"Ask the Tech "

" Anatomy of a Control Card "
Part II

The rate at which the main internal oscillator operates determines the overall speed of the vehicle. Last time we learned how the Main Oscillator receives power to operate and how the accelerator controls the speed of the vehicle by controlling the oscillator frequency. This month we will show other features that control the oscillator frequency to reduce the current through the system which helps to maintain its operating parameters.

The main oscillator monitors and receives inputs from various parts of the panel. The thermal protector, typically a resistor which changes value with temperature, monitors the main SCR operating temperature. As the temperature of the main SCR, or the main current carrying device such as an FET, becomes higher than the normal safe operating temperature the thermal protector sends a regulating voltage to the control card which reduces the oscillator frequency and in turn reduces the speed of the vehicle. By reducing the vehicle speed the current is decreased and the main SCR and entire system will run cooler. The thermal protector may be a switch or a temperature sensitive resistor known as a thermistor. Typically when a thermistor is used the resistance will increase as the temperature increases. Other systems may use a simple switch that will open or close at a particular temperature rating, somewhat like a temperature sensor on a small heater or fan.

The SCR system is designed to operate at a certain temperature, if that temperature is exceeded and the vehicle does go into a "thermal cutback" it usually means there is a fault in the system that needs to be corrected. Since the thermal protector typically increases with temperature, jumping or shorting across it may allow the vehicle to operate at normal speed. This may be a good method to verify your failure but never leave the jumper on past the over temperature range. As in an automobile if the vehicle is allowed to operate past its safe operating temperature premature failures will occur. In most cases the main SCR will overheat and be destroyed by the temperature.

Some of the more common causes of "thermal cutback" would be a leaky plugging or flyback diode, poor heat sinking between panel and vehicle chassis, current limit set too high or simply operator abuse from pushing loads rather than lifting and carrying loads.

The current sensor or shunt monitors the systems current status. This sensor sends a very small voltage to the control card which is a direct correlation of the current flowing through the system. Figure 1 shows a current shunt with the wires crossed to indicate that the wires from the shunt to the control card are twisted together. The wires are twisted as a form of simple suppression to help cut out noise pulses. The voltage sent back to the control card is a very small signal, on the order of millivolts, so any noise interference can give the control card erroneous readings. In a shunt or bar type sensor, as shown in figure 1, the voltage dropped across the shunt between the two wires is feed back to the control card. As with the thermal protector if the system current is too high or potentially damaging the control card oscillator frequency reduces and the vehicle speed is reduced. The only way to reduce the system current is by reducing the pulse rate of the main SCR thereby reducing the speed and current needs of the vehicle.

Current problems are similar to the thermal cutback failures. They include leaky plugging and flyback diode, current limit set too high, motor failures (specifically shorted field windings) and yes operator abuse by pushing instead of lifting and carrying loads. Don't forget those possible mechanical problems such as dragging brakes, worn motor bearings or faulty gear train. Current sensors rarely fail themselves, but make sure when replacing any current sensor or shunt you use the exact replacement part number for proper performance. Visual inspections of the sensor may also give you an indication of a failure, if the sensor is a shunt or bar type inspect it for a bluish tint which may indicate that it has overheated at one time or another and the parameters have changed.

Thermal protection and current limiting are a very important part of any system, to maintain basic operating parameters. The main Oscillator, as you can see, plays a very "intelligent" role in making sure those parameters are met. Next time, in part III, we will examine how plugging and bypass affect the overall system operation by controlling the internal oscillator.

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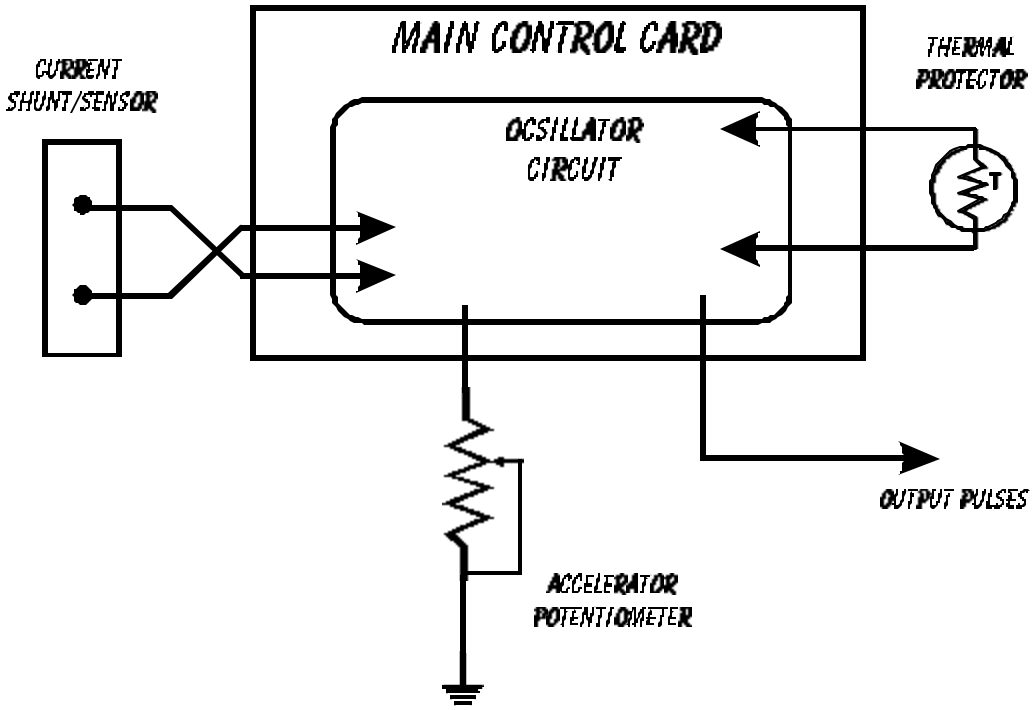
MAIN CONTROL CARD
CURRENT
SHUNT/SENSOR
OCSILLATOR
CIRCUIT
THERMAL
PROTECTOR
T
OUTPUT PULSES
ACCELERATOR
POTENTIOMETER

Figure 1