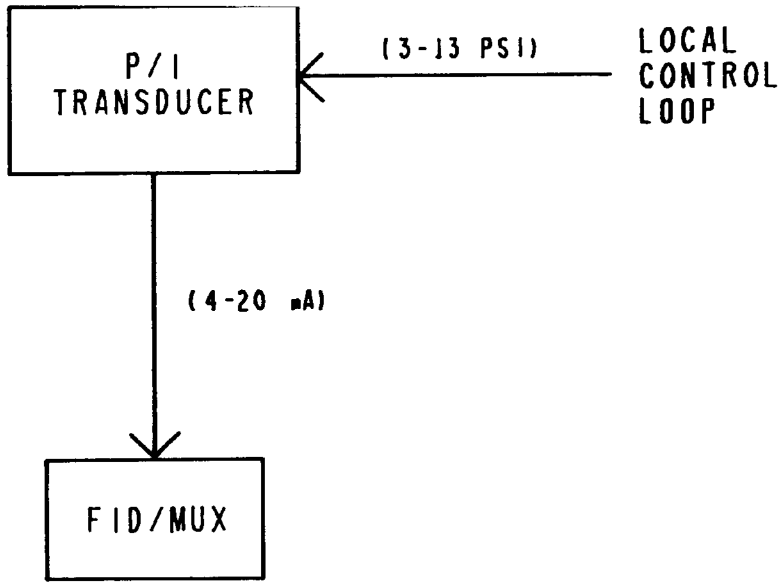

Figure 6-4. Pneumatic to electric transducer.

e. A typical local loop pneumatic controller application without CPA is shown in figure 6-5. The operation of a local loop controller with CPA is shown in figure 6-6. The effect of a 3 to 13 pound air signal on a CPA changes the setpoint plus 10 percent of the sensor span (the percentage will vary depending on the manufacturer of the controller). The EMCS will drive a transducer to change the setpoint from the high to the low setting.

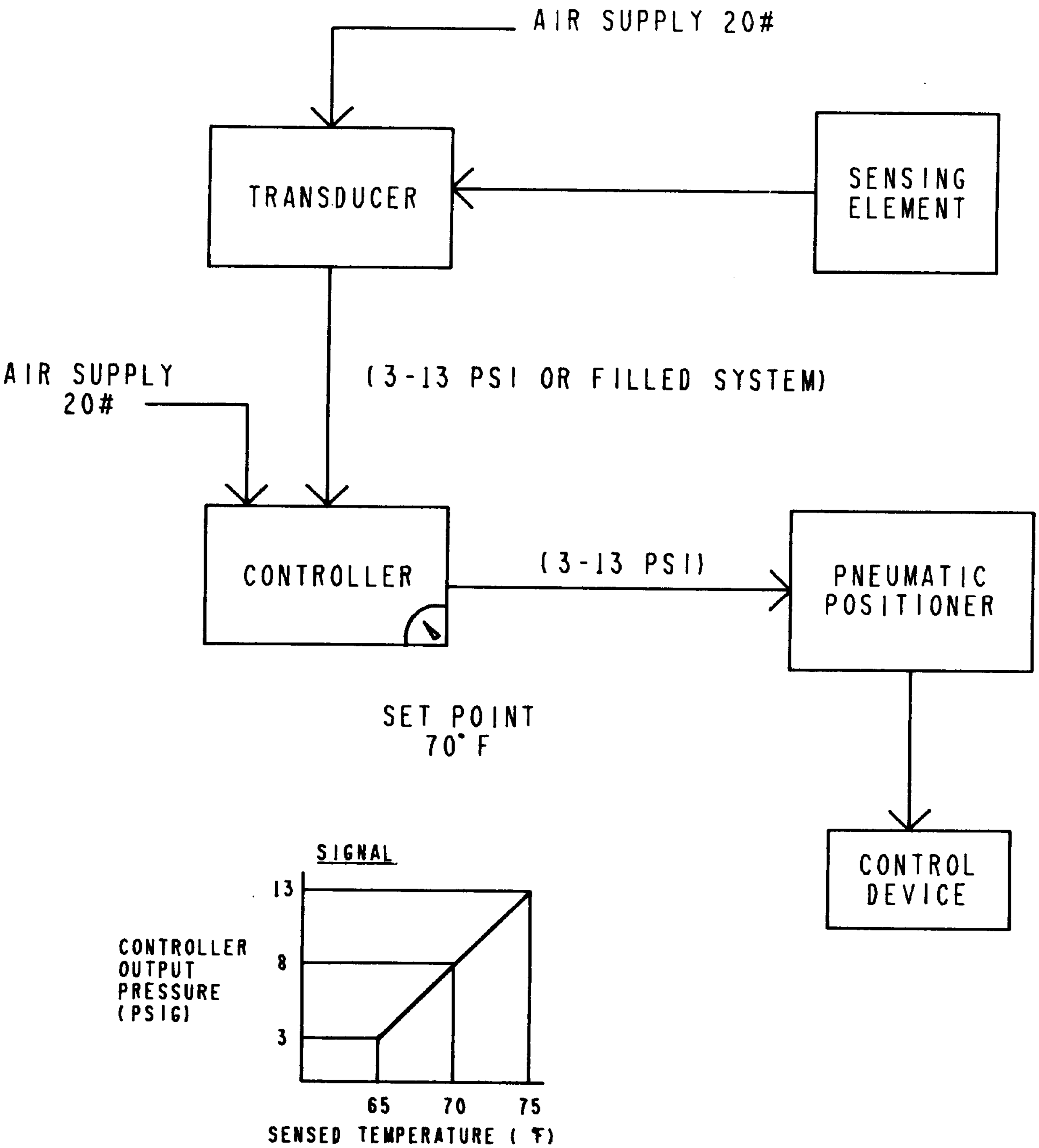

Figure 6-5. Original local loop pneumatic controller.

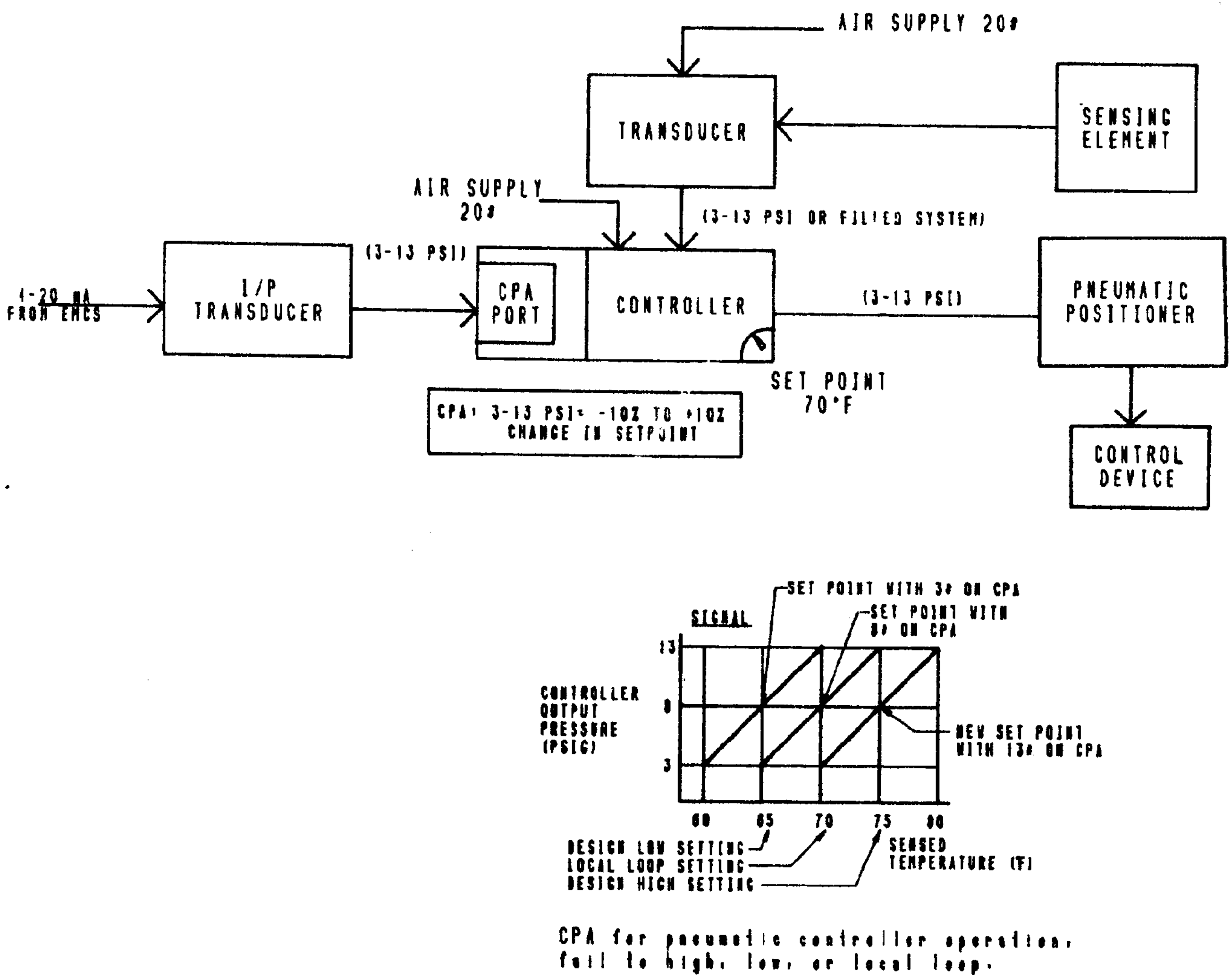

Figure 6–6. Pneumatic local loop with new CPA port.

f. The designer will determine the failure mode of operation for each CPA point. In order to fall to high, low, or local loop control, main air is fed through a pressure reducing station to produce fixed pressure input to the three-way solenoid as shown in figure 6-7. A similar arrangement using a Form C relay in lieu of a 3-way solenoid is shown in figure 6-8. If the required failure mode is to remain in the last command state, the 3-way solenoid valve or Form C relay is eliminated and the transducer (on EMCS failure) remains at the last command position (figure 6-9).

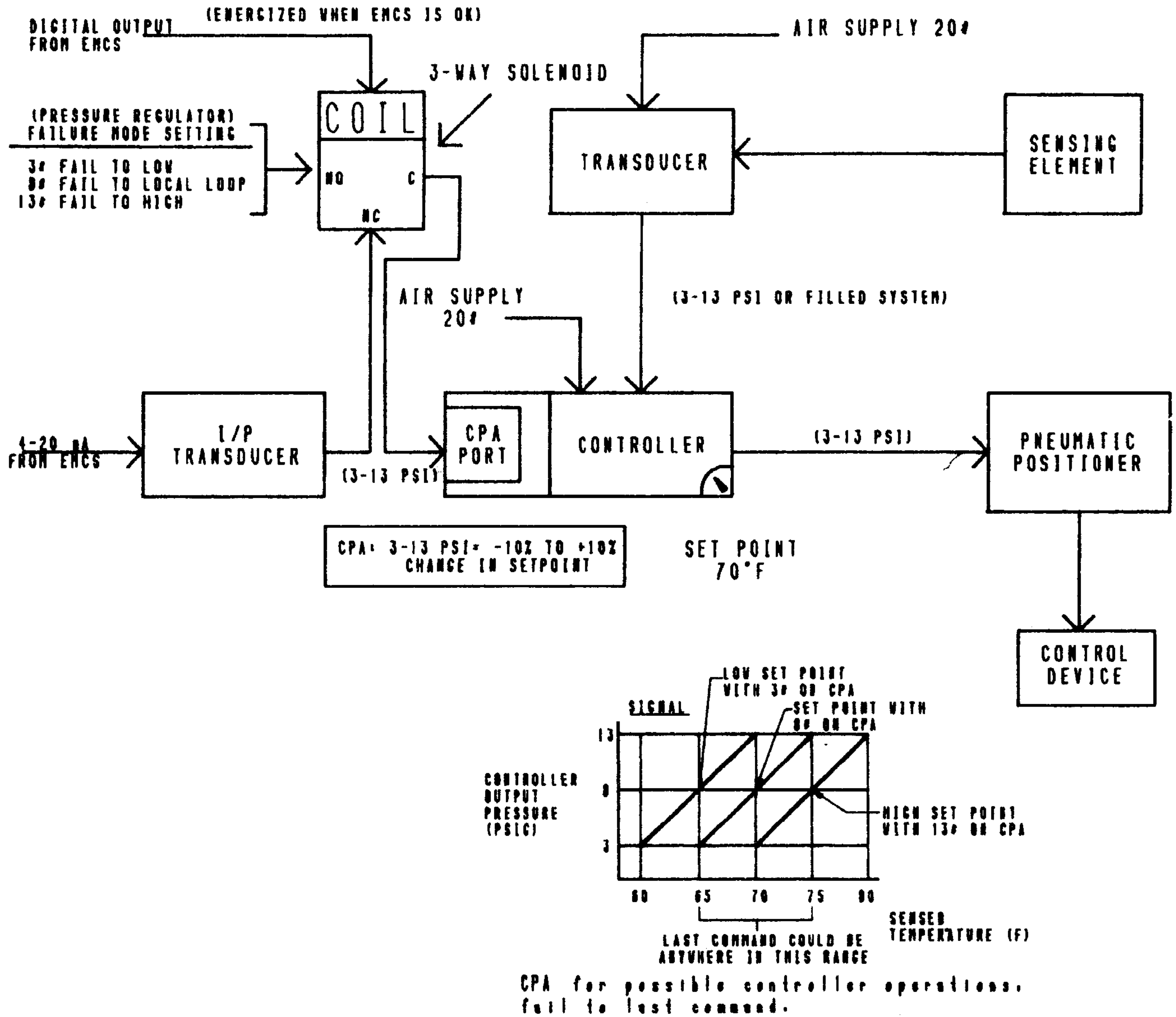

Figure 6-7. Pneumatic local loop with new CPA port and failover 3-way solenoid.

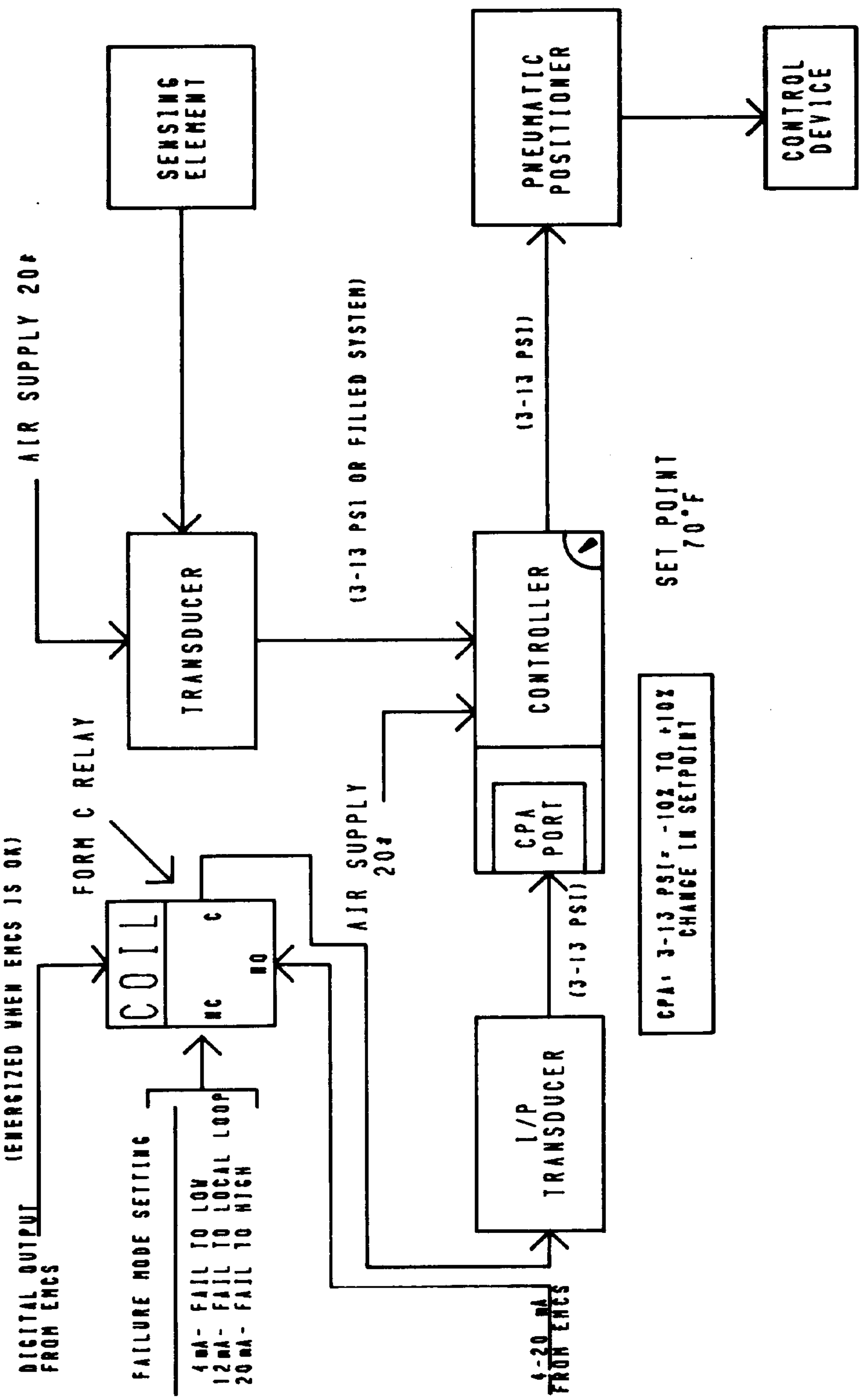

Figure 6-8. Pneumatic local loop with new CPA port and failover Form C relay.

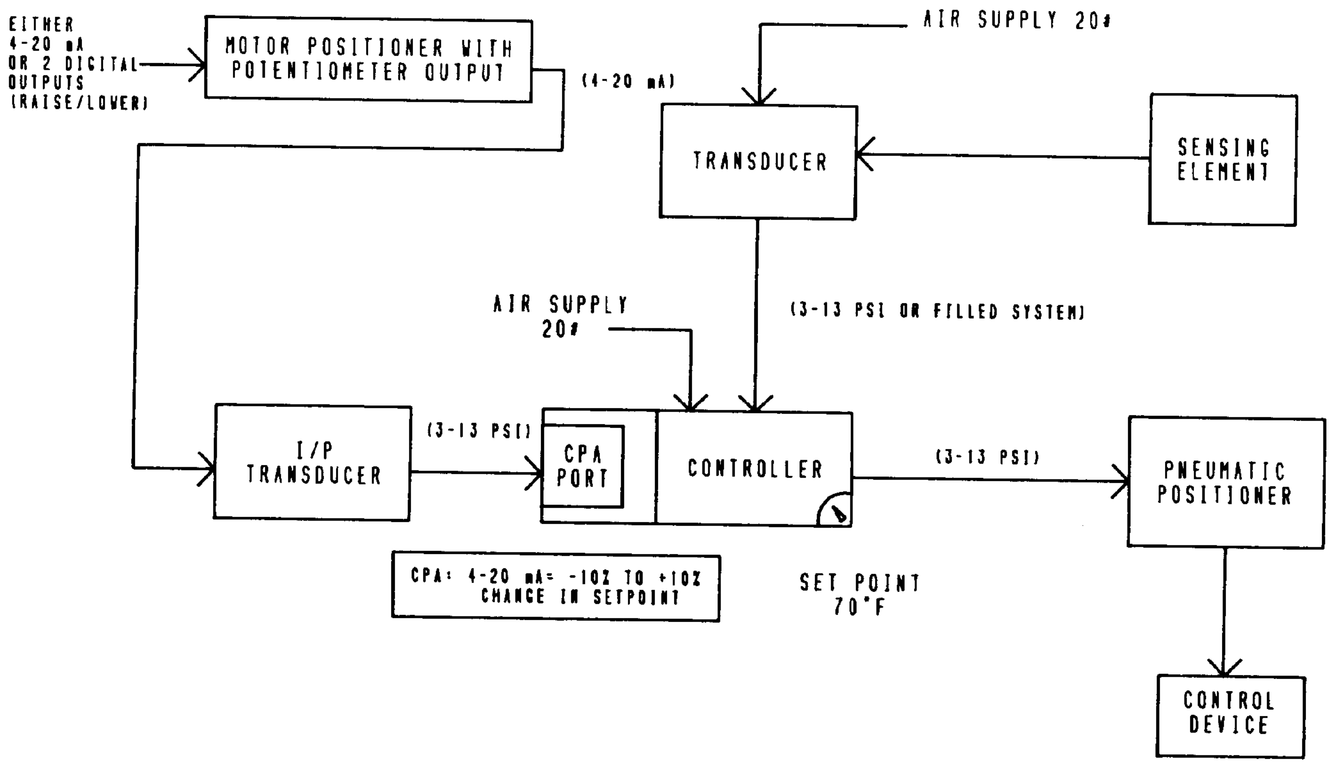

Figure 6-9. Pneumatic local loop with new CPA port and fail to last command.

g. Figures 6-10 to 6-14 illustrate electronic control circuits with the same functions as the pneumatic controllers shown in figures 6-4 to 6-8.

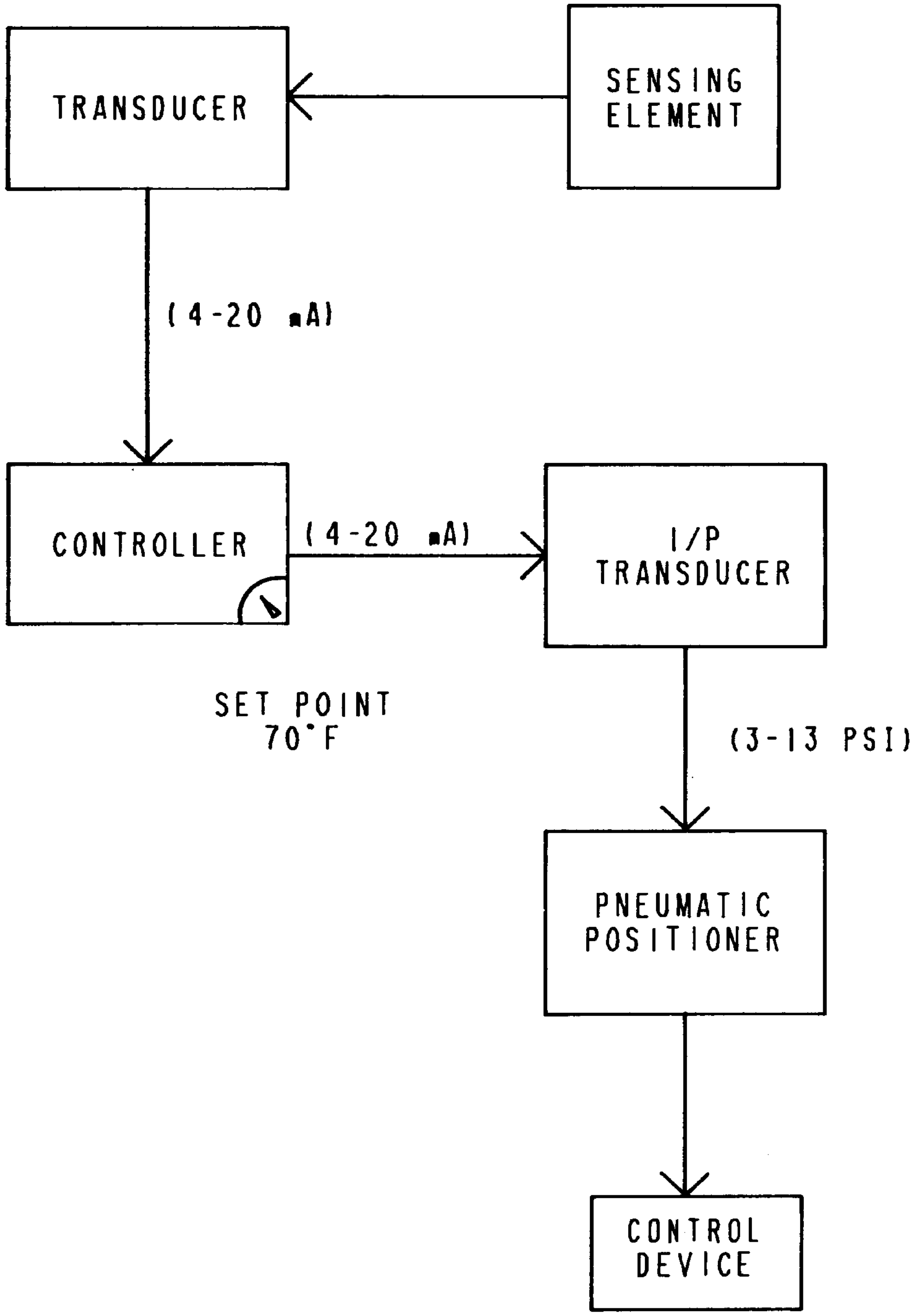

Figure 6-10. Original electronic local loop.

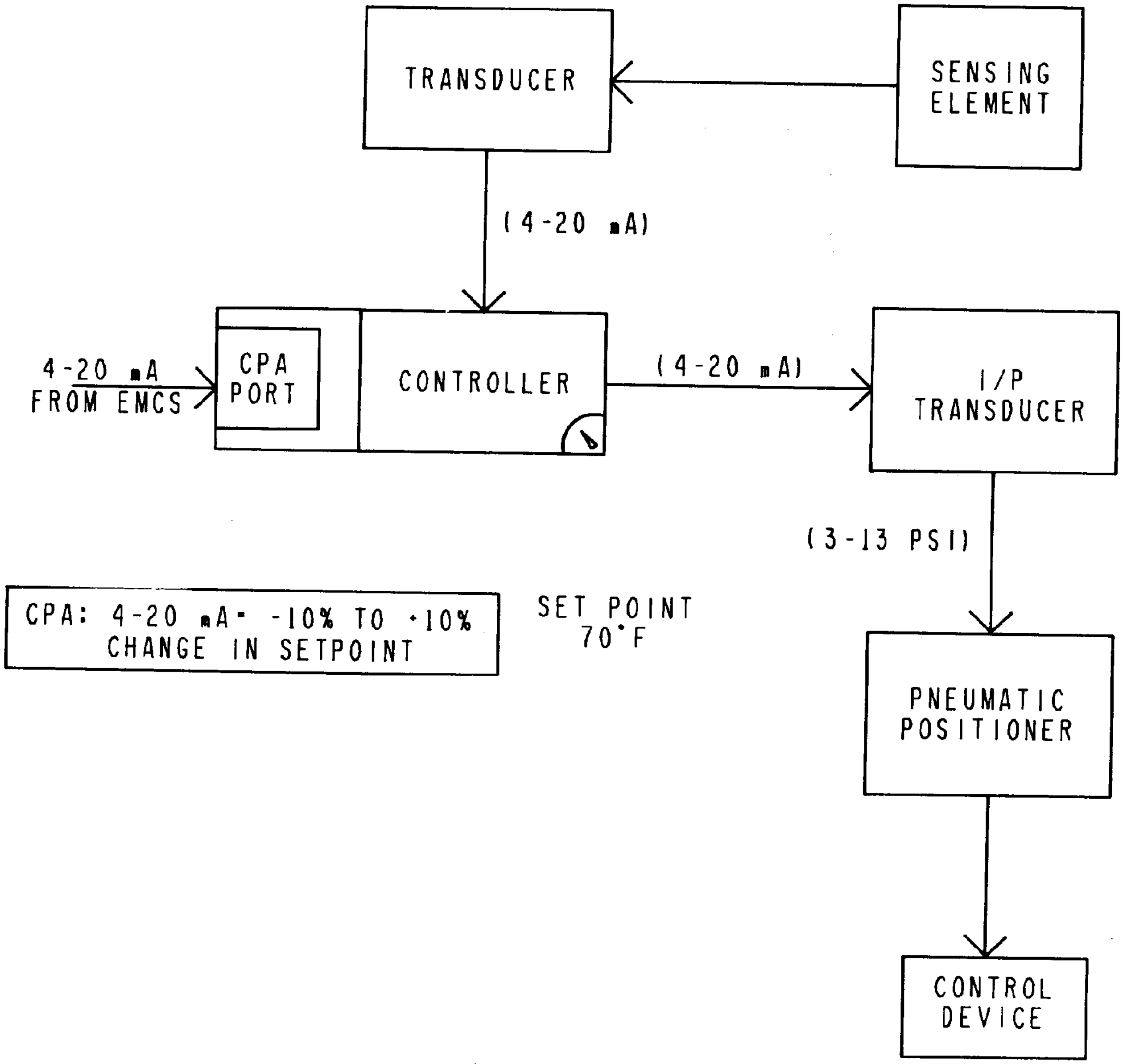

Figure 6-11. Electronic local loop with new CPA port.

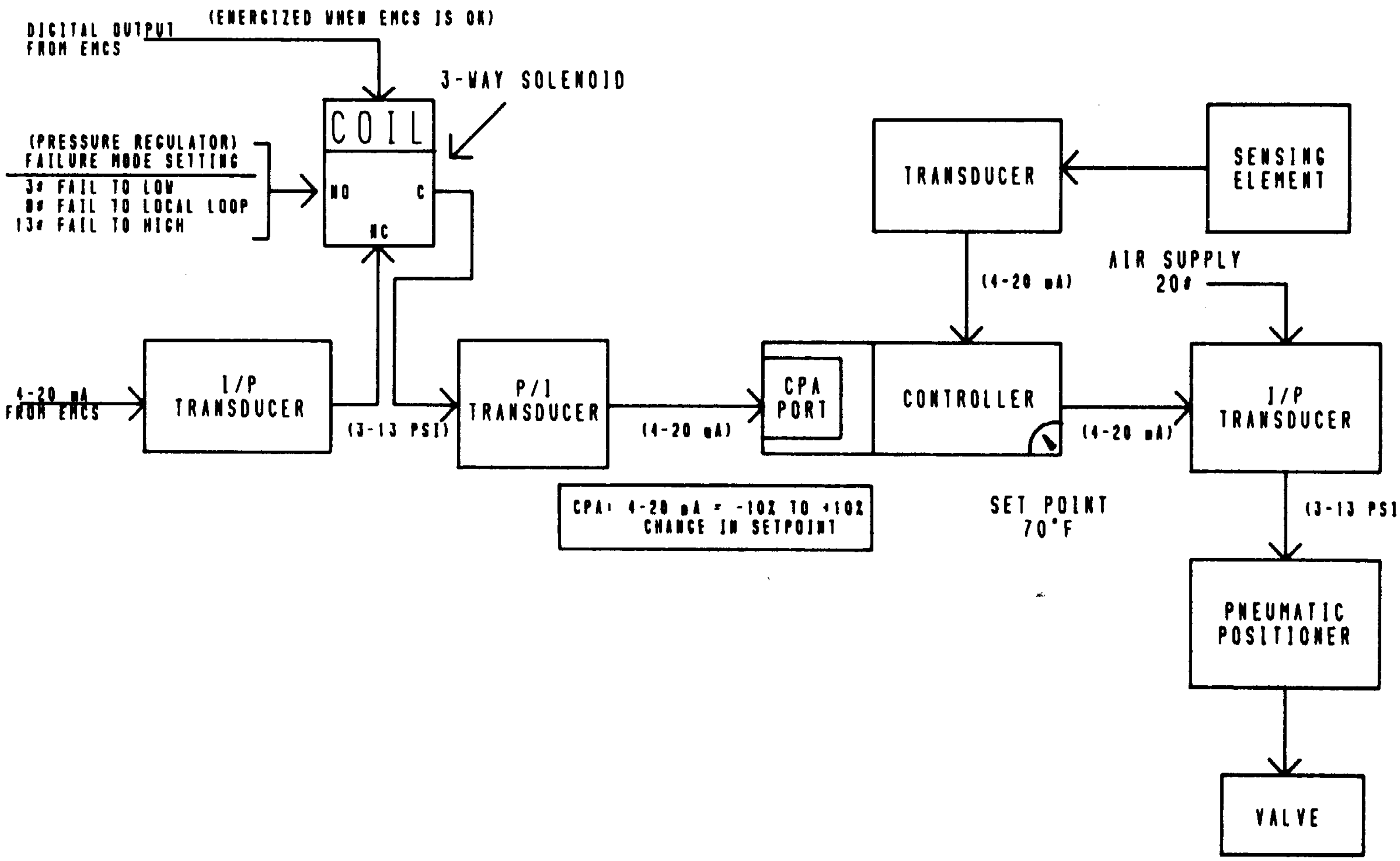

Figure 6-12. Electronic loop with new CPA port and failover 3-way solenoid.

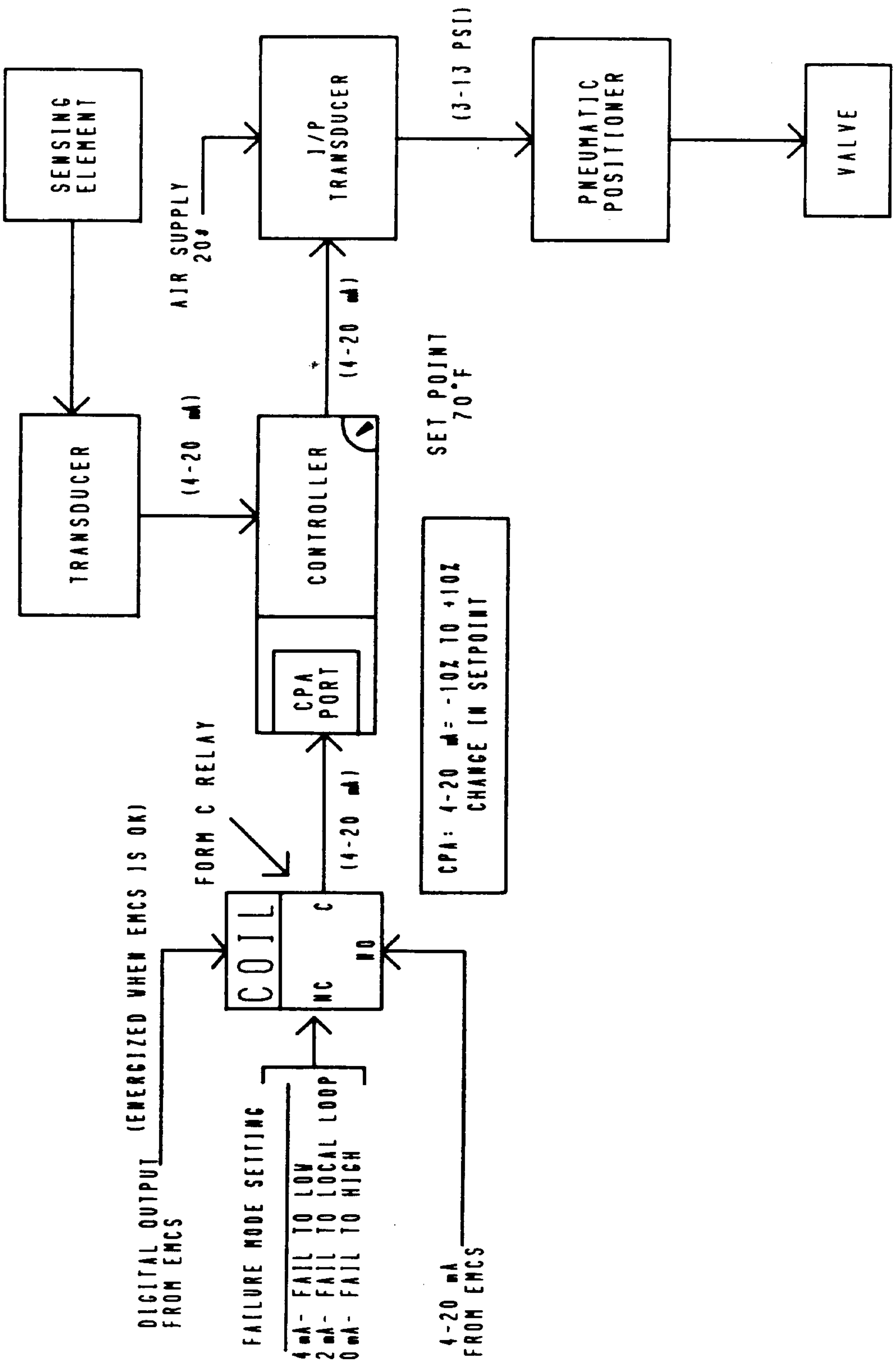

Figure 6-13. Electronic local loop with new CPA port and failover Form C relay.

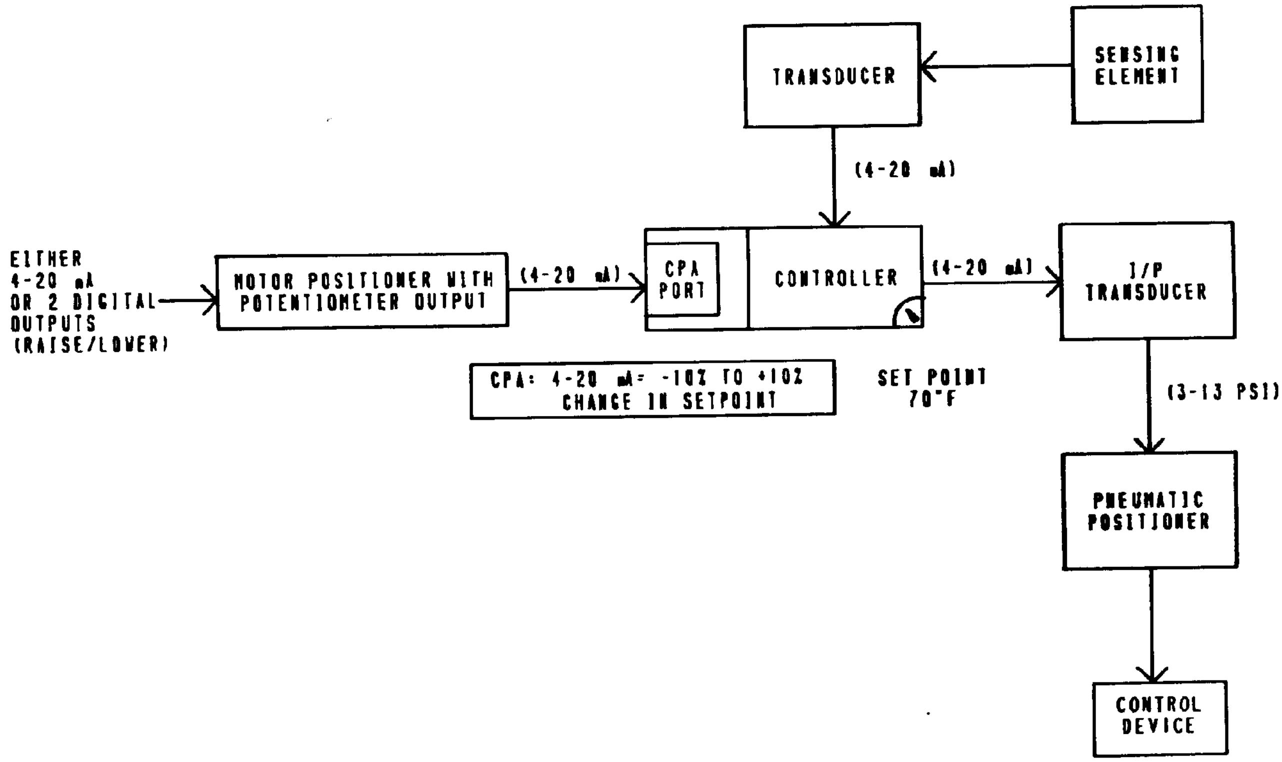

Figure 6-14. Electronic local loop with new CPA port and fail to last command.

6-4. Time clocks

The implementation of EMCS time dependent control programs requires elimination of existing time clocks. The existing time clock start/stop contacts are replaced with start/stop contacts operated from the FID/MUX.

Section II. MECHANICAL-ELECTRICAL EQUIPMENT

6-5. General

The mechanical and electrical equipment configuration and operation will be reviewed to determine modifications required for implementing EMCS applications programs.

6-6. HVAC

a. Air handling systems to which the economizer program is applicable must have 100 percent OA intake and relief air capabilities. New OA intakes will be provided for systems which do not have the capability to handle the 100 percent OA flow. New return and relief air fans will also be required to pull the air back from occupied spaces. The cost of HVAC equipment modifications will be compared with the cost savings from the economizer program to determine if the economizer program is cost effective.

b. New HVAC systems may he needed to separate a continuously operating area from an area requiring night setback capability.

6-7. Mechanical

a. Piping systems which require addition of flow measuring devices will have pump characteristics verified to determine that any additional pressure drops will not affect the system performance.

b. New valves required to implement EMCS application programs will include installation of any isolation valves needed to provide for valve maintenance and service. Valves for EMCS use include chilled water valves, hot water valves, and steam valves. Two position valves installed in steam lines will be provided with bypass lines or other means to keep sufficient heat in the piping to prevent thermal shock when the valves are reopened. Operators installed on steam line valves will have the capability for manual operation, such as a handwheel. Pumps will be added and piping modified to zone particular areas for night setback and summerwinter operation, depending on the site specific requirements. For example, domestic hot water pumps would continue to operate during the summer while space heating pumps would be shut down.

6-8. Electrical

a. Existing equipment being connected to the EMCS will require the installation of disconnect switches or locking starters within sight of the controlled equipment as required by NFPA 70.

b. Starter control circuits will be modified for EMCS interfacing. Typically, existing momentary type starters require parallel starting contacts and series stop contacts, while starters with on-off and hand-off-auto (HOA) switches will require maintained contacts in series with the local automatic control device. Start/stop switches will be replaced with HOA switches. Starter control circuits interfacing with an EMCS for controlling equipment from the EMCS are shown in figures 6-15 to 6-17. Since the pushbutton control circuit diagram requires magnetically operated contacts for momentary operation, latching relays cannot be used. During FID/MUX failure, the controlled equipment remains in the last command state. No definitive failure mode can be designed with pushbutton control. The hand-off-auto (HOA) and start-stop selector control diagrams allow magnetically held relays or latching relays to be used for contact operation, depending on the required failure mode. Latching relays will be used when the design requires equipment to remain in the last commanded state during a FID/MUX failure. Magnetically held, normally open relays will be used when the required failure mode is *off* (or an open circuit), and magnetically held, normally closed relays will be used when the required failure mode is *on* (or a closed circuit). As shown in the I/O summary table (chapter 4), the design requires definition of the failure mode during a FID/MUX failure for all types of started circuits. Magnetically held or latching relays will be selected to provide the required failure mode operation. A magnetically held relay requires one DO to control it, while a latching relay requires two DOs to control it.

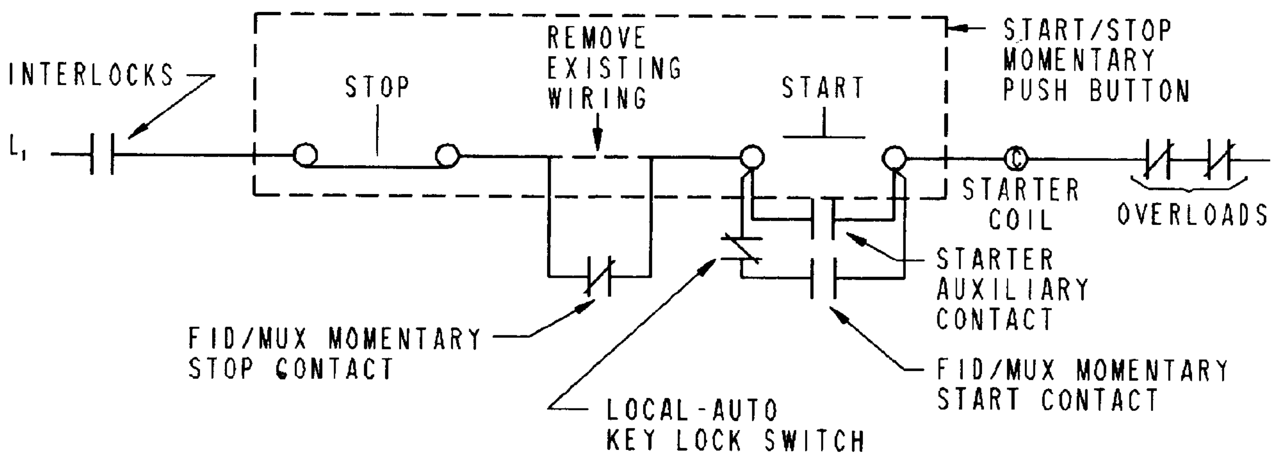

Figure 6-15. Momentary pushbotton wiring diagram.

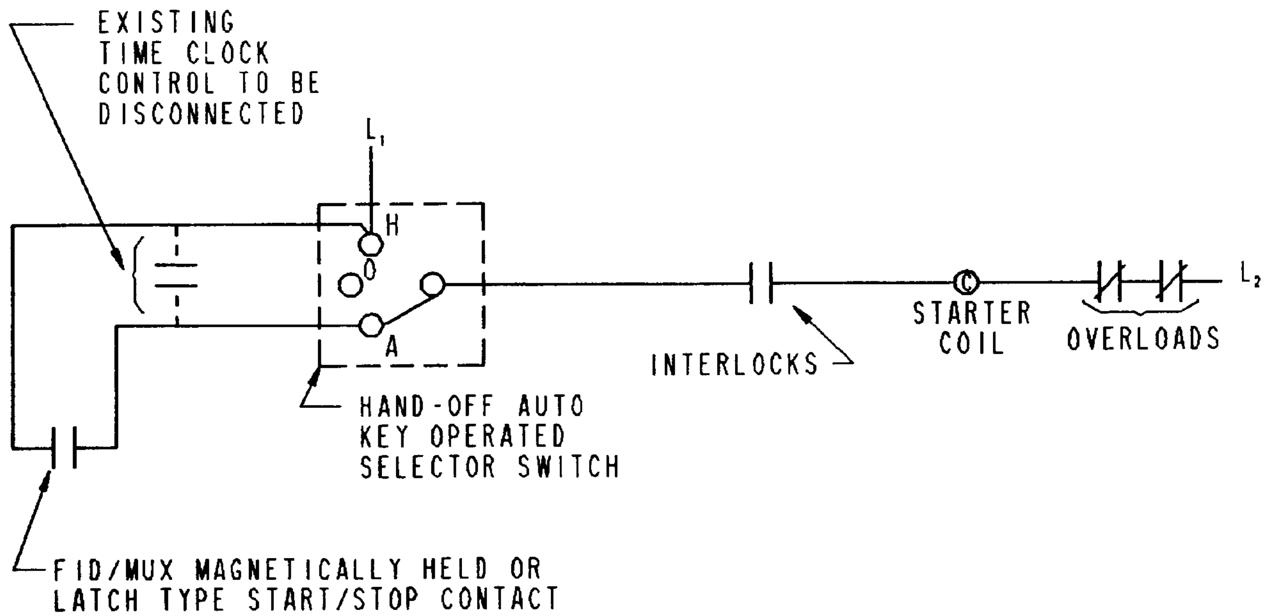

Figure 6-16. Hand-off-auto (HOA) selector wiring diagram.

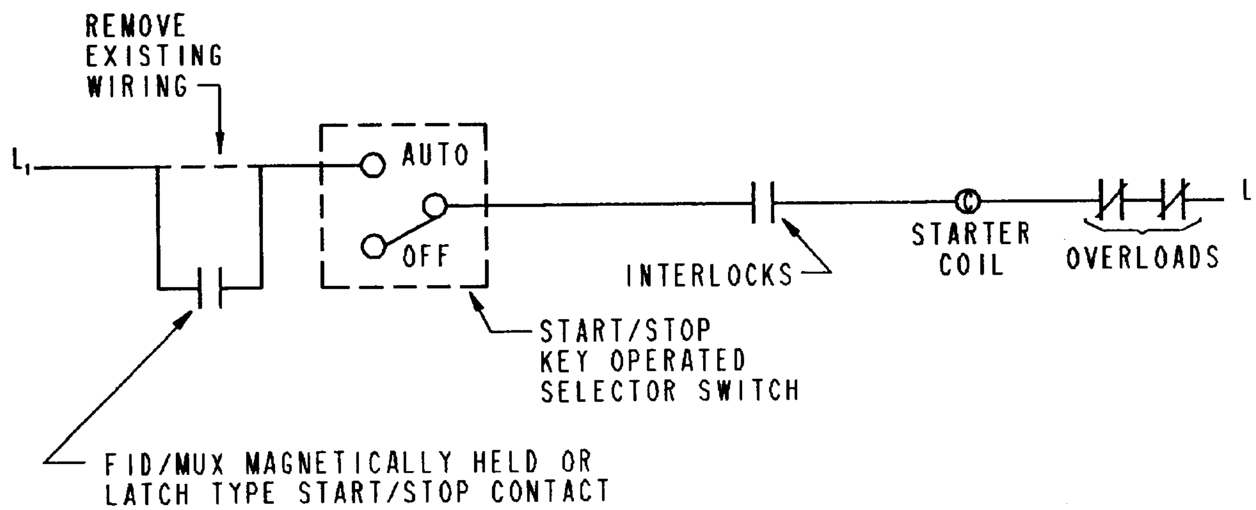

Figure 6-17. Start-stop selector wiring diagram

c. Spare electrical circuits may he locally available to supply power to EMCS equipment. If these circuits do not exist or are inadequate for the intended service, new panels or circuit breakers will be required.

Section III. ADDITIONS TO EXISTING EMCS

6-9. General

Additions will he made by one of the following methods:

a. Expand the existing system.

b. Replace the existing system with a new, larger system.

c. Install new MCR equipment and interface with existing FIDs and MUXs.

6-10. Guidelines

a. A system may be expanded where the MCR EMCS equipment has sufficient spare capacity to absorb the additional points and software in the expansion project. If the addition of points and operating requirements of the expanded system exceeds the capability of the existing MCR EMCS equipment, it will usually be necessary to upgrade the equipment to the next larger system size. Expansion of existing systems requires that the Government execute licensing agreements that allow third party personnel to use copies of technical and software data of the existing system for interfacing new equipment with the existing equipment at the particular military installation specified in the agreement.

b. Replacement of MCR equipment and reuse of FIDs and MUXs will be considered when functional capabilities of the existing MCR hardware/software would be exceeded but where the existing FIDs and MUXs are fully operational and new MCR can be easily interfaced. This method of EMCS expansion also requires that the Government execute licensing agreements for the same reasons as stated in a. above.

c. Replacement of existing system is required when no licensing agreement exists for the existing system or when the existing system's functional capabilities cannot be increased.