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# Understanding Compressor Electronics

The key to better system performance, increased profitability and more satisfied customers.



## Chapter 3: Inside How Compressor Electronics Work

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## Inside How Compressor Electronics Work

### Executive Summary

In [Chapter 2](#), we addressed some of the key issues facing our industry and how they are driving the need for compressor electronics that help ensure solid, reliable performance from HVACR systems. One of the most important of these issues being the high rate of compressor warranty returns that are classified as “No Fault Found,” which are creating major inefficiencies and adding unnecessary costs throughout the supply chain.

Armed with this background information, you are now ready for Chapter 3. In this chapter, we will dive a little deeper into the details, giving you a better understanding of how compressor electronics actually work.

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## Inside How Compressor Electronics Work

### Executive Summary

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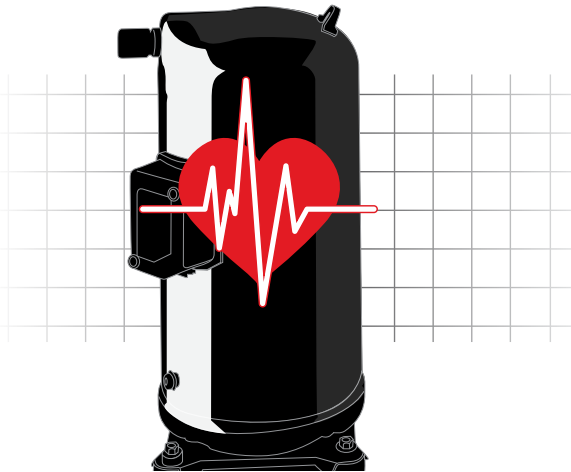
## Inside How Compressor Electronics Work

### Using the Compressor as a Sensor

If you have ever serviced or repaired HVACR systems and compressors, the chances are good that you have heard this analogy at least once: “The compressor is the heart of the HVACR system.” But have you ever stopped to really think about this comparison? It turns out, this analogy provides an easily understandable foundation for helping you understand just how compressor electronics work.

Much like the human heart, the compressor is the central organ that keeps the system running. Its primary function is to pump “life blood” (i.e., refrigerant) through the system to ensure optimal and efficient performance. In the human body, problems that occur with other organs will often manifest themselves through the heart, causing it to work harder and potentially stop functioning. This is also true for the compressor and its HVACR system.

It is for this reason that the compressor makes an ideal sensor for which to gauge the health of the entire system. Similar to an EKG monitoring the heart, we can monitor the “signals” or “information” provided by the compressor to detect symptoms that are causing less than optimal performance.



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By using the compressor as a sensor, compressor electronics monitors system data and proactively shuts down the system if conditions exist that could damage the compressor.

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## Inside How Compressor Electronics Work

### Gathering Key Operating Information

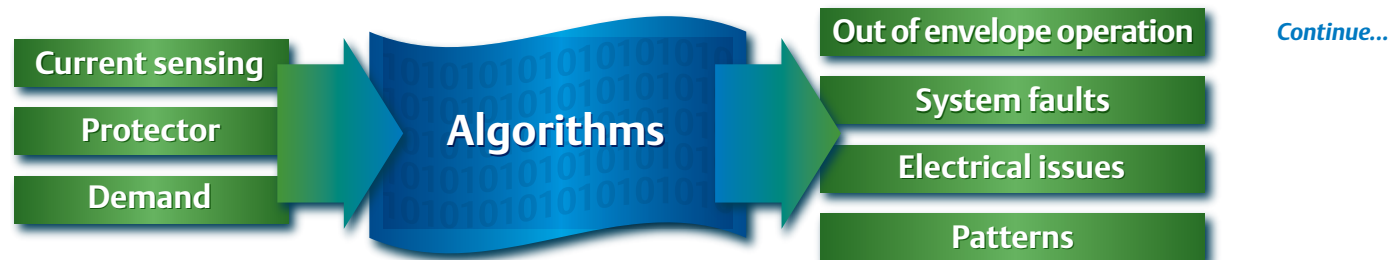
By sensing, monitoring and interpreting electrical and mechanical information from within the compressor, compressor electronics allow you to basically monitor the HVACR system as a whole on an ongoing basis. The detailed compressor and system information it delivers enables you to quickly and accurately identify performance issues for greater reliability and cost savings, giving you freedom to refocus time and money on other priorities.

Compressor electronics gathers three primary types of operating information:

1. Current signature of the compressor
2. Compressor protector behavior
3. Presence / absence of demand

This information is then interpreted by established software algorithms that are rooted in many years of compressor testing, teardown and operating experience. These software algorithms use the information to identify:

- Conditions leading to out of the envelope compressor operations
- System faults
- Electrical issues
- Escalating patterns leading to catastrophic faults



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# Inside How Compressor Electronics Work

## Directing Attention to the Root Problem




Once the information has been gathered and problems have been identified, compressor electronics directs you to the root cause of the problem, giving you the information you need to quickly and accurately diagnose and optimize the system. In many cases, providing you with detailed information at the right time allows you to diagnose system-related problem areas or performance issues even before they occur.

Without compressor electronics, service technicians would typically have to rely on years of technical experience, critical system measurements, good judgment and after-the-fact analysis when troubleshooting a unit. They may be able to run the system and duplicate the problem, but might never know with certainty what caused the issue. They might even replace the compressor or other components, when in fact the root cause of the problem is elsewhere in the system.

With compressor electronics, LED indicators now direct you to the root cause of the problem. Utilizing the key inputs and the defined software algorithms, fault conditions can be quickly and effectively presented through industry standard LED flash codes. These flashing LED codes serve as your first source of troubleshooting information during a service call. The number of flashes correlates to a common fault condition, which are typically system or electrical related.

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### LED Indicators on a Diagnostics Module

	Module has power and indicates normal operation
Solid Yellow	
	Flashes to indicate fault code
Flashing Yellow	
	Compressor is in a tripped state and locked out for repetitive fault condition
Flashing Red	

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### Inside How Compressor Electronics Work

#### Common HVACR Faults

The most common system and electrical faults that plague an air conditioning or refrigeration system, and that can be detected through the use of compressor electronics, are listed below. By addressing these concerns, you can help ensure the long-lasting reliability of the compressor and system.

Fault	Description
Compressor Trips	Compressor is in a tripped state, a Y demand signal is present, but the compressor is not running
Pressure Switch or Thermostat Cycling	Compressor is running only briefly
Discharge Pressure	Pressure is out of limits or compressor is overloaded
Locked Rotor	Low line voltage or seized compressor bearings
Long Run Time	Indicative of low capacity due to a system low-side fault
Low Voltage	Low line voltage or overloaded transformer
Low Oil Pressure	Improper oil circulation
Missing & Reverse Phase	Three-phase wiring of utility issue
Welded Contactor	Compressor always runs
Motor Trip	Motor temperature or voltage outside limits
Open Circuit	Bad capacitor or wiring issue
High Discharge Temperature	The head temperature probe has detected a temperature greater than specification

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 [Click to watch a summary of common compressor faults.](#)

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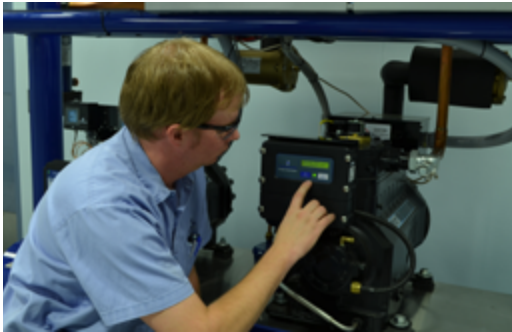
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### Conclusion

While the technology behind compressor electronics is advanced, the basic premise is quite simple: recognizing that the compressor truly is the heart of the HVACR system and capitalizing on that fact to use the compressor as a sensor to monitor the system and diagnose performance. At the end of the day, the compressor is basically alerting you to any possible problem areas or performance issues within the entire system.

Stay tuned for the next chapter in our eBook series “Understanding Compressor Electronics”. In Chapter 4, “Advanced Capabilities Delivered by Electronics”, Emerson Climate Technologies discusses some of the key benefits, features and attributes compressor electronics can offer.



“The diagnostics capability delivered by compressor electronics is simple...it takes the guess work out of troubleshooting.”

– Refrigeration contractor

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