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## Introduction

### ELECTRO-HYDRAULIC CONTROL

#### Electronic Control

Electronic control in mobile equipment can consist of the following:

**Inputs:** Inputs can be defined as the user interface, and can consist of joysticks, potentiometers, an operator panel, or other input device.

**Controller or PLC:** This is the brains of the electronic control. It processes the inputs and converts them into a defined output to the hydraulic system. The controller also can have the ability to receive feedback inputs from machine sensors and attenuate its outputs accordingly. The controller can be factory-programmed or have the ability to be user programmable to meet the specific needs of the application.

**Outputs:** Outputs can be on/off voltage signals or proportional PWM signals to control the hydraulic valving.

**Communications:** The controller can have the ability to engage in two-way communications with a bus system.

**Feedback Inputs:** Can consist of pressure transducers, temperature sensors, flow sensors, velocity sensors or RPM sensors. When feedbacks are used the system is described as “closed loop.”

#### PLC—Programmable Logic Controller

PLC's were developed to replace the older “sequential relay circuits,” that were used for machine control. The PLC works by measuring its inputs and depending on their state, switching its outputs on or off. The user enters setup instructions, usually via software, that will produce the desired results. Because many of the controller's functions are user programmable, a PLC has the versatility to be field-modified for changing applications or conditions.

Some PLC's have the capability to convert analog inputs, process them digitally, and produce analog outputs. PLC's that do not have built-in converters require separate analog-to-digital converters to convert the input.

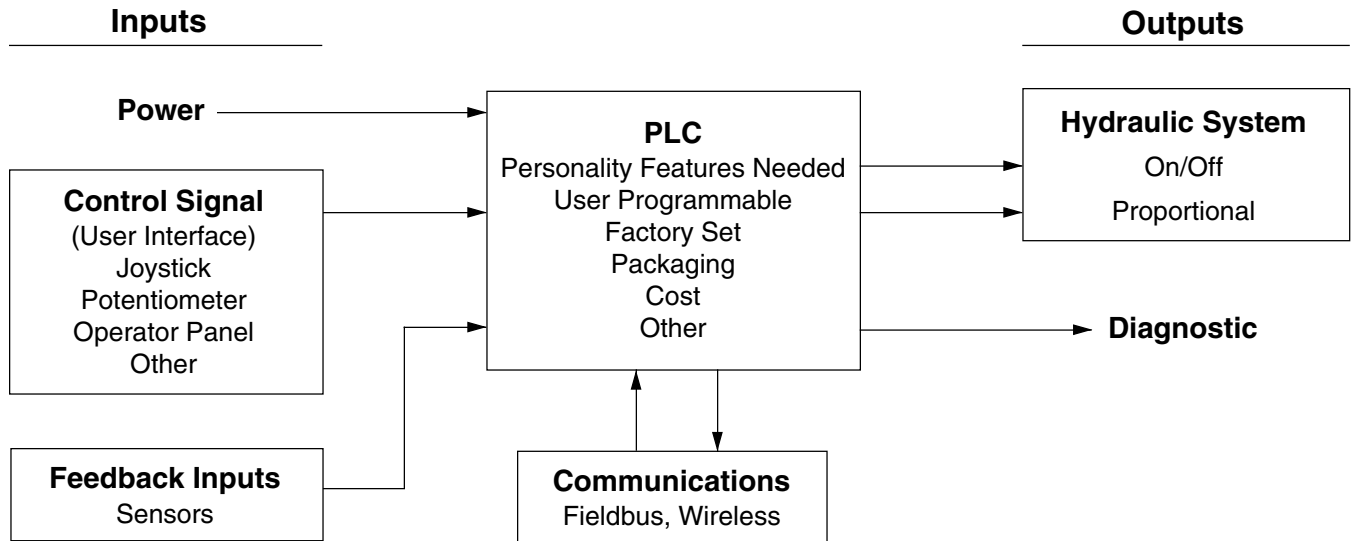
#### Analog

An analog signal is an AC or DC voltage or current that varies smoothly and continuously. In an analog system, a physical variable is represented by a proportional voltage that varies in correspondence with the physical variable. Electronic circuits that process analog signals are called linear circuits.

An example of an analog device is a traditional-style clock that has hour and minute sweep hands that rotate around the dial. It is very difficult to get a highly accurate time reading with this type of clock. The precision of the dial calibration is a limiting factor.

# Electro-Hydraulic Control Technology

## ELECTRO-HYDRAULIC CONTROL (cont'd)



### Digital

Digital signals vary in discrete steps or increments. A digital signal is normally in the form of a series of pulses that rapidly change from one distinct, fixed voltage level to another.

A clock that displays the time in actual numerals that change in one-numeral increments is an example of a digital device. Accuracy in a digital device is generally higher than in an analog device. In digital systems, physical variables are represented by numerical values using the binary (base 2) number system.

### Electronic Control Platforms

Some of the different forms that mobile electronics can take are described in the chart below. There is an increasing complexity and cost as the controllers move from single-function analog controls to complete complex digital control systems.

Digital vehicle controllers offer a high level of sophistication by executing a programmed sequence of functions that constantly control all motion parameters.

### Electronic Control Technology Platforms for the Mobile Equipment Market

