"Ask the Tech"

" Anatomy of a Control Card "
Part I

We all know by now that the Heart, the controlling factor of the electronic traction system is the *control card*, sometimes referred to as the *oscillator card*. The advent of the electronic control card took us from the simple resistor/contactor control to the advanced systems we have today. Lets look deeper into the control card and explore a little about what makes it tick.

The main brain - the control card - regulates the actual speed of the traction system. By controlling the speed it also controls current limit, plugging, thermal protection and bypass with the help of external components, used somewhat as sensors (refer to figure 1). These external components feed important information to the control card which then reacts accordingly to control the operation of the traction system.

Before we get too involved with the actual system features lets look at the first basic need of the main control card, the power supply. Any electronic device, including our system control card, requires a power supply input feed through the key switch, to enable the internal circuits to operate. The internal power supply needs a connection from battery positive and battery negative to complete the circuit path. Typically, the internal power supply receives its positive voltage through a large power dropping resistor which may be internal or external to the control card. It is called a dropping resistor because it is used to reduce the high battery current to a usable value for the internal control circuits, which also provides a voltage drop across the resistor.

Once the voltage is applied, through the key switch and dropping resistor, it must be regulated for the internal control circuit's use. The regulator circuit is usually built within the main control card, although some systems (such as those used on TCM trucks) use a separate control card for regulation only. The regulator circuits reduce the voltage by using solid state devices such as simple zener regulators or if necessary, complex integrated circuits, which may be used to reduce the battery voltage to several different voltage values, ie: 12 volts, 8 volts, and 5 volts.

It goes without saying that if there is no voltage input to the control card, there will be no internal regulation and no operation of the control card circuits. If a control card appears to be inoperative, always check for the power input source to the control card. A visual check or resistance measurement of the power dropping resistor would be a wise first step. Some control systems actually have a regulator monitoring point, such as the General Electric EV-1. The EV-1 regulator is fed out on connection R1, right hand terminal strip - pin #1, which when measured should read 8 volts. Check the wiring diagrams or service manuals for you're particular system to locate the proper power input terminals to measure.

Now that we have proper voltage regulation, lets look deeper into the main control card. If we look deep into the control circuits, we will find what is referred to as the *main oscillator section*. This is why the control card is sometimes referred to as the oscillator card. The actual "beating heart" of the control card is the internal oscillator circuit. An oscillator is an electronic circuit which generates pulses at a certain rate

determined by several controlling factors. These pulses are used to fire the power SCRs or pulse the power FETs on the traction panel. Controlling the vehicle parameters is accomplished by controlling the oscillator frequency.

The rate at which the main oscillator operates determines the overall speed of the vehicle. The accelerator control, whether a simple potentiometer, as shown in figure 1, or a solid state circuit, has the greatest control over the oscillator frequency. The accelerator controls the speed of the vehicle from creep, or slow speed, to top, or fast speed. The control card supplies voltage to the accelerator and this voltage is fed directly into the oscillator to regulate its frequency and in turn, the vehicle speed. The accelerator voltage fed back into the oscillator is dependent upon the actual resistance at any given time. In most General Electric SCR systems the accelerator voltage starts at a high voltage, typically 3-4 volts with the newer systems, and drops to a low voltage at top speed. The older Square D systems were just the opposite, starting at a low voltage and going to a high voltage for top speed. As you may already know, there are many different types of accelerator controls ranging from the simple potentiometer to the solid state types. The best way to determine if an accelerator is working properly is to measure the actual accelerator voltage being feed into the oscillator control card. With the newer solid state accelerators you must apply power to the system in order to operate them. A simple resistance check, as done with the potentiometer styles, is no longer a valid test.

The system control card monitors and controls many different features. Although each OEM system will differ in appearance and circuit construction, the basic circuit parts still apply. The control card will always need power input and it will always require some form of sensors to monitor system parameters. In our next column, Part II will examine how those control cards monitor and react to other features such as current limit, plugging and thermal conditions.

"ASK THE TECH" columnist Bob Meyers has written a Training Manual entitled "Forklift Electronics". *Included are: over 70 pages of basic electronics, panel parts, directional circuits, how to use a VOM and much more. Over 60 diagrams are used to help explain the SCR cycle, basic control features and other aspects of maintenance and troubleshooting. The four color printing and comprehensive index make it a reference manual you'll keep as long as you're servicing electric forklifts.* "Forklift Electronics" *is now available through Flight Systems Industrial Products; or the web site listed below Call 1-800-333-1194 or visit Bobs' web site for more information or to place an order.*

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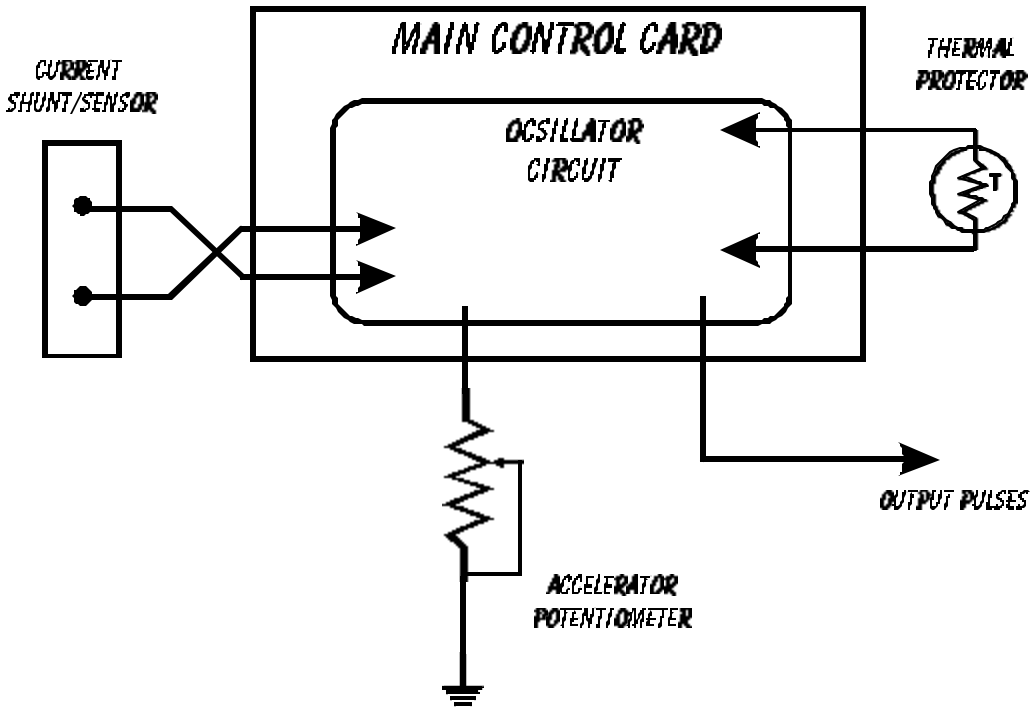
MAIN CONTROL CARD
CURRENT
SHUNT/SENSOR
OCSILLATOR
CIRCUIT
THERMAL
PROTECTOR
T
OUTPUT PULSES
ACCELERATOR
POTENTIOMETER

Figure 1