ThermoGuard SPECTRUM TS Multi-Temp Microprocessor Control System

TK 51652-1-OD (Rev. 1, 01/03)

Diagnostic Manual

Used on:
SPECTRUM TS Multi-Temperature Truck Units
Controller Software Revision 2500
HMI Software Revision 6500

Revision History

Original	June, 2002
1st Rev.	TK 51652-1-OD (Rev. 1, 01/03) Various revisions.

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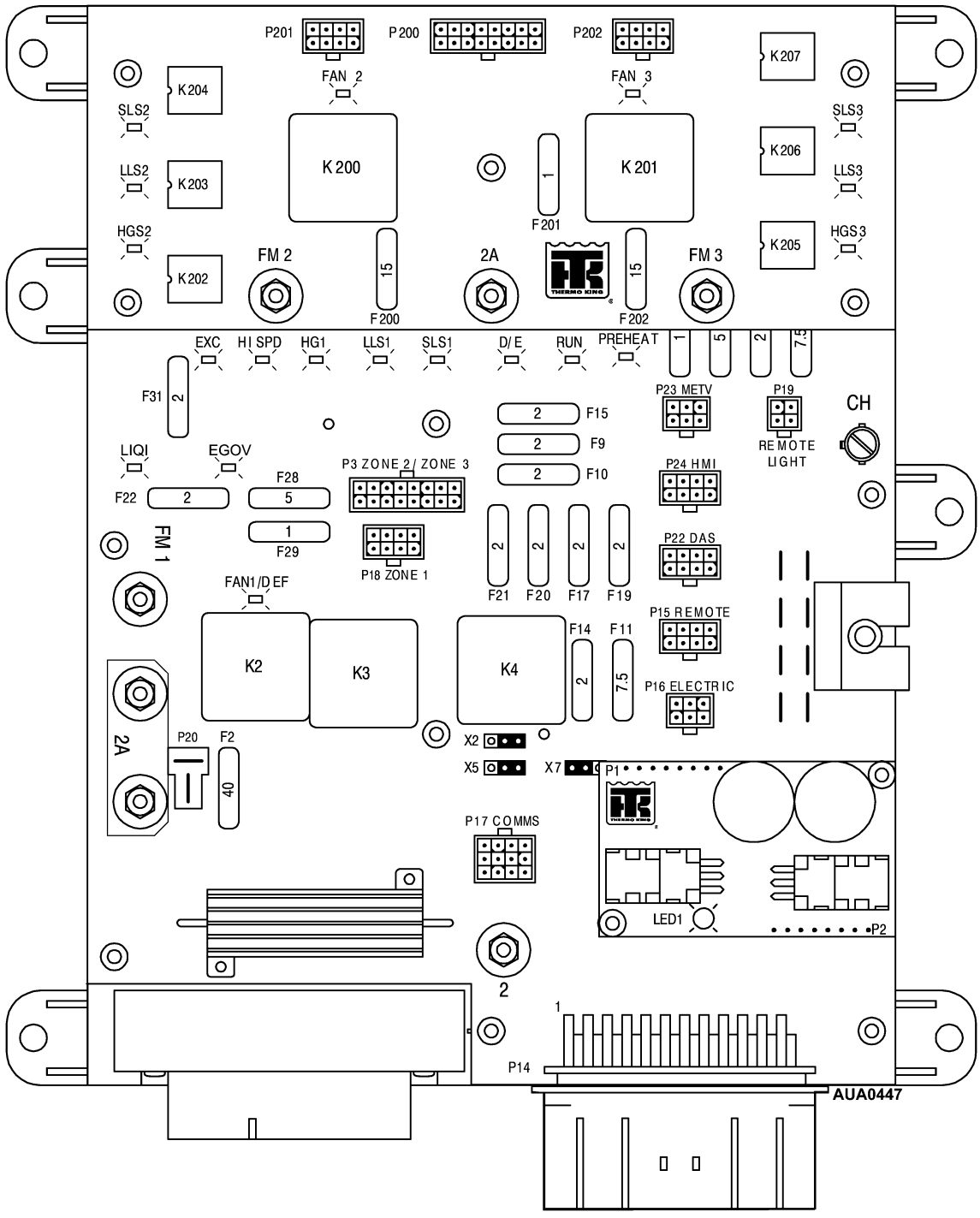
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HOW TO USE THIS MANUAL

Since not everyone is familiar with microprocessor based control systems, please take a few minutes to read this page. It explains the content and structure of this manual. This will make it easier for you to find the information you need.

Section 1 - Safety information

This section contains the safety information for the Truck SPECTRUM Microprocessor Control Systems. Read this material carefully before working on the unit.

Section 2 - Hardware Description

This section includes the Truck SPECTRUM microprocessor control system hardware description. It also contains identification of relays, LEDs, component layout and connector maps.

Section 3 - Software Description

This section discusses the operation of the Truck SPECTRUM microprocessor control system software and programmable features. Each menu and feature is discussed individually to illustrate how each works and how to change the programmable settings.

Section 4 - Operation

This section explains how to operate the Truck SPECTRUM microprocessor control system. This information is referenced by material in the Diagnosis section.

Section 5 - Diagnosis

This section explains how to diagnosis units equipped with Truck SPECTRUM microprocessor control systems. It includes both Alarm Code Diagnostics and Other Symptom Diagnostics. This section will reference material in Section 4 and 6.

Section 6 - Service Procedures

This section includes Service Procedures to assist the technician when servicing units equipped with Truck SPECTRUM microprocessor control systems. These procedures are referenced by material in the Diagnosis section.

Section 7 - Service Information

This section offers Service Information on the basic component parts of the Truck SPECTRUM microprocessor control system.

Section 8 - Refrigeration System Information

This section offers Refrigeration System Information and Refrigeration Service Procedures for units equipped with Truck SPECTRUM microprocessor control systems.

Section 9 - Diagrams and Schematics

This section includes the Truck SPECTRUM microprocessor control system electrical schematics and unit wiring diagrams.

Section 1 — SPECTRUM Safety Information

Section 1 — SPECTRUM Safety Information

General Practices

1. Always wear goggles or safety glasses. Refrigerant and battery acid can permanently damage the eyes.
2. Never close the compressor discharge service valve with the unit running. Never operate the unit with the discharge service valve closed.
3. Keep hands, clothing and tools clear of fans and belts when the unit is running.
4. Be sure gauge manifold hoses are in good condition. Never let them come in contact with belts, fans, pulleys or hot surfaces.
5. Never apply heat to a sealed refrigeration system or container.
6. Refrigerants in the presence of an open flame produce toxic gases. These gases are severe respiratory irritants capable of causing death.
7. Be sure all mounting bolts are the correct length for the application and are securely tightened.
8. Use extreme caution when drilling holes in the unit. Holes may weaken structural components. Holes drilled in wiring can cause fire or explosion. Holes drilled into the refrigeration system will release refrigerant.
9. Use caution when working around exposed coil fins. The fins can cause painful lacerations.
10. Use caution when working with refrigerant in a closed or confined area with a limited air supply such as a trailer, container or hold of a ship. Refrigerant tends to displace air and can cause oxygen depletion. This may result in unconsciousness or death due to suffocation.

Auto Start/Stop

CAUTION: The unit may start automatically and at any time when the unit is turned "on". Units start automatically in both CYCLE-SENTRY mode and Continuous mode. Be sure to turn the unit "off" before opening doors, inspecting or working on any part of the unit.

Refrigerant

At Thermo King we recognize the need to preserve the environment and limit the potential harm to the ozone layer that can result from allowing refrigerant to escape into the atmosphere.

We strictly adhere to a policy that promotes the recovery and limits the loss of refrigerant into the atmosphere.

When working on transport refrigeration systems, a recovery process that prevents or minimizes refrigerant loss to the atmosphere is required by law. In addition, service personnel must be aware of Federal, State and local regulations governing the use of refrigerants and certification of technicians.

When refrigerants are exposed to the atmosphere in liquid form, they evaporate rapidly, freezing anything they contact. If they contact the skin severe frostbite can result. In the event of frostbite, the objectives of first aid are to protect the frozen area from additional injury and to warm it rapidly.

First Aid

1. Warm the frozen area by immersing it in luke-warm (not hot) water or by covering the area with warm blankets.
2. Obtain medical assistance as soon as possible.
3. If refrigerant contacts the eyes, flush them with water immediately and obtain medical assistance as soon as possible.

Refrigeration Oil

Avoid contact with the eyes. Avoid prolonged contact with the skin or clothing. To prevent skin irritation wash hands thoroughly after handling refrigeration oil.

First Aid

In case of eye contact, flush immediately with water for at least 15 minutes. Obtain medical assistance as soon as possible.

Electrical

Microprocessor Service

Precautions must be taken to prevent electrostatic discharge when servicing the microprocessor and related components. A potential difference less than that required to create a small spark between a finger and a doorknob can cause severe damage to solid state components. Refer to the material in this manual and the Electrostatic Discharge Training Guide (TK 40282) for additional information.

Welding

Precautions must be taken before welding on the unit. Refer to the Service Procedures in this manual for additional information.

Electrical Hazards

High Voltage

Units with optional Electric Standby utilize 460, 380 or 230 volt, 3 phase or 230 volt single phase AC power any time the unit is operating in Electric mode. This voltage potential is also present any time the unit is connected to standby power. Extreme care must be used when working on the unit, as these voltages are capable of causing serious injury or death.

1. When working on high voltage circuits, do not make any rapid movements. Unplanned movements can cause contact with high voltage.
2. Use tools with insulated handles that are in good condition. Never hold metal tools in your hand if exposed high voltage conductors are within reach.
3. Treat all wires as high voltage wires.
4. Never work alone on high voltage circuits. Another person should be nearby in case of accident.

First aid

Immediate action must be taken after a person has received an electrical shock. Medical attention should be summoned as soon as possible.

The source of electricity must be immediately removed, either by shutting down the power or removing the victim from the source. If the victim must be removed from a live circuit, pull the victim off with a non-conductive material. Use the victim's clothing, a rope, wood or your belt. After separating the victim from the power source, immediately check for pulse and respiration. If a pulse is not present, start CPR (Cardio-Pulmonary Resuscitation) immediately. If a pulse is present, respiration may be restored by mouth to mouth resuscitation. Obtain emergency medical assistance as soon as possible.

Low Voltage

Control circuits are 12 volts dc. This voltage potential is not considered dangerous, but the large amount of current available can cause severe burns if shorted to ground.

Do not wear jewelry, watches or rings when working on the unit. If these items contact an electrical circuit severe burns may result.

Truck SPECTRUM Control System Notes

NOTE: The following procedures must be followed when working on units equipped with SPECTRUM control systems.

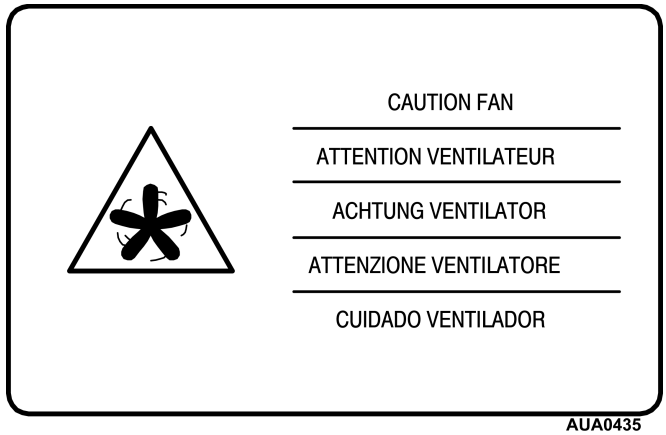
- Never use testers consisting of a battery and a light bulb to test circuits on any microprocessor based equipment.
- Before connecting or disconnecting the battery, the unit must be turned “off”.
- Any time a Return Air or Discharge Air sensor is changed, it must be calibrated as shown in Service Procedure A15A.
- Any time the SPECTRUM Microprocessor is replaced, these Service Procedures must be used:

  A02A Recording Existing Microprocessor Setup

  A03A Microprocessor Removal and Replacement

  A04A Microprocessor Setup
- Any time the SPECTRUM Interface Board is replaced, Service Procedure A03A must be followed.
- Any time welding is to be done on the unit or vehicle Service Procedure A26A must be followed.

Safety Decals



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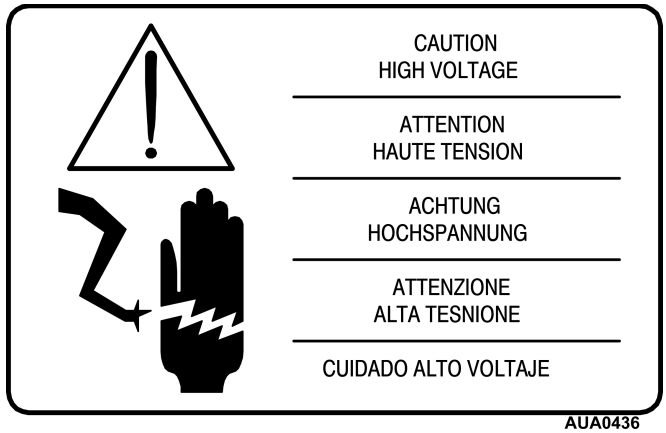

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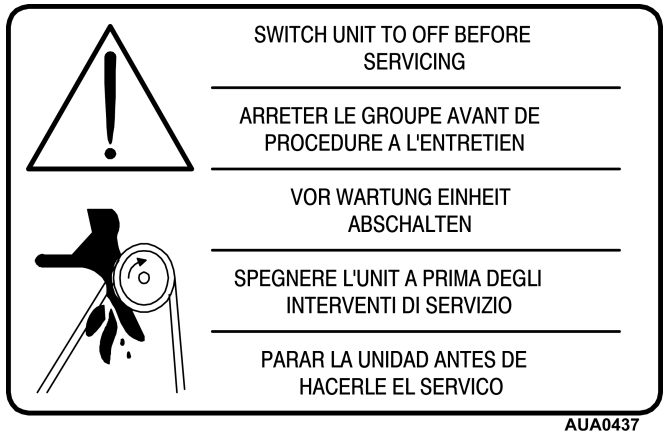

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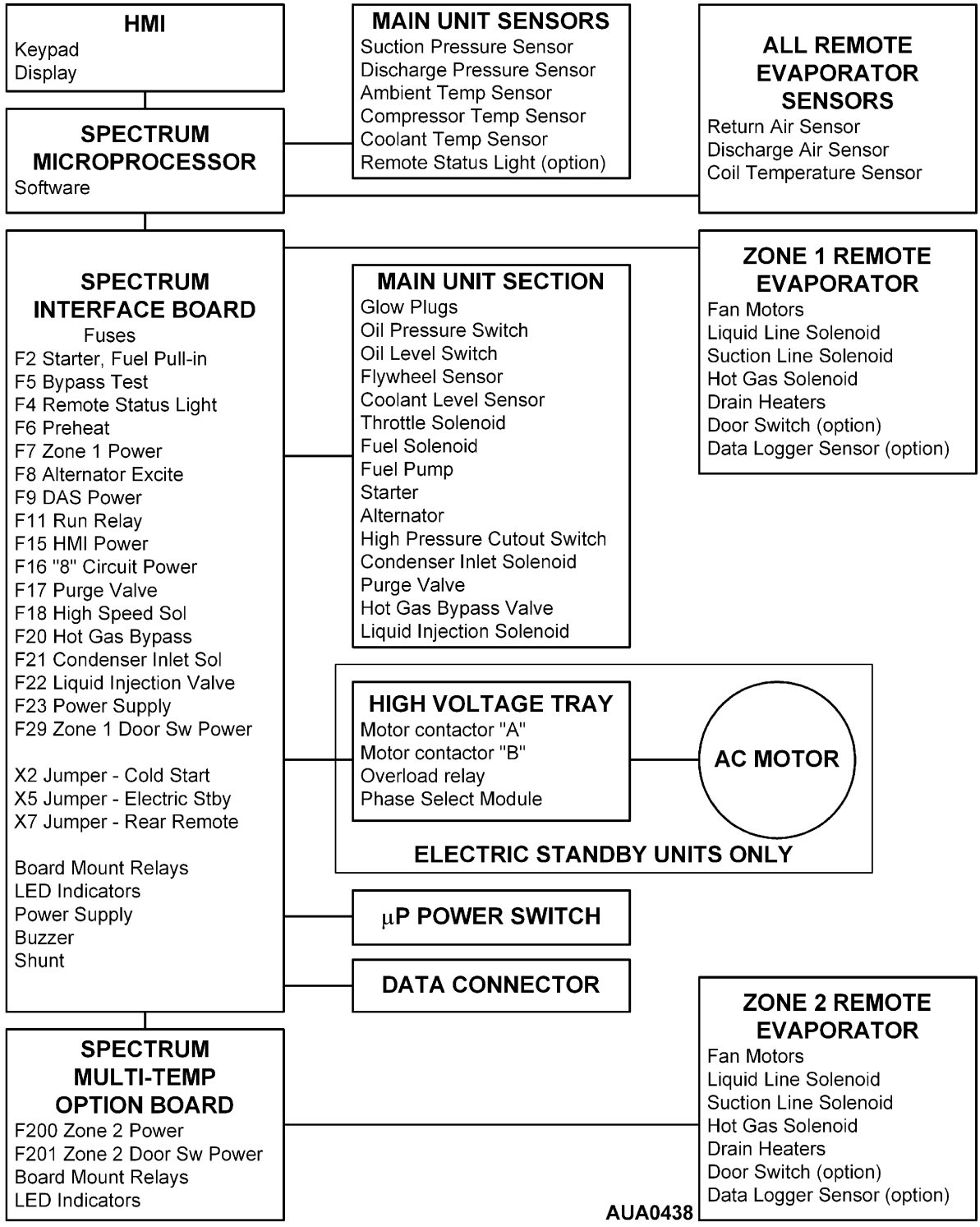
Section 2 — SPECTRUM Hardware Description

Truck SPECTRUM Block Diagram



General Description

The SPECTRUM microprocessor controller is a self contained temperature control unit designed for truck applications. Model 30 units are powered by a diesel engine and Model 50 units are powered by either the diesel engine or an external electric standby power source turning an induction motor. The unit mounts on the upper front of the truck box and is connected to one or more remote evaporators located inside the truck box. The compressor, condenser fan and alternator are belt driven. Defrost is by means of hot gas.

CAUTION: Dangerous single phase or three phase AC power is present whenever the unit is operating in Electric mode and whenever the unit is connected to external standby power. Voltages of this magnitude can be lethal. Exercise extreme caution when working on the unit.

SPECTRUM Control System

The SPECTRUM Microprocessor Control System consists of the following main components:

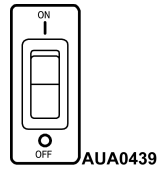
- Microprocessor Power Switch
- HMI Control Panel
- SPECTRUM Microprocessor
- Interface Board
- Multi-Temp Option Board
- Sensors
- Refrigeration System Controls
- Engine Controls
- High Voltage Tray (Model 50 Units)

Unit Configuration

The base of the control system is the microprocessor. The interface board is mounted on the microprocessor and is connected to it by means of J1 and J2. The system power supply board is located on the corner of the interface board. The multi-temp option board is mounted over the interface board. The unit is controlled by means of the HMI Control Panel.

Microprocessor Power Switch

The microprocessor power switch applies 12 volts DC control power to the HMI Control Panel. The switch is located just ahead of the control box on the compressor side of the unit. Main power to the controls is supplied by 60 amp and 40 amp fuses. Note that when the Microprocessor Power Switch is turned off that power is still applied to the HMI Control Panel and the unit control circuits. To completely remove power from the control system, disconnect the unit battery.



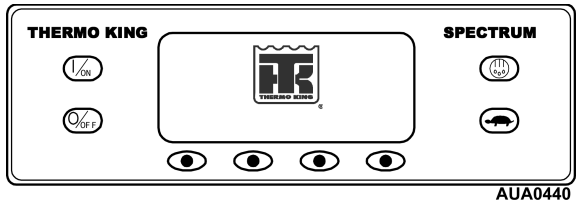
Microprocessor Power Switch

Unit Power Fuses

Over-current protection is provided by fuses. A 60 amp main power fuse is located in the “2” circuit near the unit battery. The remote evaporator fan motors are protected by 30 amp in-line fuses located inside the control box on the remote evaporator harness.

HMI Control Panel

The HMI (Human Machine Interface) Control Panel consists of the display and eight touch sensitive keys. The four keys on the sides of the control panel are used to turn the unit on and off, initiate a manual defrost cycle, and select high speed lockout operation. The function of the four keys located under the display screen change as required by the current menu shown on the display screen.



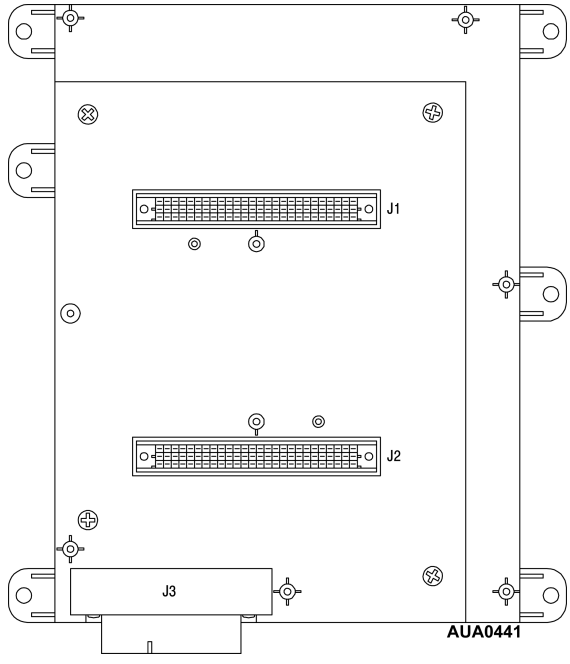
HMI Control Panel

The display screen is used by the microprocessor to provide visual prompt and display information to the operator, such as operating mode, setpoints, gauge and hourmeter readings and operating conditions of the diesel engine. All information is shown in English, with the ability to display in several other languages.

See Section 4 for complete operating details.

Microprocessor

The SPECTRUM microprocessor is located on the rear panel of the control enclosure. Two multi-pin interface board connectors (J1 and J2) are located on the front of the microprocessor. A 37 pin sensor connector (J3) is located at the lower left of the microprocessor.



SPECTRUM Microprocessor

Microprocessor Operation

The microprocessor is the heart of the control system. It consists of the actual microprocessor, software, memory, inputs and outputs. The microprocessor works together with the software loaded into it to provide the required operating and control functions.

Inputs are used to supply power and system information to the microprocessor. Outputs are used by the microprocessor to control the operation of the unit components.

The microprocessor has no user serviceable components.

SPECTRUM Microprocessor Connector Maps

J1 - Microprocessor/Interface Board

hard wired

J2 - Microprocessor/Interface Board

hard wired

J3 - Microprocessor Sensor - by use

Pin Number	Wire Number	Description
1	RTP1-01	Return Air - Zone 1 - Pos (Blue Sensor Wire)
2	RTN1-01	Return Air - Zone 1 - Neg (Brown Sensor Wire)
24	DTP1-01	Discharge Air – Zone 1 - Pos (Blue Sensor Wire)
13	DTN1-01	Discharge Air – Zone 1 - Neg (Brown Sensor Wire)
25	CTP1-01	Coil Temp - Zone 1 - Pos (Blue Sensor Wire)
14	CTN1-01	Coil Temp - Zone 1 - Neg (Brown Sensor Wire)
3	ATP-01	Ambient Temp - Pos (Blue Sensor Wire)
4	ATN-01	Ambient Temp - Neg (Brown Sensor Wire)
26	WTP-01	Water Temp - Pos (Blue Sensor Wire)
15	WTN-01	Water Temp - Neg (Brown Sensor Wire)
21	DPP-01	Discharge Pressure - Power – (Red Wire)
32	DPN-01	Discharge Pressure – Ground – (Black Wire)
9	DP-01	Discharge Pressure – Signal – (White Wire)
22	SPP-01	Suction Pressure – Power – (Red Wire)
33	SPN-01	Suction Pressure – Ground – (Black Wire)
10	SP-01	Suction Pressure – Signal – (White Wire)
23	CLSP-01	Coolant Level Sensor Power (Red Wire)
34	Not Used	
11	Not Used	Oil Pressure – Signal (Not used – Oil Pressure Switch)
5	RTP2-01	Return Air - Zone 2 - Pos (Blue Sensor Wire)
6	RTN2-01	Return Air - Zone 2 - Neg (Brown Sensor Wire)
19	CTP2-01	Coil Temp - Zone 2 - Pos (Blue Sensor Wire)
30	CTN2-01	Coil Temp - Zone 2 - Neg (Brown Sensor Wire)
18	Not Used	Return Air - Zone 3 - Pos (Blue Sensor Wire)

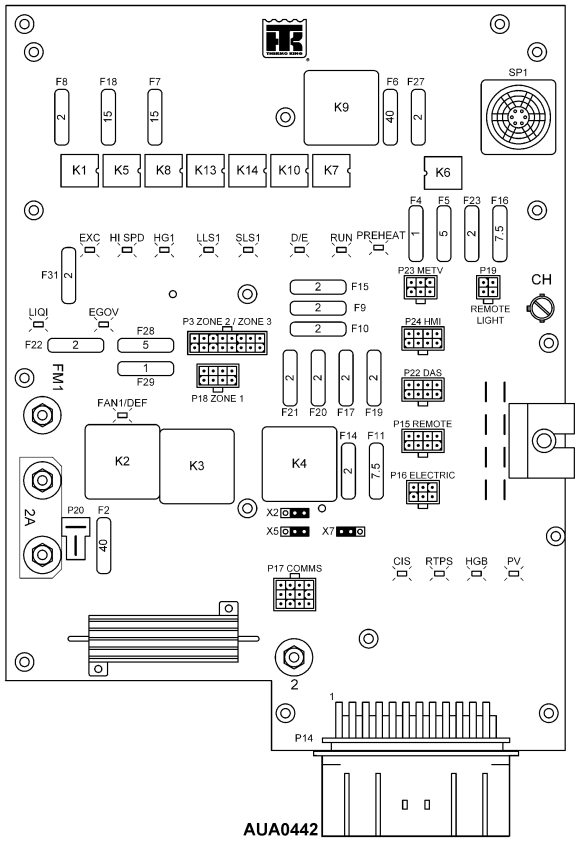
J3 - Microprocessor Sensor - by use (continued)

Pin Number	Wire Number	Description
29	Not Used	Return Air - Zone 3 - Neg (Brown Sensor Wire)
7	Not Used	Coil Temp - Zone 3 - Pos (Blue Sensor Wire)
8	Not Used	Coil Temp - Zone 3 - Neg (Brown Sensor Wire)
27	Not Used	Spare Temp Sensor - Pos (Blue Sensor Wire)
16	Not Used	Spare Temp Sensor - Neg (Brown Sensor Wire)
35	CPTP-01	Compressor Temperature - Pos (Blue Sensor Wire)
12	CPTN-01	Compressor Temperature - Neg (Brown Sensor Wire)
17	DTP2-01	Discharge Air - Zone 2 - Pos (Blue Sensor Wire)
28	DTN2-01	Discharge Air - Zone 2 - Neg (Brown Sensor Wire)
20	Not Used	Discharge Air - Zone 3 - Pos (Blue Sensor Wire)
31	Not Used	Discharge Air - Zone 3 - Neg (Brown Sensor Wire)

Interface Board

The Interface Board acts as the interface between the microprocessor and the unit components such as motor contactors, solenoids and valves. It also provides fuse protection for the controls and components.

The microprocessor controls the operation of the unit through the control relays on the interface board. Each relay is individually fuse protected. An LED next to each relay is illuminated when the relay is energized by the microprocessor and has transferred its contacts to the energized state.



SPECTRUM Interface Board

The interface board is plugged into the microprocessor and secured with mounting hardware. The main components on the interface board are the control relays, fuses, LEDs (to indicate relay or output states) CYCLE-SENTRY buzzer, jumpers and the wire harness connectors. The interface board directly supports Zone 1. Zone 2 is supported by a multi-temp option board.

The only user serviceable components on the interface board are the fuses and jumpers.

Interface Board Fuse Size & Function

Fuse	Size	Function
F2	40A	Starter, Fuel Pull-In
F4	1A	Remote Status Light (Option)
F5	5A	Install for Control System Functional Test
F6	40A	Preheat
F7	15A	2A Power Zone 1
F8	2A	Alternator Excitation
F9	2A	DAS 2A Power (Option)
F10	2A	Remote 2A Power (Option)
F11	7.5A	Run Relay
F14	2A	Not Used
F15	2A	HMI 2A Power
F16	7.5A	8 Power to HMI, DAS
F17	2A	Purge Valve
F18	15A	High Speed Solenoid
F19	2A	Not Used
F20	2A	Hot Gas Bypass
F21	2A	Condenser Inlet Solenoid
F22	2A	Liquid Injection Valve
F23	2A	Power Supply
F27	2A	Not Used
F28	5A	Not Used
F29	1A	Zone 1 Door Switch 2A Power
F31	2A	Not Used

Interface Board LED Functions

LED	Function
1	Alternator Excitation Circuit
2	High Speed Circuit
3	Zone 1 Hot Gas Circuit
4	Zone 1 Liquid Line Solenoid Circuit
5	Zone 1 Suction Line Solenoid Circuit
6	Diesel/Electric Circuit
7	Run Circuit
8	Preheat Circuit
9	Liquid Injection Circuit
10	Not Used
11	Zone 1 Fan or Defrost Circuit
12	Condenser Inlet Solenoid
13	Not used
14	Hot Gas Bypass Valve
15	Purge Valve

These LEDs are illuminated when the associated circuit is energized.

Interface Board Relay Functions

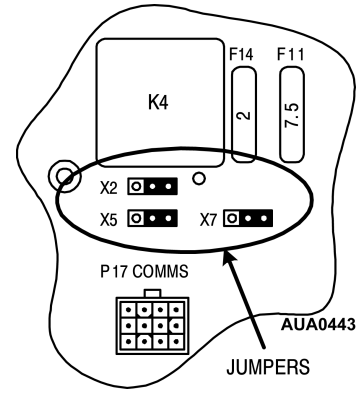
Relay	Function
K1	Alternator Excitation Relay
K2	Zone 1 Fan Relay
K3	Starter Relay
K4	Fuel Solenoid Pull In Relay
K5	Throttle Solenoid Relay
K6	On/Off Relay
K7	Run Relay
K8	Zone 1 Hot Gas Solenoid Relay
K9	Preheat Relay
K10	Diesel/Electric Relay
K13	Zone 1 Liquid Line Solenoid Relay
K14	Zone 1 Suction Line Solenoid Relay

Interface Board Jumpers

Three sets of jumper pins are located on the Interface Board. Each set consists of a shorting connector and three pins. For normal operation, the shorting connectors must be installed as shown for each set of jumpers. To change the setting remove the shorting connector and place it over either the center pin and right pin or the center pin and left pin.

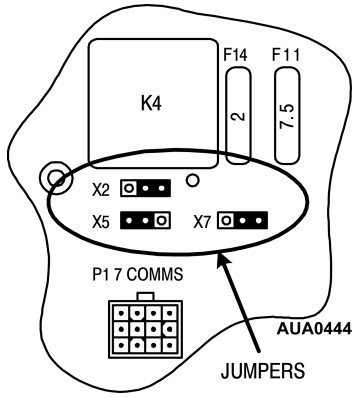
Jumper Functions

Jumper	Function
X2	Cold Start Jumper
X5	Electric Standby Jumper
X7	Rear Remote Jumper



Jumper Setup – Model 30 Units

For normal operation on Model 30 units that do not include the electric standby option, the jumpers should be set as shown here. Jumpers X2, X5 and X7 should all be set to the right.



Jumper Setup – Model 50 Units

For normal operation on Model 50 units that include the electric standby option, the jumpers should be set as shown here. Jumpers X2 and X7 should all be set to the right and jumper X5 should be set to the left.

Interface Board Connector Maps

P1 - Microprocessor/Interface Board

hard wired

P2 - Microprocessor/Interface Board

hard wired

P14 - Interface Board - by use

Pin Number	Wire Number	Description
14	Not Used	HPCI (N/O, other side to CH)
18	8H-01	HPCO
23	HPCO-01	HPCO
20	HGBP-01	HGB +
34	HGBN-01	HGB -
35	LIQP-01	PWMP + (LIQ INJ)
36	LIQN-01	PWMN - (LIQ INJ)
3	PVP-01	PV +
4	PVN-01	PV -
2		Not used
10		Not used
8	CISP-01	CIS +
1	CISN-01	CIS -
5	Not Used	SLP
31	Not Used	PT
24	EXC-01	EXC
13	W-01	W ALT
11	Not Used	2A
16	20B-01	20B
28	CLS-01	CLS (Signal)
12	OLSP-01	OLSP (Oil Level Switch - Positive)
29	OLSN-01	OLSC (Oil Level Switch - Signal)
15	Not Used	FPR
25	RPMP-01	RPM +
26	RPMN-01	RPM -
17	Not Used	D114 (Electric Clutch)
9	Not Used	D115/D111 (Spare)

P14 - Interface Board - by use (continued)

Pin Number	Wire Number	Description
27	Not Used	SP IN
22	Not Used	SP OUT1
21	Not Used	SP OUT2
30	Not Used	PWMP (GOV +)
33	Not Used	PWMN (GOV -)
6	Not Used	ETV A
19	Not Used	ETV B
7	Not Used	ETV C
32	Not Used	ETV D

P16 - Electric Connector

Pin Number	Wire Number	Description
1	7EH-01	7E to Phase Detect Module
2	EOL-01	From Overload Relay
3	8F-01	8F to Phase Detect Module
4	CHP-01	Chassis Ground
5	ER-01	ER from Phase Detect Module
6	Not Used	26E

P18 - Zone 1 Connector

Pin Number	Wire Number	Description
1	SLS1-01	Zone 1 Suction Line Solenoid
2	HGS1-01	Zone 1 Hot Gas Solenoid
3	FS1-01	Zone 1 Fan speed signal
4	LLS1-01	Zone 1 Liquid Line Solenoid
5	2AAL-01	Zone 1 2AAL Power (Door Switch)
6	DS1-01	Zone 1 Door Switch (Signal)
7	Not Used	
8	LLS1-02	Zone 1 Liquid Line Solenoid

P9 - Remote Light Connector

Pin Number	Wire Number	Description
1	Not Used	RL (Blk) RL-01
2	Not Used	F4 (Red) 8FC-01
3	Not Used	ALM (Wht) ALM-01
4	Not Used	Not Used

P20 - Power Switch Connector

Pin Number	Wire Number	Description
1	2A-01	2A Power
8	8-01	8 Power

P21 - Engine Connector

Pin Number	Wire Number	Description
1	Not Used	29 to Defrost Damper
2	Not Used	29A to Defrost Damper Sense
3	8S-01	8S to Starter Solenoid
4	H-01	PH to Glow Plugs
5	7D-01	7D to Throttle Solenoid
6	8DP-01	8DP to Fuel Solenoid Pull In Coil
7	8D-01	8D to Fuel Solenoid Hold Coil
8	FP-01	FP Power to Fuel Pump

P24 - HMI Connector

Pin Number	Wire Number	Description
1	CANL-01	To HMI Control Panel
2	CANH-01	To HMI Control Panel
3	SHLD-01	To HMI Control Panel
4	ON-01	To HMI Control Panel
5	2A-04	To HMI Control Panel
6	8FP-01	To HMI Control Panel
7	Not Used	To HMI Control Panel
8	CHP-04	Chassis ground to HMI Control Panel

P22 - DAS Connector

Pin Number	Wire Number	Description
1	Not Used	
2	Not Used	
3	Not Used	
4	Not Used	
5	2A-06	Power to DAS
6	2L-01	Power to DAS
7	2P-01	Power to Printer Port
8	CHP-06	Chassis ground to DAS

P17 - Communications Connector

Pin Number	Wire Number	Description
1	CCOM-05	Chassis ground
2	CCOM-04	Chassis ground
3	DPD1-01	Jumper to P17 Pin 4
4	DPD1-01	Jumper from P17 Pin 3
5	CCOM-07	DPD to chassis ground

P17 - Communications Connector (continued)

Pin Number	Wire Number	Description
6	Not Used	
7	TXD1-01	Transmit COM 1
8	RXD2-01	Receive COM 2
9	Not Used	
10	RXD1-01	Receive COM 1
11	TXD2-01	Transmit COM 2
12	Not Used	

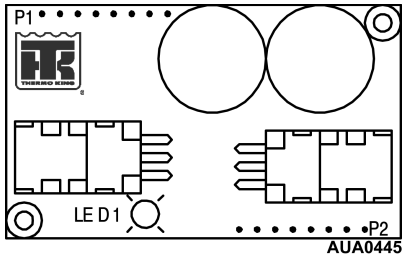
P3 - Interface Board and P200 - Multi-Temp Option Board Connectors

Pin Number	Wire Number	Description
1	FS3-01	Zone 3 Fan Speed Signal
2	HGS3-01	Zone 3 Hot Gas Solenoid
3	SLS3-01	Zone 3 Suction Line Solenoid
4	FM3-01	Zone 3 Fan Motor
5	CHP-03	Chassis Ground
6	LLS2-01	Zone 2 Liquid Line Solenoid
7	FS2-02	Zone 2 Fan Speed Signal
8	DS3-01	Zone 3 Door Switch
9	LLS3-01	Zone 3 Liquid Line Solenoid
10	8-02	8 Circuit Power
11	FM2-01	Zone 2 Fan Motor
12	SLS2-01	Zone 2 Suction Line Solenoid
13	HGS2-01	Zone 2 Hot Gas Solenoid
14	DS2-01	Zone 2 Door Switch
15	Not Used	
16	Not Used	

Power Supply Board

The power supply board provides regulated DC power to the microprocessor and interface board. It is separate from the other boards due to manufacturing considerations and to allow the capability to be increased as required for future applications.

If the LED on the power supply board is glowing the power supply board is functioning normally.

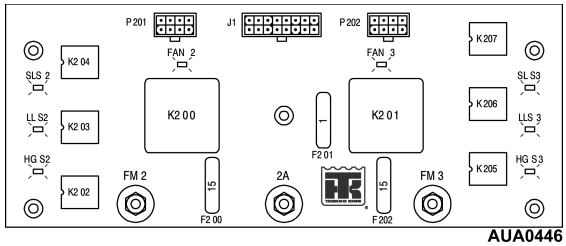


SPECTRUM Power Supply Board

The power supply board has no user serviceable components.

Multi-Temp Option Board

The Multi-Temp Option Board adds the control functions for Zone 2 and Zone 3. The microprocessor controls the operation of the additional zones through the control relays on the multi-temp option board. An LED is illuminated when a relay is energized by the microprocessor and has transferred its contacts to the energized state.



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SPECTRUM Multi-Temp Option Board

The only user serviceable components on the interface board are the fuses and jumpers.

Multi-Temp Option Board Fuse Size & Function

Fuse	Size	Function
F200	15A	2A Power Zone 2
F201	1A	Zone 2,3 Door Switch 2A Power
F202	15A	2A Power Zone 3

Multi-Temp Option Board LED Functions

LED	Function
1	Zone 2 Suction Line Solenoid Circuit
2	Zone 2 Liquid Line Solenoid Circuit
3	Zone 2 Hot Gas Circuit
4	Zone 2 Fan or Defrost Circuit
5	Zone 3 Suction Line Solenoid Circuit
6	Zone 3 Liquid Line Solenoid Circuit
7	Zone 3 Hot Gas Circuit
8	Zone 3 Fan or Defrost Circuit

These LEDs are illuminated when the associated circuit is energized.

Multi-Temp Option Board Relay Functions

Relay	Function
K200	Zone 2 Fan Relay
K202	Zone 2 Hot Gas Solenoid Relay
K203	Zone 2 Liquid Line Solenoid Relay
K204	Zone 2 Suction Line Solenoid Relay

Multi-Temp Option Board Connector Maps

P3 - Interface Board and P200 - Multi-Temp Option Board Connectors

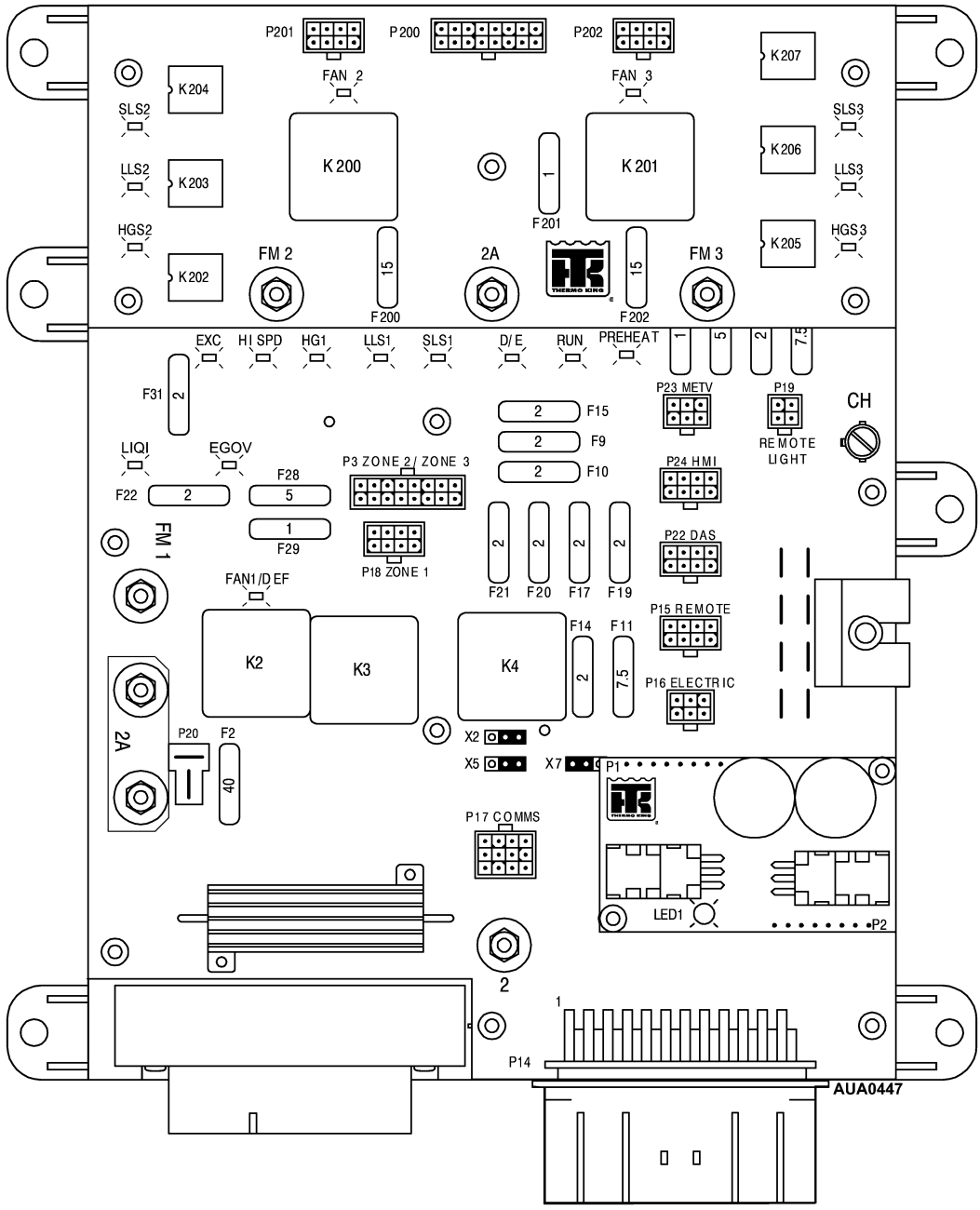
Pin Number	Wire Number	Description
1	FS3-01	Zone 3 Fan Speed Signal
2	HGS3-01	Zone 3 Hot Gas Solenoid
3	SLS3-01	Zone 3 Suction Line Solenoid
4	FM3-01	Zone 3 Fan Motor
5	CHP-03	Chassis Ground
6	LLS2-01	Zone 2 Liquid Line Solenoid
7	FS2-02	Zone 2 Fan Speed Signal
8	DS3-01	Zone 3 Door Switch
9	LLS3-01	Zone 3 Liquid Line Solenoid
10	8-02	8 Circuit Power
11	FM2-01	Zone 2 Fan Motor
12	SLS2-01	Zone 2 Suction Line Solenoid
13	HGS2-01	Zone 2 Hot Gas Solenoid
14	DS2-01	Zone 2 Door Switch
15	Not Used	
16	Not Used	

P201 - Zone 2 Connector

Pin Number	Wire Number	Description
1	SLS2-01	Zone 2 Suction Line Solenoid
2	HGS2-01	Zone 2 Hot Gas Solenoid
3	FS2-01	Zone 2 Fan speed signal
4	LLS2-01	Zone 2 Liquid Line Solenoid
5	2AAL-02	Zone 2 2AAL Power (Zone 2 Door Switch)
6	DS2-01	Zone 2 Door Switch (Zone 2 Signal)
7	Not Used	
8	LLS2-02	Zone 2 Liquid Line Solenoid

P202 - Zone 3 Connector

Pin Number	Wire Number	Description
1	SLS3-01	Zone 3 Suction Line Solenoid
2	HGS3-01	Zone 3 Hot Gas Solenoid
3	FS3-01	Zone 3 Fan speed signal
4	LLS3-01	Zone 3 Liquid Line Solenoid
5	2AAL-03	Zone 3 2AAL Power (Zone 3 Door Switch)
6	DS3-01	Zone 3 Door Switch (Zone 3 Signal)
7	Not Used	
8	LLS3-02	Zone 3 Liquid Line Solenoid



Complete SPECTRUM Control System with Multi-Temp Option Board Installed

Sensors

The sensors monitor temperatures at various points in the system as well as oil pressure, oil and coolant levels and engine speed.

Graded and Ungraded Sensors

The Return Air and Discharge Air sensors are graded sensors. This feature allows accuracy without the need for ice water calibration. The sensor grade (from 1L through 9H) is stamped on the sensor and must be entered into the microprocessor when a sensor is changed in order to properly calibrate temperature readings.

An ungraded sensor is used to measure the evaporator coil temperature and ambient temperature since these temperatures are not as critical as Return and Discharge air temperatures.

Return Air Sensor: This sensor monitors the temperature of the air returning to the remote evaporator coil. The sensor is located in the return air flow and is connected directly to the microprocessor. The unit controls on this sensor under normal conditions. This is a graded sensor and must be replaced with a graded sensor. The microprocessor must be calibrated to the sensor grade of the sensor installed in the return air position in order to operate properly. It is connected to the microprocessor via the RTP and RTN wires.

Discharge Air Sensor: This sensor monitors the temperature of the air leaving the evaporator coil. The sensor is located in the remote evaporator discharge air path and is connected directly to the microprocessor. The unit will control on this sensor if the return air sensor fails or if discharge air sensor control is selected. This is a graded sensor and must be replaced with a graded sensor. The microprocessor must be calibrated to the sensor grade of the sensor installed in the discharge air position in order to operate properly. It is connected to the microprocessor via the DTP and DTN wires.

Coil Temperature Sensor: This sensor monitors the temperature of the evaporator coil. The sensor is located on the remote evaporator coil header plate and is connected directly to the microprocessor. This is not a graded sensor. It is connected to the microprocessor via the CTP and CTN wires.

Ambient Temperature Sensor: This sensor monitors the ambient air temperature. The sensor is located in the main unit and is connected directly to the microprocessor. This is not a graded sensor. It is connected to the microprocessor via the ATP and ATN wires.

Refrigeration System Components

The refrigeration system controls are used to control the operation of the refrigeration system as required by the microprocessor. The microprocessor determines these requirements by considering the setpoint, the software, the setting of programmable features and the information supplied by the sensors. For additional information see Section 8 of this manual.

These three valves are located in the condenser section of the unit. They are common to all zones.

Condenser Inlet Solenoid: This valve controls the flow of refrigerant to the condenser. This solenoid is energized (closed) when any compartment is operating in heat or defrost mode. This is a normally open valve.

Receiver Tank Check Valve: This valve relieves excessive pressure in the receiver tank when the unit is turned off.

Purge Valve: The purge valve is energized (open) during heat and defrost mode. This is a normally closed valve.

The following components are also located in the main unit.

High Pressure Cutout: The high pressure cutout is located at the compressor head of two cylinder compressors, on the discharge manifold of four cylinder compressors and on the discharge line of scroll compressors. This switch monitors the discharge pressure at the compressor. The switch is closed with normal pressures and open with excessive pressures. The switch will open and close at pressures determined by the refrigerant used in the unit. It opens on high discharge pressure to shut the unit down to prevent damage.

Discharge Pressure Transducer: This transducer supplies the discharge pressure at the compressor to the microprocessor. This information is used by the microprocessor and software to determine the unit operating conditions.

Suction Pressure Transducer: This transducer supplies the suction pressure at the compressor to the microprocessor. This information is used by the microprocessor and software to determine the unit operating conditions. It should be noted that the suction pressure transducer is located downstream of the throttling valve. As a result, the suction pressure displayed is compressor suction pressure.

Compressor Temperature Sensor: This transducer supplies the compressor temperature to the microprocessor. This information is used by the microprocessor and software to determine the unit operating conditions.

The following valves are required for each zone. They are located in the remote evaporator(s) for each zone.

Liquid Line Solenoid: This valve is energized (open) any time cooling, heating or defrosting is required in its zone. The valve is de-energized when the zone is in null to stop refrigerant flow in that zone. This is normally closed valve.

Hot Gas Solenoid: This valve is energized (open) any time heating or defrosting is required in the zone. This is a normally closed valve.

Suction Line Solenoid: If a zone is capable of reverse cycle operation it is said to be invertible. Reverse cycle means that the evaporator coil in that zone is used as the condenser coil during heat operation as long as at least one other zone is operating in cool mode.

The suction line solenoid is energized (closed) when its compartment is operating in heat mode as long as at least one other zone is operating in cool mode. This is a normally open valve.

Engine Controls

The engine controls are used to control the operation of the diesel engine (or electric motor) as required by the microprocessor. The microprocessor determines these requirements by considering the setpoint, the software, the setting of programmable features and the information supplied by the sensors.

Coolant Temperature Sensor: This sensor monitors the temperature of the coolant in the diesel engine. It is located on the diesel engine thermostat housing and is connected to the microprocessor via the WTP and WTN wires.

Coolant Level Sensor: This sensor monitors the level of coolant in the radiator used by the diesel engine. It is located on the radiator expansion tank. If the coolant level falls below the sensor for a specified period of time a low coolant condition is assumed to exist. It is connected to the microprocessor via the CLS wire.

Oil Pressure Switch: The oil pressure switch monitors the oil pressure of the diesel engine. It is located on the engine side of the unit frame. It is connected to the microprocessor via the 20B and CHO- wires.

Oil Level Sensor: The oil level sensor monitors the oil level in the diesel engine. It is located above the oil pan on the door side of the engine. It supplies information on the oil level to the microprocessor via the OLS wire. The switch is closed with low oil level.

Flywheel Sensor: This sensor monitors the RPM of the diesel engine. The flywheel sensor is located just under the door side engine mount. It supplies engine speed information to the microprocessor via the RPMP and RPMN wires.

Glow Plugs: The glow plugs are energized by the microprocessor via the H wire to preheat the engine.

Starter: The starter is located on the compressor side of the engine. It is energized by the microprocessor via the 8S wire to crank the engine.

Fuel Solenoid: The fuel solenoid is located at the rear of the injector pump and is used to start and stop the flow of fuel to the diesel engine. It is energized to start fuel flow by the microprocessor via the 8D wire. The fuel solenoid features two coils, a pull-in coil and a hold coil. The pull-in coil draws approximately 40 amperes and the hold coil draws approximately 1 ampere. The pull-in coil is momentarily energized by the fuel solenoid timer for a few seconds to shift the fuel linkage.

Throttle Solenoid: The high speed (throttle) solenoid is located just below the fuel injection pump. It is energized by the microprocessor via the 7D wire to initiate high speed operation.

Optional Electric Standby

(Model 50 units only)

The Electric Standby option allows the unit to be operated on either the diesel engine or external electric power. The units are supplied to operate on three phase power.

CAUTION: High voltage AC power is present whenever the unit is operating in Electric mode and whenever the unit is connected to external standby power. Voltages of this magnitude can be lethal. Exercise extreme caution when working on the unit.

Standard Model 50 Features

The following features are standard equipment on units equipped with Electric Standby.

Automatic Diesel/Electric Selection: The unit will automatically switch to electric operation when a power cord is connected and the standby power is switched “on”. The unit can also be programmed to automatically switch back to diesel power if the standby power is switched off or fails.

Automatic Overload Reset: The overload relay resets automatically after the motor cools.

Hot Gas Heat: Hot gas heat is utilized on standard model 50 units.

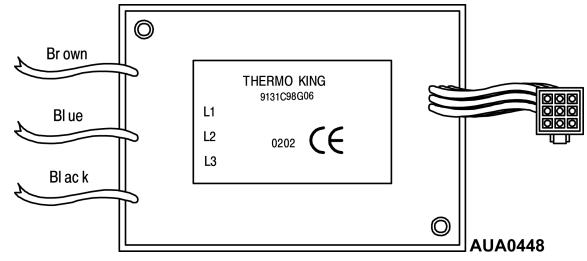
Automatic Phase Correction: The control system features two motor contactors. This allows correct motor rotation regardless of phase rotation on the incoming power.

High Voltage Tray

The high voltage tray contains the contactors, overload relay and phase detect module used to operate the drive motor on units equipped with Electric Standby. The contactors are controlled by +12 volt dc control signals from the Interface Board. The high voltage tray is located inside the control box just to the rear of the Microprocessor/ Interface Board Assembly.

Phase Detect Module

The phase detect module is designed to monitor both single and 3 phase voltages from 160 volts AC through 510 volts AC. The phase detect module will detect missing phases, phase rotation and low voltage on three phase or single phase power. For operation and diagnostics see Section 5.



Phase Detect Module

Section 3 — SPECTRUM Software Description

Section 3 — SPECTRUM Software Description

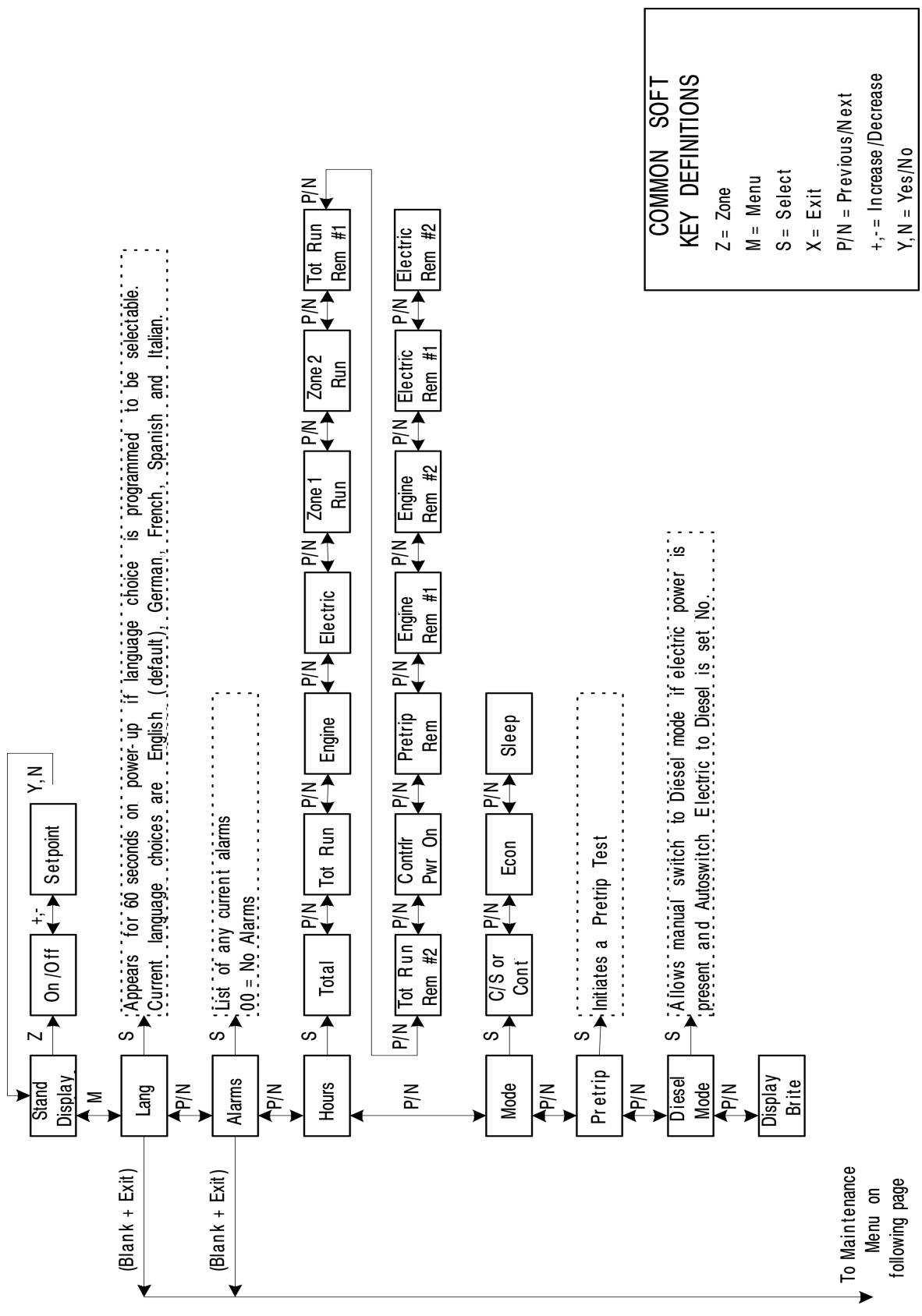
Software Operation

The software is a very complex set of instructions used to operate the microprocessor. The microprocessor examines the conditions of all the inputs and compares them to the instructions contained in the software. The outputs are then energized as specified by the software instructions.

There is no way to determine from the schematic what conditions will cause the unit to operate in a particular mode. This decision is made by the microprocessor and software after examining all the input conditions and setpoint. However, operating mode can usually be deduced from the existing conditions. As an example, if a 35°F (2°C) setpoint is selected and the box temperature as indicated by the return air sensor is 60°F (16°C), the unit should operate in Cool mode when turned on.

The software is flashloaded using a PC computer. See Service Procedure A46A for details.
To check software revision of the microprocessor and HMI control panel refer to Section 4 of this manual.

Operator Menu Overview



Operator Menu Features

The Thermo King SPECTRUM control system features many special operator functions. These functions are available from the Operator Menu. A brief explanation of each menu is included here. For additional details see Section 4 of this manual.

Accessing the Operator Menu

From the Standard Display press the MENU key. The controller will display the Operator Menu.

Language Selection Menu

If enabled, the Language Selection Menu allows the operator to select a desired language from a predetermined list. For more information see Section 4.

Alarm Display Menu

The Alarm Menu allows the operator to display alarms in plain language as opposed to showing only an alarm code. Operator level Help screens are available for each alarm code. The operator can also clear alarms from this menu. For more information see Section 4.

Hourmeter Display Menu

The Hourmeter Menu allows the operator to check the readings of all unit hour-meters that have been enabled. For more information see Section 4.

Mode Select Menu

This menu allows the operator to select various modes of operation or turn modes on and off. These modes should be selected as specified by the customer.

CYCLE-SENTRY Mode

The unit automatically starts on demand when temperature control is required in any zone and shuts the unit down when all demands in all zones are satisfied. The engine block temperature and battery charge levels are also monitored and maintained. If the block temperature falls below 30°F (-1°C) and Diesel CYCLE-SENTRY mode is selected, the engine will start and run until the block temperature is above 120°F (49°C). If the battery voltage falls below 12.2 volts and Diesel CYCLE-SENTRY mode is selected, the engine will start and run until the battery voltage has remained above 13.6 volts for at least 7 minutes. For more information see Section 4.

Continuous Mode

The unit runs at all times to control temperature and provide circulation in all zones. For more information see Section 4.

Economy Mode

Economy Mode is used on selected loads that do not require critical temperature control. The temperature control points are relaxed and other features are optimized for maximum fuel economy. This mode should be used as directed by individual company policy. For more information see Section 4.

Sleep Mode

Normal CYCLE-SENTRY mode starts and stops the unit as required to maintain the desired temperature in all zones, maintain the unit battery in a charged condition and keep the unit engine warm in cold ambient conditions. Sleep mode does not maintain zone temperatures. In Diesel mode, Sleep mode keeps the engine warm and the unit battery charged. This is useful in extremely cold weather or when the unit is to be out of service for an extended time. In Electric Mode the engine temperature is ignored. The unit starts and stops only to keep the battery charged. For more information see Section 4.

Pretrip Test Menu

A Pretrip Test verifies unit operation. This menu allows a Pretrip Test to be initiated by the operator. If the test is started with the engine off a full test including amp checks is performed. If the test is started with the engine or motor running the amp checks are omitted. Test results are reported as PASS, CHECK or FAIL. For more information see Section 4.

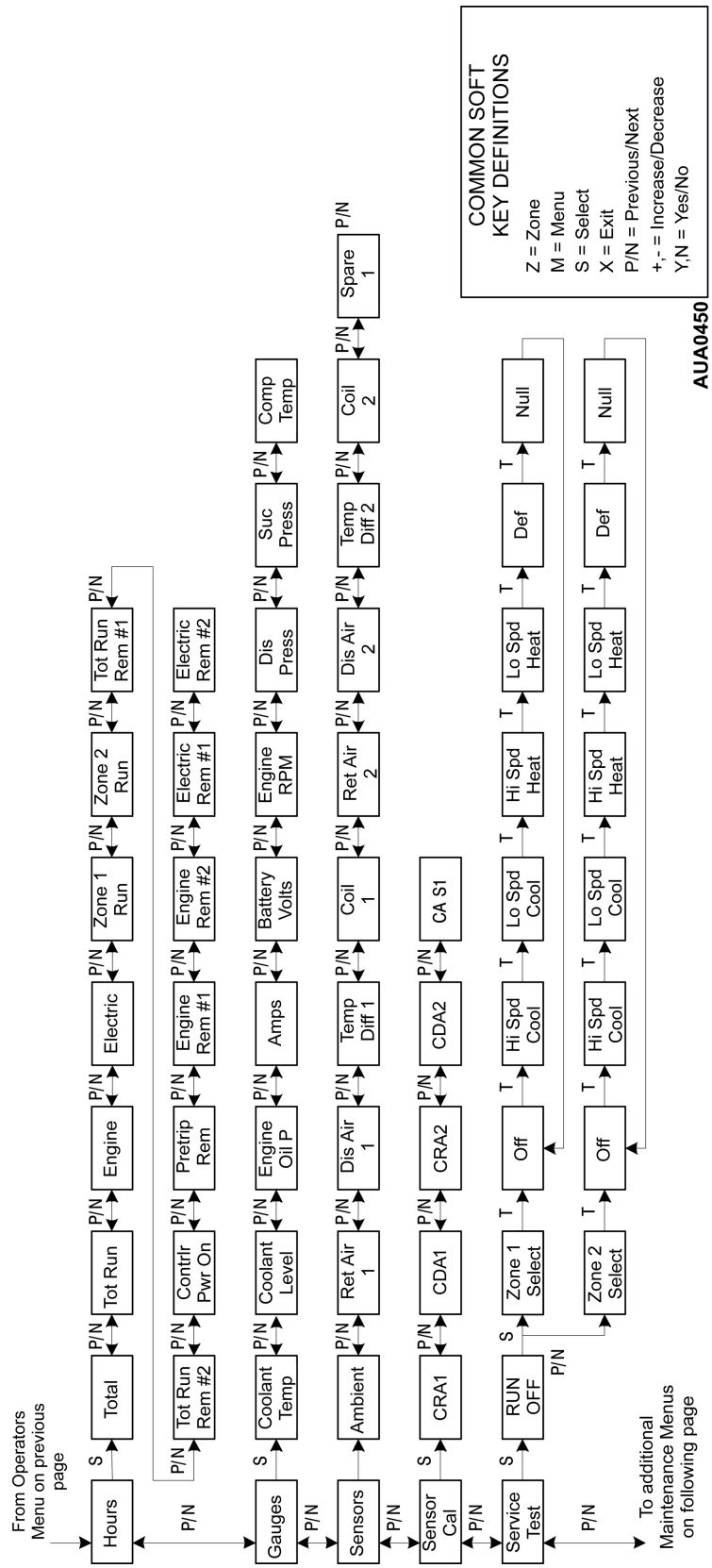
Diesel Mode Menu

This menu allows the operator to switch to diesel mode operation if the standby power fails or is disconnected. For more information see Section 4.

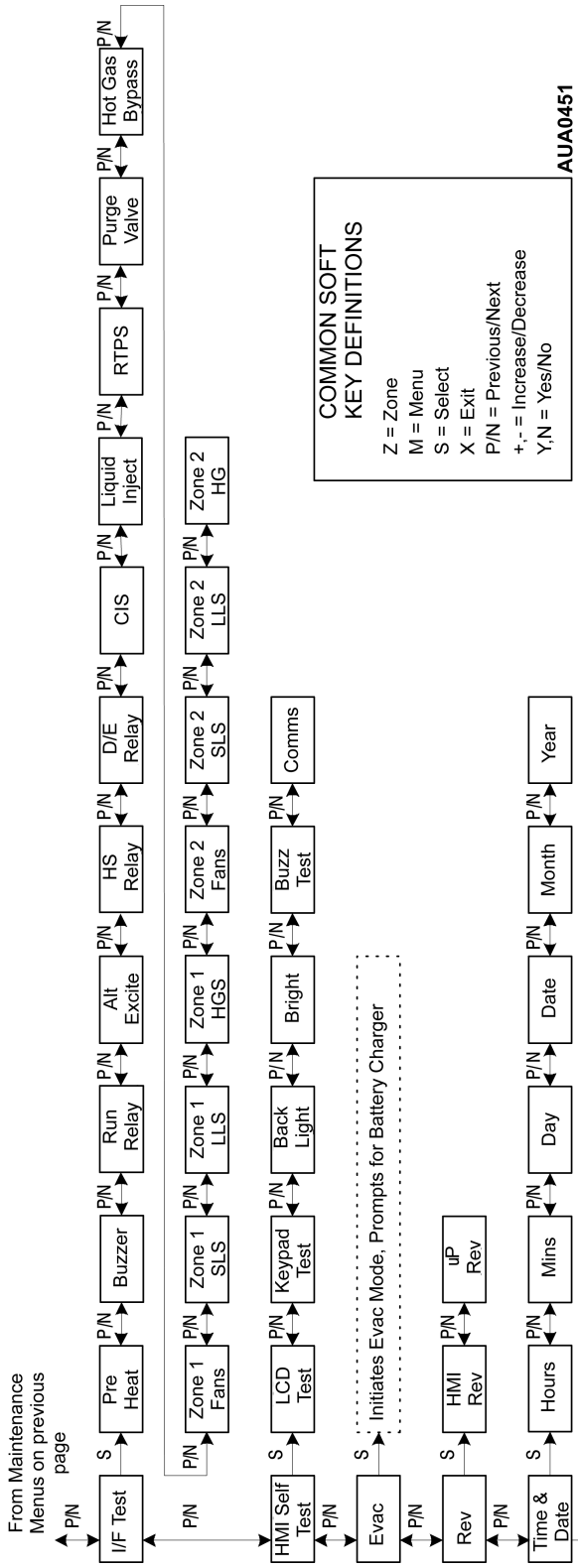
Display Brightness Menu

This menu allows the operator to change the brightness of the display as required by ambient light conditions. For more information see Section 4.

Maintenance Menu Overview



Maintenance Menu Overview (continued)



Maintenance Menu Features

The Thermo King SPECTRUM control system features many special technician functions. These functions are available from the Maintenance Menus. A brief explanation of each menu is included here. For additional details see Section 4 of this manual.

Accessing the Maintenance Menu

From the Standard Display press the MENU key. The controller will display the Operator Menu. From the first Operator Menu display (either Alarms or Language) press and hold both the EXIT key and the key with no label above it for 5 seconds. After 5 seconds the controller will display the Maintenance Menu.

Hours Display Menu

The Hours Menu allows the operator to check the readings of all unit hour-meters that have been enabled. In addition, a reset button is provided for each user programmable hourmeter. For more information see Section 4.

Gauges Display Menu

The Gauges Display allows the operator to display unit operating information such as coolant level and temperature, engine RPM, battery amps, battery volts and suction and discharge pressure. For more information see Section 4.

Sensor Display Menu

The Sensors Display allows the operator to display the temperature of all unit temperature sensors and the temperature differential for each zone. For more information see Section 4.

Sensor Calibration Menu

The Sensor Calibration Menu allows the operator to select the correct grade for all graded sensors. For more information see Section 4.

Service Test Mode Menu

Since the complexity of the control software makes it impossible to predict exact operating conditions, a trouble-shooting feature called Service Test Mode has been incorporated. This feature allows the unit to be “forced” to a known set of operating conditions in Diesel mode, regardless of setpoint or temperature sensor inputs. Service personnel can now troubleshoot the system under defined conditions. Service Test Mode can be used with the unit running or shut down.

When a Service Test Mode function is selected, the unit will operate in that mode for 15 minutes. If no other Service Test Mode function is selected during this time the unit will shut down and generate Alarm Code 54. All protection circuits operate normally in Service Test Mode.

The Service Test Mode display also shows return air temperature, discharge air temperature, evaporator coil temperature and the calculated value for temperature differential. The Gauge Menu is also available. For a complete list of Service Test Mode functions see Section 4.

Interface Board Test Mode Menu

Interface Board Test Mode allows individual relays or outputs to be energized. This permits service personnel to troubleshoot the system under defined conditions. Interface Board Test mode is used with the unit shut down.

Relays and outputs can all be energized momentarily. In addition, all functions except the Preheat relay and buzzer can be locked on. If a function is locked on that function will remain energized for 15 minutes if no other Interface Board Test Mode function is selected. At the end of 15 minutes, if no other function is selected the unit will shut down and record Alarm Code 54. All protection circuits operate normally in Service Test Mode.

The Interface Board Test Mode display also shows suction pressure, discharge pressure, amps and battery volts. For a complete list of Interface Board Test Mode functions see Section 4.

Display Self Test Menu

The Display Self Test Menu allows the operator to perform a series of built in tests on the HMI Control Panel. For more information see Section 4.

Evacuation Mode Menu

Evacuation Mode allows a full system evacuation to be performed. All normally closed valves are opened to allow the entire system to be evacuated and charged. If battery voltage falls below acceptable limits the operator is prompted to connect a battery charger to maintain sufficient battery voltage to hold all necessary valves open during the procedure. For more information on Evacuation Mode see Section 4.

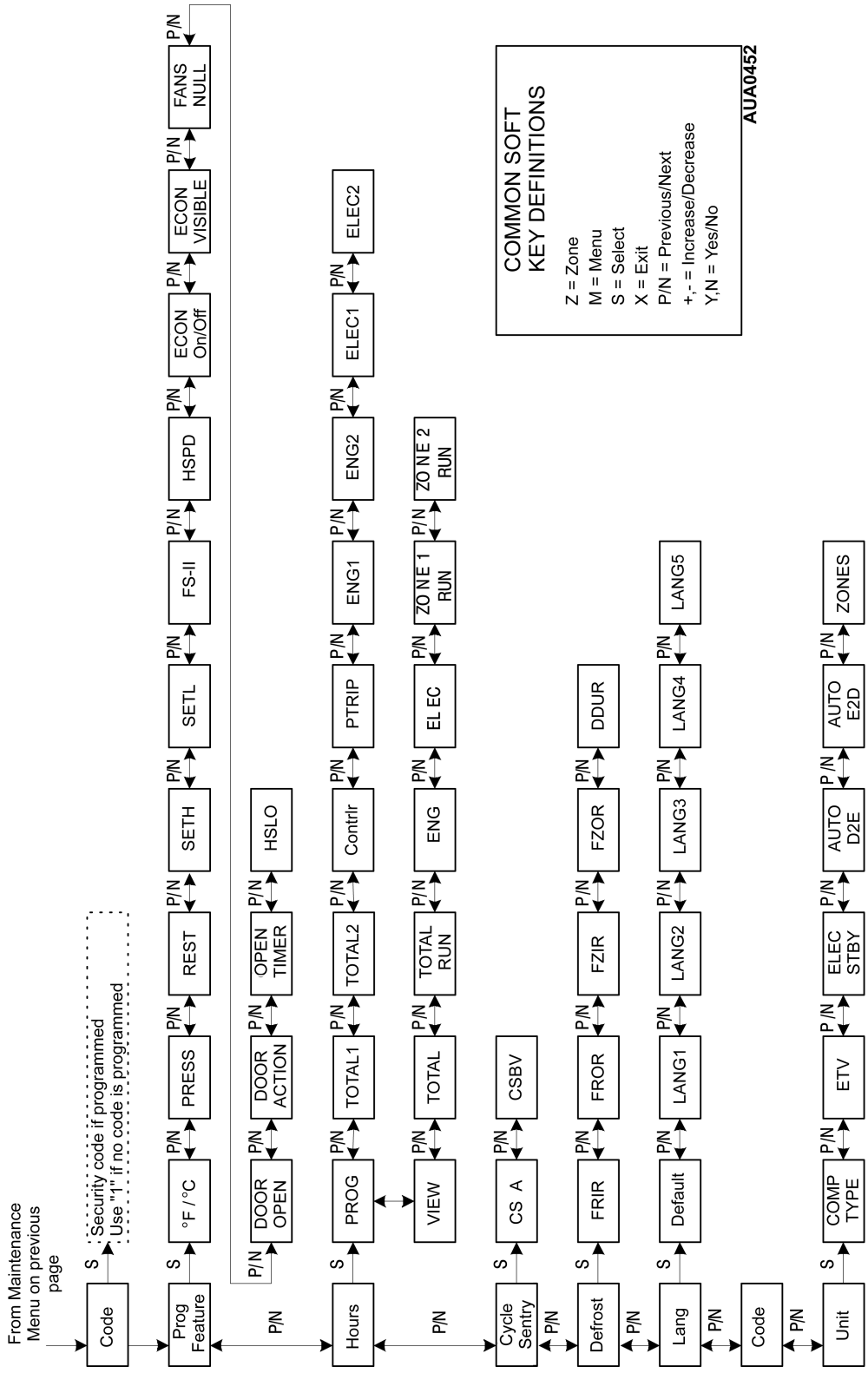
Revision Display Menu

The Revision Display shows the software revision of both the HMI Display Panel and the unit Controller. For more information see Section 4.

Time and Date Display Menu

The Time and Date Display allows the system time and date to be checked and changed as required. For more information see Section 4.

Guarded Access Menu Overview



Guarded Access Menu Features

The programmable features allow unit operation to be configured to user requirements. These features are programmed thru HMI Guarded Access or a communications port interface with appropriate user access level.

Programmable Feature Compare

When the unit is turned on, the programmable settings stored in the controller are compared to the settings stored in the HMI Control Panel. If the settings do not match, the controller settings are updated to the HMI Control Panel.

Security Code Protection

A security code can be set to restrict access to the Guarded Access Menu. If a security code is set the Technician will be prompted to enter the correct code when accessing the Guarded Access Menu.

Accessing the Guarded Access Menu

From the Standard Display press the MENU key. The controller will display the Operator Menu. From the first Operator Menu display (either Alarms or Language) press and hold both the EXIT key and the key with no label above it for 5 seconds. After 5 seconds the controller will display the Maintenance Menu. Press the NEXT key until the Time and Date Menu appears. From the Time and Date Menu press and hold both the EXIT key and the key with no label above it for 5 seconds. After 5 seconds the controller will display a Security Code challenge. If no Security Code has been set the display will show “1”. Press the YES key to enter the Guarded Access Menu. If a Security Code has been set the operator is prompted to enter the correct code and press the YES key to enter the Guarded Access Menu. If the correct Security Code is not entered, access to the Guarded Access Menu will be denied.

Programmable Features Menu

The Programmable Features Menu allows overall unit operation to be configured to specific end user requirements. These features are set to factory defaults when shipped, but can easily be changed to suit the end users needs.

Temperature Units

The controller can be set to display temperatures in either degrees Fahrenheit or degrees Celsius. The default setting is Fahrenheit.

Pressure Units

The controller can be set to display pressures in PSIG, kPa or BARS. The default setting is PSI.

Restarts After Shutdown are Enabled

Setting this feature Yes enables all restarts after shutdown alarms. If a shutdown alarm occurs the unit will restart after a set time to provide load protection. Depending on the cause of the shutdown alarm unit performance may be temporarily reduced in an attempt to allow continued operation. Setting this feature No will cause the unit to remain shut down after any shutdown alarm occurs. The default setting is Yes.

Setpoint High Limit

Setpoint High Limit allows the upper setpoint limit to be set to a maximum of 90°F (32°C) in one degree increments. The minimum setting available is determined by the setting of Setpoint Low Limit as described below. If the driver attempts to select a setpoint higher than the Setpoint High Limit the display will show Setpoint Limit, indicating that the selected Setpoint High Limit has been reached. Setting the Setpoint High Limit and the Setpoint Low Limit shown below to the same temperature results in a single setpoint available to the driver. The default setting is 80°F (27°C).

Setpoint Low Limit

The Setpoint Low Limit allows the lower setpoint limit to be set to a minimum of -25°F (-32°C) in one degree increments. The maximum setting available is determined by the setting of Setpoint High Limit as described above. If the driver attempts to select a setpoint lower than the Setpoint Low Limit the display will show Setpoint Limit, indicating that the selected Setpoint Low Limit has been reached. Setting the Setpoint High Limit and the Setpoint Low Limit to the same temperature results in a single setpoint available to the driver. The default setting is -20°F (-29°C).

Fuel Saver II is Enabled

If Fuel Saver II is set YES and the box temperature changes a predetermined amount above or below setpoint in CYCLE-SENTRY mode operation, or temperature indicates a need for high speed in Continuous mode operation, the unit will first run in low speed. An 8 minute timer is started and the control sensor air temperature is monitored. As long as the temperature falls (in cool mode operation) or rises (in heat mode operation) a specified amount before the timer expires, the 8 minute timer is reset and low speed operation continues. If the temperature has not changed the pre-determined amount when the timer times out, then high speed operation is resumed if allowed. If the unit switches to high speed from FS-II, the zone will run in high speed until setpoint is reached. If set NO, then high speed cool and high speed heat is allowed with no delay. The default setting is Yes if trailer, No if truck.

High Speed Pull Down Enabled

If High Speed Pull Down is set YES the unit will run in high speed on initial start until setpoint is reached in both cool and heat mode. If set NO then low speed cool and low speed heat switch points are active. The default setting is YES.

Economy Mode is Enabled

This feature allows Economy Mode to be enabled or disabled. If Economy Mode is disabled the unit operates with the normal temperature control specifications. Enabling Economy Mode relaxes the temperature control specifications for additional savings. This feature should only be used as specified by the end user. The default setting is DISABLED.

Economy Mode Visible

If Economy Mode is enabled above, the Economy Mode Visible feature is available. Setting this feature YES will add Economy Mode to the operator selections available under the Mode Menu. Setting this feature NO removes Economy Mode from the Mode Menu. The default setting is YES.

Running Fans in Null

This feature allows the fans in a zone to run when the zone is in running null to maintain airflow within the zone (normally used for fresh loads only). If Running Fans in Null is set to ENABLED the remote compartment fans will run for 3 minutes, shut down for 3 minutes and then restart for 3 minutes as long as the zone is in null. If Running Fans in Null is set to DISABLED the remote compartment fans will not run when the zone is in running null. The default setting is DISABLED.

Door Open is Enabled

This feature allows the Door Open feature to be enabled or disabled. If Door Open is set ENABLED the door switch will operate as selected with the Door Action feature below. If Door Open is set DISABLED the door switch has no function. The default setting is DISABLED

Door Action

This feature allows the door switch function to be set to operate in one of the following schemes.

1. **Running in Null** Place the zone in Running Null when the zone door is opened for 2 seconds and allow the zone to run when zone door is closed for 5 seconds. If the unit is operating as a single zone or zone Running Null is not allowed the unit will be forced to Null (unit off).
2. **Null** Force the zone into Null (zone off) when the zone door is opened for 2 seconds and allow the zone to run 5 seconds after zone door is closed. If the unit is operating as a single zone or zone Null is not allowed, the unit will be forced to Null (unit off). Door switch Null is not allowed if all other zones are in Null.
3. **Timed Off** The unit will shut down for the time interval selected by Select Time Off. After this time period elapses the unit will restart even if the door is still open.
   Select Time Off This feature only appears if Timed Off operation is selected. Select Time Off sets a time limit for door open event. If the time is exceeded, unit operation resumes even if the door is still open. The time range is from 1 to 4 hours in 10 minute increments. The default setting is 1 hour.
4. **Log Only** Log door opening and closing only. No other unit action. There is a 4 second delay to log door open and door closed.
5. **Unit Off** Force the unit into Null (unit off) when any door is opened for 2 seconds and allow the unit to run when all doors are closed for 5 seconds.

The default setting is Running in Null.

High Speed Lockout Key is Enabled

This feature enables or disables the High Speed Lockout feature. If the feature is set YES the HMI Control Panel High Speed Lockout key is enabled. If set NO the HMI Control Panel High Speed Lockout key is disabled. The default setting is YES.

Sleep After Pretrip is Enabled

This feature enables or disables Sleep Mode after a Pretrip Test. If the feature is set ENABLED the unit will enter Sleep Mode after a Pretrip Test. If the feature is set DISABLED the unit will not enter Sleep Mode after a Pretrip Test. The default setting is DISABLED.

Hourmeter Setup Menu

The Hourmeter Setup Menu allows the unit hourmeters to be configured to customer requirements. There are two sub-menus under the Hourmeter Setup Menu.

Program Hourmeter Sub-menu

The hourmeters listed below allow a time limit to be established for each Hourmeter. These time limits are defined by the customer and are typically used as maintenance reminders. The Program Hourmeter Sub-menu is used to set and clear the adjustable time limits for each Hourmeter as required by a customers maintenance program. The default time limit for all hourmeters is 100 hours. The hourmeters appear in the order shown below.

- Total Run Time Reminder # 1
- Total Run Time Reminder # 2
- Controller Power On Hours
- Pretrip Reminder Hours
- Engine Run Time Reminder # 1
- Engine Run Time Reminder # 2
- Electric Run Time Reminder # 1
- Electric Run Time Reminder # 2

Viewable Hourmeter Setup Sub-menu

The hourmeters can also be programmed to be visible or hidden to the operator. The hourmeters continue to accumulate time even if the hourmeter view is hidden. The default setting for all hourmeters is DISABLE. The hourmeters appear in the order shown below.

- Total Hours Viewing
- Total Run Hours Viewing
- Controller Power On Hours Viewing
- Engine Run Time Viewing
- Electric Run Time Viewing
- Zone 1 Run Time Viewing
- Zone 2 Run Time Viewing

CYCLE-SENTRY Setup Menu

The CYCLE-SENTRY Menu allows the unit defaults for CYCLE-SENTRY shut down on battery charge current and starts on battery voltage to be modified as required by end user requirements.

CYCLE-SENTRY Amps Level

When operating in CYCLE-SENTRY or Sleep mode the unit will continue to run to charge the battery until the charging current falls below this set limit. This occurs even if no zones require cooling, heating or defrosting. Choices range from 2 thru 8 amps in 1 amp increments. The default setting is 5 amps.

Battery Sentry Voltage Level

When operating in CYCLE-SENTRY or Sleep mode the controller will monitor battery voltage and restart the unit to charge the battery if the battery voltage falls below this set limit. This occurs even if no zones require cooling, heating or defrosting. Choices range from 11.8 volts thru 12.6 volts in 0.1 volt increments. The default setting is 12.2 volts.

Defrost Setup Menu

The Defrost Setup Menu allows the defrost cycle to be configured for maximum performance.

Defrost Interval In Range with Fresh Setpoint

This feature selects the timed interval between defrost cycles with fresh range setpoints when the temperature is in-range. Choices are 2, 4, 6, 8 or 12 hours. The default setting is 6 hours.

Defrost Interval Not In Range with Fresh Setpoint

This feature selects the timed interval between defrost cycles with fresh range setpoints when the temperature is not in-range. Choices are 2, 4, 6, 8 or 12 hours. The default setting is 4 hours.

Defrost Interval In Range with Frozen Setpoint

This feature selects the timed interval between defrost cycles with frozen range setpoints when the temperature is in-range. Choices are 2, 4, 6, 8 or 12 hours. The default setting is 6 hours.

Defrost Interval Not In Range with Frozen Setpoint

This feature selects the timed interval between defrost cycles with frozen range setpoints when the temperature is not in-range. Choices are 2, 4, 6, 8 or 12 hours. The default setting is 4 hours.

Maximum Defrost Duration

This feature selects the maximum time the unit can remain in a defrost cycle. Choices are 30 or 45 minutes. The default setting is 45 minutes.

Language Setup Menu

This menu allows the display language to be selected as required. Currently English, Spanish, French, German and Italian are supported. When a language is selected all subsequent displays are in the language.

Default Language

This feature allows the default language to be selected. The default language is the language that will appear when the unit is first turned on. Choices are English, Spanish, French, German and Italian. The default setting is English.

Enable Language English

If more than one language is enabled the operator has the option to select the desired language from the Operator Menu. This display allows English to be enabled or disabled. If English is enabled a DISABLE soft key will be present. Pressing this key will disable English and an Enable soft key will appear. Pressing this key will enable English. The default setting for English is Enabled.

Enable Language Spanish

If more than one language is enabled the operator has the option to select the desired language from the Operator Menu. This display allows Spanish to be enabled or disabled. If Spanish is enabled a DISABLE soft key will be present. Pressing this key will disable Spanish and an Enable soft key will appear. Pressing this key will enable Spanish. The default setting for Spanish is Disabled.

Enable Language French

If more than one language is enabled the operator has the option to select the desired language from the Operator Menu. This display allows French to be enabled or disabled. If French is enabled a DISABLE soft key will be present. Pressing this key will disable French and an Enable soft key will appear. Pressing this key will enable French. The default setting for French is Disabled.

Enable Language German

If more than one language is enabled the operator has the option to select the desired language from the Operator Menu. This display allows German to be enabled or disabled. If German is enabled a DISABLE soft key will be present. Pressing this key will disable German and an Enable soft key will appear. Pressing this key will enable German. The default setting for German is Disabled.

Enable Language Italian

If more than one language is enabled the operator has the option to select the desired language from the Operator Menu. This display allows Italian to be enabled or disabled. If Italian is enabled a DISABLE soft key will be present. Pressing this key will disable Italian and an Enable soft key will appear. Pressing this key will enable Italian. The default setting for Italian is Disabled.

Access Code Setup Menu

This menu allows the Access code for entry to the Guarded Access Menu

Enter Access Code

The + and – keys are used to change the Access Code as desired. The code should be recorded for use by authorized personnel.

Unit Configuration Setup Menu

The Unit Setup Menu is used to specify the actual unit configuration.

Compressor Type

This feature allows the compressor type to be selected. Choices are Scroll or Reciprocating. The default setting is Scroll.

Number of ETVs (Electronic Throttling Valves)

This feature allows the number of ETVs (Electronic Throttling Valves) to be specified. Choices are No ETVs or 1 ETV. The default setting is No ETVs.

Electric Standby Equipped

This feature specifies if the unit is equipped with optional electric standby. Choices are Yes or No. If the unit is equipped with electric standby this feature must be set Yes. If the unit is not equipped with electric standby this feature should be set No. The default setting is Yes.

Auto Switch Diesel to Electric

This feature allows the Auto Switch from Diesel to Electric to be enabled or disabled. Enabling this feature allows unit to switch automatically to electric mode when standby power is connected. Default is No if trailer, Yes if truck.

Auto Switch Electric to Diesel Yes or No

This feature allows the Auto Switch from Electric to Diesel to be enabled or disabled. Enabling this feature allows unit to switch automatically to diesel mode when standby power is disconnected. Default is No.

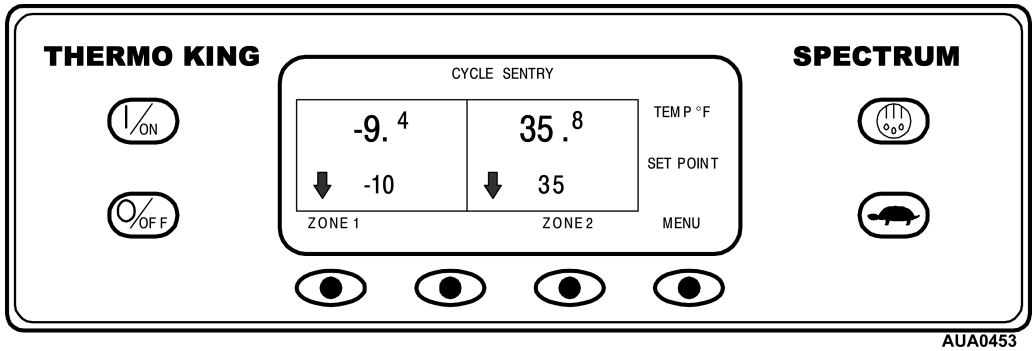
Zones

This feature specifies the number of zones installed. The default setting is 2 Zones.

Section 4 — SPECTRUM Operation

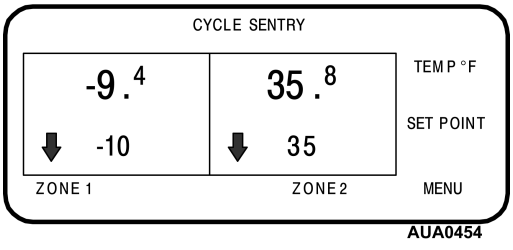
HMI Control Panel Features

The HMI (Human/Machine Interface) Control Panel is connected to the microprocessor and is used to operate the unit. It may be located in the truck dashboard using a DIN mounting ring or under the dashboard using an under dash mounting kit.



The HMI control panel consists of a display and 8 touch sensitive keys. The display is capable of showing both text and graphics. The two keys on the left and right sides of the display are dedicated keys as explained below. The four keys under the display are “soft” keys. The function of these keys change depending on the operation being performed. If a soft key is active the current key function will be shown in the display directly above the key.

Display



The display is used to supply unit information to the operator. This information includes setpoint and temperature for all installed zones, zone operating information, unit gauge readings, system temperatures and other information as selected by the operator. The Standard Display of box temperature and setpoint for 2 zones is shown here. In the display shown here the unit is running in CYCLE-SENTRY Mode, Zone 1 has a setpoint of –10°F and an actual box temperature of –9.4°F. Zone 2 has a setpoint of 35°F and an actual box temperature of 35.8°F. The two arrows show that both zones are cooling.

Keys

This key is used to turn the unit on. The Thermo King Logo screen will appear briefly and the display will then show the Standard Display of box temperature and setpoint for each zone. For more information see “Turning the Unit On and Off” later in this section.

This key is used to turn the unit off. The unit will enter the power-down sequence when this key is pressed. For more information see “Turning the Unit On and Off” later in this section.

This key is used to initiate a manual defrost cycle. For more information see “Initiating a Manual Defrost Cycle” later in this section.

This key is used to lock out high speed operation in noise sensitive areas. For more information see “Selecting High Speed Lockout” later in this section.

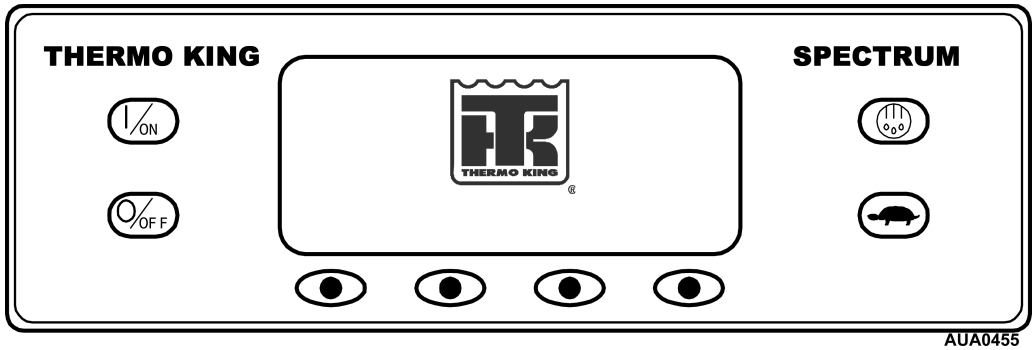
The four “soft” keys under the display are multi-purpose keys. Their function changes depending on the operation being performed. If a soft key is active the key function will be shown in the display directly above the key.

Typical Soft key applications:

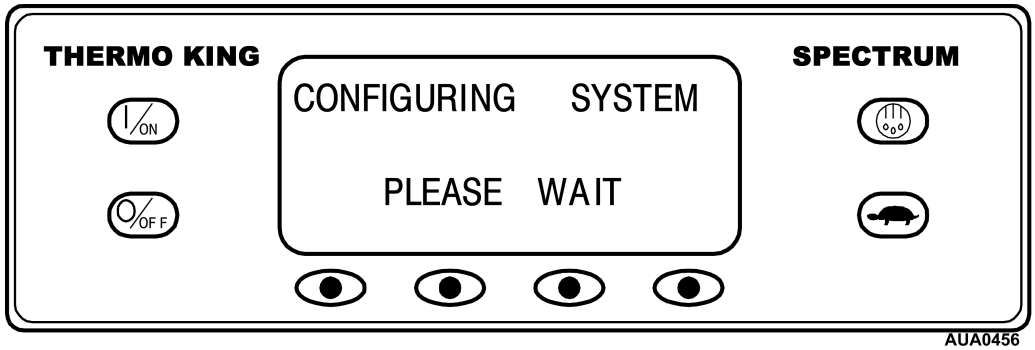
ZONE	MENU
NEXT	PREVIOUS
YES	NO
+	-
UP	DOWN
SELECT	EXIT
CLEAR	HELP
HOUR METERS	SENSORS
GAUGES	ABORT

Turning the Unit On and Off

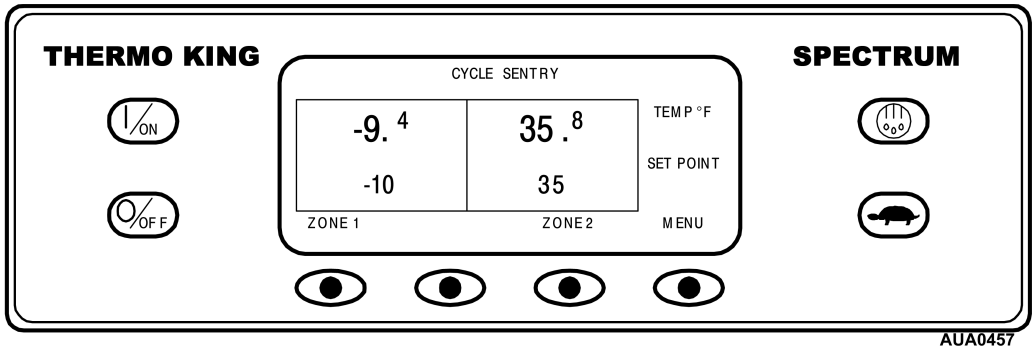
The unit is turned on by pressing the ON key and off by pressing the OFF key. When the On key is pressed the display will briefly show the THERMO KING Logo as the display initializes.



Then the startup screen shown below appears while communications are established and the unit prepares for operation.

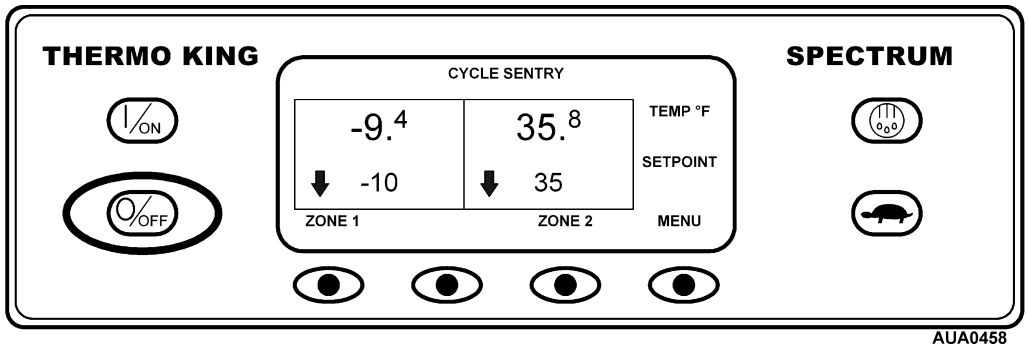


When the unit is ready to run the Standard Display will appear.

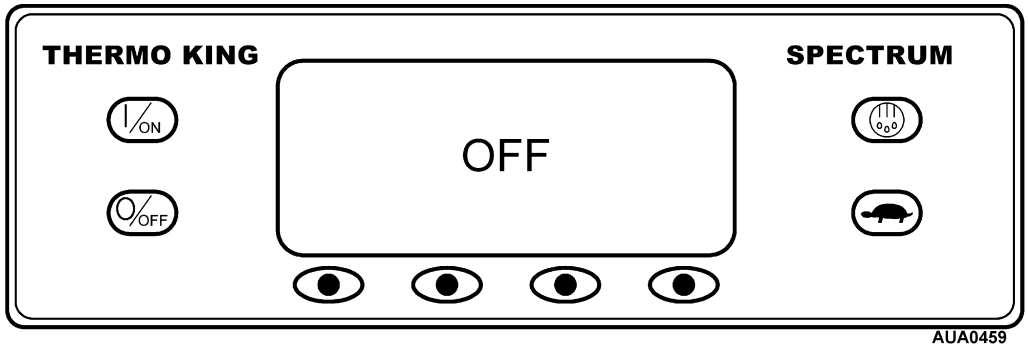


Turning the Unit On and Off - (continued)

Pressing the OFF key stops unit operation.

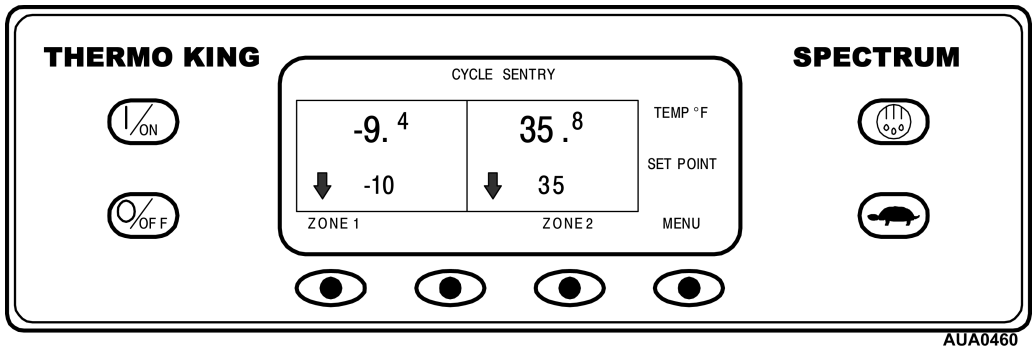


The unit will shut down and the display will briefly show OFF. The display will then go blank.

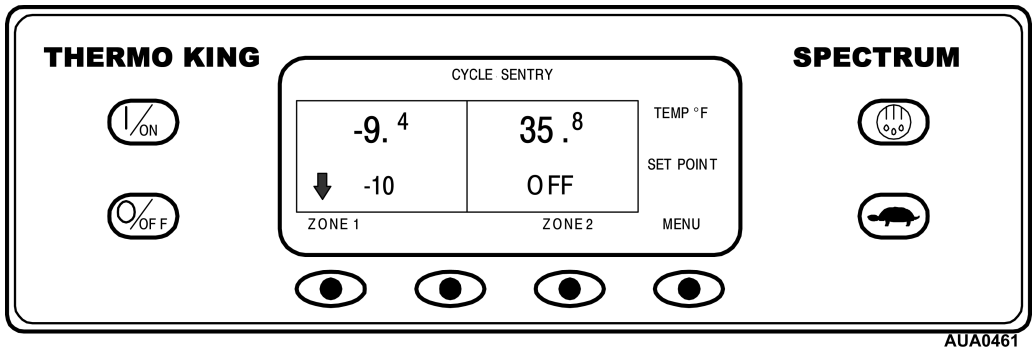


The Standard Display

The Standard Display is the default display that appears if no other display function is selected. The Standard Display shows the box temperature and setpoint or OFF for all installed zones. The box temperature is that measured by the controlling sensor, usually the return air sensor. A two zone application is shown here. The temperature in Zone 1 is –9.4°F with a –10°F setpoint. The temperature in Zone 2 is 35.8°F with a 35°F setpoint. The top of the display shows that the unit is operating in CYCLE-SENTRY mode. The two arrows indicate that both zones are cooling.



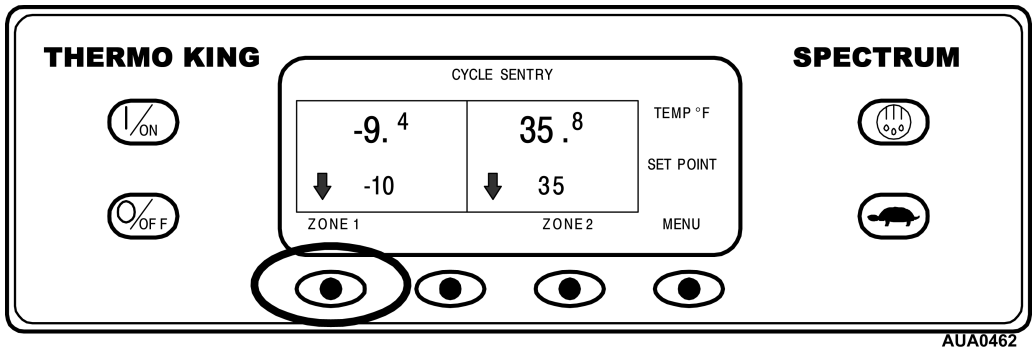
If OFF appears below the box temperature as shown below for Zone 2, then the zone has been turned off. If the setpoint appears the zone is turned on, as shown below for Zone 1.



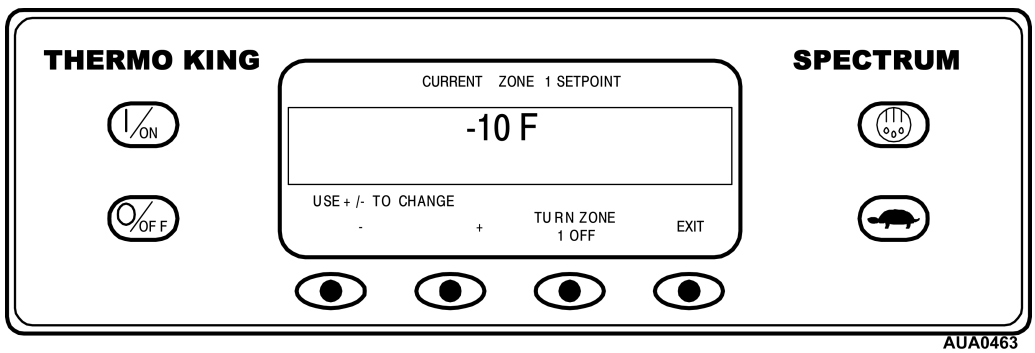
The soft key labeled Zone 1 is used to select the Zone 1 Display, the Zone 2 soft key selects Zone 2 Display, and the Menu soft key selects the Main Menu Display. The unlabeled soft key is not used from the Standard Display.

Selecting a Zone Display

To select a zone from the Standard Display, press the soft key for the desired zone. Zone 1 will be selected here.



When a Zone soft key is pressed the Zone Display shown below will appear. The zone display allows the operator to change the zone setpoint and turn the zone on and off. To return to the Standard Display press the soft key labeled EXIT. If no key is pressed the display will return to the Standard Display after 30 seconds.



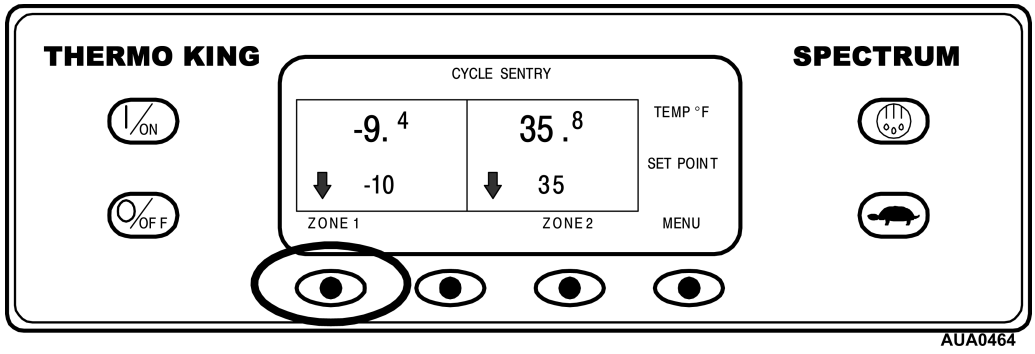
The soft keys labeled "–" and "+" are used to change the setpoint.

The Turn Zone X On/Off soft key identifies the zone being displayed and indicates if the zone is on or off. If the zone being shown by the Zone Display is currently turned on the third soft key will be labeled "TURN ZONE X OFF". If the zone is currently turned off the third soft key will be labeled "TURN ZONE X ON". Zone 1 is currently turned on in the illustration shown above.

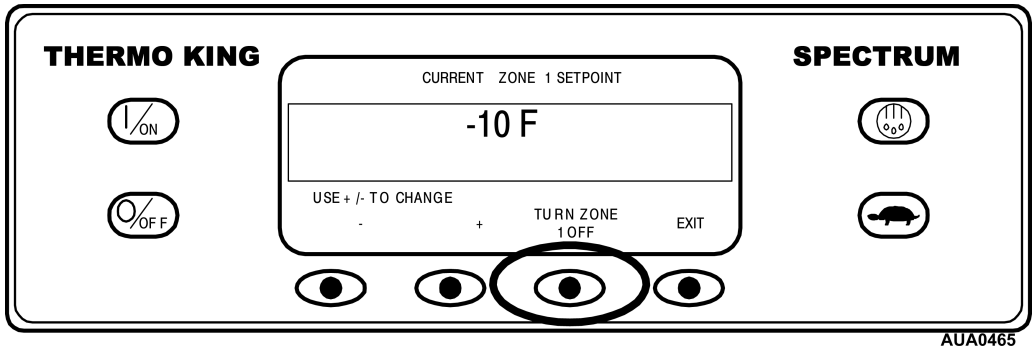
Pressing the EXIT soft key returns the display to the Standard Display.

Turning a Zone On and Off

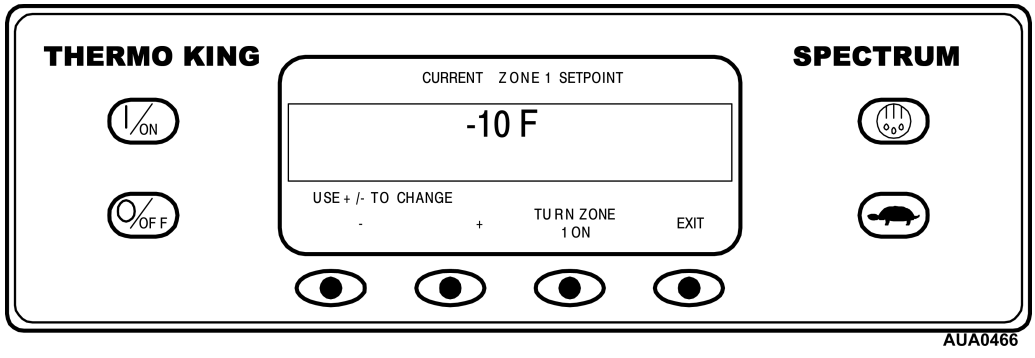
At the Standard Display, press the soft key to show the Zone Display for the desired zone.



If the zone shown by the Zone Display is currently turned on the third soft key will be labeled “TURN ZONE X OFF”, where X is the zone number. If the zone is currently turned off the third soft key will be labeled “TURN ZONE X ON”. Zone 1 is shown on the display below, with the zone turned on.

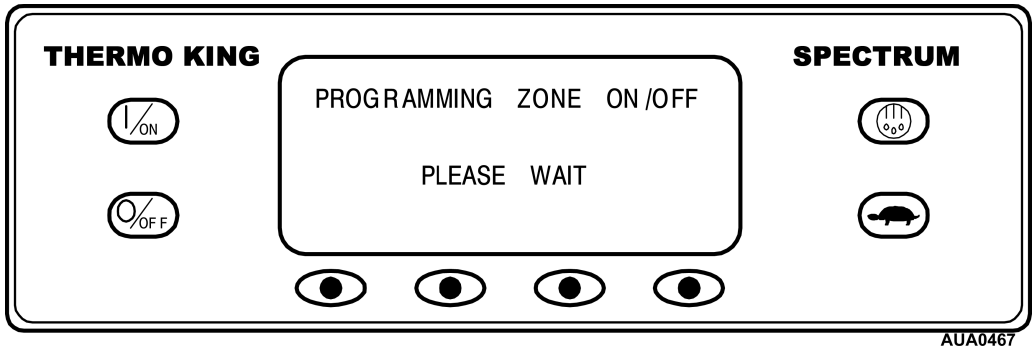


Pressing the TURN ZONE 1 OFF key will turn Zone 1 off, and the soft key label will then read TURN ZONE 1 ON as shown below. Pressing the key again will turn the zone back on.

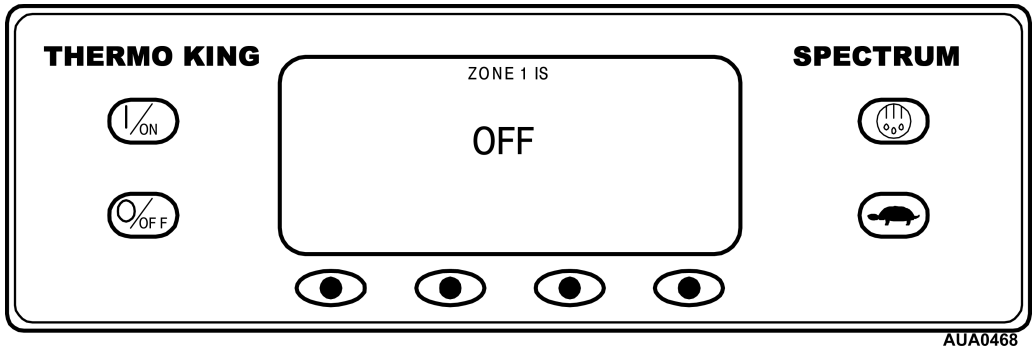


Turning a Zone On and Off – (continued)

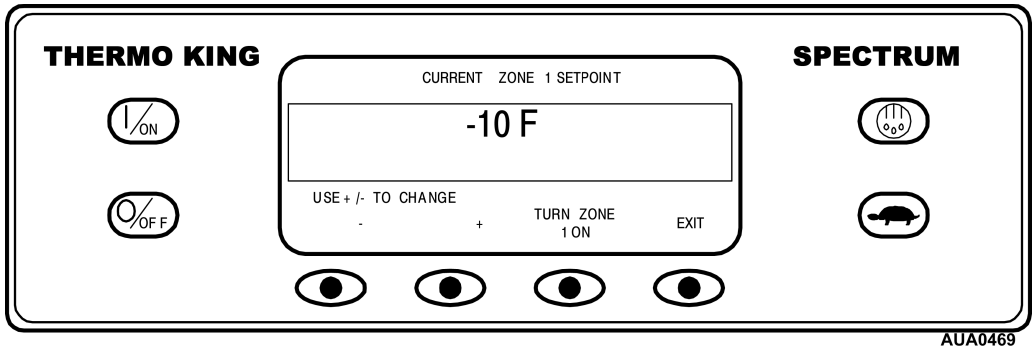
When the zone is turned on or off the display will briefly indicate that the change is being made as shown below.



The display will show the new zone setting for several seconds as shown below.



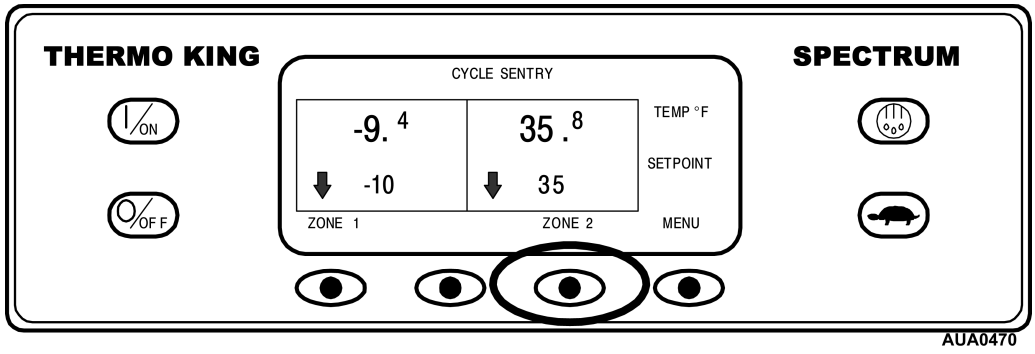
The display then returns to the Zone Display. Pressing the TURN ZONE 1 ON key will turn the zone back on.



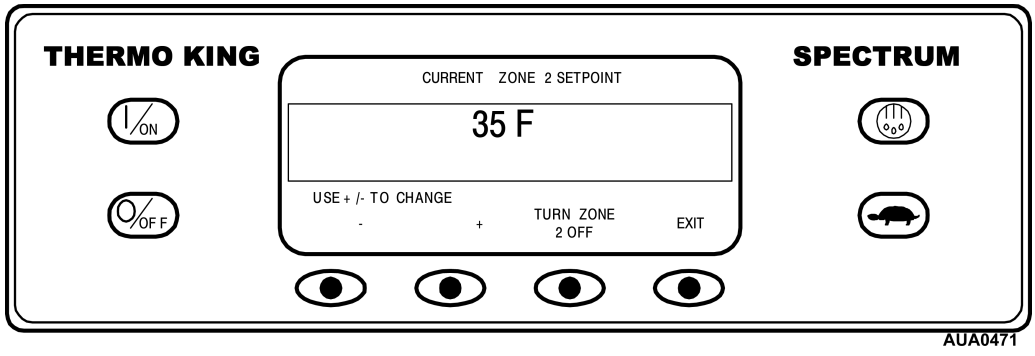
Pressing the EXIT key will return to the Standard Display. If no keys are pressed the display will return to the Standard Display after 30 seconds.

Changing the Setpoint

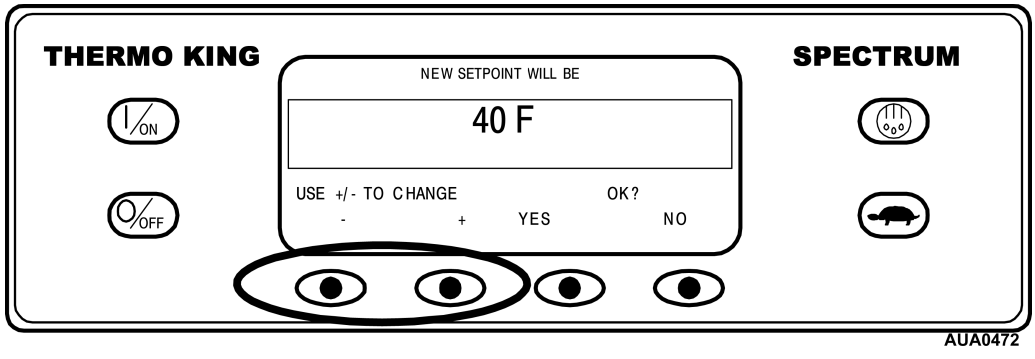
At the Standard Display, press the soft key to show the Zone Display for the desired zone.



The display below shows the Zone 2 display with a setpoint of 35°F. The Zone is turned on as shown previously.

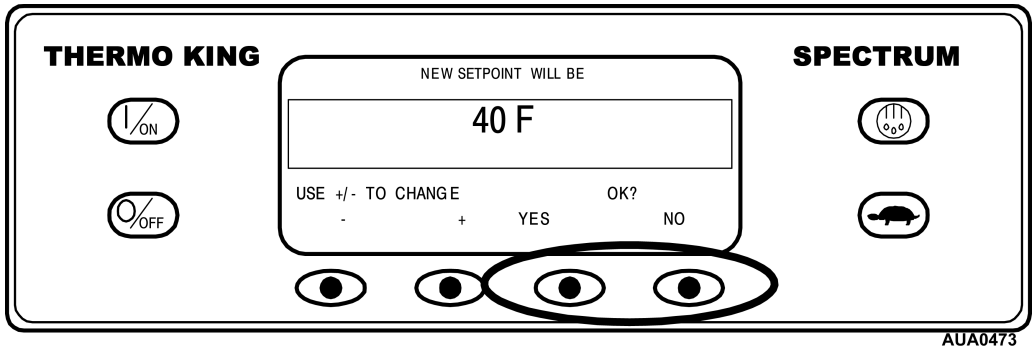


Pressing the “-” and/or “+” soft keys changes the display to the Setpoint Display for the selected zone. The display title changes and the YES and NO soft keys appear as shown below. The “+” and “-” soft keys are used to increase or decrease the setpoint. Here the setpoint has been changed to 40°F using the “+” key.



Changing the Setpoint – (continued)

The YES and NO soft keys confirm the setpoint change. When the desired setpoint has been selected using the "+" and/or "-" keys, press the YES soft key to confirm and load the new setpoint. If the setpoint is changed using the "+" or "-" keys, the change must confirmed or rejected by pressing the YES or NO soft key within 10 seconds of changing the setpoint. Failure to confirm the new setpoint by pressing Yes or No within 10 seconds of changing the setpoint will result in Alarm Code 127 Setpoint Not Entered.



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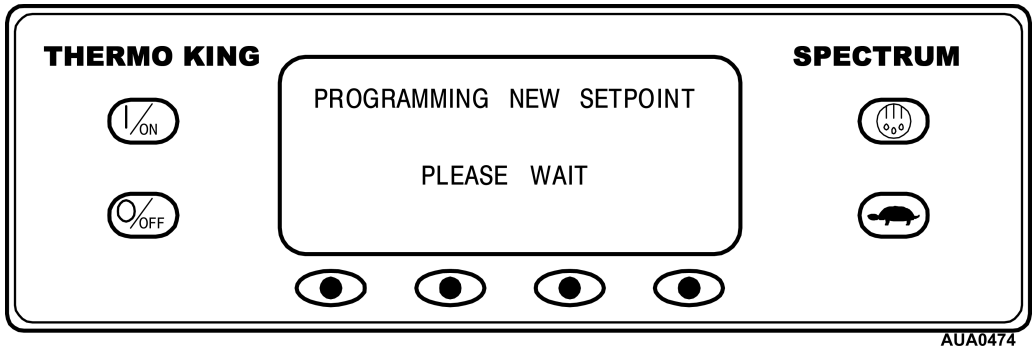
After the YES soft key has been pressed the display will briefly show PROGRAMMING NEW SETPOINT.



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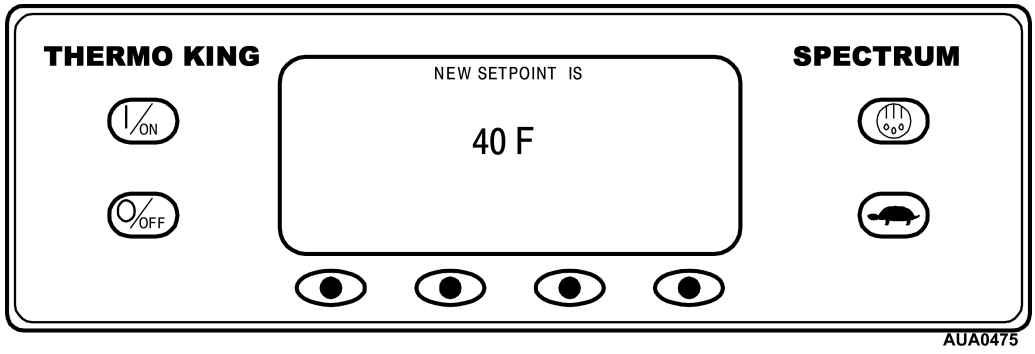
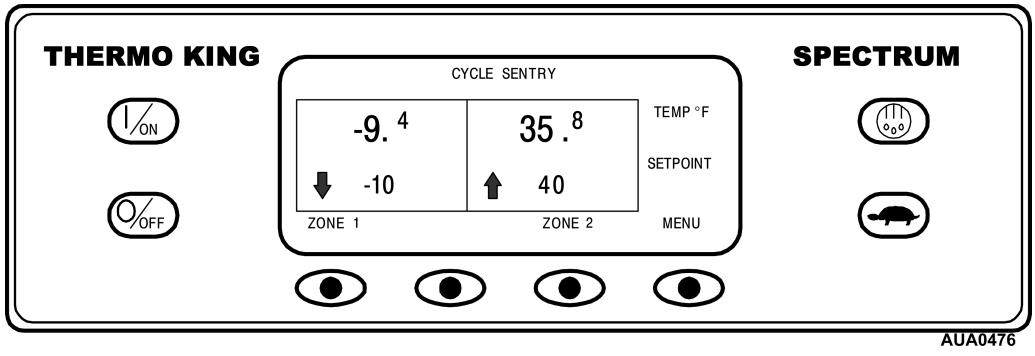
Changing the Setpoint – (continued)

The display then confirms the new setpoint for several seconds.



The display then returns to the Standard Display showing the new setpoint. Notice that the Zone 2 arrow now points up to indicate the zone is heating

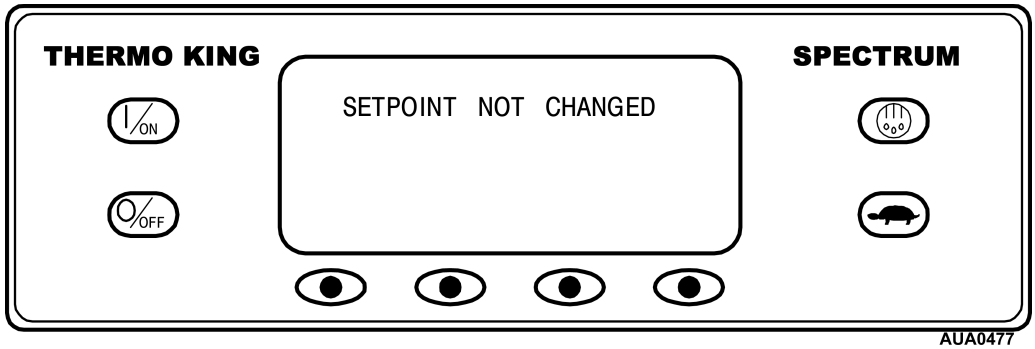


IMPORTANT: If the setpoint is changed using the "+" or "-" keys, the change must be confirmed or rejected by pressing the YES or NO soft key within 10 seconds of changing the setpoint.

- If the YES key is pressed, the setpoint change made with the "+" or "-" keys will be accepted, the setpoint will be changed and the display will return to the Standard Display.
- If the NO key is pressed the setpoint change made with the "+" or "-" keys will not be accepted, the setpoint will not be changed and the display will return to the Setpoint Display.

Changing the Setpoint – (continued)

- If the YES or NO key is not pressed within 10 seconds of making a change with the “+” or “-” keys, the setpoint will not be changed and the display will return to the Setpoint Display. The display will briefly show [SETPOINT NOT CHANGED] and **Alarm Code 127 Setpoint Not Entered** will be set to indicate that the setpoint change was started but not completed.



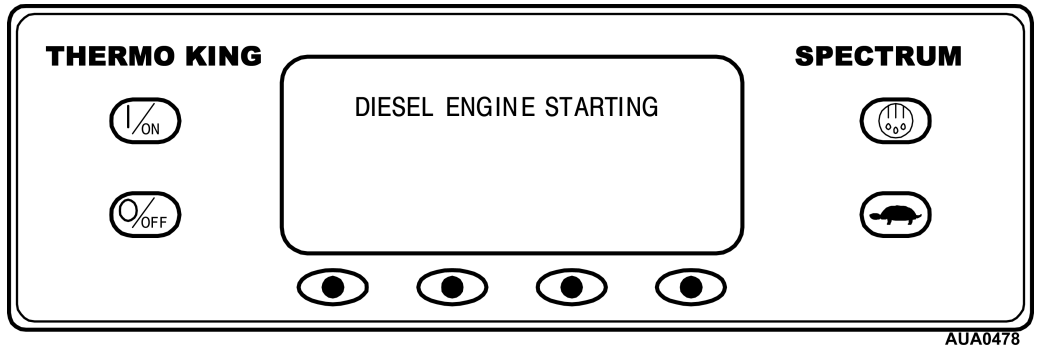
Starting the Diesel Engine

Diesel engine preheats and starts are automatic in both Continuous Mode and CYCLE-SENTRY Mode. The engine will preheat and start if necessary when the unit is turned on. The engine preheat and start will be delayed in CYCLE-SENTRY mode if there is no current need for the engine to run. If any keys are being pressed on the HMI the engine will preheat and start 10 seconds after the last key is pressed.

CAUTION: The engine may start automatically any time the unit is turned on.

WARNING: Never use starting fluid.

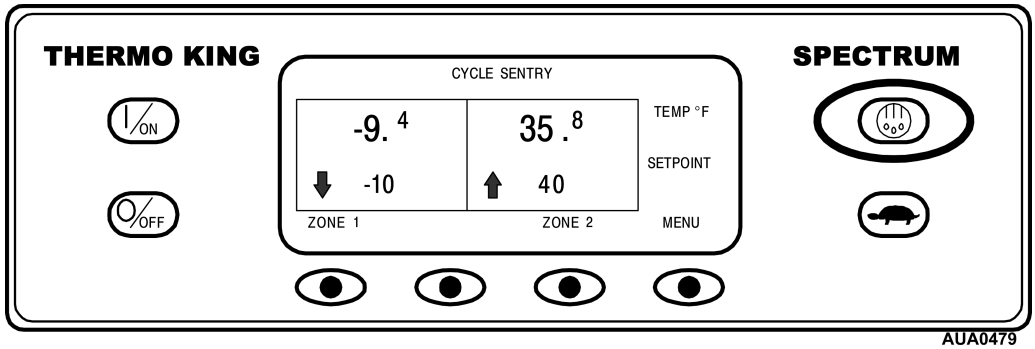
When the engine is preparing to start the HMI will display the engine start screen as shown below.



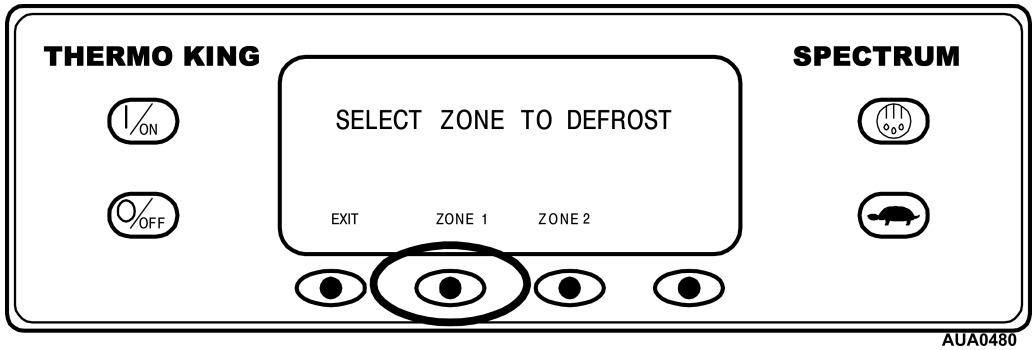
Initiating a Manual Defrost Cycle

Defrost cycles are usually initiated automatically based on time or demand. Manual defrost is also available.

Manual defrost is available if the unit is running, the zone is turned on and the zone coil temperature is less than 45°F (7°C). Only one zone can be in defrost at a time. Other features such as door switch settings may not allow manual defrost under some conditions. To initiate a manual defrost cycle, press the Defrost Key as shown below. The display will prompt for the desired zone.

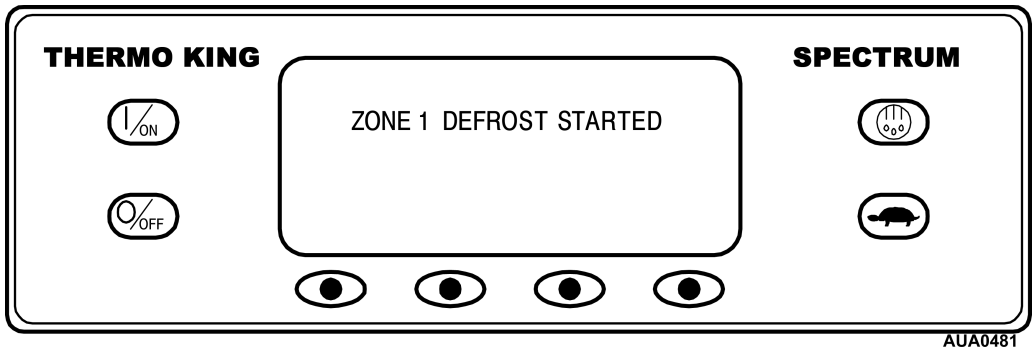


Press the soft key to select the zone to defrost as shown below. Pressing the indicated soft key will initiate a defrost cycle in Zone 1.

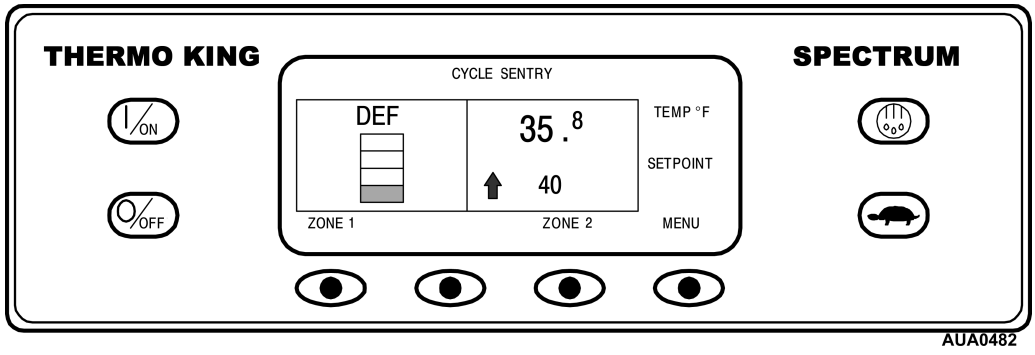


Initiating a Manual Defrost Cycle - continued

The display will briefly show [PROGRAMMING DEFROST] and then briefly show [ZONE “X” DEFROST STARTED], where “X” is the number of the selected zone. Zone 1 has started defrost as shown below.



The display will then return to the Standard Display as shown below. The zone in defrost will show “DEF” instead of setpoint as shown below. The bar indicator below “DEF” will show approximately how much time remains to complete the defrost cycle. The bar indicator below shows that the defrost cycle is about 25% complete.



Terminating a Defrost Cycle

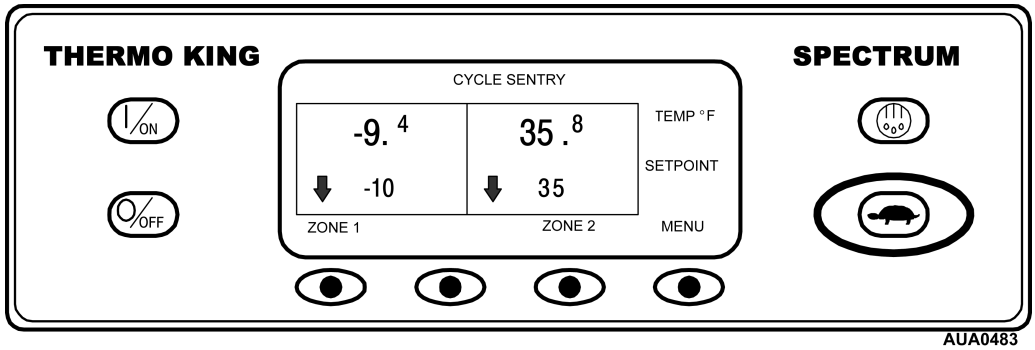
The defrost cycle will terminate automatically when the coil temperature is greater than 52°F (11°C) or the defrost timer expires. Defrost can also be terminated by turning the unit off and back on.

Selecting High Speed Lockout (if enabled)

If enabled, high speed operation can be locked out if required in noise sensitive areas.

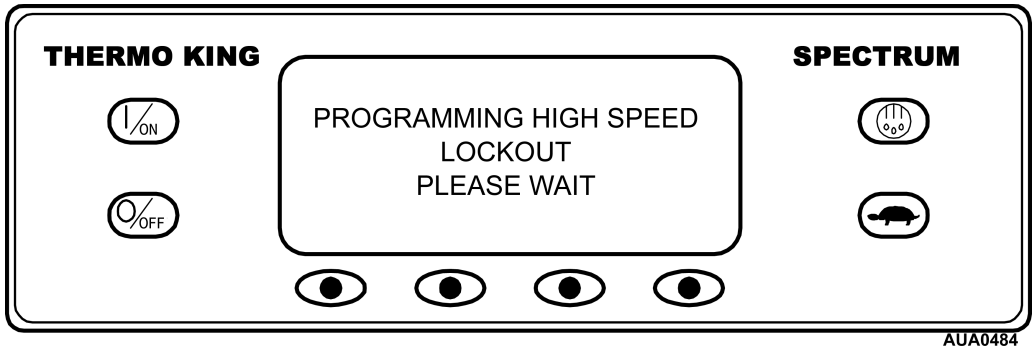
NOTE: High Speed Lock Out Enable must be programmed [YES] or this feature will not be available.

The High Speed Lockout key is a toggle. If high speed is enabled, then pressing the key will disable high speed operation. Pressing the key again will enable high speed operation. To change the setting press the High Speed Lockout key as shown below.



AUA0483

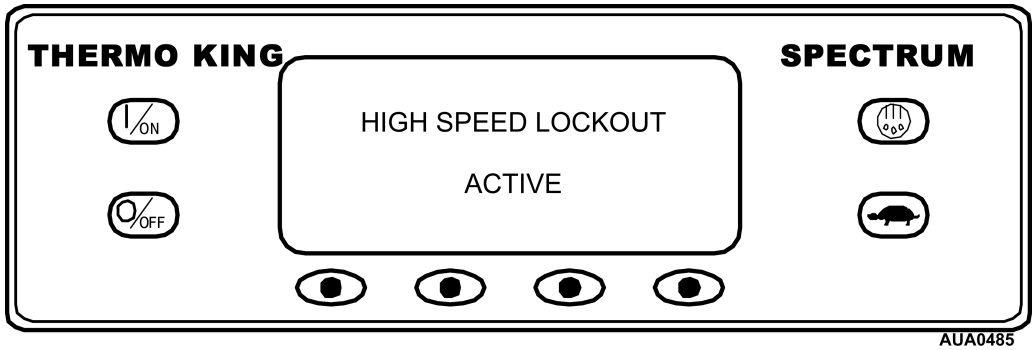
The display will briefly show [PROGRAMMING HIGH SPEED LOCKOUT – PLEASE WAIT].



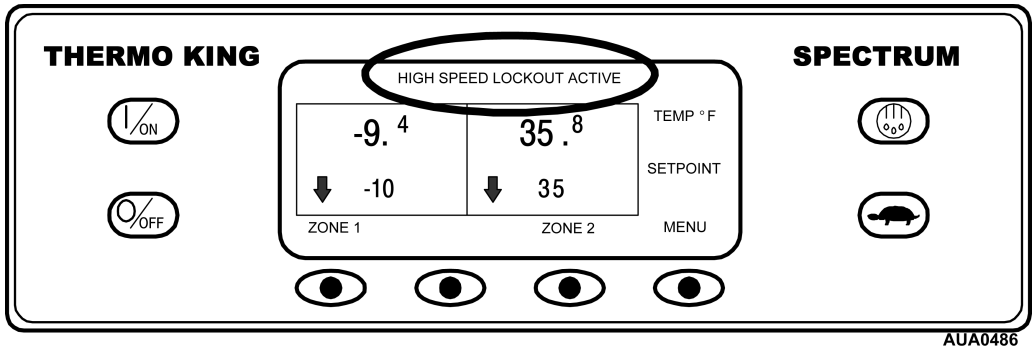
AUA0484

Selecting High Speed Lockout - (continued)

The change is confirmed by briefly displaying [HIGH SPEED LOCKOUT ACTIVE] or [HIGH SPEED LOCKOUT INACTIVE].

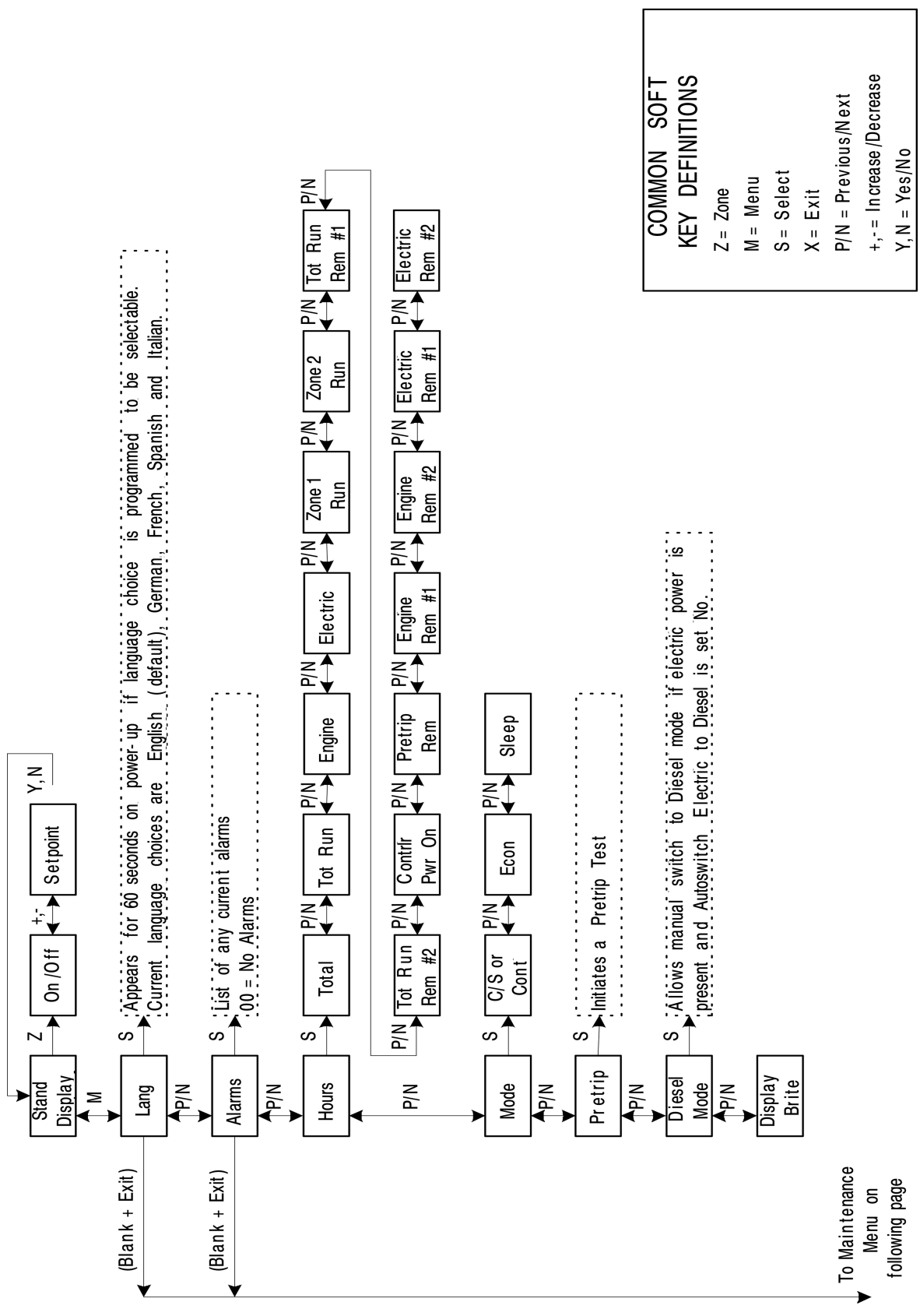


The display will then return to the Standard Display. If High Speed Lockout is turned on, the message HIGH SPEED LOCKOUT ACTIVE will replace the CYCLE-SENTRY/CONTINUOUS indication at the top of the display.



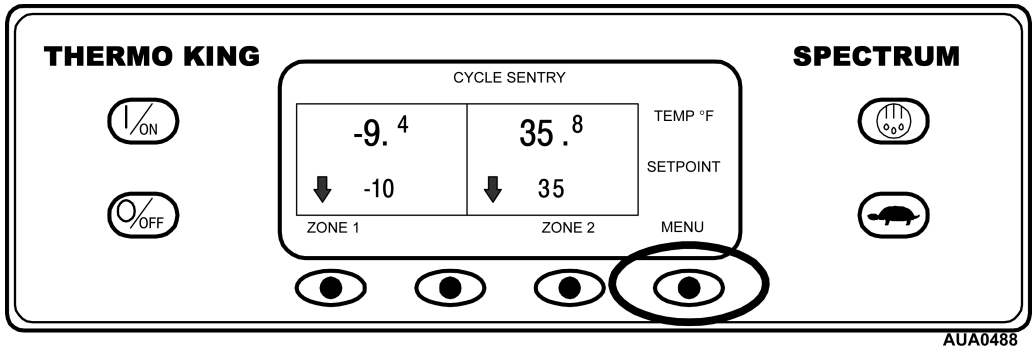
Pressing the High Speed Lockout key again will turn the feature off.

Operator Menu Overview

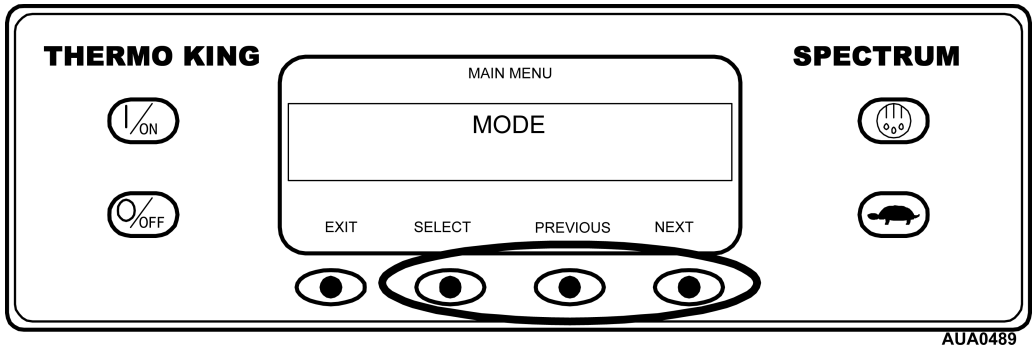


Using the Operator Menu

The Operator Menu contains several additional menus that allow the operator to view information and modify unit operation. To access the Operator Menu press the MENU key.



The first menu choice will appear. Press the NEXT and PREVIOUS keys to scroll through the menu choices. When the desired choice is shown on the display, press the SELECT key to access it. The MODE Menu is shown here.



The Operator Menu choices are shown on the next page. For detailed information see the individual explanations of each menu item on the following pages.

To return to the Standard Display press the EXIT key.

Operator Menu Choices

Language Menu: If enabled, allows the operator to select a language from a list of 5 languages. All other subsequent displays are shown in the selected language. English is the default language.

Alarm Menu: Shows any active alarms, and allows alarms to be cleared.

Hourmeter Menu: Allows the operator to view the unit hourmeters that have the view feature turned on. If the view feature for an hourmeter is not turned on, that hourmeter can not be viewed.

Total Unit Hours	Total Run Hours	Total Engine Hours	Total Electric Hours
Total Zone 1 Run Hours	Total Zone 2 Run Hours	Total Zone 3 Run Hours	Maint. Total Hours 1
Maint. Total Hours 2	Controller On Hours	Maint. Pretrip Hours	Maint. Engine Hours 1
Maint. Engine Hours 2	Maint. Electric Hours 1	Maint. Electric Hours 2	

Mode Menu: Allows the operator to change the unit operating modes.

CYCLE-SENTRY Mode.

Continuous Mode.

Economy Mode.

Sleep Mode.

Pretrip Menu: Allows the operator to start a Pretrip.

Diesel/Electric Menu: If enabled, allows the operator to select diesel or electric mode operation.

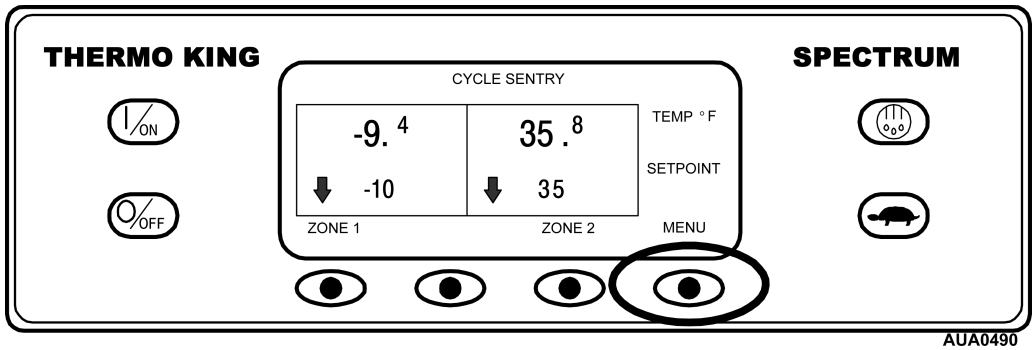
Display Intensity: Allows the operator to adjust the display intensity as required by conditions.

Selecting a Language

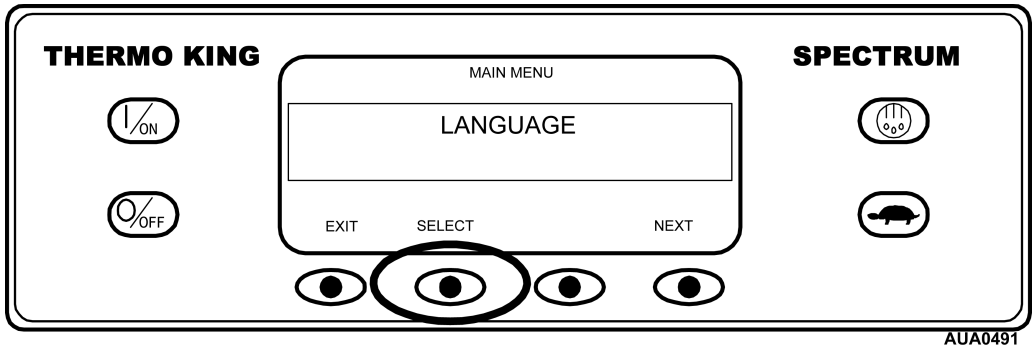
If the Language feature is enabled an alternate language can be selected from the Operator Menu. After a new language is chosen all displays will appear in that language. If the language feature is not enabled this menu does not appear.

Languages currently supported are English, German, Spanish, French and Italian. The default language is English. Only languages that have been enabled in the Guarded Access Menu will appear on this menu.

To select an alternate language, press the MENU key.

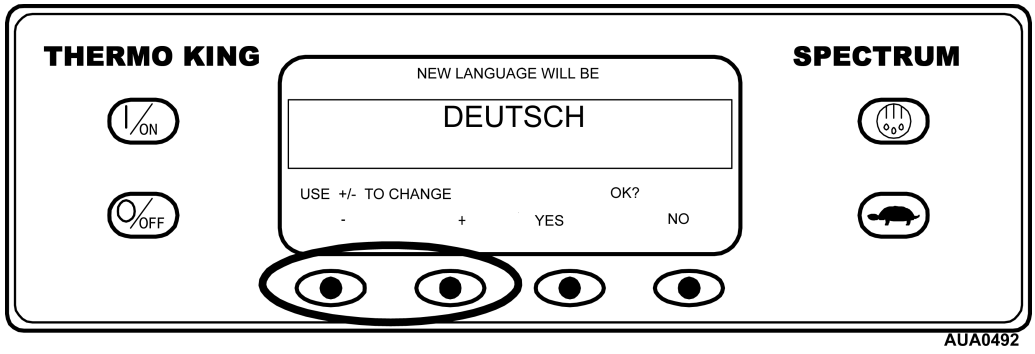


The Language Menu is the first menu item to appear as shown below. Press the SELECT key to chose the Language menu.



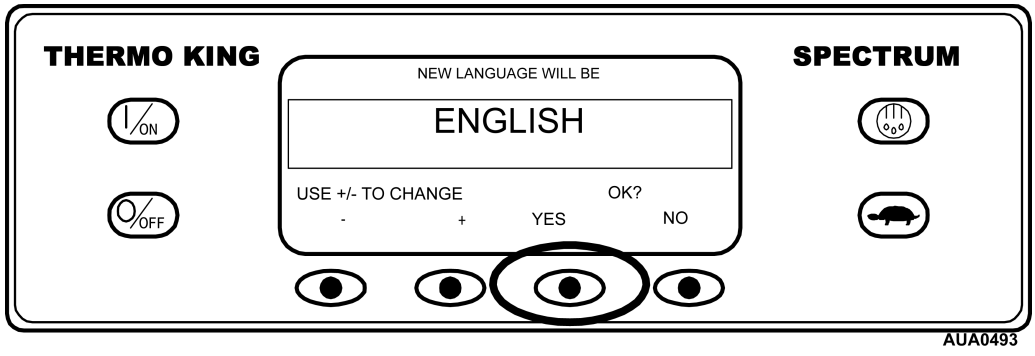
Selecting a Language - (continued)

The Language menu will appear as shown below. Press the + or – keys to select the desired language.



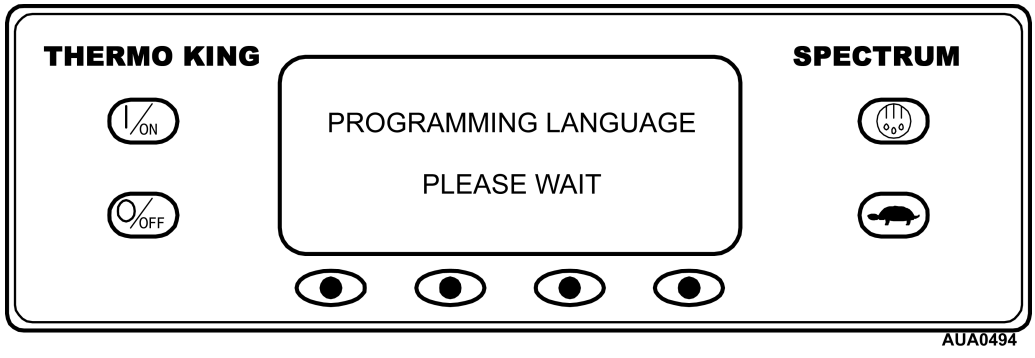
AUA0492

When the desired language is shown press the YES key to confirm the choice.



AUA0493

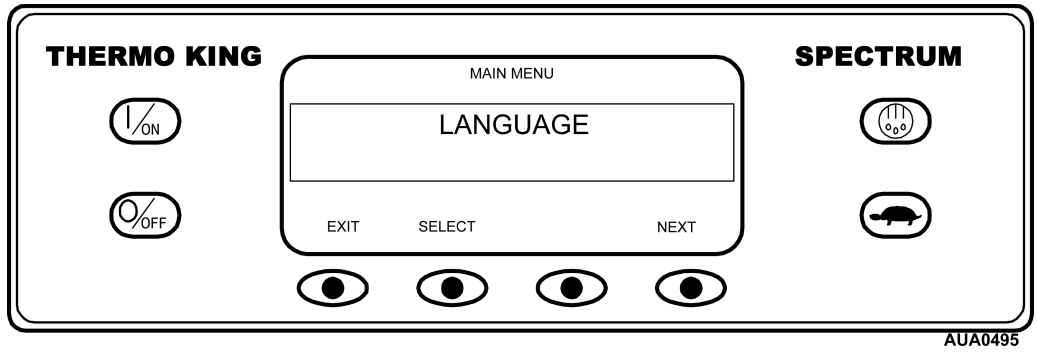
The display will briefly show PROGRAMMING LANGUAGE – PLEASE WAIT



AUA0494

Selecting a Language - (continued)

The display will then return to the Language menu.



To select a different Operator Menu item press the NEXT key. To return to the Standard Display press the EXIT key.

Alarm Codes

Alarms may be one of four types as shown below. If an alarm applies only to a specific zone, that zone will be displayed with the alarm code.

Log Alarms

Log Alarms are indicated at the top of the Standard Display for 30 seconds each time the unit is turned on. The alarm indication will go off after 30 seconds. The Alarm Display must be used to view the existing alarms. This level of alarm serves as a notice to take corrective action before a problem becomes severe. Maintenance items such as maintenance hourmeter time-outs are log alarms.

Check Alarms

Check Alarms are indicated at the top of the Standard Display with the statement [SERVICE REQUIRED WITHIN 24 HOURS]. The Alarm Display must be used to view the existing alarms. This level of alarm serves as a notice to take corrective action before a problem becomes severe. The unit will run with check alarms but some features and functions may be inhibited. If an alarm applies only to a specific zone, that zone will be displayed with the alarm code. On a multi-temp application if a zone specific problem is severe the zone will shut down but the alarm is set as a check alarm to allow the other zones to continue to run. If severe problems occur in all zones the unit will shut down.

Prevent Alarms

Prevent Alarms are indicated at the top of the Standard Display with the statement [UNIT IN PREVENT MODE]. The Alarm Display must be used to view the existing alarms. The unit may wait a timed restart interval or until conditions allow and then restart. If the unit is in a restart interval Alarm Code 84 Restart Null will be present along with the Prevent Alarm. In other cases the unit may restart or run with reduced performance to determine if continued operation is possible. If the alarm does not reoccur with reduced performance the unit will then return to full performance. If the unit is operating with reduced performance Alarm Code 85 Forced Unit Operation will also be present. If the alarm condition re-occurs a set number of times the alarm is set as a shutdown alarm and no further restarts are possible. If an alarm applies only to a specific zone, that zone will be displayed with the alarm code.

Shutdown Alarms

Shutdown Alarms replace the Standard Display with a flashing Alarm Display and the statement [UNIT NOT RUNNING – SERVICE REQUIRED]. The flashing display shows the alarm that caused the shutdown. Shutdown alarms will force the unit into shutdown. The unit will remain in shutdown until the shutdown alarm is cleared. Exceptions are some engine and electric shutdown alarms that become log alarms when switched to the alternate operating mode (diesel to electric or electric to diesel).

Alarm Codes – (continued)

Special Considerations

Pretrip Alarm Codes

If an alarm occurs during a Pretrip Test the alarm code will be displayed as Pretrip Alarm XX, where XX is the alarm code.

Alarm Codes and Switching Modes from Diesel to Electric or Electric to Diesel

If a shutdown alarm occurs that affects only diesel mode operation and the unit is switched to electric, the diesel mode shutdown alarm becomes an electric mode log alarm. This allows the unit to run in electric mode without clearing the shutdown alarm that is preventing diesel mode operation. If the unit is switched back to diesel mode, the alarm again becomes a diesel mode shutdown alarm and prevents unit operation.

In the same manner, if a shutdown alarm occurs that affects only electric mode operation and the unit is switched to diesel, the electric mode shutdown alarm becomes a diesel mode log alarm to allow diesel mode operation. If the unit is switched back to electric mode, the alarm reverts to an electric mode shutdown alarm and prevents unit operation.

SPECTRUM Alarm Codes

Code	Description	Operator Help
00	No Alarms	
2	Evaporator Coil Sensor	Manually monitor load temperature. Report alarm at end of the day.
3	Return Air Sensor	Manually monitor load temperature. Report alarm at end of the day.
4	Discharge Air Sensor	Manually monitor load temperature. Report alarm at end of the day.
5	Ambient Air Sensor	Report alarm at end of the day.
6	Engine Coolant Sensor	Report alarm at end of the day.
7	Engine RPM Sensor	Report alarm at end of the day.
9	High Evaporator Temperature	Manually monitor load temperature. Report alarm at end of the day.
10	High Discharge Pressure	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
11	Alternate Control Sensor	Manually monitor load temperature. Report alarm at end of the day.
12	Sensor Shutdown	The indicated zone is not longer able to operate and has been shut down. Repair immediately.
13	Sensor Check	Manually monitor load temperature. Report alarm at end of the day.
15	Check Glow Plugs/Intake Heater	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
17	Engine Failed to Crank	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.

Code	Description	Operator Help
18	High Engine Coolant Temperature	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
19	Low Engine Oil Pressure	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
20	Engine Failed to Start	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
21	Cooling Cycle Check	Manually monitor load temperature. Report alarm at end of the day.
22	Heating Cycle Check	Manually monitor load temperature. Report alarm at end of the day.
23	Cooling Cycle Fault	The indicated zone is no longer able to operate and has been shut down. Repair immediately.
24	Heating Cycle Fault	The indicated zone is no longer able to operate and has been shut down. Repair immediately.
25	Alternator Check	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
26	Refrigeration Capacity Check	Manually monitor load temperature. Report alarm at end of the day.
28	Pretrip Abort	Report alarm at end of the day.
29	Defrost Damper Circuit (Not Currently Used)	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
31	Oil Pressure Switch	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
32	Refrigeration Capacity Shutdown	The indicated zone is no longer able to operate and has been shut down. Repair immediately.
33	Check Engine RPM	Report alarm at end of the day.

Code	Description	Operator Help
35	Run Relay Circuit	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
36	Electric Motor Failed to Run	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
37	Engine Coolant Level	Report alarm at end of the day.
38	Electric Phase Reversed	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
40	High Speed Circuit	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
42	Unit Forced to Low Speed	Report alarm at end of the day.
44	Check Fuel System (Not Currently Used)	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
45	Hot Gas Bypass Circuit	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
48	Check Belts/Clutch	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
50	Reset Clock	Report alarm at end of the day.
52	Check Hot Gas Circuit	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
54	Test Mode Timeout	Service Test or Interface Board Test timed out after 15 minutes. Report alarm at end of the day.
61	Low Battery Voltage	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
62	Ammeter Out of Calibration	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.

Code	Description	Operator Help
63	Engine Stopped	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
64	Pretrip Reminder	Report alarm at end of the day.
66	Low Engine Oil Level	Check engine oil level. If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
67	Liquid Line Solenoid Circuit	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
68	Controller Fault	Report alarm at end of the day.
70	Hourmeter Failure	Report alarm at end of the day.
74	Controller Reset to Defaults	Report alarm at end of the day.
79	Data Log Overflow	Report alarm at end of the day.
80	Compressor Temperature Sensor	Report alarm at end of the day.
82	High Compressor Temperature	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
84	Restart Null	Report alarm at end of the day.
85	Forced Unit Operation	Report alarm at end of the day.
86	Discharge Pressure Sensor	Report alarm at end of the day.
87	Suction Pressure Sensor	Report alarm at end of the day.

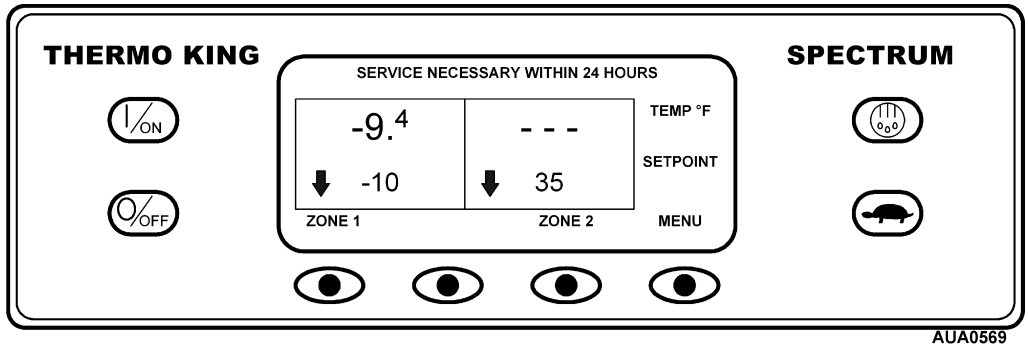
Code	Description	Operator Help
89	ETV Circuit (Not Currently Used)	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
90	Electric Overload	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
91	Electric Ready Input	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
92	Sensor Grades Not Set	Report alarm at end of the day.
93	Low Compressor Suction	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
94	Unloader #1 (Not Currently Used)	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
95	Unloader #2 (Not Currently Used)	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
99	High Pressure Ratio (Not Currently Used)	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
104	Check Remote Fan Speed (Not Currently Used)	Report alarm at end of the day.
105	Rcvr Tank Pressure Solenoid Circuit	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
106	Purge Valve Circuit	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
107	Condenser Inlet Solenoid	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
108	Door Open Timeout	Close Doors. Report alarm at end of the day.
110	Suction Line Solenoid Circuit	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.

Code	Description	Operator Help
111	Unit Configuration	Report alarm at end of the day.
112	Check Remote Fans	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
114	Many Alarms – Can Not Run	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
115	High Pressure Cutout Switch	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
116	High Pressure Cut In Switch (Not Currently Used)	Report alarm at end of the day.
117	Autoswitch to Electric	Report alarm at end of the day.
118	Autoswitch to Diesel	Report alarm at end of the day.
120	Alternator Exciter Circuit	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
121	Liquid Injection Circuit	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
122	Diesel/Electric Relay Circuit	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
127	Setpoint Not Entered	Be sure the setpoint is set to the required temperature.
128	Engine Reminder #1	Report alarm at end of the day.
129	Engine Reminder #2	Report alarm at end of the day.
130	Electric Reminder #1	Report alarm at end of the day.

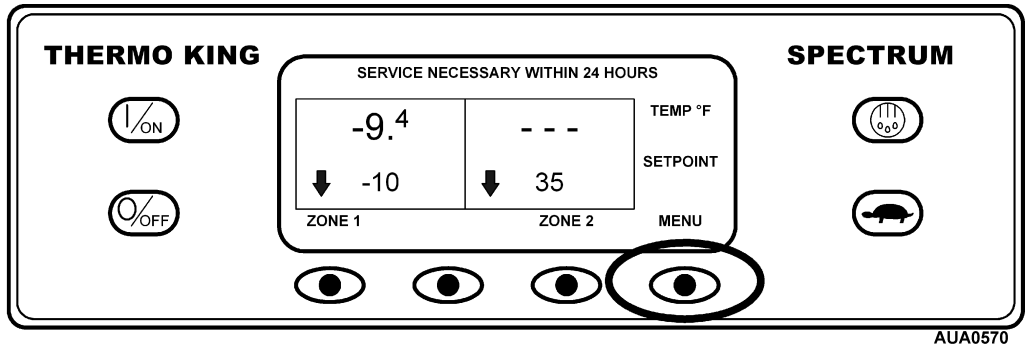
Code	Description	Operator Help
131	Electric Reminder #2	Report alarm at end of the day.
132	Unit Run Reminder #1	Report alarm at end of the day.
133	Unit Run Reminder #2	Report alarm at end of the day.
134	Power On Hours	Report alarm at end of the day.

Viewing and Clearing Alarm Codes

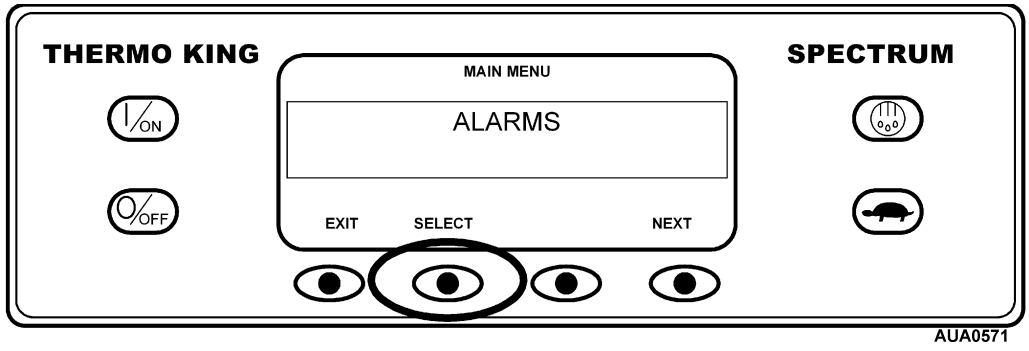
If an alarm condition occurs an alarm message will appear in place of the mode indication in the display as shown below.



Alarms are displayed and cleared using the Alarm Menu. From the Standard Display, press the MENU key.

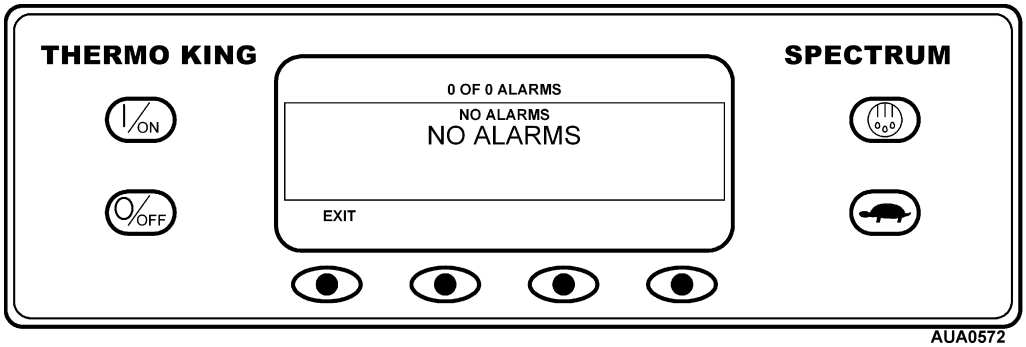


The Language Menu or Alarm Menu will appear. If the Language Menu appears press the NEXT key to show the Alarm Menu. When the Alarm Menu is shown press the SELECT key.

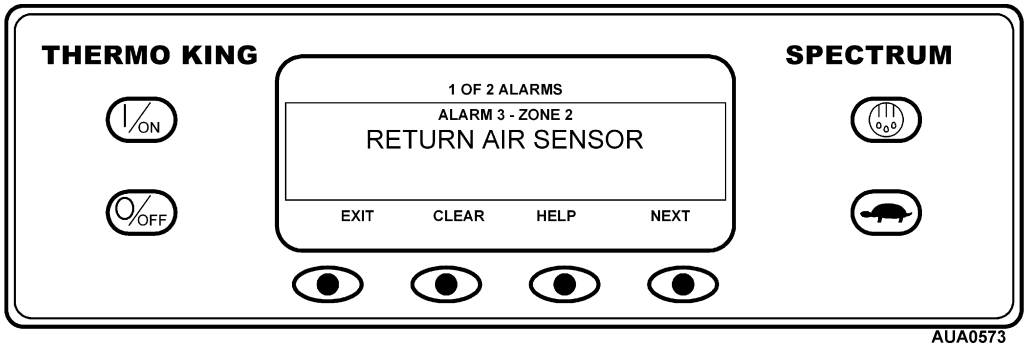


Viewing and Clearing Alarm Codes – (continued)

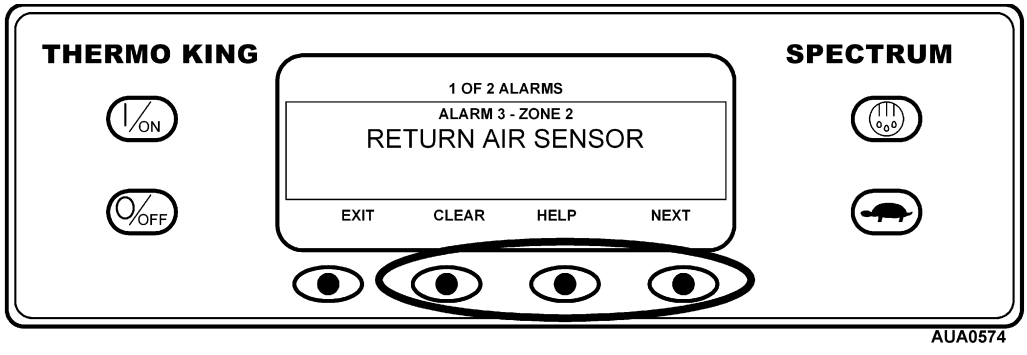
The Alarm Display will appear. If no alarms are present NO ALARMS will be shown.



If alarms are present, the quantity of alarms (if more than one) and the most recent alarm code number will be shown. If the alarm pertains to a specific zone, that zone will be identified. In the example below, there are two alarms present. The most recent is Alarm Code 3 in Zone 2. It indicates a problem with the return air sensor.

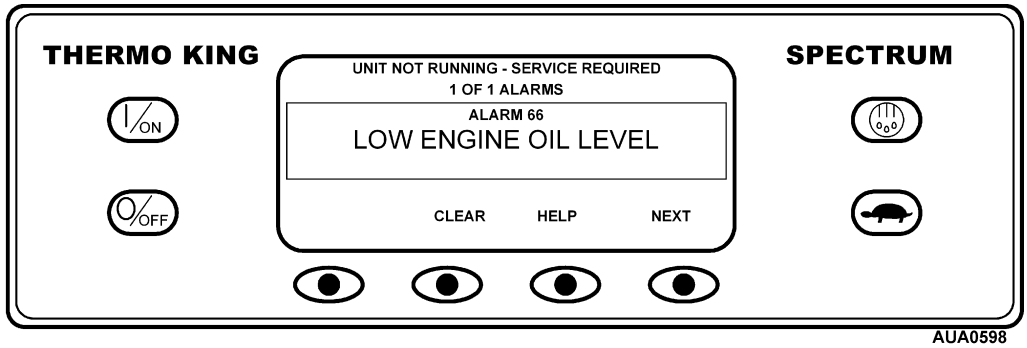


After the alarm situation is resolved press the CLEAR key to clear the alarm. For additional information regarding the alarm shown on the display press the HELP key. To display the next alarm, press the NEXT key.



Viewing and Clearing Alarm Codes – (continued)

If a serious condition occurs, the unit will be shut down to prevent damage to the unit or the load. If this occurs, the display will show that the unit is shut down and display the alarm code that caused the shutdown. In the example below, the unit is shut down due to low oil level. For additional information regarding the alarm shown on the display press the HELP key.

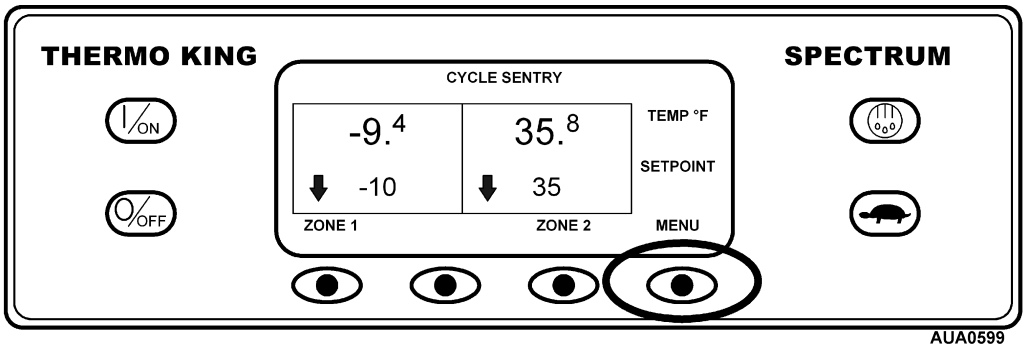


A help message will appear. For the alarm shown above, the message “CHECK OIL LEVEL. IF UNIT IS SHUT DOWN, REPAIR IMMEDIATELY. OTHERWISE, REPORT ALARM AT END OF THE DAY” will be shown on the display. Check the oil level and add oil as required, clear the alarm and restart the engine.

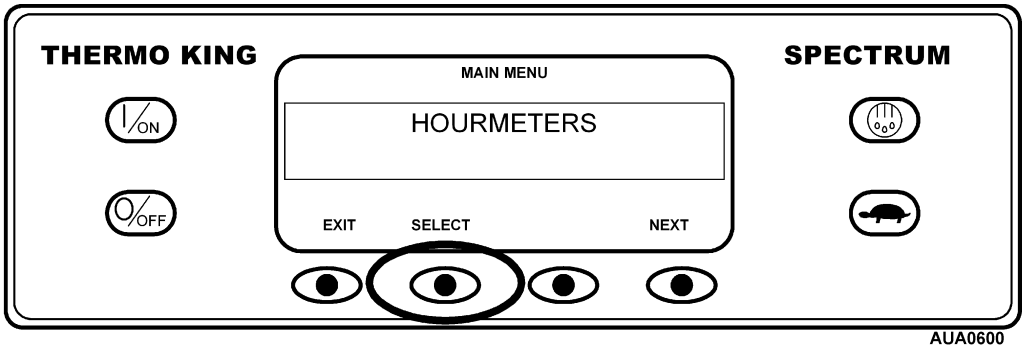
To select a different Operator Menu item press the NEXT key. To return to the Standard Display press the EXIT key.

Viewing Hourmeters

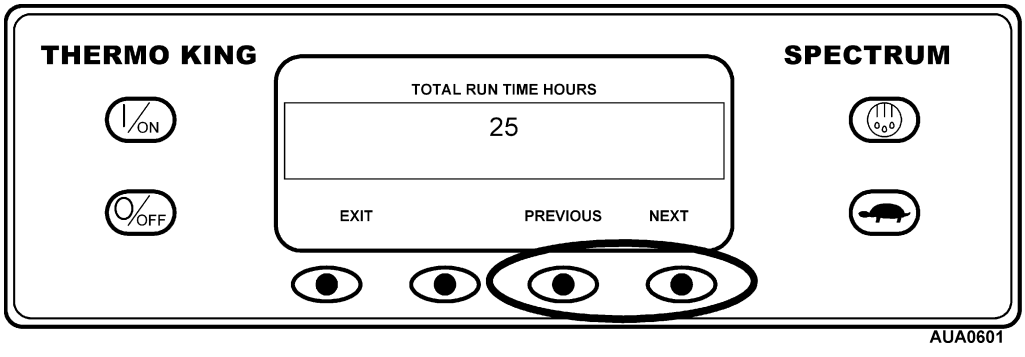
Hourmeters are displayed using the Hourmeter Display. From the Standard Display, press the MENU key.



The Language Menu or Alarm Menu will appear. Press the NEXT key as required to show the Hourmeter Menu. When the Hourmeter Menu is shown press the SELECT key. The Hourmeter Display will appear.



Press the NEXT or PREVIOUS key to scroll through the hourmeters.



Viewing Hourmeters – (continued)

Hourmeter names and definitions are shown below in the order they appear. Only hourmeters enabled in the Guarded Access Menu will be shown. To return to the Standard Display, press the EXIT key.

HOURMETER NAMES AND DEFINITIONS

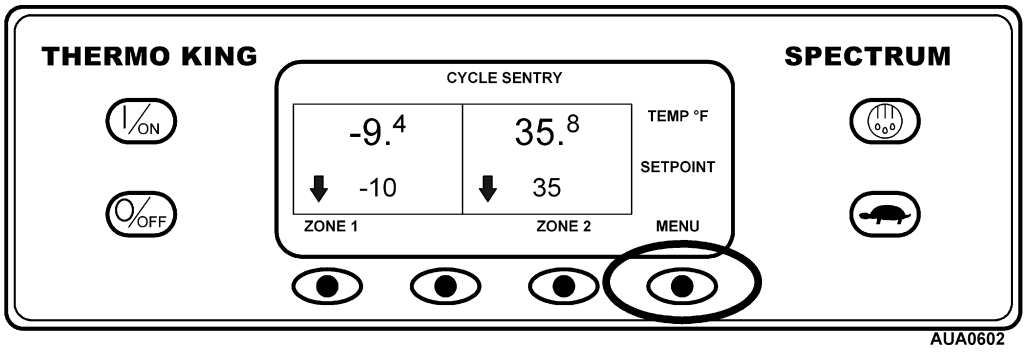
Hourmeter Name	Definition
Total Hours	Total number of hours the unit has been turned on (protection hours).
Total Run Hours	Total number of hours the unit has run in both diesel and electric mode.
Engine Hours	Total number of hours the unit has run in diesel mode.
Electric Hours	Total number of hours the unit has run in electric mode.
Zone 1 Run Hours	Total number of hours that Zone 1 has run in both diesel and electric mode. Includes running null time.
Zone 2 Run Hours	Total number of hours that Zone 2 has run in both diesel and electric mode. Includes running null time.
Total Maintenance Hours 1	User Programmable – The number of hours before a Total Hours Maintenance Reminder 1 occurs.
Total Maintenance Hours 2	User Programmable – The number of hours before a Total Hours Maintenance Reminder 2 occurs.
Total Controller Hours	Total hours the controller and HMI control panel have been turned on.
Pretrip Reminder Hours	User Programmable – number of hours before a Pretrip Reminder occurs.
Engine Maintenance Hours 1	User Programmable – The number of hours before an Engine Hours Maintenance Reminder 1 occurs.
Engine Maintenance Hours 2	User Programmable – The number of hours before an Engine Hours Maintenance Reminder 2 occurs.
Electric Maintenance Hours 1	User Programmable – The number of hours before an Electric Hours Maintenance Reminder 1 occurs.
Electric Maintenance Hours 2	User Programmable – The number of hours before an Electric Hours Maintenance Reminder 2 occurs.

IMPORTANT: If a programmable hourmeter is not enabled and/or the view for that hourmeter is not turned on it will not appear in the display sequence.

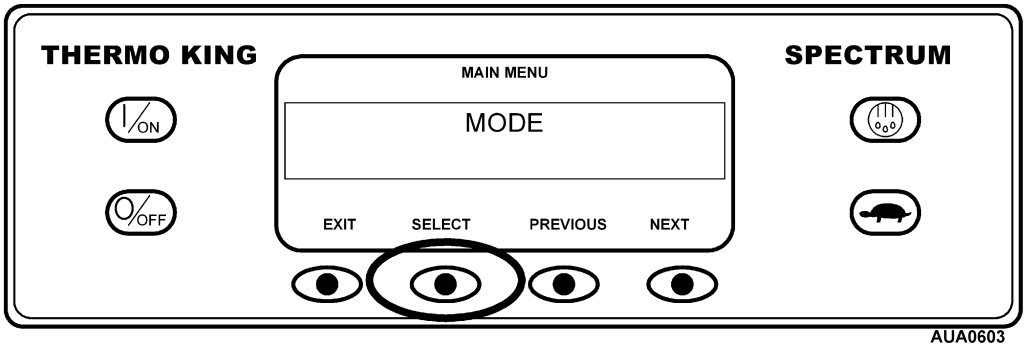
Selecting CYCLE-SENTRY or Continuous Mode

When CYCLE-SENTRY mode is selected the unit will start and stop automatically to maintain setpoint in all compartments, keep the engine warm and the battery charged. When Continuous Mode is selected, the unit will start automatically and run continuously to maintain setpoint and provide constant airflow.

CYCLE-SENTRY and Continuous Mode are selected using the Mode Menu. From the Standard Display, press the MENU key.

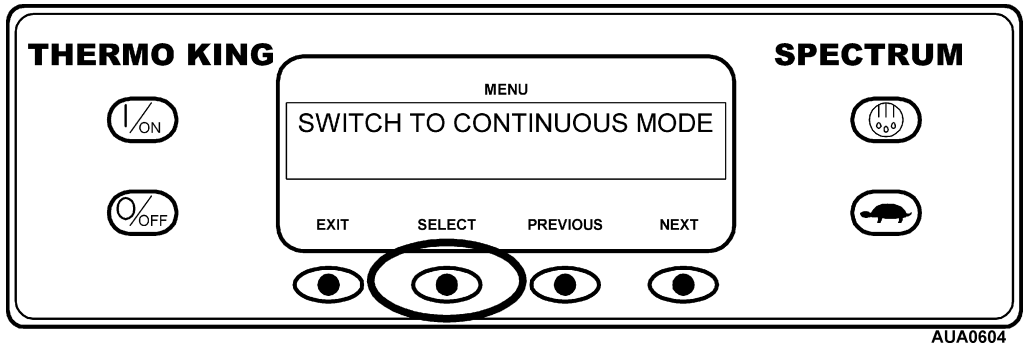


The Language Menu or Alarm Menu will appear. Press the NEXT key as required to show the Mode Menu. When the Mode Menu is shown press the SELECT key.

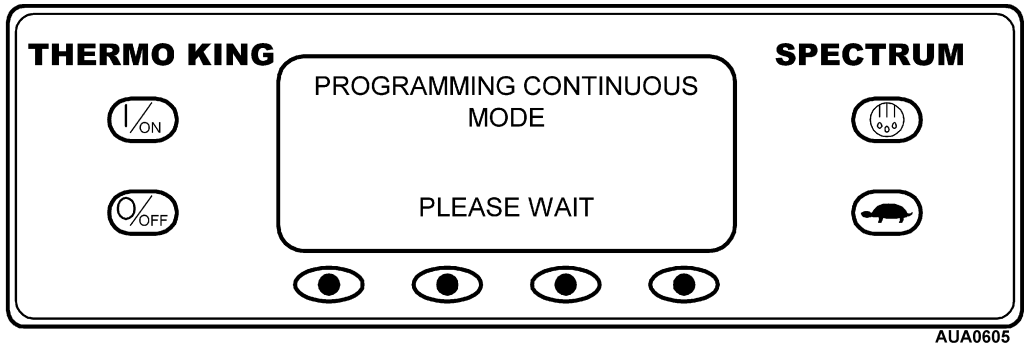


Selecting CYCLE-SENTRY or Continuous Mode - (continued)

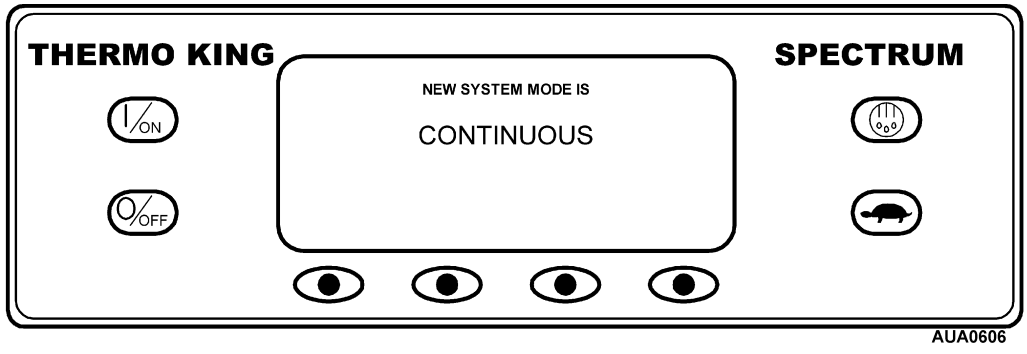
In the display shown below, the unit is operating in CYCLE-SENTRY mode and the option exists to switch to Continuous mode. Pressing the Select key will switch the mode from CYCLE-SENTRY to Continuous.



Pressing the Select key will change the mode from CYCLE-SENTRY to Continuous. The display will confirm the change as shown below.

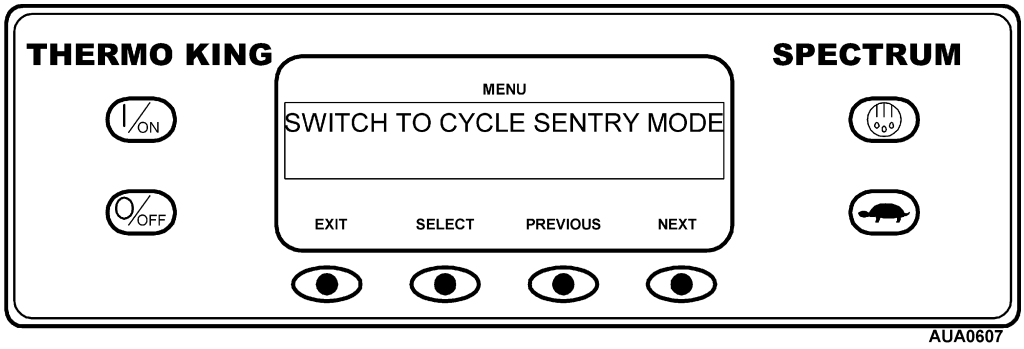


The new mode is then confirmed for 10 seconds.



Selecting CYCLE-SENTRY or Continuous Mode - (continued)

The display then returns to the Mode Menu. In the example here the unit is currently running in Continuous mode. Pressing the Select key again allows the operator to change back to CYCLE-SENTRY mode operation.

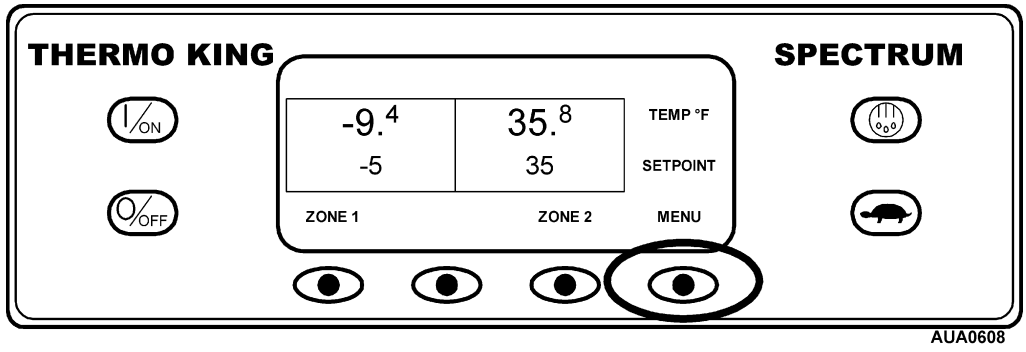


IMPORTANT: If the unit is in CYCLE-SENTRY null and the mode is switched to Continuous Mode, the unit will start automatically.

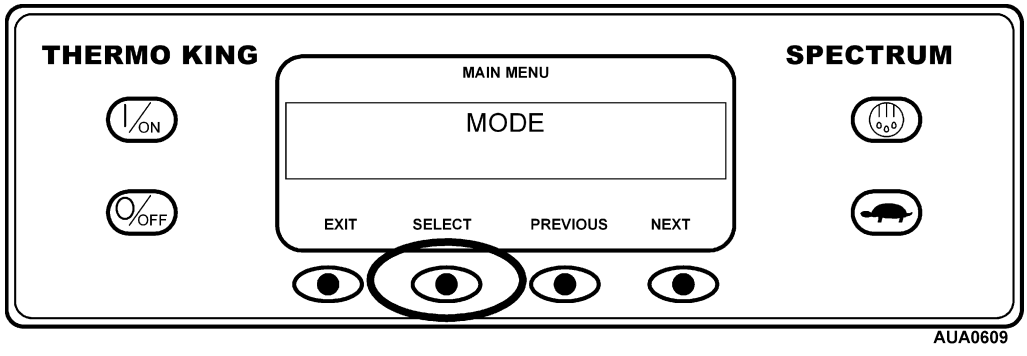
Selecting Economy Mode

Economy Mode is used on selected loads that do not require critical temperature control. The temperature control points are relaxed and other features are optimized for maximum fuel economy. This mode should be used as directed by individual company policy. Economy Mode can be turned on or off as required.

Economy Mode is turned On and Off using the Mode Menu. From the Standard Display, press the MENU key.

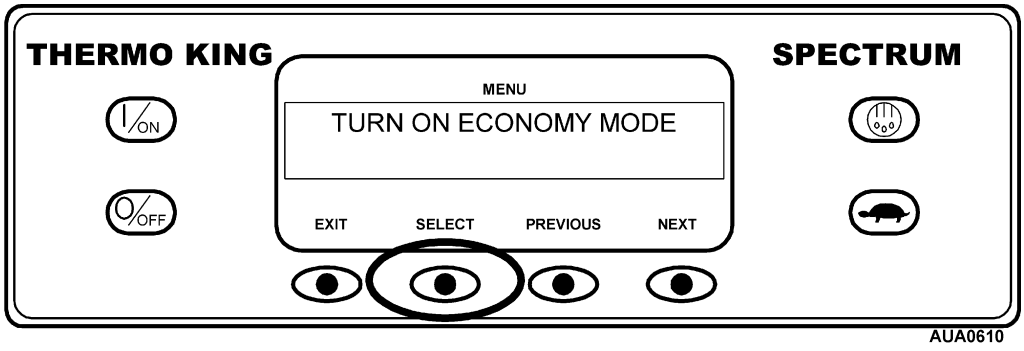


The Language Menu or Alarm Menu will appear. Press the NEXT key as required to show the Mode Menu. When the Mode Menu is shown press the SELECT key.

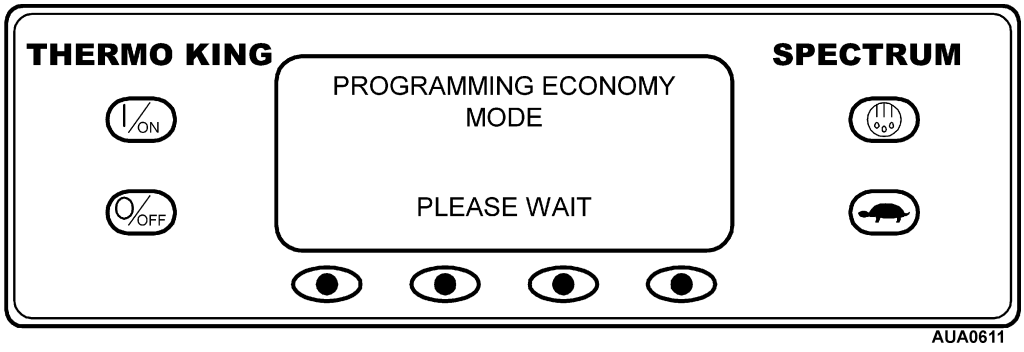


Selecting Economy Mode – (continued)

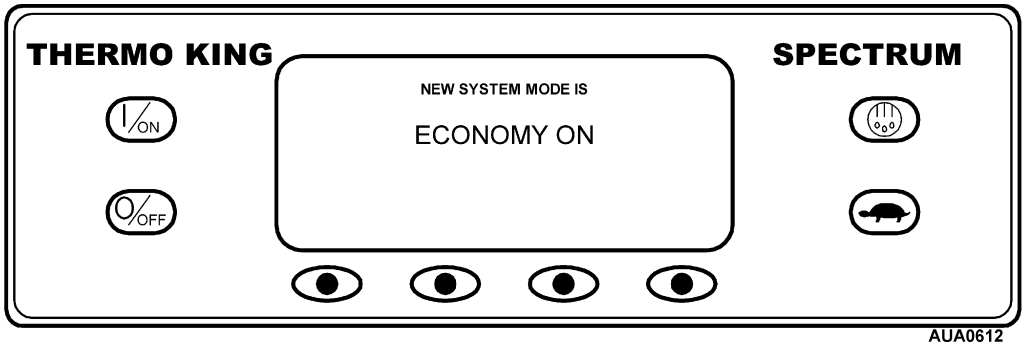
Press the Next key as required to display Economy Mode. In the display shown below, Economy Mode is turned off and the option exists to turn Economy mode on. Pressing the Select key will turn Economy Mode on.



Pressing the Select key will turn Economy Mode on. The display will confirm the change as shown below.

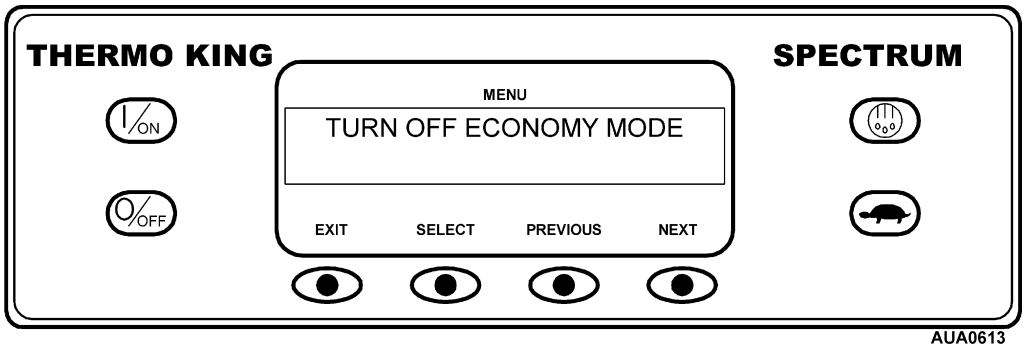


The new mode is then confirmed for 10 seconds.



Selecting Economy Mode - (continued)

The display then returns to the Mode Menu. In the example here Economy Mode is currently turned on. Pressing the Select key again allows the operator to turn Economy Mode off.

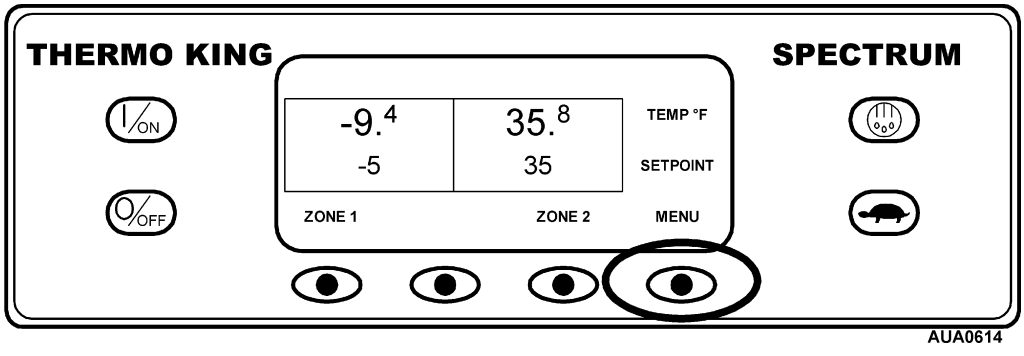


Selecting Sleep Mode

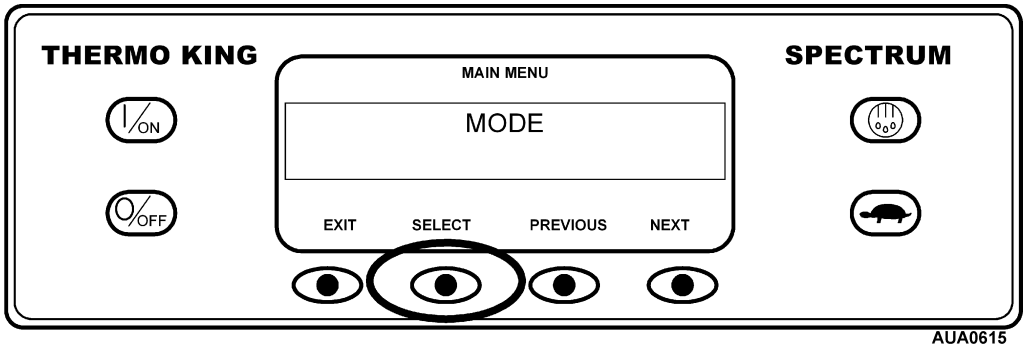
Normal CYCLE-SENTRY mode starts and stops the unit as required to maintain the desired temperature in all zones, maintain the unit battery in a charged condition and keep the unit engine warm in cold ambient conditions. Sleep mode does not maintain zone temperatures – it only keeps the engine warm and the unit battery charged. This is useful in extremely cold weather or when the unit is to be out of service for an extended time. Sleep mode operates in both Diesel mode and Electric mode. In Diesel mode the unit will start and stop as required to maintain engine temperature and battery charge. In Electric mode the unit starts and stops as necessary to maintain battery charge only.

When Sleep mode is entered, the operator can program an automatic Wake-up Time up to a week away. Using this feature, the unit will automatically restart and run normally at the determined time. If a Wake-up Time is programmed the operator can also program an automatic Pretrip Test when the unit restarts.

Sleep Mode is turned On and Off using the Mode Menu. From the Standard Display, press the MENU key.

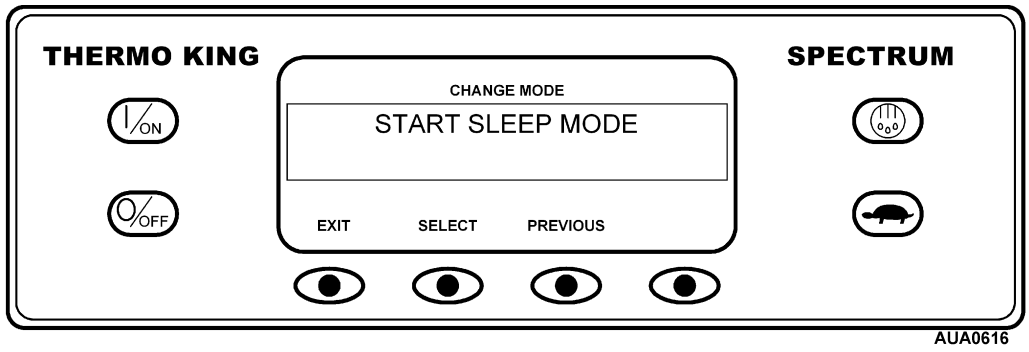


The Language Menu or Alarm Menu will appear. Press the NEXT key as required to show the Mode Menu. When the Mode Menu is shown press the SELECT key.

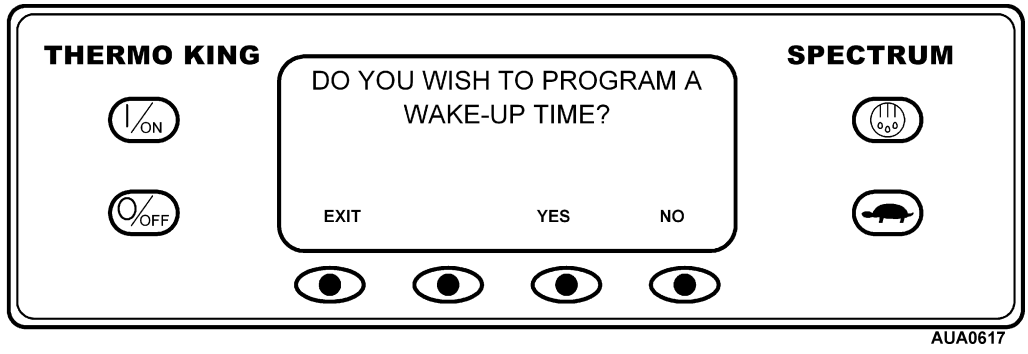


Selecting Sleep Mode – (continued)

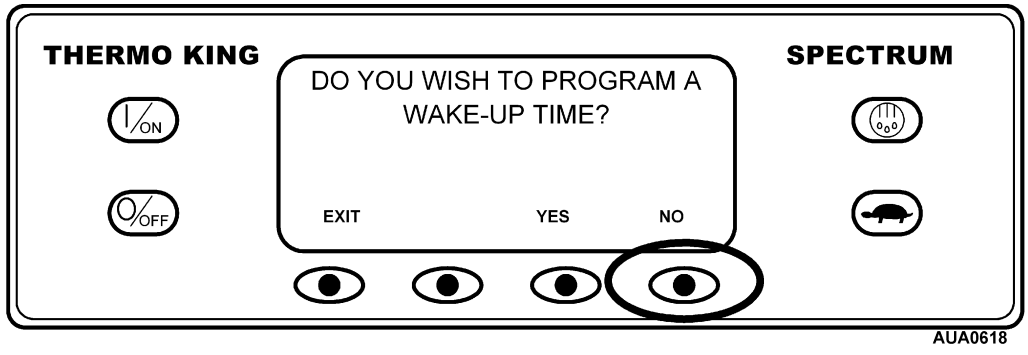
Press the Next key as required to display the Sleep Mode prompt.



Press the Select key to choose the Sleep Mode menu.

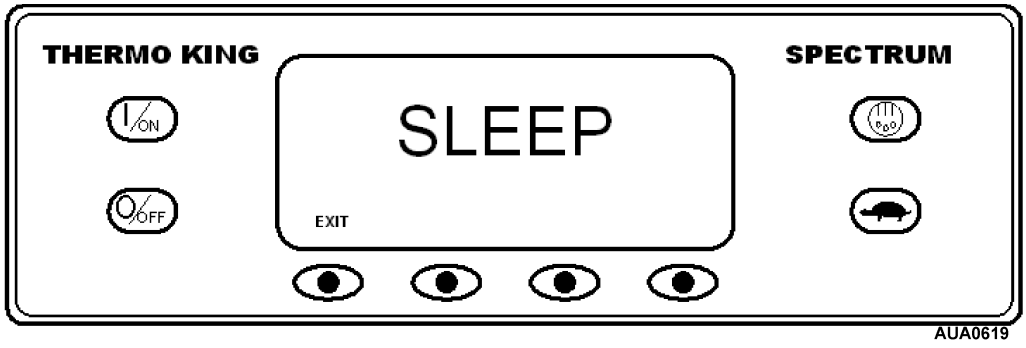


The operator can now choose a Sleep Mode Wake-up Time or simply enter Sleep Mode immediately. If NO is pressed the unit will immediately enter Sleep Mode.

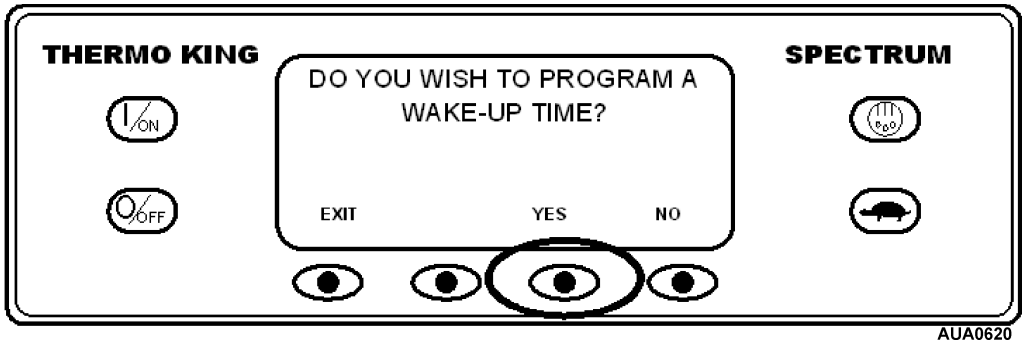


Selecting Sleep Mode – (continued)

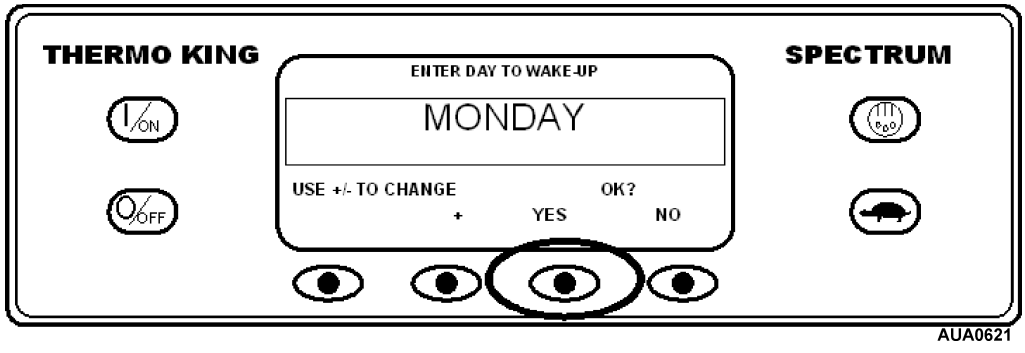
The display will show SLEEP and the unit will start and stop as required to keep the engine warm and/or the battery charged. Sleep mode does not maintain zone temperatures. To exit Sleep Mode press the EXIT key or turn the unit off and back on. The unit will resume normal operation and control to setpoint.



To enter a Wake-up Time verify the unit clock is set properly. Then press the YES key at the Sleep Mode menu.

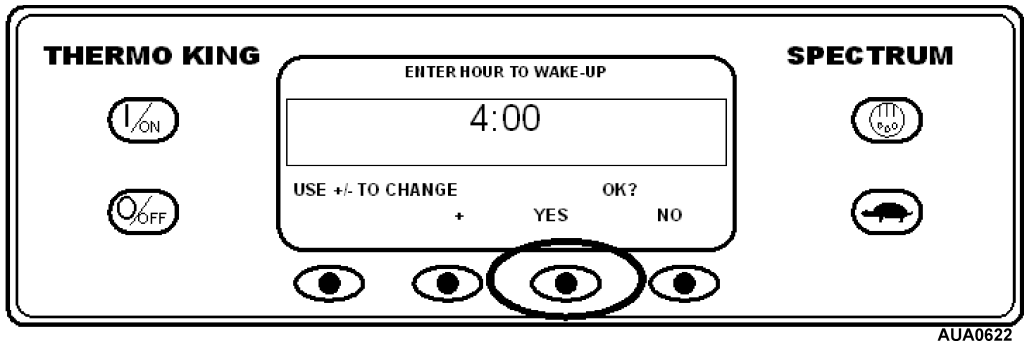


The display will prompt the operator for the DAY the unit is to restart in normal operation. In this example Monday has been chosen. Press the YES key to confirm the DAY.

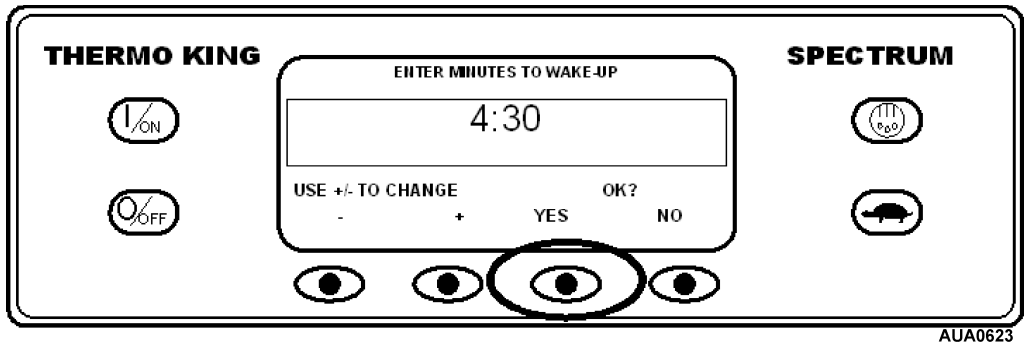


Selecting Sleep Mode – (continued)

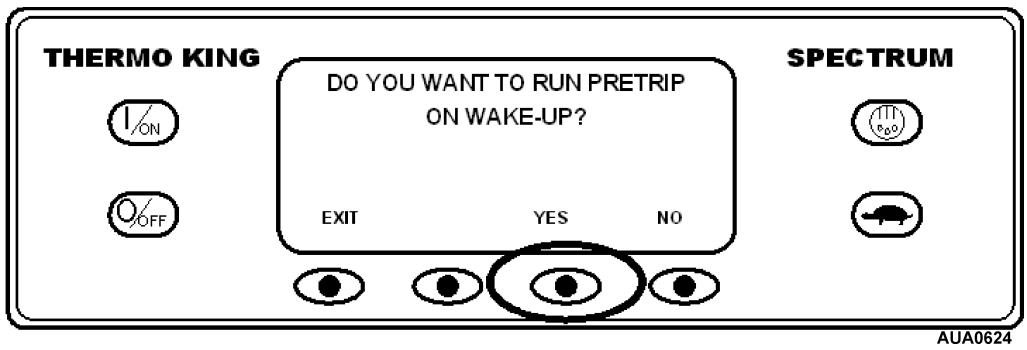
The display will now prompt the operator for the Hour the unit is to restart in normal operation. In this example **4**:00 am has been chosen. Press the YES key to confirm the HOUR. Note that 24 hour "military time" is used.



The display will now prompt the operator for the MINUTE the unit is to restart in normal operation. In this example 4:**30** am has been chosen. Press the YES key to confirm the MINUTE.

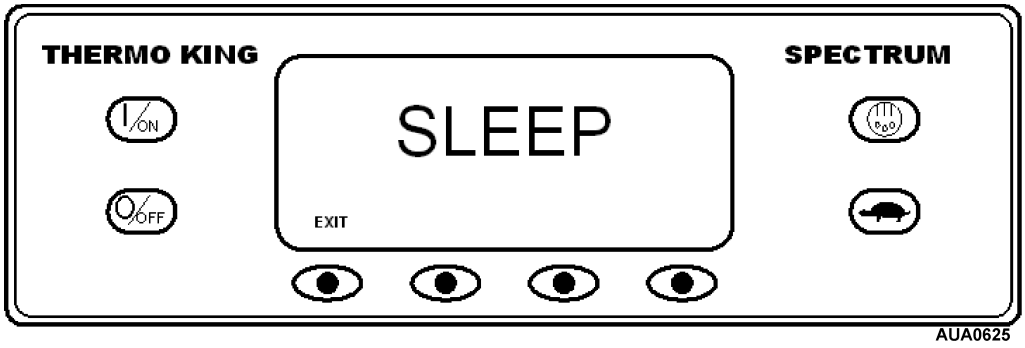


The display will now prompt for a Pretrip Test on Wake-up. Press the YES key to perform a Pretrip Test on Wake-up. If the No key is pressed the unit will resume normal operation on Wake-up.



Selecting Sleep Mode – (continued)

The display will show SLEEP and the unit will start and stop as required to keep the engine warm and/or the battery charged. Sleep mode does not maintain zone temperatures.



The unit will restart at the programmed time (in this example 4:30 am) and perform a Pretrip Test (if selected). After the Pretrip Test is complete the test results will be displayed and the unit will resume normal operation and control to setpoint.

To exit Sleep Mode before the selected Wake-up time press the EXIT key or turn the unit off and back on. The unit will resume normal operation and control to setpoint.

Pretrip Tests

A Pretrip Test verifies unit operation. This display allows a Pretrip Test to be selected and initiated by the operator. If the Pretrip Test is entered with the unit shut down a Full Pretrip Test with device amp checks will be performed. If the Pretrip Test is entered with the unit running in either diesel or electric mode a Partial Pretrip Test is performed. Test results are reported as PASS, CHECK or FAIL when the Pretrip Test is completed.

Pretrip Test Conditions

- All zones are forced on.
- Pretrip Test can be run in either Diesel or Electric Mode.
- The unit will autoswitch from Diesel Mode to Electric Mode or from Electric Mode to Diesel Mode during a Pretrip Test if these features are enabled.

Pretrip Tests are not allowed if:

- Any alarms are present.
- The unit is in Sleep Mode.
- Unit is in Service Test Mode, Interface Board Test Mode or Evacuation Mode.

Pretrip Test Sequence

Pretrip tests proceed in the order shown below. A Full Pretrip Test includes all tests. A Partial Pretrip Test is started with the engine or motor running and does not include the Amp Checks or Engine Start Check.

- Amp Checks – Each electrical control component is energized and the current drawn is confirmed as within specification.
- Engine Start – The Engine will start automatically.
- Zone 1 Defrost – If the Zone 1 coil temperature is below 45°F (7°C), a defrost is cycle is initiated.
- Zone 1 Cool Check – The ability of the unit to cool in low speed is checked.
- RPM Check – The engine RPM in high and low speed is checked during the Zone 1 Cool Check.
- Zone 1 Heat Check - The ability of the unit to heat in low speed is checked.
- Zone 2 Cool Check – The ability of the unit to cool in low speed is checked.
- Zone 2 Heat Check – The ability of the unit to heat in low speed is checked.
- Report Test Results – The test results are reported as PASS, CHECK or FAIL when the Pretrip Test is completed. If test results are CHECK or FAIL, alarm codes will exist to direct the technician to the source of the problem.

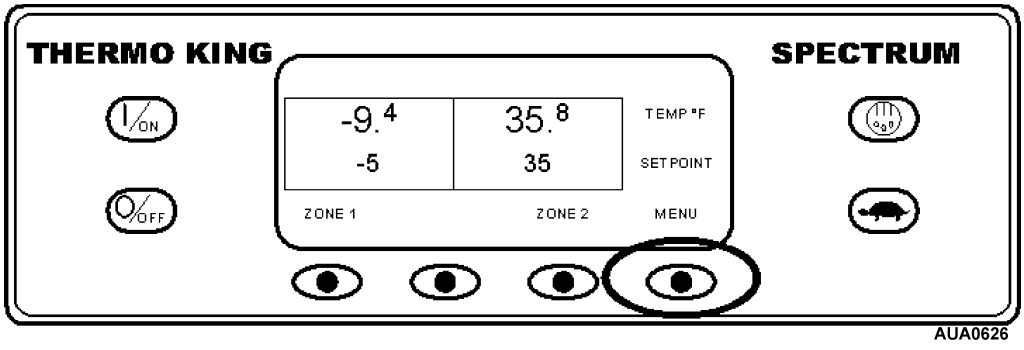
Performing a Pretrip Test

If a Pretrip Test is initiated with the engine shut down a Full Pretrip Test will be performed. If a Pretrip Test is initiated with the engine or motor running a Partial Pretrip Test is performed.

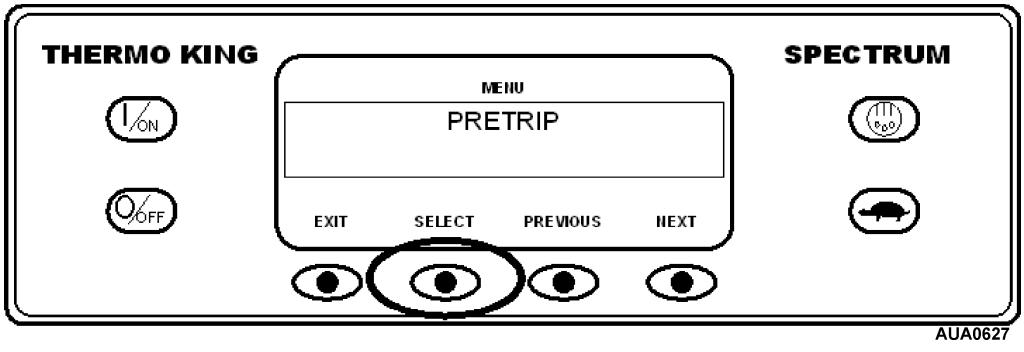
Before initiating a Pretrip Test, clear all alarm codes.

To stop a Pretrip Test at any time turn the unit off.

Pretrip Tests are initiated using the Pretrip Menu. From the Standard Display, press the MENU key.

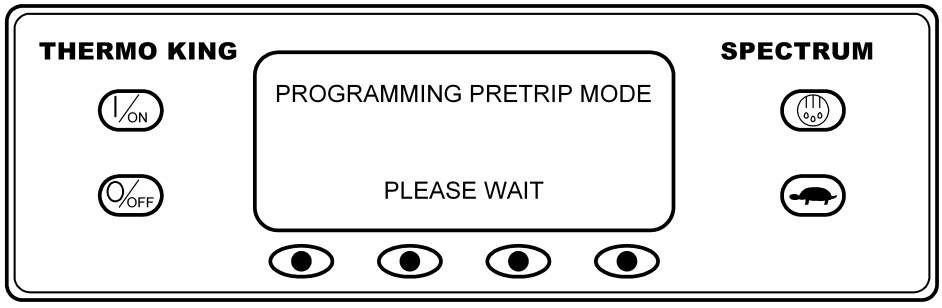


The Language Menu or Alarm Menu will appear. Press the NEXT key as required to show the Pretrip Menu. When the Pretrip Menu is shown press the SELECT key to start a Pretrip Test.

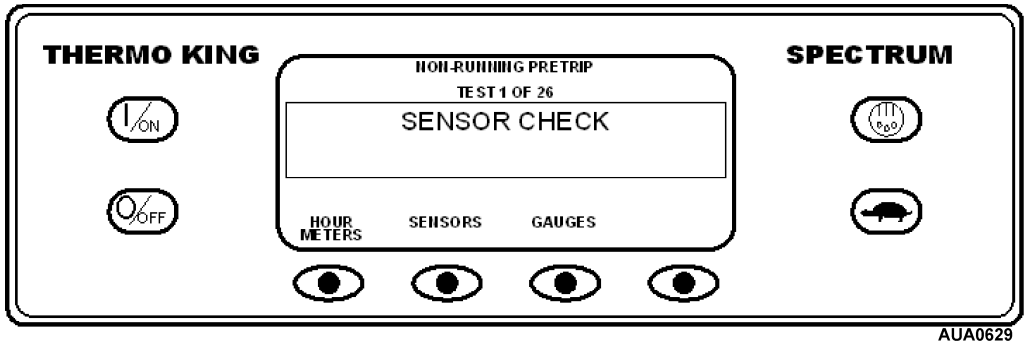


Performing a Pretrip Test – (continued)

If the unit is not running a Full Pretrip Test will be initiated. If the unit is running in either diesel or electric mode a Running Pretrip will be performed.



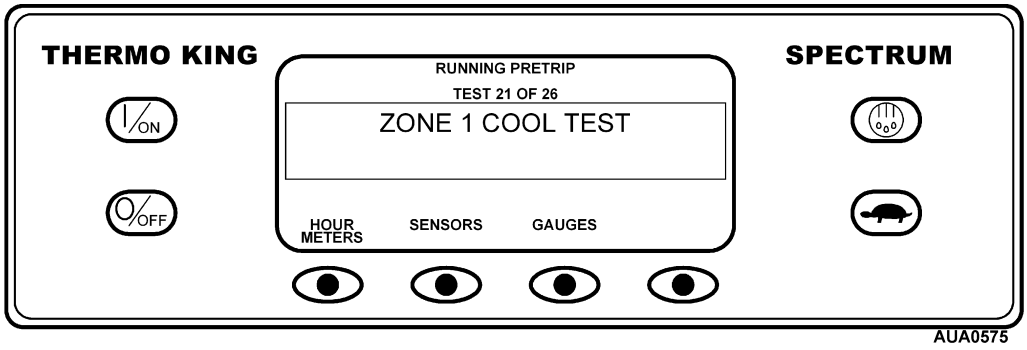
The Pretrip Test display appears. The top line of the display indicates the unit is performing the non-running Pretrip Test. Test progress is measured by the number of tests completed out of a total of 26. In the example below the unit is performing Test 1 of 26, Sensor Check. The soft keys may be used during the Pretrip Test to select the Hourmeter, Gauge or Sensor menus.



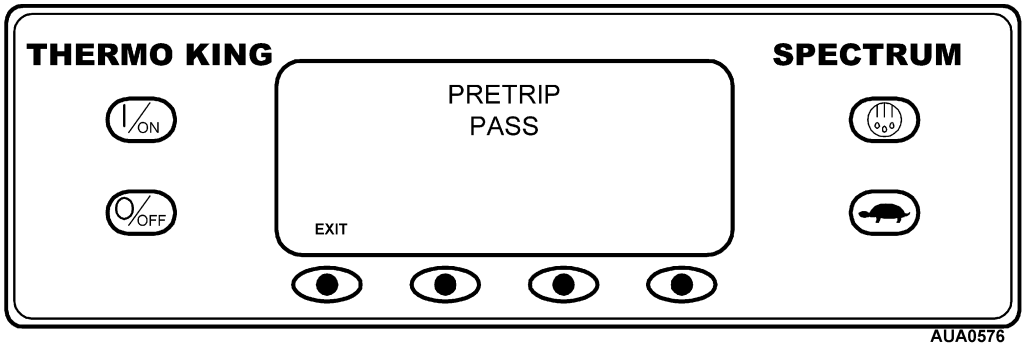
To stop a Pretrip Test at any time turn the unit off. This will generate Alarm Code 28 Pretrip Abort. Other alarm codes may also be generated. This is normal when the Pretrip Test is halted before completion.

Performing a Pretrip Test - (continued)

When the non-running tests are complete the unit will start automatically and continue with the Running Pretrip Test. In the example shown below the unit is in the Running Pretrip and is performing Test 21 of 26, Zone 1 Cool Test.



When all tests are complete, the results are reported as PASS, CHECK or FAIL. If the results are CHECK or FAIL, the accompanying alarm codes will direct the technician to the cause of the problem.



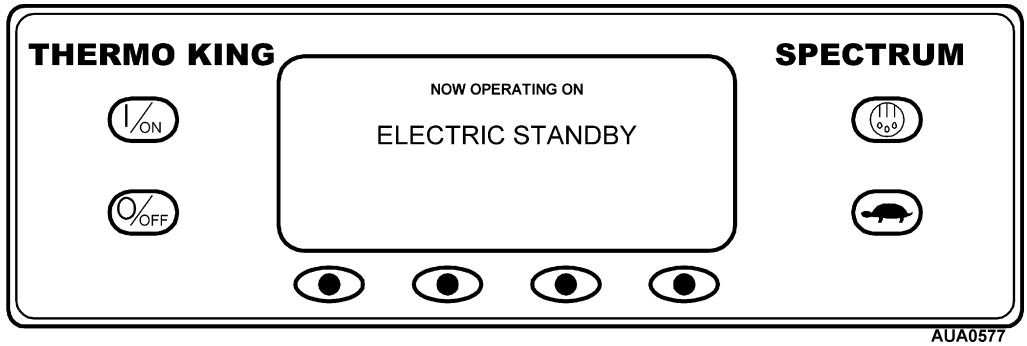
If the Pretrip Test results are CHECK or FAIL the problem should be diagnosed and corrected before the unit is released for service.

Selecting Diesel or Electric Operation

The Diesel Electric Display allows the operator to manually select diesel or electric mode operation. The unit can also be programmed to automatically select electric mode operation when standby power is available and diesel mode operation if standby power fails or is removed. If the unit is programmed to switch automatically from diesel to electric and electric to diesel, these screens do not appear.

Factory units are programmed to automatically switch to electric mode when standby power becomes available. The unit must be switched to diesel power manually.

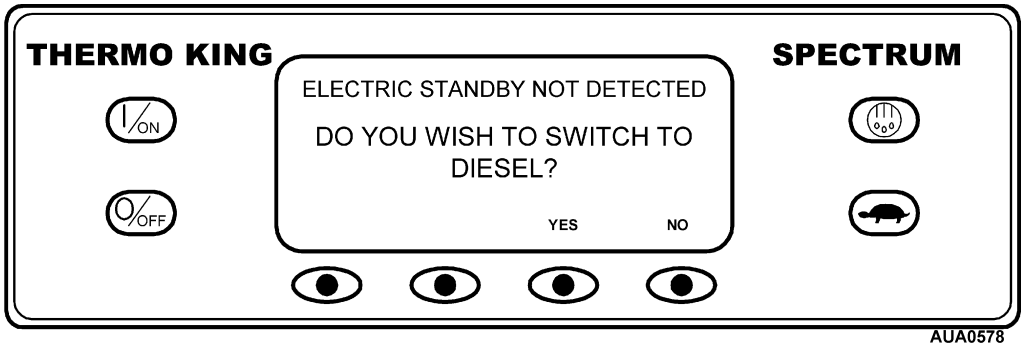
If the unit has standby power available and is turned on, the electric standby run screen will appear after the standard screen. The new mode is then confirmed for 10 seconds.



Selecting Diesel or Electric Operation - (continued)

If the unit was switched on in electric and electric standby power is not available, the operator will receive a prompt to return to Diesel Mode operation. The prompt will appear as shown below.

IMPORTANT: If the unit is switched to Electric Standby Mode and electric standby power is not available, the operator will receive a prompt to return to Diesel Mode operation. The prompt will appear as shown below.

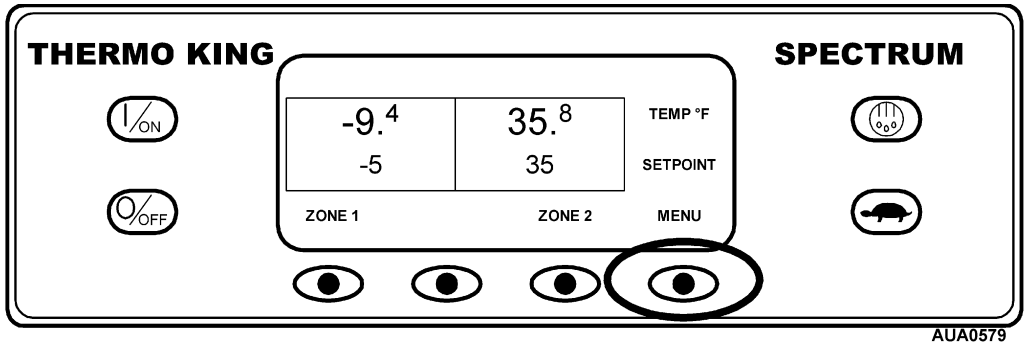


To switch back to Diesel mode press the YES key. Pressing the NO key will allow the unit to remain in Electric Standby mode even though standby power is not available.

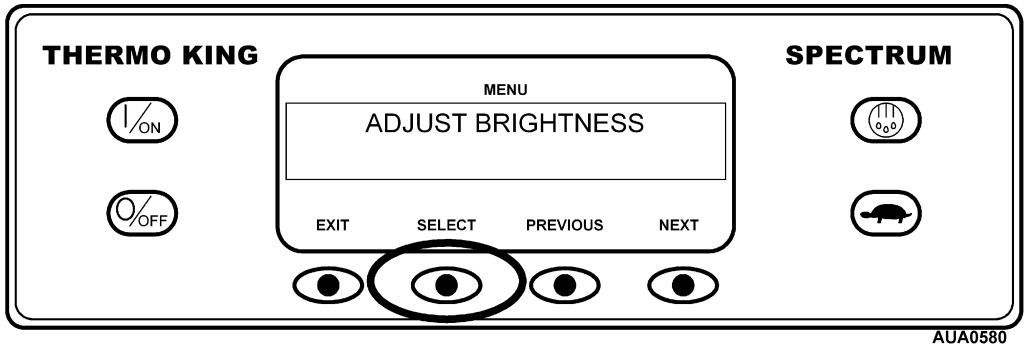
Display Brightness

The brightness of the HMI Control Panel display can be adjusted to allow for changing ambient light conditions. The choices available to the operator are HIGH, MEDIUM, LOW and OFF. OFF actually results in a very dim screen suitable for low light conditions.

Display brightness is adjusted using the Adjust Brightness Menu. From the Standard Display, press the MENU key.

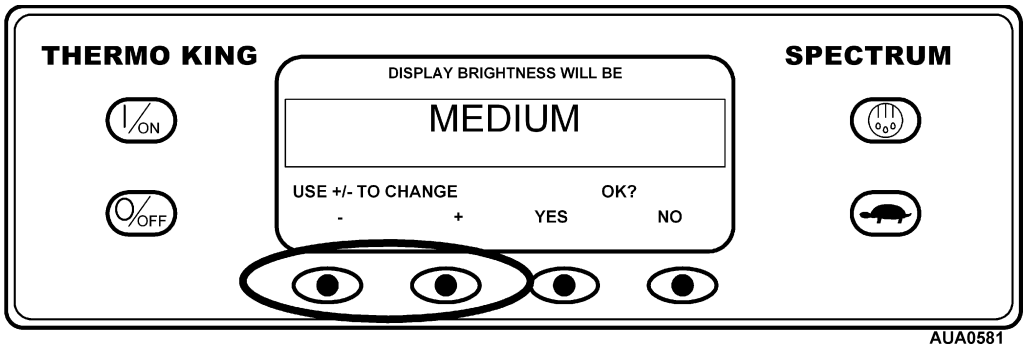


The Language Menu or Alarm Menu will appear. Press the NEXT key as required to show the Adjust Brightness Menu. When the Adjust Brightness Menu is shown press the SELECT key.

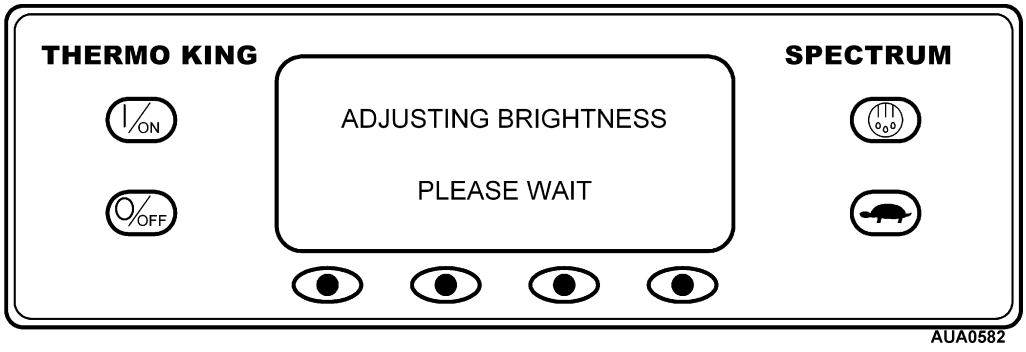


Display Brightness - (continued)

The Display Brightness menu will appear as shown below. Press the + or – keys to select the desired display brightness. When the desired brightness is shown press the YES key to confirm the choice.

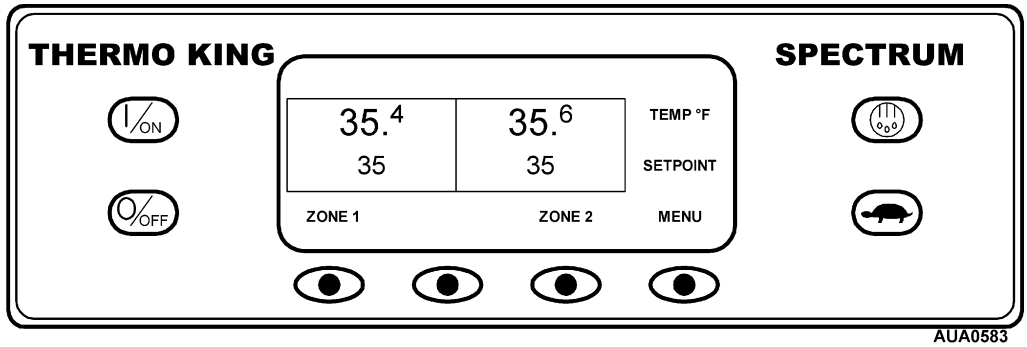


The display will briefly show ADJUSTING BRIGHTNESS – PLEASE WAIT

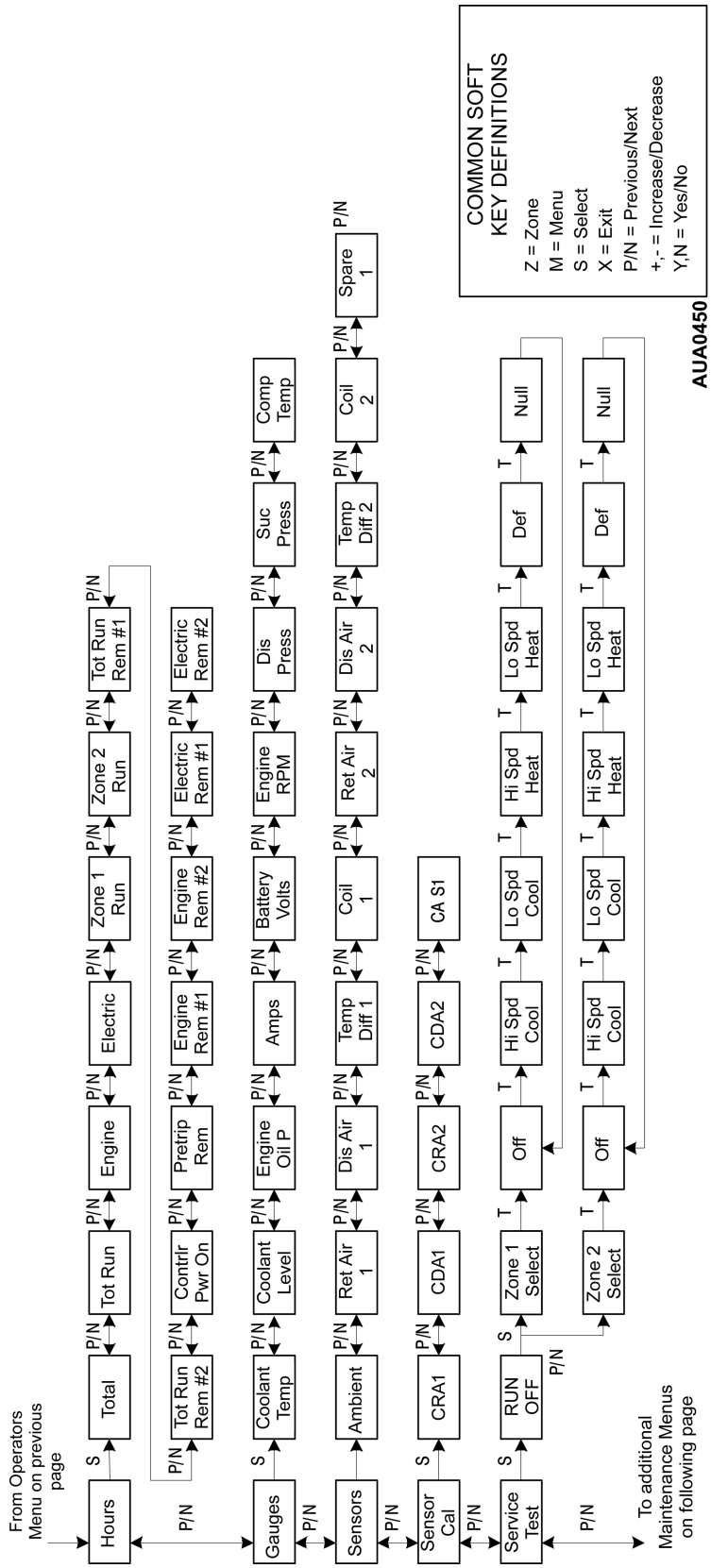


Single Temperature Operation

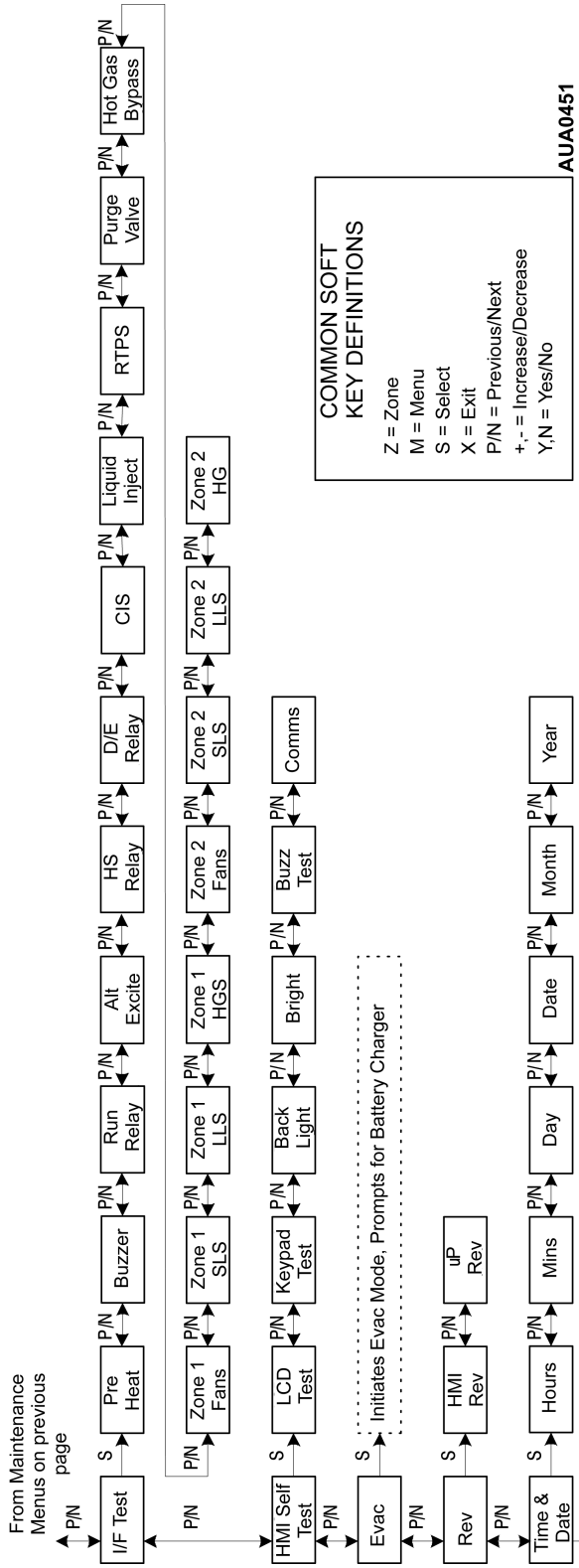
If a single temperature is desired in both zones, turn both zones on and set the same setpoint in both zones. The compartment bulkheads may be installed or removed. In the example shown below, a single temperature of 35°F (2°C) has been set for both zones.



Maintenance Menu Overview



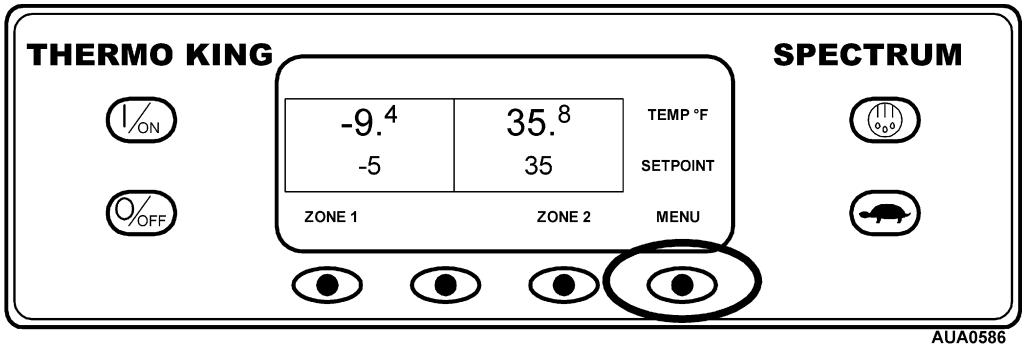
Maintenance Menu Overview (continued)



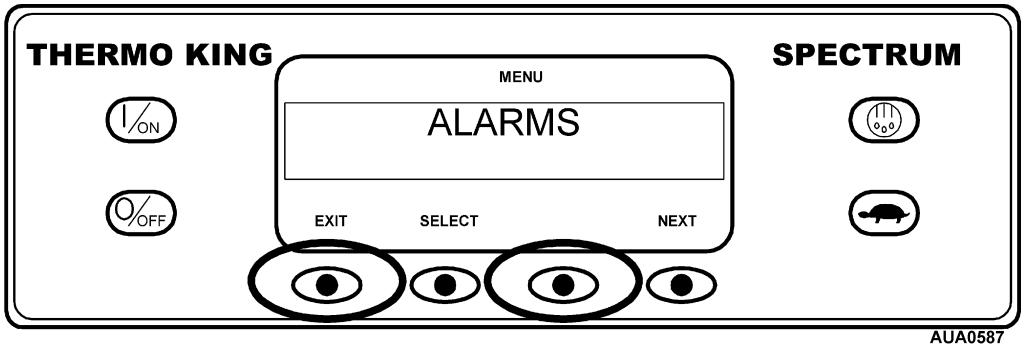
Using the Maintenance Menu

The Maintenance Menu contains menus that allow the technician to view additional information, perform unit diagnostics using Service Test Mode and Interface Board Test Mode and evacuate and charge the unit with refrigerant using Evacuation Mode. Software revisions can be checked and the time and date can be set.

To access the Maintenance Menu press the MENU key.

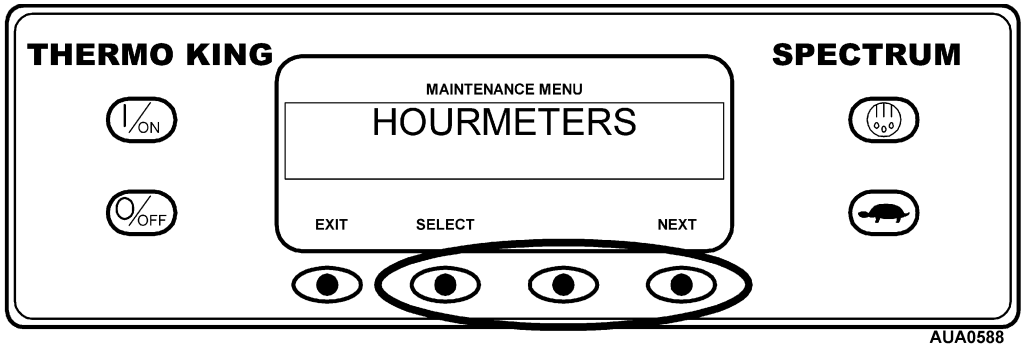


The Maintenance Menu is accessed from the first Operator Menu screen that appears; either the Language Display or the Alarms Display. The Alarms Display is shown here. Press and hold both the unlabeled soft key and the Exit key for 5 seconds.



Using the Maintenance Menu - (continued)

The first Maintenance Menu choice will appear. Press the NEXT and PREVIOUS keys to scroll through the Maintenance Menu choices. When the desired choice is shown on the display, press the SELECT key to access it.



The Maintenance Menu choices are shown on the next page. For detailed information see the individual explanations of each item later in this section of the manual.

To return to the Standard Display press the EXIT key.

Maintenance Menu Choices

Hourmeter Menu: Allows the technician to view all the active unit hourmeters even if the Operator Menu view has been turned off. The Maintenance Menu Hourmeter Display also allows the technician to reset the time on hourmeters with a programmed time limit.

Total Unit Hours	Total Run Hours	Total Engine Hours	Total Electric Hours
Total Zone 1 Run Hours	Total Zone 2 Run Hours	Maint. Total Hours 1	Maint. Total Hours 2
Controller On Hours	Maint. Pretrip Hours	Maint. Engine Hours 1	Maint. Engine Hours 2
Maint. Electric Hours 1	Maint. Electric Hours 2		

Gauges Menu: Allows the technician to view the unit gauges.

Coolant Temp	Coolant Level	Engine Oil Pressure	Amps
Battery Voltage	Engine RPM	Discharge Pressure	Suction Pressure
Compressor Temp			

Sensors Menu: Allows the technician to view the unit temperature sensors.

Ambient Temp	Zone 1 Return Air	Zone 1 Discharge Air	Zone 1 Temp Diff
Zone 1 Coil	Zone 2 Return Air	Zone 2 Discharge Air	Zone 2 Temp Diff
Zone 2 Coil	Spare 1 Sensor	DAS Sensor 1	DAS Sensor 2
DAS Sensor 3	DAS Sensor 4	DAS Sensor 5	DAS Sensor 6

Sensor Calibration Menu: Allows the technician to calibrate the graded unit temperature sensors.

Zone 1 Return Air	Zone 1 Discharge Air	Zone 2 Return Air	Zone 2 Discharge Air
Spare 1 Sensor			

Service Test Mode Menu: Allows the technician to force the unit to a known mode in each zone for diagnostic purposes. The unit can be either running or shut down. Each zone can be set to one of the modes shown below. Only one zone can be in defrost at a time. Null is only available if another zone is cooling, heating or defrosting.

High Speed Cool	Low Speed Cool	High Speed Heat	Low Speed Heat
Defrost	Running Null		

Maintenance Menu Choices – (continued)

Interface Board Test Mode Menu: Allows the technician to energize and de-energize outputs to diagnose control devices. The unit is shut down to use this test.

Preheat	Buzzer	Run Relay	Alternator Excite Relay
High Speed Relay	Diesel/Electric Relay	Condenser Inlet Sol	Liquid Injection Sol
Rcvr Tank Pressure Sol	Purge Valve	Hot Gas Bypass Sol	Zone 1 Fans
Zone 1 Suction Line Sol	Zone 1 Liquid Line Sol	Zone 1 Hot Gas Sol	Zone 2 Fans
Zone 2 Suction Line Sol	Zone 2 Liquid Line Sol	Zone 2 Hot Gas Sol	

Display Self Test Menu: Allows the operator to perform a self test on the unit HMI display panel.

Evacuation Mode Menu: Allows the technician to open all normally closed refrigeration system valves to evacuate and charge the unit with refrigerant. The technician is prompted to install a battery charger to guarantee sufficient voltage to keep all valves open during the evacuation and charging process.

Software Revision Menu: Allows the technician to view the software revision for the HMI Control Panel and Controller.

Time and Date Menu: Allows the technician to view and change the HMI Control Panel clock/calendar.

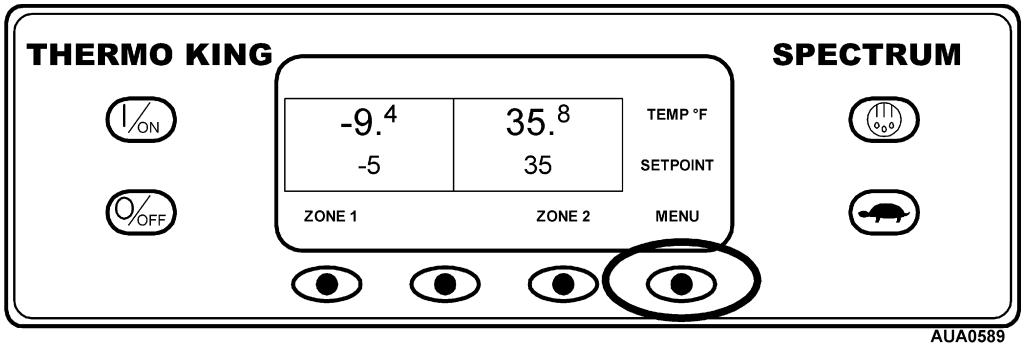
Using the Hourmeters Menu

Hourmeters are displayed using the Hourmeter Display.

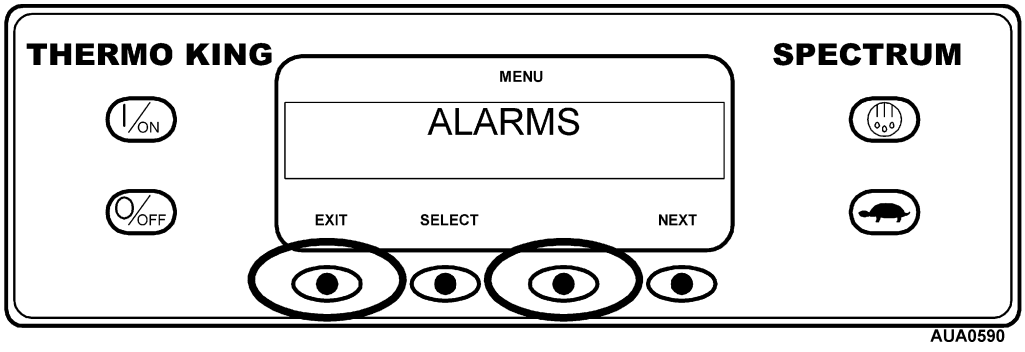
There are two important differences between the Operators Hourmeter Display and the Maintenance Hourmeter Display.

- All active hourmeters are displayed from the Maintenance Hourmeter Display, even if the hourmeter view is turned off. This feature is not available from the Operators Hourmeter Display.
- The Maintenance Hourmeter Display provides the technician with a Reset key to reset the time limits on any programmable hourmeters that are in use. This feature is not available from the Operators Hourmeter Display.

To access the Maintenance Hourmeter Menu press the MENU key.

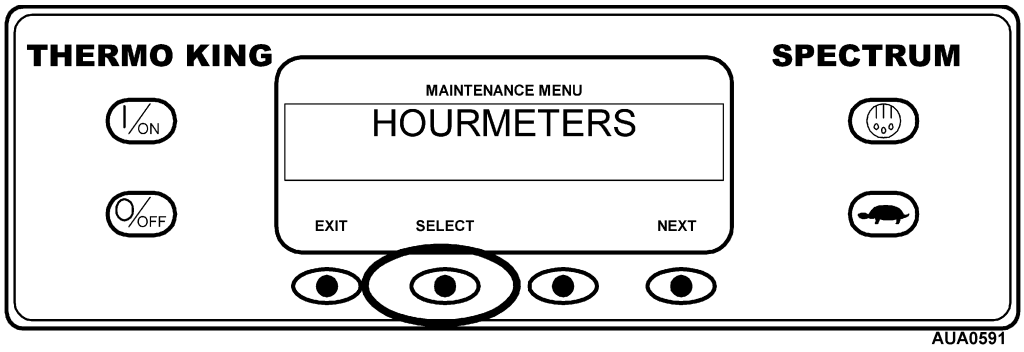


The Maintenance Menu is accessed from the first Operator Menu screen that appears; either the Language Display or the Alarms Display. The Alarms Display is shown here. Press and hold both the unlabeled soft key and the Exit key for 5 seconds.

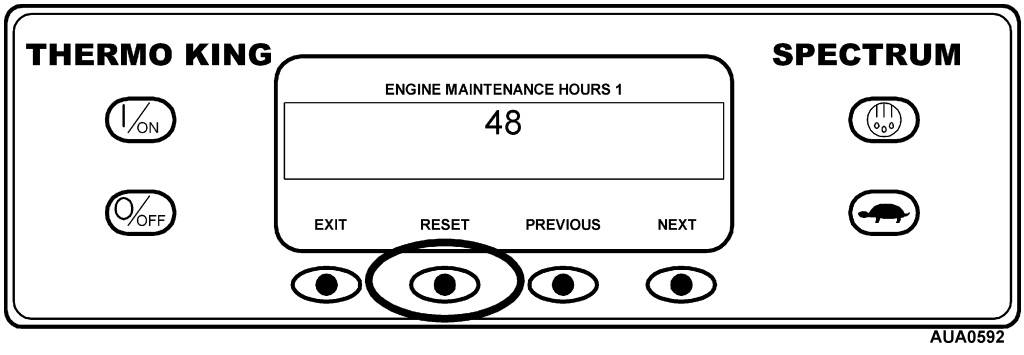


Using the Hourmeters Menu – (continued)

The Maintenance Hourmeter Menu will appear. Press the Select key to choose the hourmeter displays.



Press the NEXT or PREVIOUS key to scroll through the hourmeters. Note that a Reset soft key is available to reset the programmable hourmeters that feature limits. Pressing the Reset key will reset the hourmeter to 0.



To return to the Maintenance Menu press the Exit key.

Using the Hourmeters Menu – (continued)

Hourmeter names and definitions are listed below in the order they appear. To return to the Maintenance Menu from the Maintenance Hourmeter Display, press the EXIT key.

HOURMETER NAMES AND DEFINITIONS

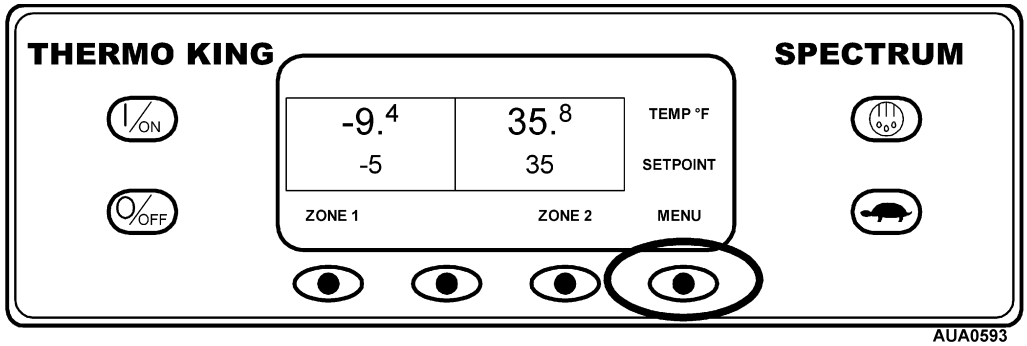
Hourmeter Name	Definition
Total Hours	Total number of hours the unit has been turned on (protection hours).
Total Run Hours	Total number of hours the unit has run in both diesel and electric mode.
Engine Hours	Total number of hours the unit has run in diesel mode.
Electric Hours	Total number of hours the unit has run in electric mode.
Zone 1 Run Hours	Total number of hours that Zone 1 has run in both diesel and electric mode. Includes running null time.
Zone 2 Run Hours	Total number of hours that Zone 2 has run in both diesel and electric mode. Includes running null time.
Total Maintenance Hours 1	User Programmable – The number of hours before a Total Hours Maintenance Reminder 1 occurs as determined by hourmeter limit setting.
Total Maintenance Hours 2	User Programmable – The number of hours before a Total Hours Maintenance Reminder 2 occurs as determined by hourmeter limit setting.
Total Controller Hours	Total hours the controller and HMI control panel have been turned on.
Pretrip Reminder Hours	User Programmable – The number of hours before a Pretrip Reminder occurs as determined by hourmeter limit setting.
Engine Maintenance Hours 1	User Programmable – The number of hours before an Engine Hours Maintenance Reminder 1 occurs as determined by hourmeter limit setting.
Engine Maintenance Hours 2	User Programmable – The number of hours before an Engine Hours Maintenance Reminder 2 occurs as determined by hourmeter limit setting.
Electric Maintenance Hours 1	User Programmable – The number of hours before an Electric Hours Maintenance Reminder 1 occurs as determined by hourmeter limit setting.
Electric Maintenance Hours 2	User Programmable – The number of hours before an Electric Hours Maintenance Reminder 2 occurs as determined by hourmeter limit setting.

Using the Gauges Menu

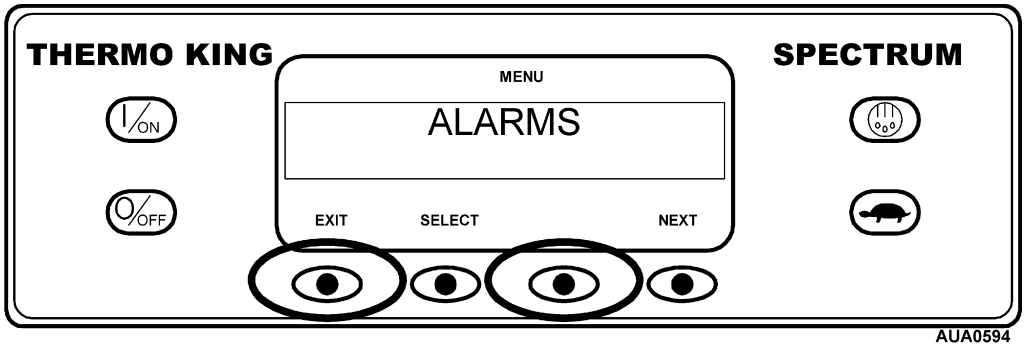
The Gauges Display allows the technician to view unit operating information. Gauge readings are updated once per second. The Gauges Display is also available from the Pretrip Display and Service Test Mode Display.

A Lock key is provided to lock a selected gauge on the display. This prevents the display from timing out in 30 seconds and allows the technician to view the gauge for an extended period of time.

To access the Gauges Menu press the MENU key.

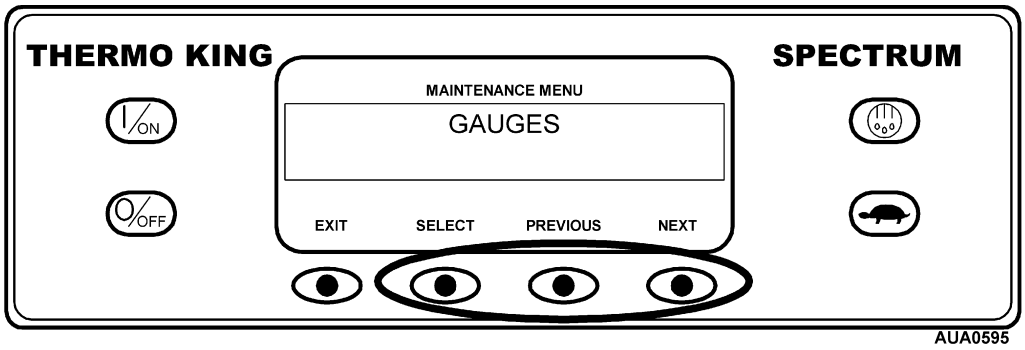


The Maintenance Menu is accessed from the first Operator Menu screen that appears; either the Language Display or the Alarms Display. The Alarms Display is shown here. Press and hold both the unlabeled soft key and the Exit key for 5 seconds.

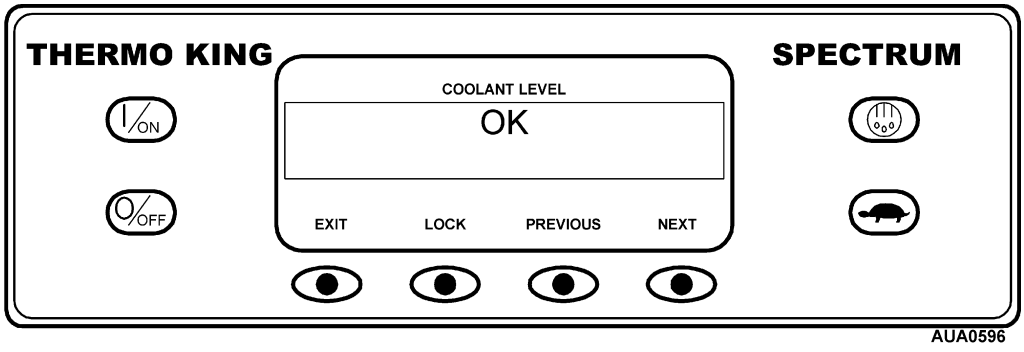


Using the Gauges Menu – (continued)

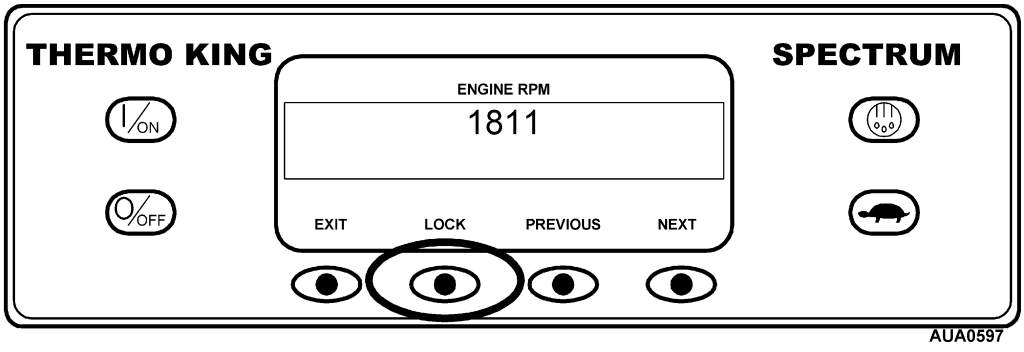
The Maintenance Hourmeter Menu will appear. Press the NEXT key as required to show the Gauges Menu. When the Gauges Menu is shown press the SELECT key.



Press the NEXT or PREVIOUS key to scroll through the gauges. The coolant level gauge is shown here.



To lock a gauge on the display press the Lock key. In this case, pressing the Lock key will lock the RPM Gauge on the display.



Using the Gauges Menu – (continued)

Gauge names and definitions are listed below in the order they appear. To return to the Maintenance Menu from the Gauges Display, press the EXIT key.

GAUGE NAMES AND DEFINITIONS

Units will be as selected by programmable features

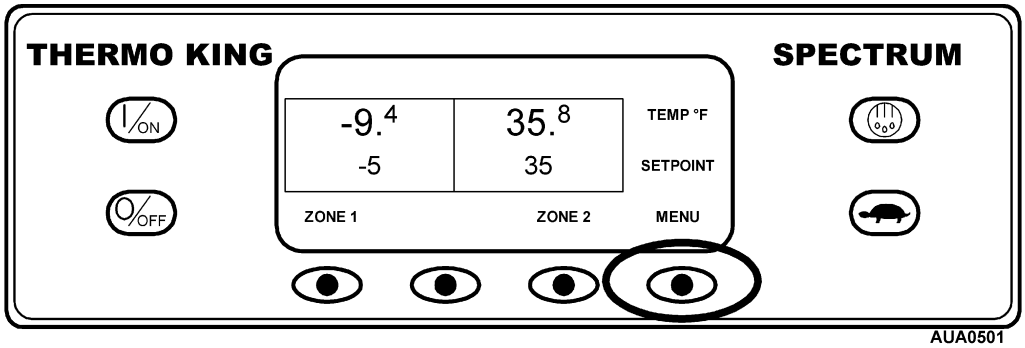
Gauge Name	Definition
Coolant Temperature	Temperature of the diesel engine coolant in degrees F or C.
Coolant Level	Level of the diesel engine coolant. Reported as OK or LOW.
Oil Pressure	Diesel engine oil pressure. Reported as OK or LOW.
Oil Level	Diesel engine oil level. Reported as OK or LOW.
Amps	Battery current flow in amperes. A negative value indicates a battery discharge condition exists.
Battery Volts	Battery voltage in volts.
RPM	Engine speed in revolutions per minute (RPM).
Discharge Pressure	Compressor discharge pressure in PSI, kPa or BARS.
Suction Pressure	Compressor suction pressure in PSI, kPa or BARS. It should be noted that the suction pressure transducer is located downstream of the throttling valve. As a result, the suction pressure displayed is compressor suction pressure, not system suction pressure.
Compressor Temperature	Temperature of the compressor as sensed by the compressor temperature sensor.

Using the Temperature Sensor Menu

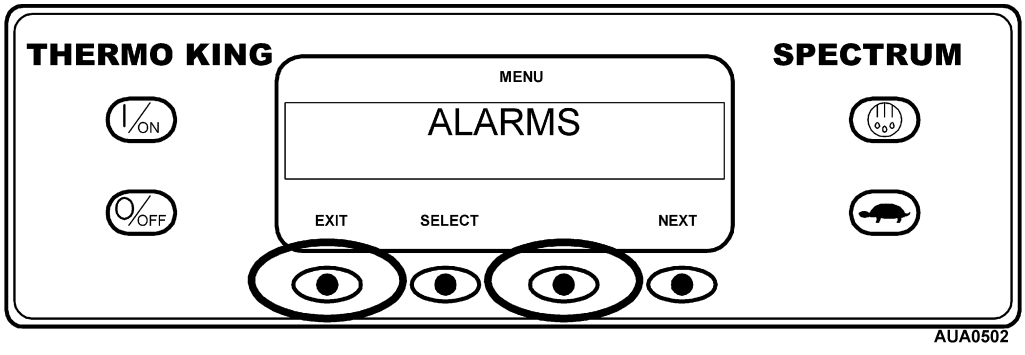
The Temperature Sensor Display allows the technician to view the readings of the unit and zone temperature sensors. Sensor readings are updated once per second. The Temperature Sensors Display is also available from the Pretrip Display and Service Test Mode Display.

Temperature differential (ΔT) is automatically calculated for each zone as an aid for the technician. A negative temperature differential indicates the zone is cooling and a positive temperature differential indicates the zone is heating. A Lock key is provided to lock a selected temperature sensor on the display. This prevents the display from timing out in 30 seconds and allows the technician to view the sensor for an extended period of time.

To access the Temperature Sensor Menu press the MENU key.

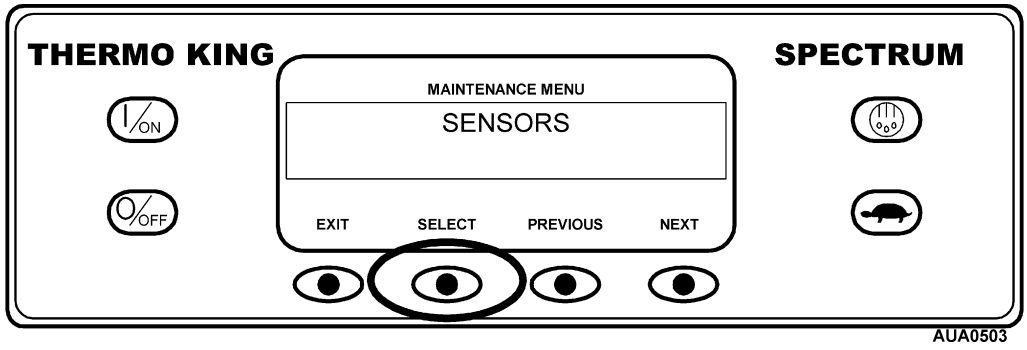


The Maintenance Menu is accessed from the first Operator Menu screen that appears; either the Language Display or the Alarms Display. The Alarms Display is shown here. Press and hold both the unlabeled soft key and the Exit key for 5 seconds.

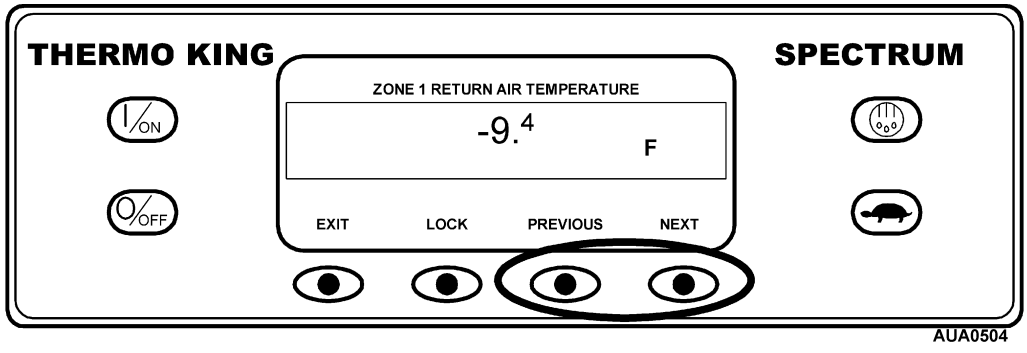


Using the Temperature Sensor Menu – (continued)

The Maintenance Hourmeter Menu will appear. Press the NEXT key as required to show the Sensors Menu. When the Sensors Menu is shown press the SELECT key.



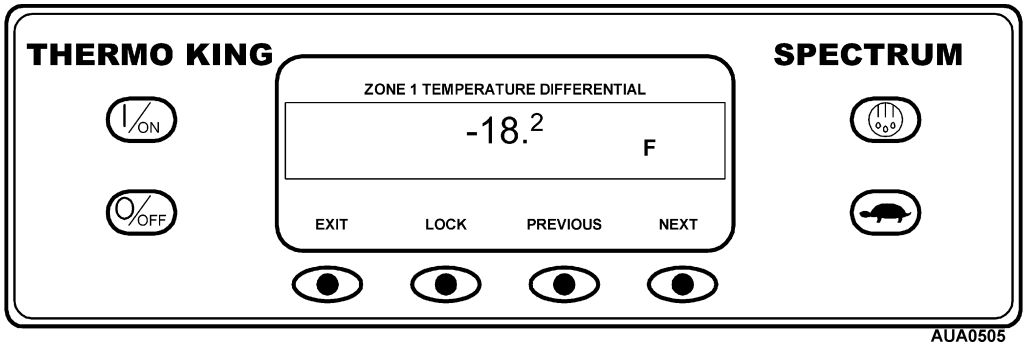
Press the NEXT or PREVIOUS key to scroll through the sensors. The return air sensor for Zone 1 is shown here.



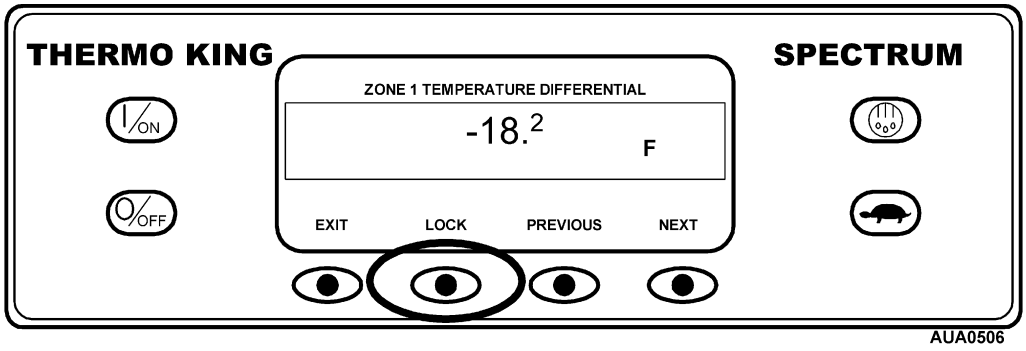
Using the Temperature Sensor Menu – (continued)

Temperature differential (ΔT) is automatically calculated for each zone as an aid for the technician. A negative temperature differential indicates the zone is cooling and a positive temperature differential indicates the zone is heating.

The temperature differential is displayed after the return and discharge temperatures for each zone. The display below shows the temperature differential for Zone 1.



To lock a gauge on the display press the Lock key. In this case, pressing the Lock key will lock the Zone 1 Temperature Differential on the display.



Using the Temperature Sensor Menu – (continued)

Sensor names and definitions are listed below in the order they appear. To return to the Maintenance Menu from the Sensors Display, press the EXIT key.

TEMPERATURE SENSOR NAMES AND DEFINITIONS

Temperatures units (F or C) will be as selected by programmable features

Sensor Name	Definition
Ambient Temp Sensor	Ambient or outside air temperature
Zone 1 Return Air Temp	Temperature of the air returning to the Zone 1 evaporator.
Zone 1 Discharge Air Temp	Temperature of the air leaving the Zone 1 evaporator.
Zone 1 Temp Differential	(Discharge air temperature) minus (return air temperature) for Zone 1.
Zone 1 Coil Temp	Temperature of the Zone 1 evaporator coil.
Zone 2 Return Air Temp	Temperature of the air returning to the Zone 2 evaporator.
Zone 2 Discharge Air Temp	Temperature of the air leaving the Zone 2 evaporator.
Zone 2 Temp Differential	(Discharge air temperature) minus (return air temperature) for Zone 2.
Zone 2 Coil Temp	Temperature of the Zone 2 evaporator coil.
Spare Temp 1	Temperature measured by the optional Spare Sensor 1 (if installed).

Using the Temperature Sensor Calibration Menu

In order to achieve maximum accuracy the return air and discharge air temperature sensors as well as the spare temperature sensor are graded sensors. Sensors are graded by the manufacturer with a sensor grade from 1 to 9. Each sensor is then further graded as low, center or high within each grade range. Sensor grades are physically stamped on each sensor and range from 1L to 9H. A sensor in the center grade range is stamped with the grade number only. These grades eliminate the need for sensors to be calibrated using an ice water bath.

Due to sensor calibration scaling factors Grade 5H sensors do not exist (Grade 5L and 5 do exist). Therefore, grade 5H is the sensor grade factory default as it indicates the sensor grade has not been set.

Sensor grade settings are checked when unit power switch is turned on. If any return, discharge or spare air sensor is indicating a valid temperature and is set to Grade 5H then Alarm Code 111 will be set during a Pretrip Test. This alarm clears automatically when all graded sensors are set to a value other than Grade 5H.

Other unit sensors (coil temperature, ambient temperature, engine coolant temperature and compressor temperature) are ungraded sensors and need not be calibrated.

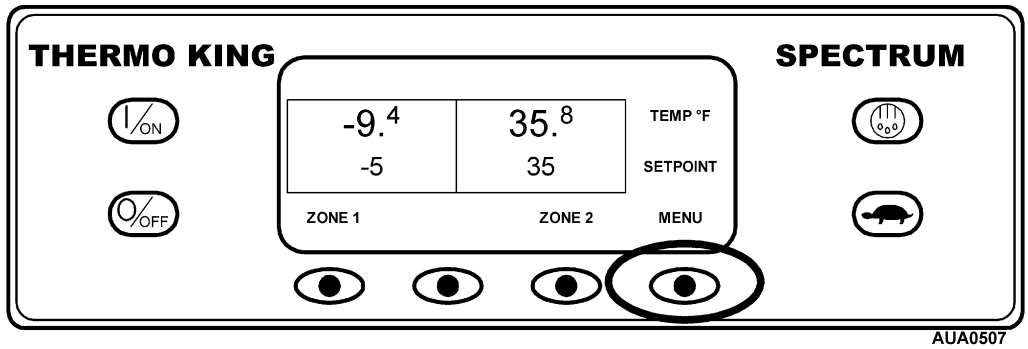
IMPORTANT: Any time a graded sensor is replaced the sensor grade of the replacement sensor must be checked and set.

Only configured zones appear in sensor calibration menu unless a valid sensor reading is detected.

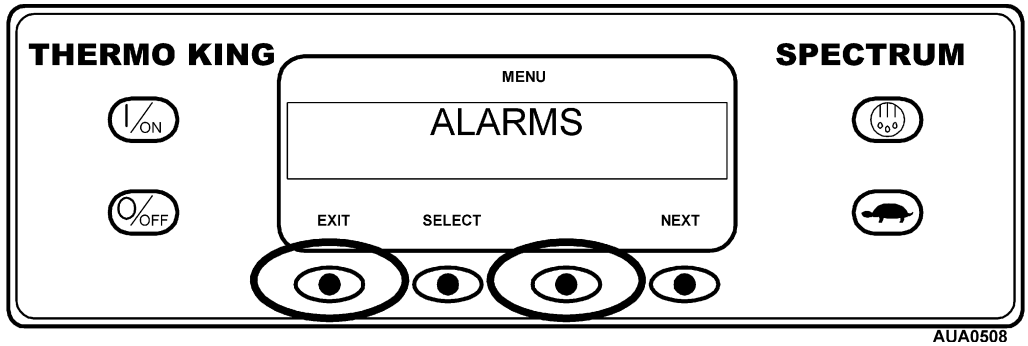
The Temperature Sensor Calibration Display allows the technician to view and change the grade of return, discharge and spare sensors.

Using the Temperature Sensor Calibration Menu – (continued)

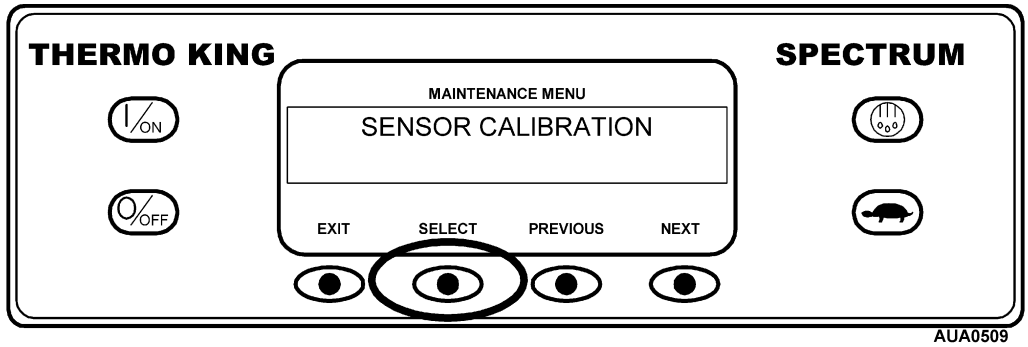
To access the Temperature Sensor Calibration Menu press the MENU key.



The Maintenance Menu is accessed from the first Operator Menu screen that appears; either the Language Display or the Alarms Display. The Alarms Display is shown here. Press and hold both the unlabeled soft key and the Exit key for 5 seconds.

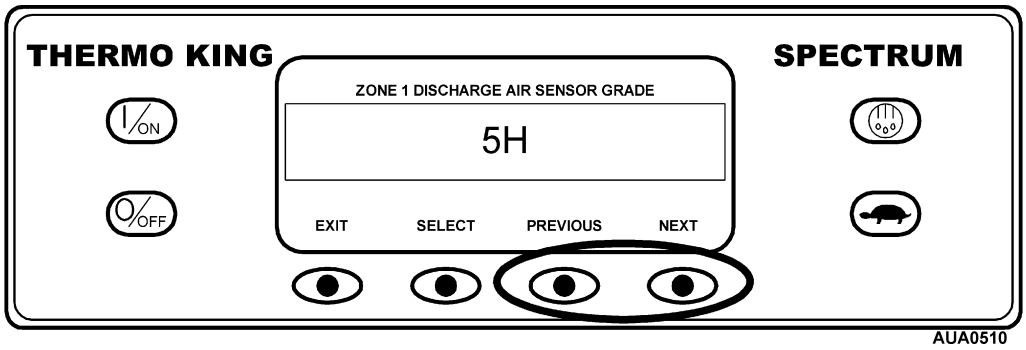


The Maintenance Hourmeter Menu will appear. Press the NEXT key as required to show the Sensor Calibration Menu. When the Sensor Calibration Menu is shown press the SELECT key.

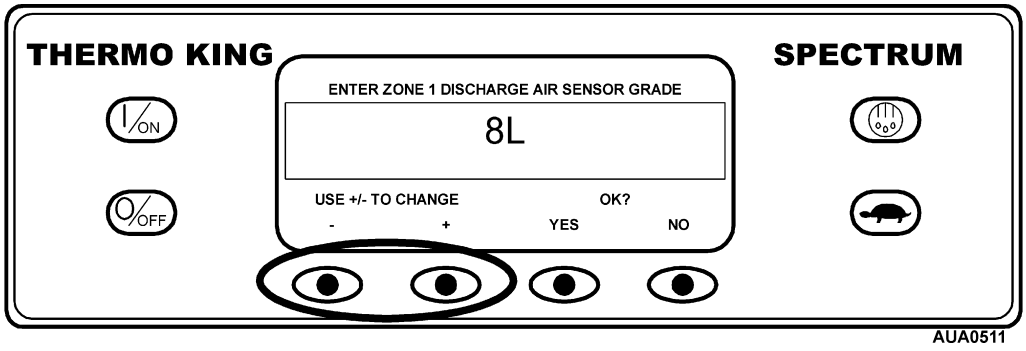


Using the Temperature Sensor Calibration Menu – (continued)

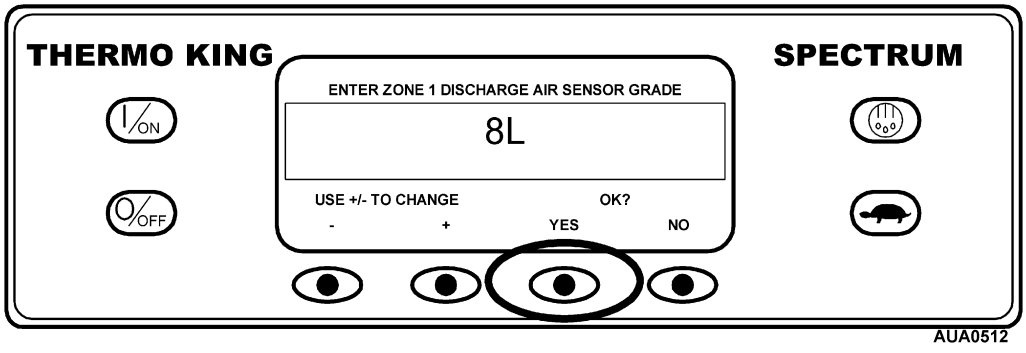
Press the NEXT or PREVIOUS key to chose the desired sensor. The discharge air sensor for Zone 1 is shown here. Grade 5H indicates that the sensor has not been set.



When the desired sensor is shown press the SELECT key to chose the sensor. The sensor grade can now be changed using the - and/or + keys. Here the sensor grade has been changed to 8L.

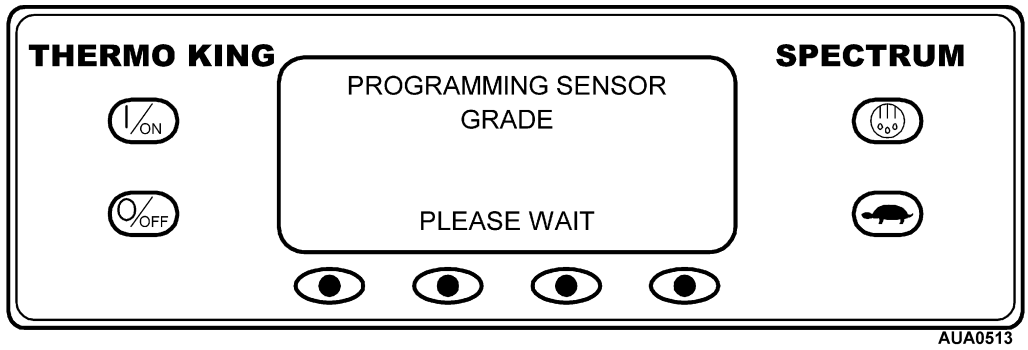


When the desired sensor grade is shown press the YES key to set the grade.



Using the Temperature Sensor Calibration Menu – (continued)

The display will confirm that the grade is being changed as shown below and then the new sensor grade will appear.



IMPORTANT: For optimum performance the sensor grades for all return air sensors and discharge air sensors must be properly set. Failure to do so may result in reduced performance and/or nuisance alarm codes.

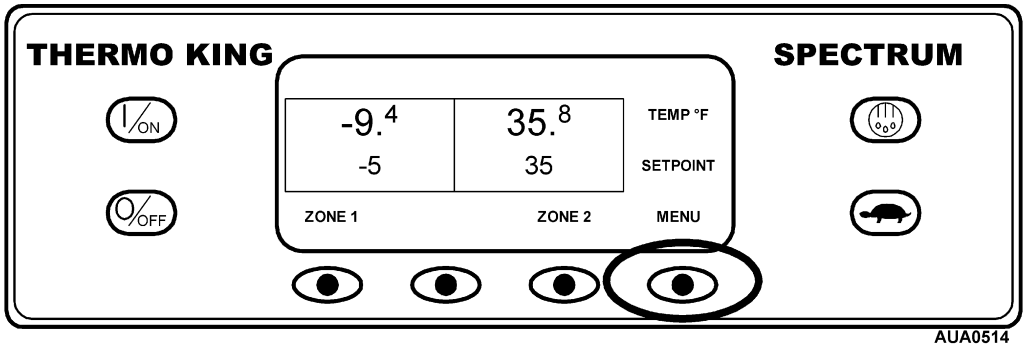
Using the Service Test Mode Menu

Since it is impossible to predict exact operating conditions, a diagnostic feature called Service Test Mode has been incorporated. This feature allows the unit to be "forced" to a known operating state in Diesel mode, regardless of setpoint or temperature sensor inputs. Service personnel can now troubleshoot the system under defined conditions. Service Test Mode can be used with the unit running or shut down.

When a Service Test Mode operating state is selected, the unit will operate in that state for 15 minutes. If no other Service Test Mode state is selected during this time the unit will shut down and generate Alarm Code 54 Test Mode Timeout. All protection circuits and functions operate normally in Service Test Mode.

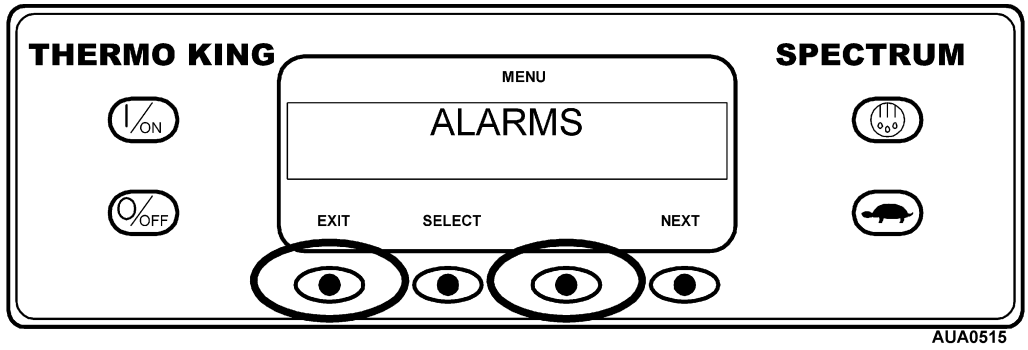
The Service Test Mode display shows operating state, return air temperature, discharge air temperature, evaporator coil temperature and the calculated value for temperature differential. The Gauge Menu is also available.

To access the Service Test Mode Menu press the MENU key.

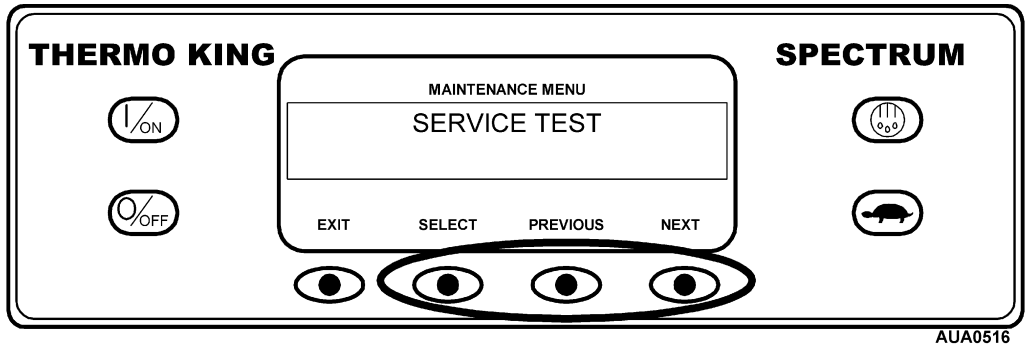


Using the Service Test Mode Menu - (continued)

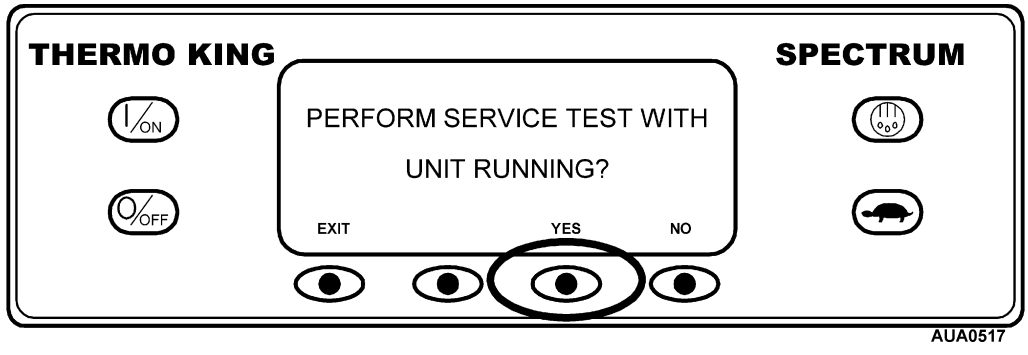
The Maintenance Menu is accessed from the first Operator Menu screen that appears; either the Language Display or the Alarms Display. The Alarms Display is shown here. Press and hold both the unlabeled soft key and the Exit key for 5 seconds.



The Maintenance Hourmeter Menu will appear. Press the NEXT key as required to show the Service Test Menu. When the Service Test Menu is shown press the SELECT key.

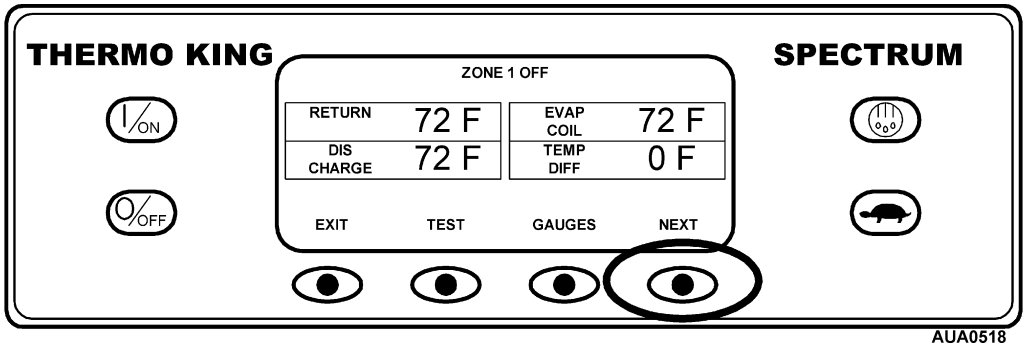


The display will prompt for running or non-running test as shown below. Yes is chosen here.

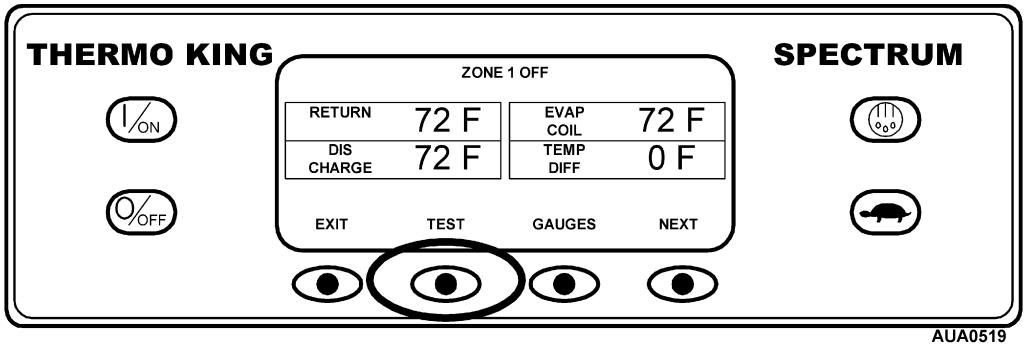


Using the Service Test Mode Menu - (continued)

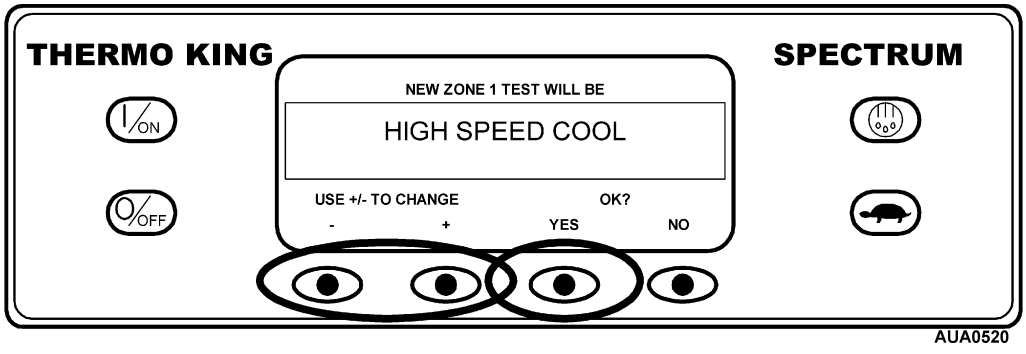
The Service Test Display is shown below. Pressing the NEXT key switches between Zone 1 and Zone 2. After a test is chosen in one zone the NEXT key is used to choose another zone to start a second test in that zone. Zone 1 has been chosen below, and the zone is currently turned off as shown by the top line of the display.



Pressing the TEST key allows the operator to choose the desired test.

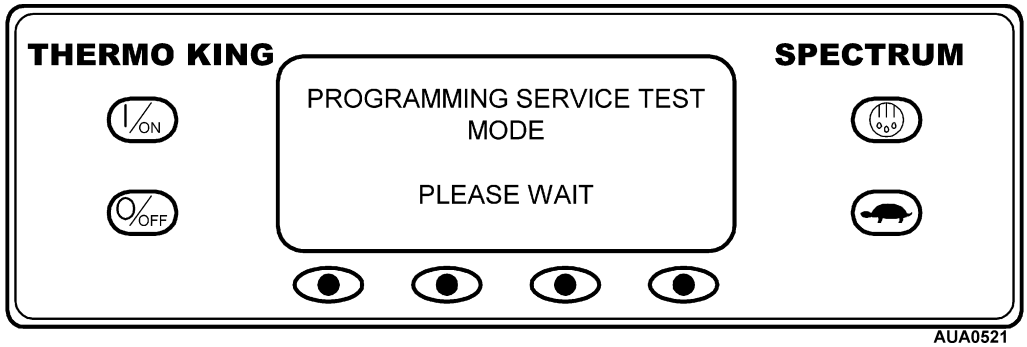


The – and/or + keys are used to scroll through the available tests for the selected zone, starting with OFF. High Speed Cool is shown here. When the desired test is shown press the YES key.

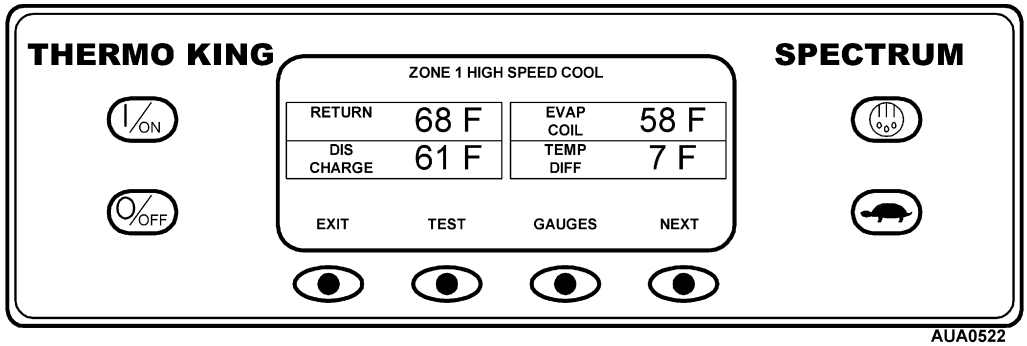


Using the Service Test Mode Menu - (continued)

The display will indicate that the change is being programmed.



The new test mode for the zone is then shown. In the example shown here, zone 1 is now running in high speed cool. Pressing the NEXT key will select Zone 2. Pressing the TEST key allows a test mode to be chosen for Zone 2.



To return to the Maintenance Menu from the Service Test Mode Display, press the EXIT key.

Using the Service Test Mode Menu - (continued)

Service Test Mode Operating States are listed below in the order they appear. All operating states are available in all zones with the following considerations:

- A different operating state, from the table below, can be selected for each zone.
- Only one zone at a time may be in defrost.
- A zone may not be in running null unless another zone is running in cool, heat or defrost.
- The Service Test Mode starts with all zones off. Once an operating state has been selected the last zone still running cannot be turned off. This is normal operation.
- To operate the unit in Reverse Cycle Heat, place one zone in cool and the other zone in heat.
- If no other Service Test Mode state is selected during this time, the unit will shut down and generate Alarm Code 54 Test Mode Timeout.
- All protection circuits and functions operate normally in Service Test Mode.
- To return to the Maintenance Menu from the Service Test Mode Display, press the EXIT key.

Service Test Mode Operating States and Conditions

See the table on the next page for a list of control devices energized in each operating state.

Operating State	Definition
Zone 1 Off	Zone 1 is turned off.
Zone 1 High Speed Cool	Zone 1 is running in High Speed Cool regardless of temperatures.
Zone 1 Low Speed Cool	Zone 1 is running in Low Speed Cool regardless of temperatures.
Zone 1 High Speed Heat	Zone 1 is running in High Speed Heat regardless of temperatures.
Zone 1 Low Speed Heat	Zone 1 is running in Low Speed Heat regardless of temperatures.
Zone 1 Defrost	Zone 1 is running in Defrost regardless of temperatures.
Zone 1 Running Null	Zone 1 is in running null, all zone devices off but fans are running.
Zone 2 Off	Zone 2 is turned off.
Zone 2 High Speed Cool	Zone 2 is running in High Speed Cool regardless of temperatures.
Zone 2 Low Speed Cool	Zone 2 is running in Low Speed Cool regardless of temperatures.
Zone 2 High Speed Heat	Zone 2 is running in High Speed Heat regardless of temperatures.
Zone 2 Low Speed Heat	Zone 2 is running in Low Speed Heat regardless of temperatures.
Zone 2 Defrost	Zone 2 is running in Defrost regardless of temperatures.
Zone 2 Running Null	Zone 2 is in running null, all zone devices off but fans are running.

Using the Service Test Mode Menu - (continued)

Operation of Multi-Temperature Unit Solenoids and Valves

Energized means that the microprocessor and interface board is supplying battery voltage to the device.

Item	ID	Type	Cool	Heat	Defrost	Reverse Cycle
Condenser Inlet Solenoid (Note 1)	CIS	NO		Energized (closed)	Energized (closed)	Energized (closed)
Receiver Tank Pressure Solenoid (Note 2)	RTPS	NC				
Purge Valve (Note 1)	PV	NC		Energized (open)	Energized (open)	Energized (open)
Liquid Line Solenoid	LLS	NC	Energized (open)	Energized (open)	Energized (open)	Energized (open)
Hot Gas Solenoid	HGS	NC		Energized (open)	Energized (open)	Energized (open)
Hot Gas Bypass Valve (Note 1)	HGB	NC	Energized or De-energized			
Liquid Injection Valve	LIV	NC	Energized (open)			
Discharge Pressure Regulator (Note 3)	DPR	NC		Regulates	Regulates	Regulates
Suction Line Solenoid	SLS	NO				Energized (closed)

Note 1 = Influenced by the pressure transducers

Note 2 = Only energized during Evacuation Mode

Note 3 = Mechanical device

Summary

- When a zone is cooling the Liquid Line Solenoid (LLS) is energized (open).
- When a zone is heating or defrosting the Liquid Line Solenoid (LLS) is energized (open) and the Hot Gas Solenoid (HGS) is energized (open).
- When a zone is in reverse cycle heat the Liquid Line Solenoid (LLS) is energized (open), the Hot Gas Solenoid (HGS) is energized (open) and the Suction Line Solenoid (SLS) is energized (closed).
- When any zone is heating or defrosting the discharge pressure regulator is controlling discharge pressure.

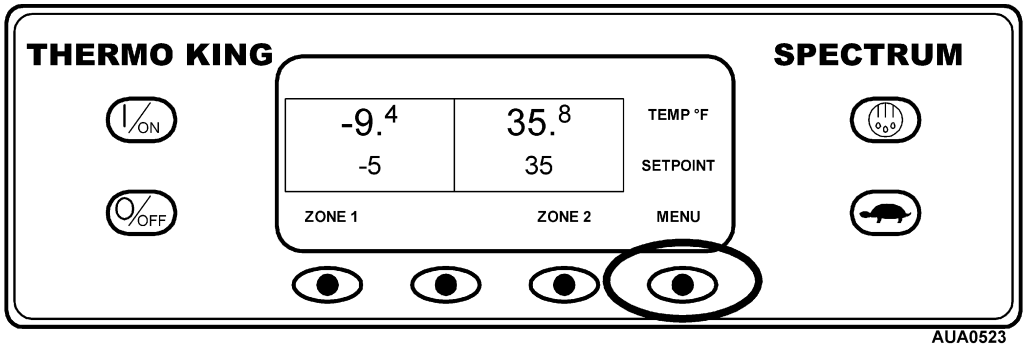
Using the Interface Board Test Mode Menu

Interface Board Test Mode allows individual relays or outputs to be energized. This permits service personnel to troubleshoot the system under defined conditions. Interface Board Test mode is only available with the unit shut down. If the unit is running when Interface Board Test is entered the unit will shut down.

Relays and outputs can all be energized momentarily. In addition, all functions except the Preheat relay and buzzer can be locked on. If a function is locked on that function will remain energized for 15 minutes if no other Interface Board Test Mode function is selected. At the end of 15 minutes, if no other function is selected the unit will shut down and record Alarm Code 54 Test Mode Timeout. All protection circuits operate normally in Service Test Mode.

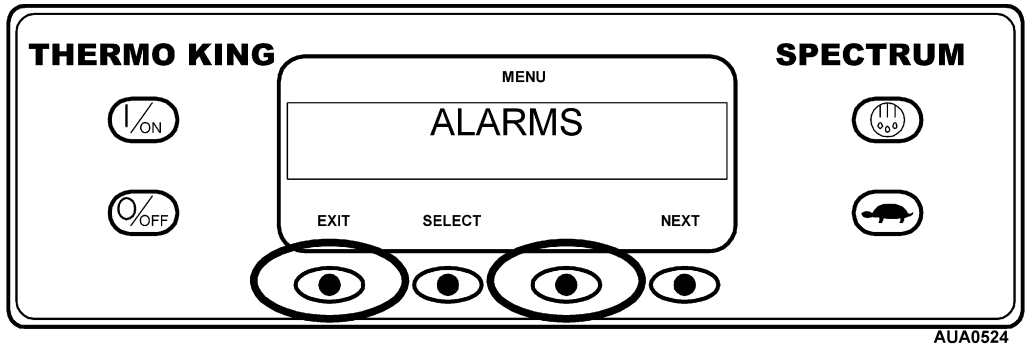
The Interface Board Test Mode display also shows suction pressure, discharge pressure, amps and battery volts.

To access the Interface Board Test Menu press the MENU key.

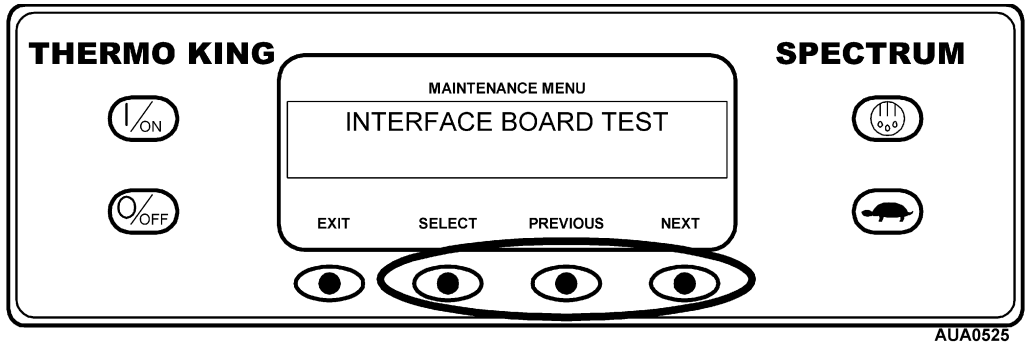


Using the Interface Board Test Mode Menu - (continued)

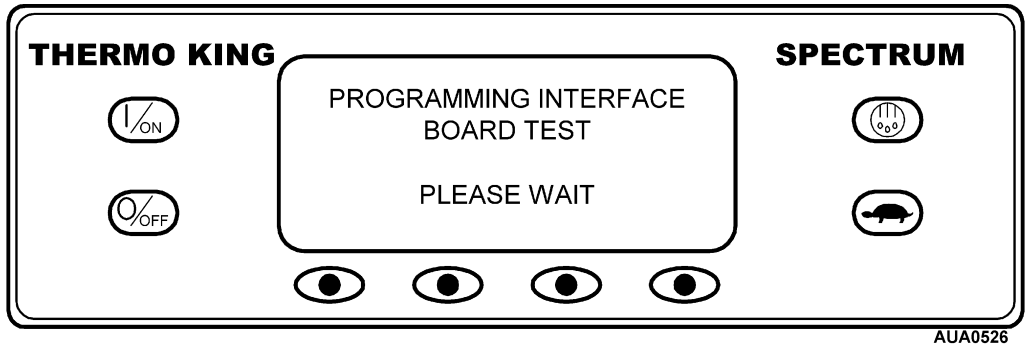
The Maintenance Menu is accessed from the first Operator Menu screen that appears; either the Language Display or the Alarms Display. The Alarms Display is shown here. Press and hold both the unlabeled soft key and the Exit key for 5 seconds.



The Maintenance Hourmeter Menu will appear. Press the NEXT key as required to show the Interface Board Test Menu. When the Interface Board Test Menu is shown press the SELECT key.

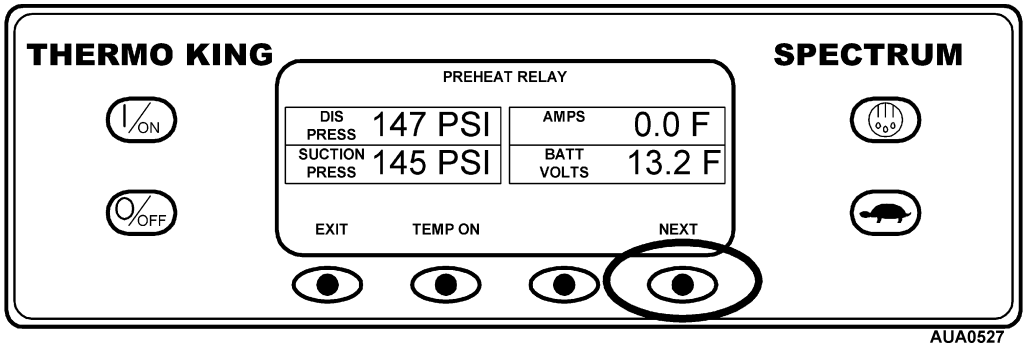


The display will indicate that the Interface Board Test Mode is being programmed.

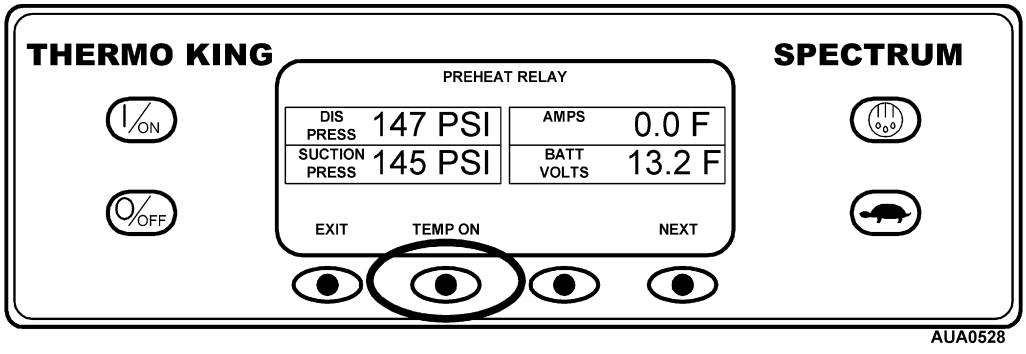


Using the Interface Board Test Mode Menu - (continued)

The Interface Board Test Display is shown below. Pressing the NEXT key scrolls forward through the available Interface Board Test modes. When the end of the list is reached, pressing the NEXT key will start over from the beginning of the list.

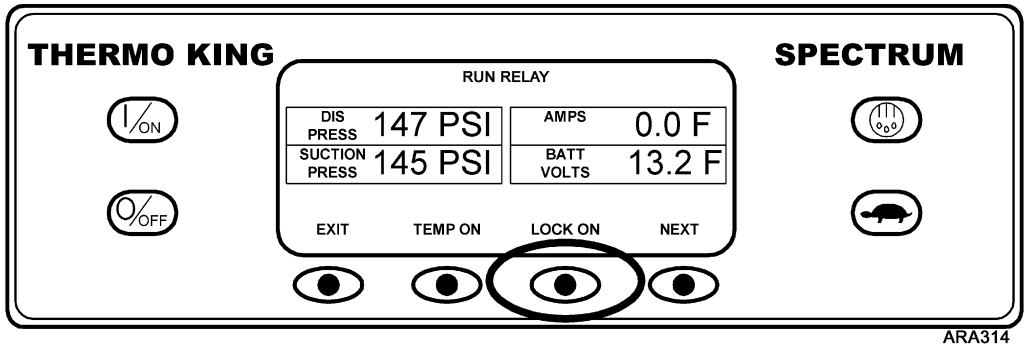


The Preheat Relay and Buzzer selections can only be energized temporarily by pressing the TEMP ON key. The Preheat Relay selection is shown below.



Using the Interface Board Test Mode Menu - (continued)

All other selections can be either energized temporarily using the TEMP ON key or locked on using the LOCK ON key. If a selection is locked on it will remain on for 15 minutes or until another function is selected. If another selection is made the current selection is de-energized. Only one selection can be energized at a time. If no other selection is made, the selection will be de-energized after 15 minutes and Alarm Code 54 Test Mode Timeout will be generated.



To return to the Maintenance Menu from the Interface Board Test Mode Display, press the EXIT key.

Using the Interface Board Test Mode Menu – (continued)

- Interface Board Test Mode selections are listed below in the order they appear. All tests are run with the unit shut down.
- Only one selection can be energized at a time. Making another selection de-energizes the previous selection.
- If no other Interface Board Test Mode state is selected within 15 minutes, the unit will shut down and generate Alarm Code 54 Test Mode Timeout.
- To return to the Maintenance Menu from the Interface Board Test Mode Display, press the EXIT key.

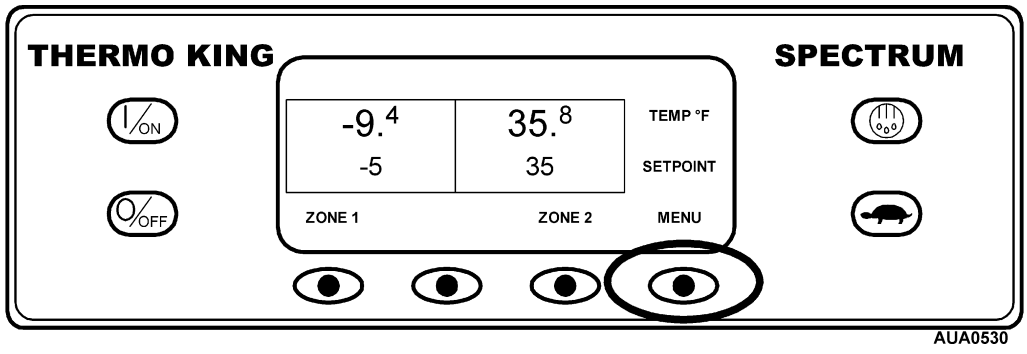
Interface Board Test Mode Operating States and Conditions

Selection	Definition
Preheat	Temporarily energizes the Preheat Relay
Buzzer	Temporarily energizes the Buzzer
Run Relay	Temporarily energizes or locks on the Run Relay
Alternator Excite Relay	Temporarily energizes or locks on the Alternator Excite Relay
High Speed Relay	Temporarily energizes or locks on the High Speed Relay
Diesel/Electric Relay	Temporarily energizes or locks on the Diesel/Electric Relay
Condenser Inlet Solenoid	Temporarily energizes or locks on the Condenser Inlet Solenoid
Scroll/Liquid Injection Valve	Temporarily energizes or locks on the Liquid Injection Valve
Receiver Tank Press Solenoid	Temporarily energizes or locks on the Receiver Tank Press Solenoid
Purge Valve	Temporarily energizes or locks on the Purge Valve
Hot Gas Bypass Valve	Temporarily energizes or locks on the Hot Gas Bypass Valve
Zone 1 Fans	Temporarily energizes or locks on the Zone 1 Fans
Zone 1 Suction Line Solenoid	Temporarily energizes or locks on the Zone 1 Suction Line Solenoid
Zone 1 Liquid Line Solenoid	Temporarily energizes or locks on the Zone 1 Liquid Line Solenoid
Zone 1 Hot Gas Solenoid	Temporarily energizes or locks on the Zone 1 Hot Gas Solenoid
Zone 2 Fans	Temporarily energizes or locks on the Zone 2 Fans
Zone 2 Suction Line Solenoid	Temporarily energizes or locks on the Zone 2 Suction Line Solenoid
Zone 2 Liquid Line Solenoid	Temporarily energizes or locks on the Zone 2 Liquid Line Solenoid
Zone 2 Hot Gas Solenoid	Temporarily energizes or locks on the Zone 2 Hot Gas Solenoid

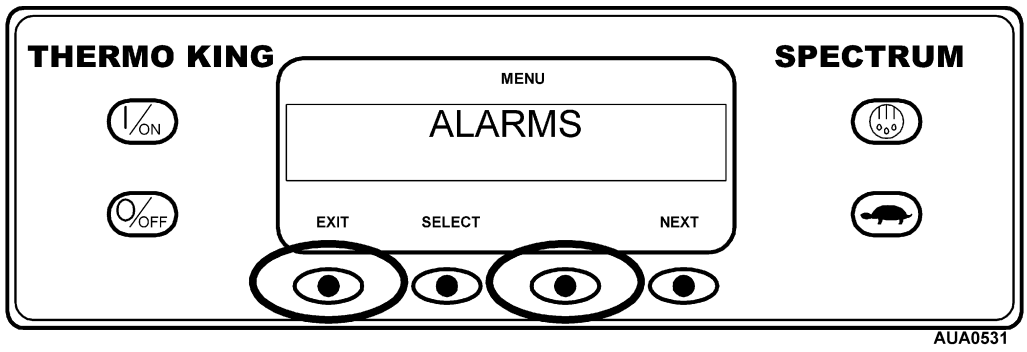
Using the Display Self Test Menu

The Display Self Test allows the operation of the Control Panel display, keypad, backlight, display intensity, buzzer and communication ports to be verified.

To access the Display Self Test Menu press the MENU key.

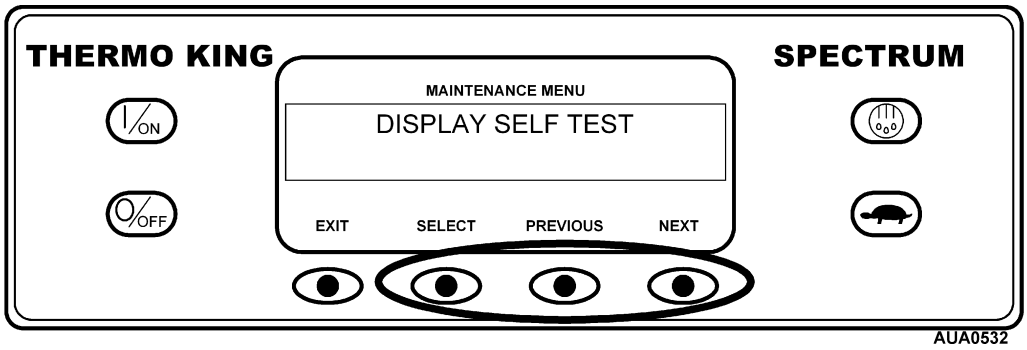


The Maintenance Menu is accessed from the first Operator Menu screen that appears; either the Language Display or the Alarms Display. The Alarms Display is shown here. Press and hold both the unlabeled soft key and the Exit key for 5 seconds.

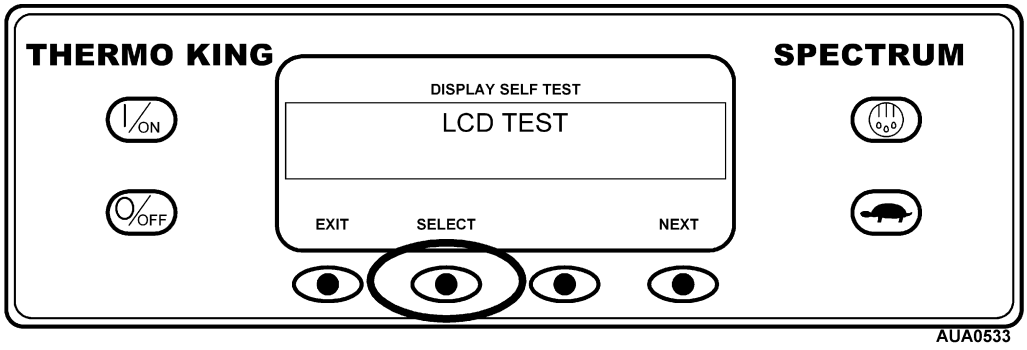


Using the Display Self Test Menu – (continued)

The Maintenance Hourmeter Menu will appear. Press the NEXT key as required to show the Display Self Test Menu. When the Display Self Test Menu is shown press the SELECT key.



The first Display Self Test will appear. Press the NEXT or PREVIOUS key as required to scroll through the Display Self Test Menu. When the desired Display Self Test Menu is shown press the SELECT key and follow the prompts for that test.



The Display Self Tests are defined on the next page. When the last test is performed the results will be display as PASS or FAIL.

To exit the Display Self Test press the EXIT key or turn the unit off.

Using the Display Self Test Menu – (continued)

Display Self Test names and definitions are listed below in the order they appear. To return to the Maintenance Menu from the Display Self Test Display, press the EXIT key.

Display Self Test Names and Definitions

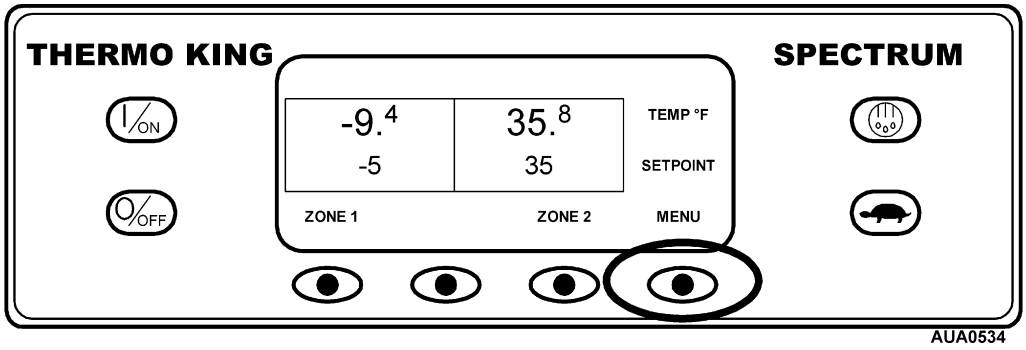
Test Name	Definition
LCD Test	Selecting this test allows a visual check of the display pixels. When NORMAL is selected all display pixels are turned off except the ones necessary to display the text. When INVERT is selected all display pixels are turned on except the ones necessary to display the text.
Keypad Test	Selecting this test allows operation of all the display keys except the On and Off keys to be verified. The operator is prompted to press each soft key, the defrost key and the turtle key to confirm operation.
Backlight Test	Selecting this test allows backlight operation to be verified. The operator is prompted to turn the backlight on and off to confirm operation.
Brightness Test	Selecting this test allows the display brightness to be verified. The operator is prompted to change the brightness level to confirm operation.
Buzzer Test	Selecting this test allows the HMI buzzer to be verified. The operator is prompted to turn the buzzer on and off to confirm operation.
Communications Test	Selecting this test allows the operation of each serial communications port to be verified.
Results Display	The test results are displayed as PASS or FAIL.

Using the Evacuation Mode Menu

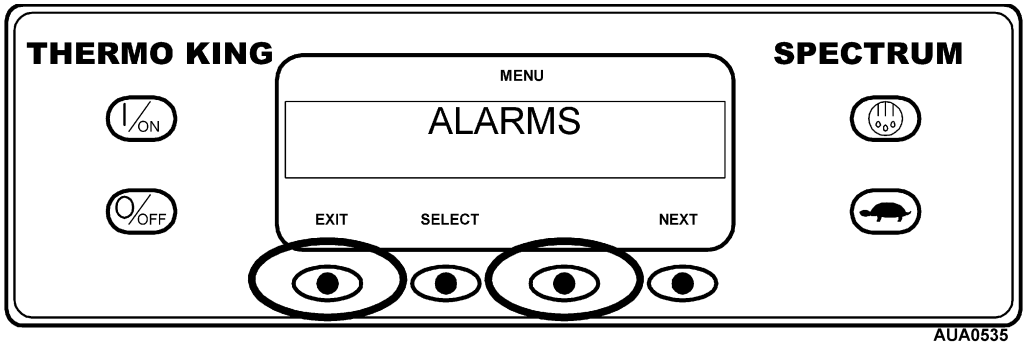
Evacuation Mode opens the system by energizing all normally closed refrigeration valves. This allows the entire refrigeration system to be evacuated.

Evacuation mode is only used with the unit off. Since a number of refrigeration valves must be energized for an extended period of time, the operator is prompted to connect a battery charger to the unit battery. This maintains the unit battery in a charged condition and insures ample voltage to hold all refrigeration valves in the open position during the evacuation process.

To access the Interface Board Test Menu press the MENU key.

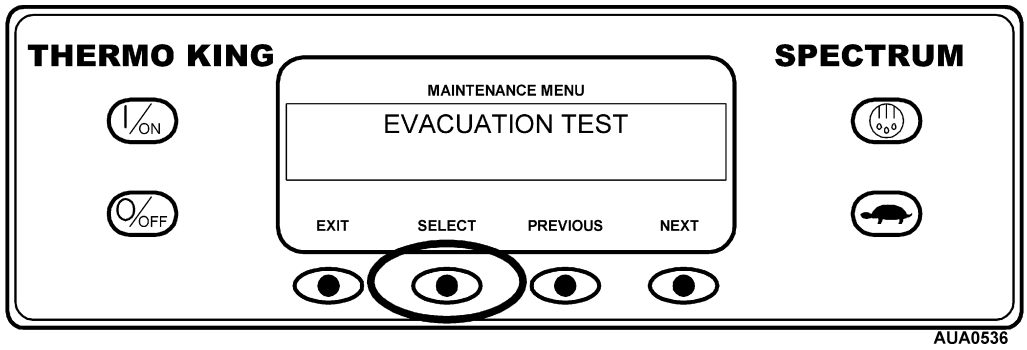


The Maintenance Menu is accessed from the first Operator Menu screen that appears; either the Language Display or the Alarms Display. The Alarms Display is shown here. Press and hold both the unlabeled soft key and the Exit key for 5 seconds.

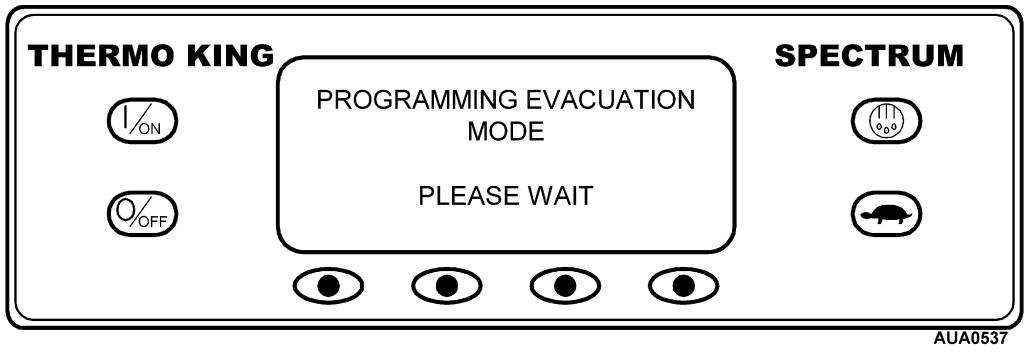


Using the Evacuation Mode Menu – (continued)

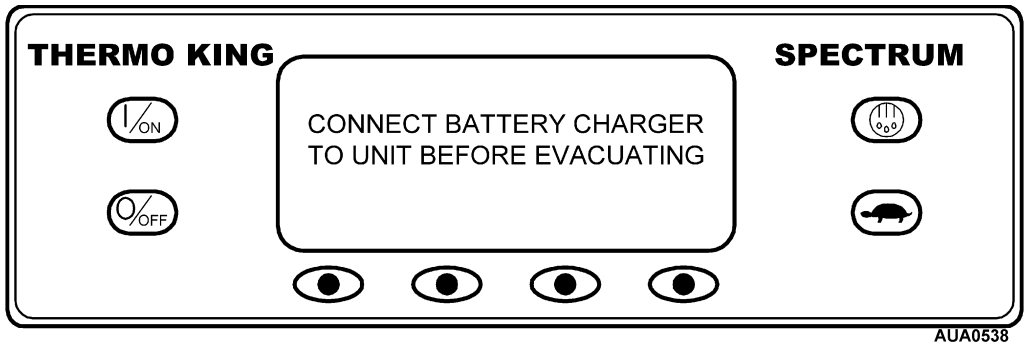
The Maintenance Hourmeter Menu will appear. Press the NEXT key as required to show the Evacuation Mode Menu. When the Evacuation Mode Menu is shown press the SELECT key.



The display will indicate that the Evacuation Mode is being programmed.

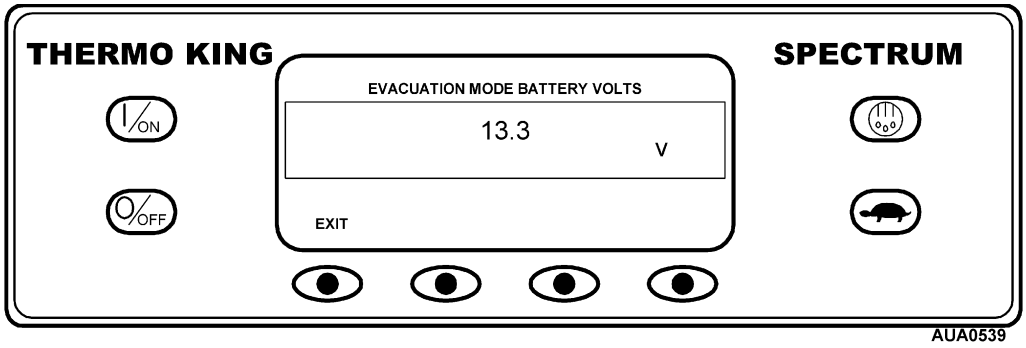


The operator is prompted to connect a battery charger capable of 20 amps to the unit battery. This maintains the unit battery in a charged condition and insures ample voltage to hold all refrigeration valves in the open position during the evacuation process.



Using the Evacuation Mode Menu – (continued)

The battery voltage is shown and all normally closed refrigeration valves are opened. They will remain open until the EXIT key is pressed or the battery voltage falls below a minimum voltage.



Proceed with system evacuation.

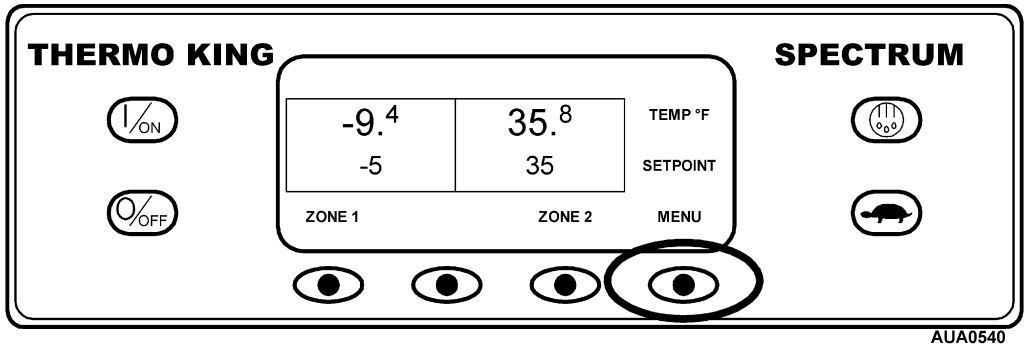
Using the Software Revision Menu

Software revisions are displayed using the Software Revision Menu.

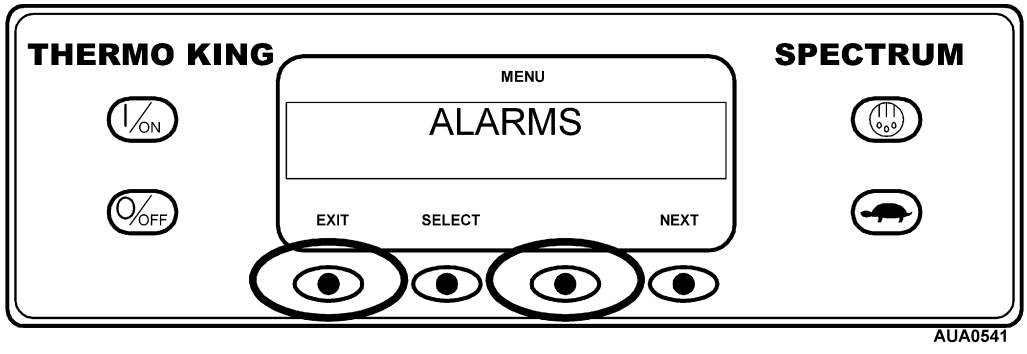
The following revisions are displayed:

- Controller Software Revision
- HMI Control Panel Software Revision

To access the Software Revision Menu press the MENU key.

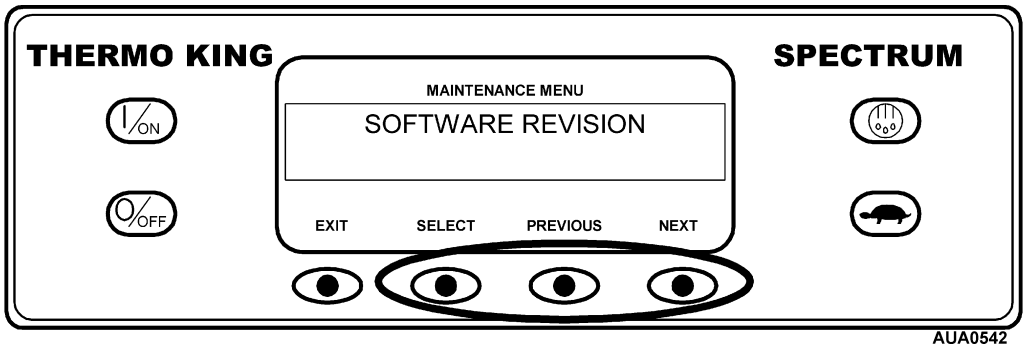


The Maintenance Menu is accessed from the first Operator Menu screen that appears; either the Language Display or the Alarms Display. The Alarms Display is shown here. Press and hold both the unlabeled soft key and the Exit key for 5 seconds.

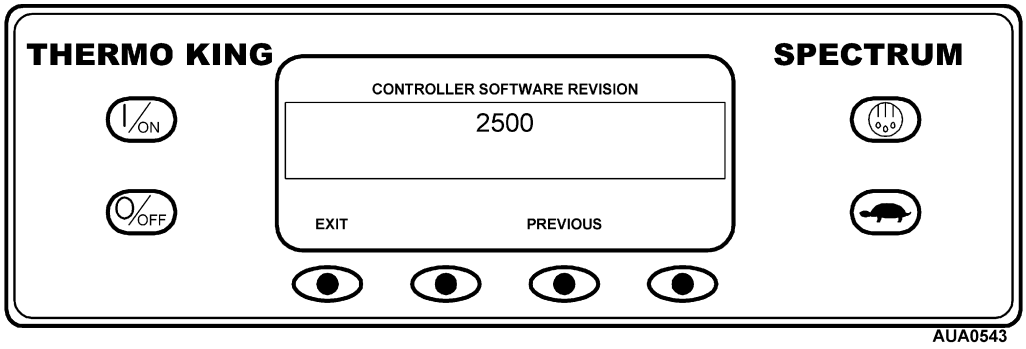


Using the Software Revision Menu – (continued)

The Maintenance Hourmeter Menu will appear. Press the NEXT key as required to show the Software Revision Menu. When the Software Revision Menu is shown press the SELECT key.



Press the NEXT or PREVIOUS key to scroll through the software revisions. The controller software revision is shown here. To return to the Maintenance Menu press the Exit key.

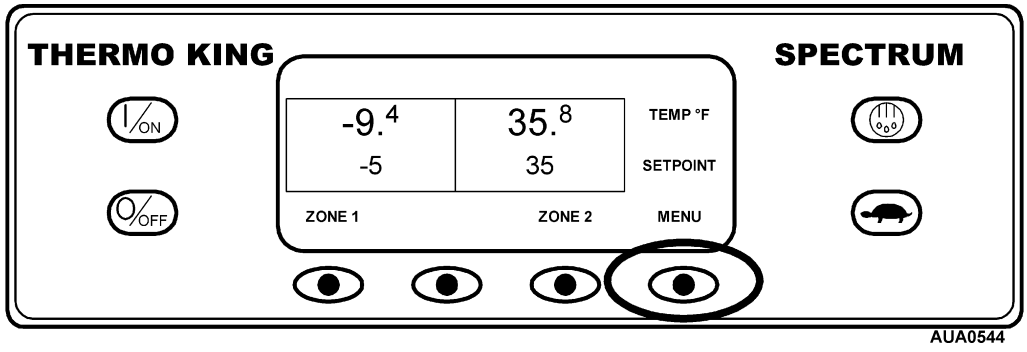


Using the Set Time and Date Menu

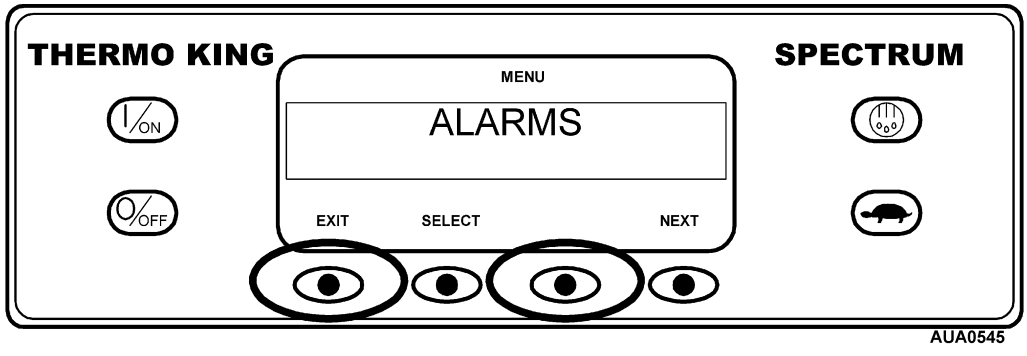
Unit time and date information is held within the HMI Control Panel. The Set Time and Date Menu is used to set or change the time and date.

It should be noted that the time display is shown in 24 hour time. For example, 1 pm is displayed as 13xx and 8 pm is shown as 20xx where xx are the minutes past the hour.

To access the Set Time and Date Menu press the MENU key.

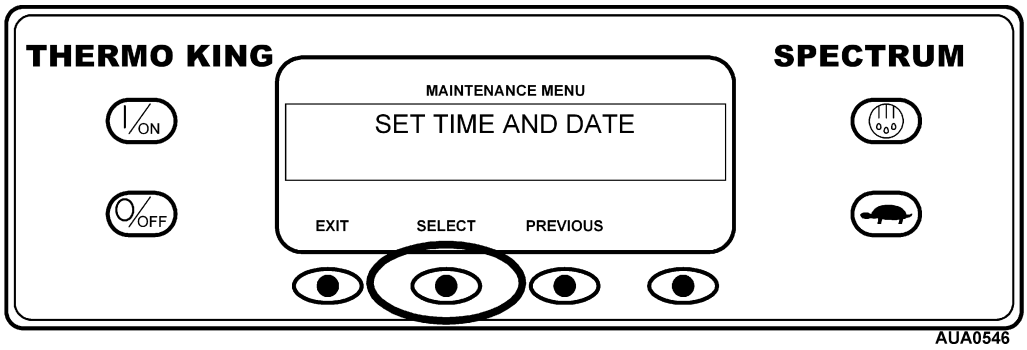


The Maintenance Menu is accessed from the first Operator Menu screen that appears; either the Language Display or the Alarms Display. The Alarms Display is shown here. Press and hold both the unlabeled soft key and the Exit key for 5 seconds.

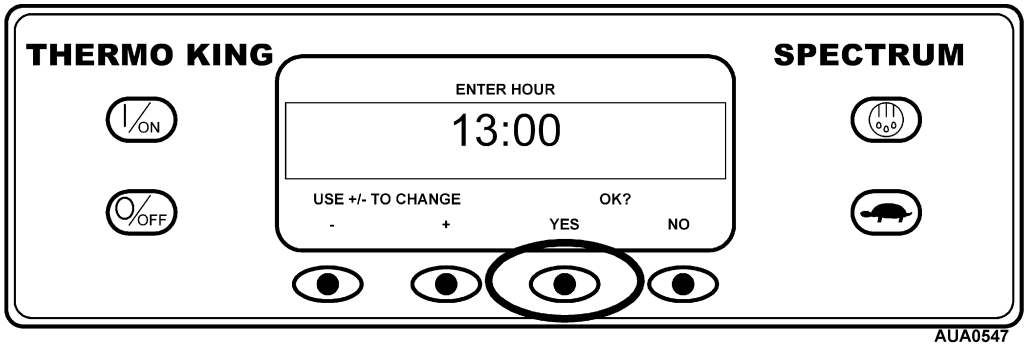


Using the Set Time and Date Menu – (continued)

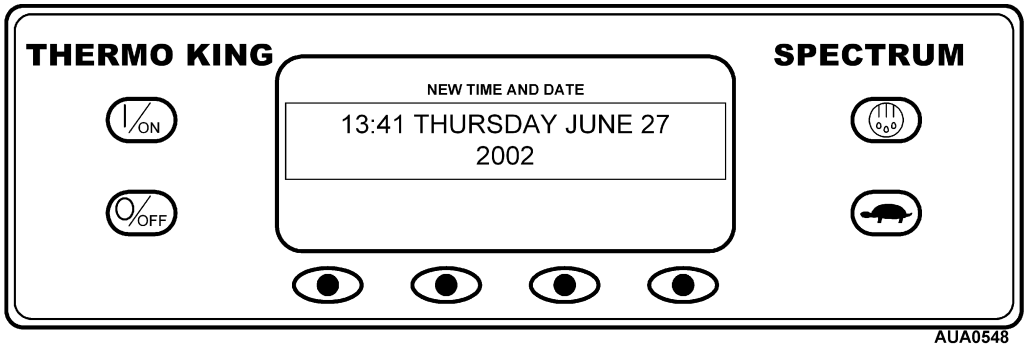
The Maintenance Hourmeter Menu will appear. Press the NEXT key as required to show the Set Time and Date Menu. When the Time and Date Menu is shown press the SELECT key.



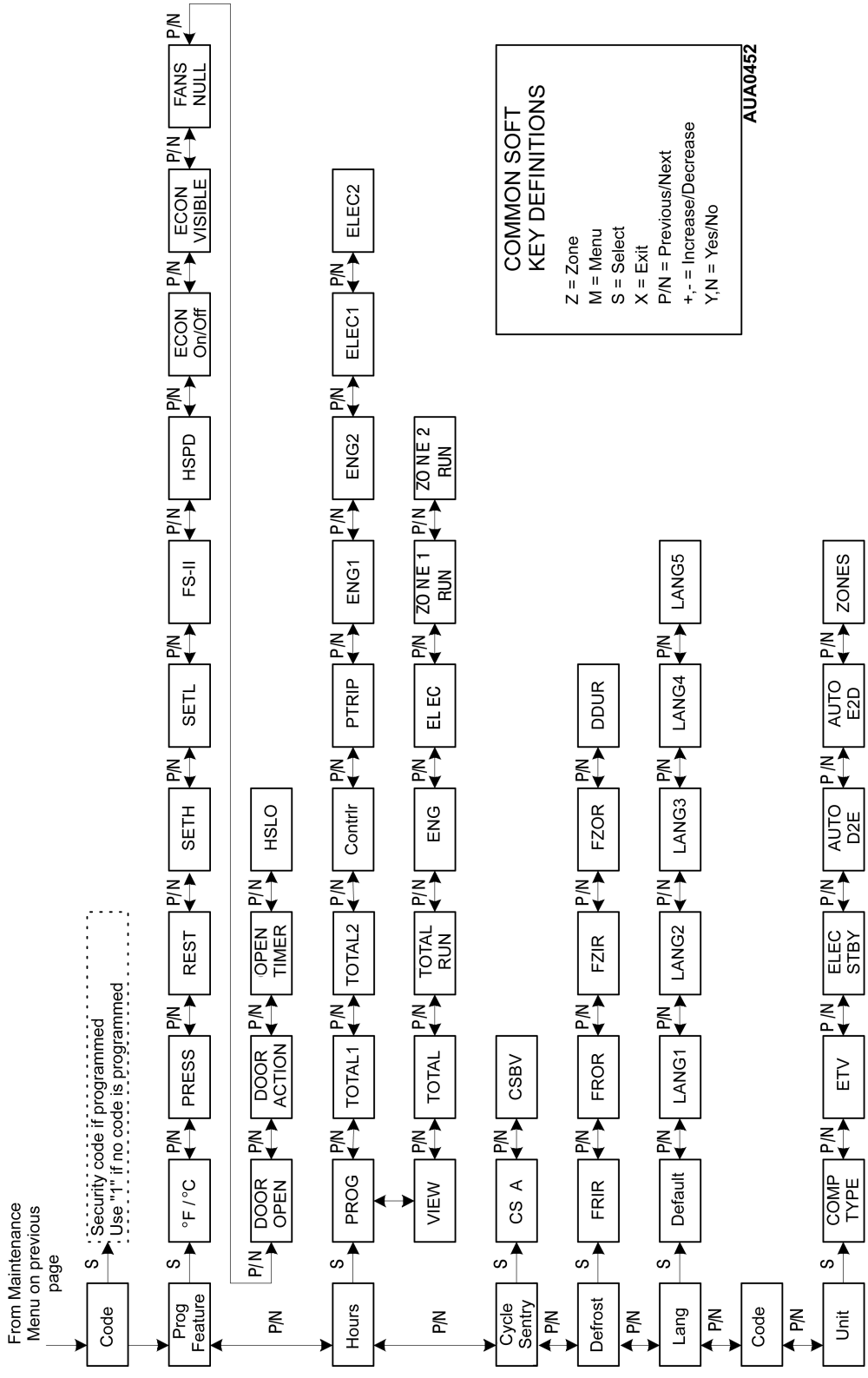
The Enter Hour display will appear. Use the "+" and "-" keys to adjust hours to the desired number and then press the YES key to confirm. 1300 hours (or 1 pm) is shown here.



Set the minutes, date, month and year in the same manner. After the Year is set and confirmed the display will briefly show the new time and date.



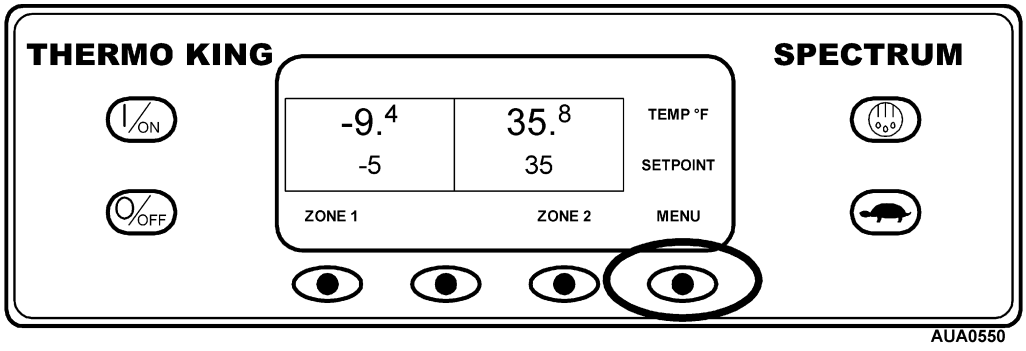
Guarded Access Menu Overview



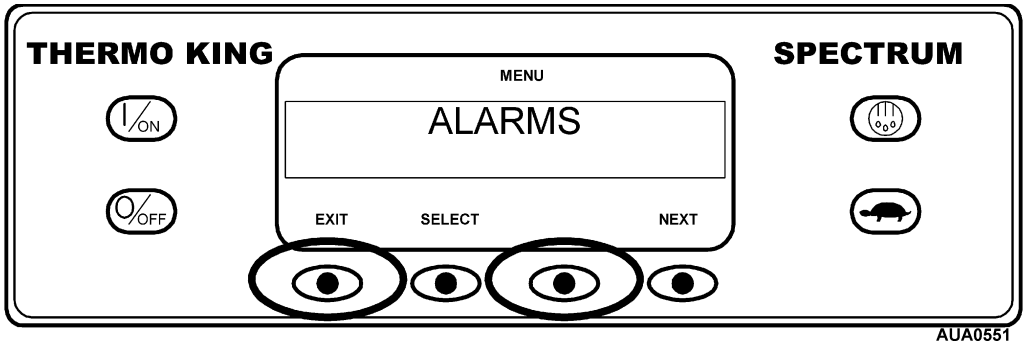
Using the Guarded Access Menu

The Guarded Access Menu contains menus that allow the technician to check and change the unit's programmable features. These features are detailed in Section 3 of this manual. Service Procedure A02A explains how to read and record the programmable feature settings. Service Procedure A04A explains how to set the programmable features.

To access the Guarded Access Menu press the MENU key.

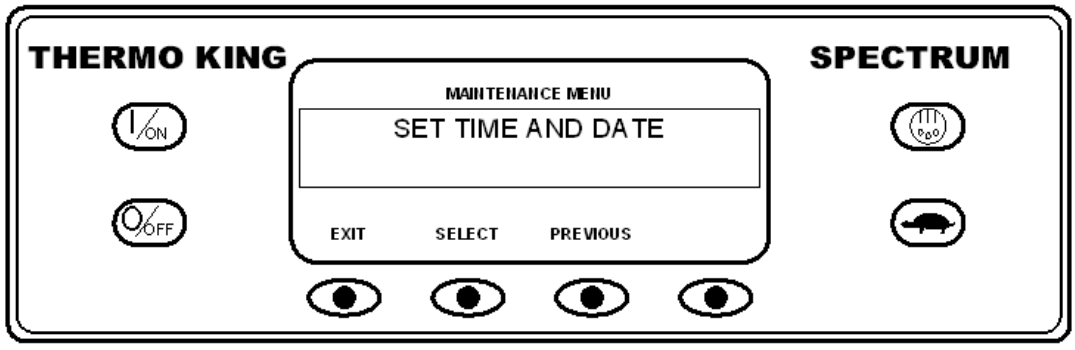


The Maintenance Menu is accessed from the first Operator Menu screen that appears; either the Language Display or the Alarms Display. The Alarms Display is shown here. Press and hold both the unlabeled soft key and the Exit key for 5 seconds.

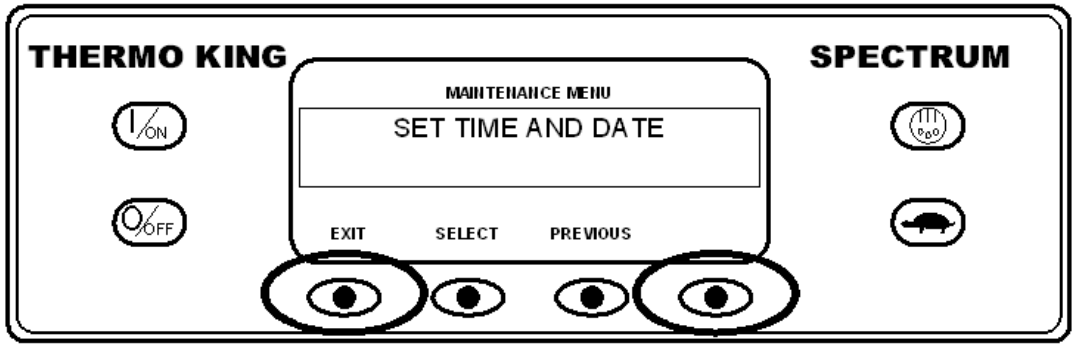


Using the Guarded Access Menu - (continued)

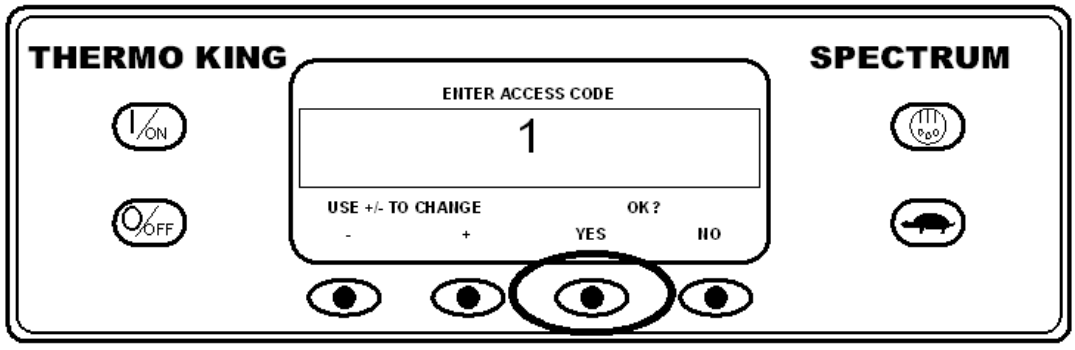
The first Maintenance Menu choice will appear. Press the NEXT key to scroll through all of the Maintenance Menu choices. When the last choice is shown on the display, the next key will disappear as shown below.



Press and hold both the unlabeled soft key and the Exit key for 5 seconds.



The Access Code challenge will appear. Enter “1” (or the code used by the customer) and press the YES key. The first submenu will appear. See the next page for complete details.



Using the Guarded Access Menu - (continued)

See Section 3 of this manual for descriptions of each feature. Service Procedure A02A in Section 6 explains how to read and record the programmable feature settings. Service Procedure A04A in Section 6 explains how to set the programmable features.

Guarded Access Menu Choices

Programmable Features Menu: Allows the technician to set the programmable features shown below.

Temperature Units	Pressure Units	Restarts are Enabled
Setpoint High Limit	Setpoint Low Limit	Fuel Saver II is Enabled
High Speed Pull Down Enabled	Economy Mode Enabled	Economy Mode Visible
Running Fans in Null	Door Open Enabled	Door Action
High Speed Lockout Enabled	Sleep After Pretrip Enabled	

Hourmeter Setup Menu: Allows the technician to set the hourmeter operation shown below.

Program Hourmeter Submenu

Total Run Time Reminder # 1	Total Run Time Reminder # 2	Controller Power On Hours
Pretrip Reminder Hours	Engine Run Time Reminder # 1	Engine Run Time Reminder # 2
Electric Run Time Reminder # 1	Electric Run Time Reminder 2	

Viewable Hourmeter Submenu

Total Hours Viewing	Total Run Hours Viewing	Controller Power Hours Viewing
Engine Run Time Viewing	Electric Run Time Viewing	Zone 1 Run Time Viewing
Zone 2 Run Time Viewing		

CYCLE-SENTRY Setup Menu: Allows the technician to set the CYCLE-SENTRY features shown below.

CYCLE-SENTRY Amps	Battery Sentry Volts

Defrost Setup Menu: Allows the technician to set the Defrost features shown below.

Defrost Interval In Range - Fresh Setpoint	Defrost Interval Not In Range - Fresh Setpoint
Defrost Interval In Range - Frozen Setpoint	Defrost Interval Not In Range - Frozen Setpoint
Maximum Defrost Duration	

Using the Guarded Access Menu - (continued)

Language Setup Menu: Allows the technician to set the Language features shown below.

Default Language	Enable Language English	Enable Language Spanish
Enable Language French	Enable Language German	Enable Language Italian

Access Code Setup Menu: Allows the technician to set the Access Code.

Enter Access Code

Unit Configuration Menu: Allows the technician to set the Unit Configuration features shown below.

Compressor Type	Number of ETV's	Electric Standby Equipped
Auto Switch Diesel to Electric	Auto Switch Electric to Diesel	Number of Zones

Section 5 — SPECTRUM Diagnostics

SPECTRUM Diagnostics

Section 5 is devoted to diagnostic routines designed to help the technician quickly identify the cause of a problem and repair it using the correct tools, information and procedures. It is important that the required procedures be followed exactly. Failure to do so may result in an incomplete repair.

The remaining material is divided into two tables. The first table suggests corrective actions as a result of alarm codes. The second table suggests corrective actions as a result of symptoms other than alarm codes.

The following hints will prove helpful.

- Every effort should be made to perform a Pretrip Test on a suspect unit. In almost all cases, the Pretrip Test will result in one or more alarm codes that will lead you directly to the problem.
- Operators should record all alarm codes in sequence for reference. Alarm codes are displayed in order of occurrence, with the most recent alarm code displayed first.
- Clear all alarm codes before starting a Pretrip Test.
- Be certain all connectors on the interface board are completely seated.
- Be certain all harness connectors are securely in place.
- Before releasing the unit for service make sure all programmable features are set to the customers specifications.

SPECTRUM Microprocessor Notes

The following procedures must be followed when working on units equipped with SPECTRUM microprocessors.

- Never use testers consisting of a battery and a light bulb to test circuits on any microprocessor based device.
- Any time a Return Air or Discharge Air sensor is changed, it must be calibrated using the Sensor Calibration feature in the Maintenance Menu.
- Any time the microprocessor is replaced, these Service Procedures must be used:

  A02A - Recording Existing Microprocessor Setup

  A03A - Microprocessor Removal and Replacement

  A04A - Microprocessor Setup
- Any time welding is necessary, Service Procedure A26A must be followed.

Electrostatic Discharge

The following electrostatic precautions must be taken.

- Keep all SPECTRUM Microprocessors and SPECTRUM HMI Control Panels in anti-static bags at all times.
- Protect any defective SPECTRUM microprocessors and SPECTRUM HMI control panels from physical damage by placing them in the shipping carton supplied with the replacement. They will be returned for failure analysis and possible re-manufacture.

Corrective Actions As A Result Of Alarm Codes

Every effort should be made to perform a Pretrip Test on a unit suspected of having a defect. In almost all cases, the Pretrip Test will result in one or more alarm codes that will lead you directly to the problem.

Alarms may be one of four types as shown below. If an alarm applies only to a specific zone, that zone will be displayed with the alarm code.

Log Alarms

Log Alarms are indicated at the top of the display for 30 seconds each time the unit is turned on. The alarm indication will go off after 30 seconds. This level of alarm serves as a notice to take corrective action before a problem becomes severe. Maintenance items such as maintenance hourmeter time-outs are log alarms.

Check Alarms

Check Alarms are indicated by a steady alarm indication at the top of the display and the message “Service Required within 24 Hours”. This level of alarm serves as a notice to take corrective action before a problem becomes severe. The unit will run with check alarms but some features and functions may be inhibited. If an alarm applies only to a specific zone, that zone will be displayed with the alarm code. On a multi-temp application if a zone specific problem is severe the zone will shut down but the alarm is set as a check alarm to allow the other zones to continue to run. If severe problems occur in all zones the unit will shut down.

Prevent Alarms

Prevent Alarms are indicated by a steady alarm indication at the top of the display and the message “Unit in Prevent Mode”. The unit will wait a timed restart interval or until conditions allow and then restart. If the unit is in a restart interval Alarm Code 84 Restart Null will be present along with the Prevent Alarm. In other cases the unit may restart with reduced performance to determine if continued operation is possible. If the alarm does not reoccur with reduced performance the unit will then return to full performance. If the unit is operating with reduced performance Alarm Code 85 Forced Unit Operation will also be present. If the alarm condition re-occurs a defined number of times the alarm is set as a shutdown alarm and no further restarts are possible. If an alarm applies only to a specific zone, that zone will be displayed with the alarm code.

Shutdown Alarms

Shutdown Alarms are indicated by a flashing alarm display and the message “Unit Not Running - Service Required”. Shutdown alarms will force the unit into shutdown. The unit will remain in shutdown until the shutdown alarm is cleared. Exceptions are some engine and electric shutdown alarms that become log alarms when switched to the alternate operating mode (diesel to electric or electric to diesel).

Special Considerations

Pretrip Alarm Codes

If an alarm occurs during a Pretrip Test the alarm code will be displayed as Pretrip Alarm XX, where XX is the alarm code.

Alarm Codes and Switching Modes from Diesel to Electric or Electric to Diesel

If a shutdown alarm occurs that affects only diesel mode operation and the unit is switched to electric, the diesel mode shutdown alarm becomes an electric mode log alarm. This allows the unit to run in electric mode without clearing the shutdown alarm that is preventing diesel mode operation. If the unit is switched back to diesel mode, the alarm again become a diesel mode shutdown alarm and prevents unit operation.

In the same manner, if a shutdown alarm occurs that affects only electric mode operation and the unit is switched to diesel, the electric mode shutdown alarm becomes a diesel mode log alarm to allow diesel mode operation. If the unit is switched back to electric mode, the alarm reverts to an electric mode shutdown alarm and prevents unit operation.

ALARM CODE Diagnostics

Alarm Code 00 - No Alarms Exist

Code	Description and Type	Corrective Action (check in order shown)
00	**No alarms exist**	None

Alarm Code 02 - Failed Evaporator Coil Sensor (in Indicated Zone)

Code	Description and Type	Corrective Action (check in order shown)
02	**Failed Evaporator Coil Sensor (in Indicated Zone)**. This is a log or shutdown alarm. A problem exists with the sensor or its wiring. The sensor is located on the evaporator coil header plate. The wiring is part of the Evaporator Zone Harness and Controller Harness and is connected to the microprocessor at the 35 pin microprocessor connector. Consult the unit wiring diagrams for complete information. ***NOTE: If all the Sensor Codes (02, 03, 04, 05, 06, 11 and 12) are present, the microprocessor may be defective or a problem may exist with the 35 pin sensor connector at the microprocessor.***	**Operator Help** 1. Manually monitor load temperature. Report this alarm at end of the day. **Technical Help** 1. Display the sensor reading using the Sensor Menu. If the display shows [----], the sensor is defective or the circuit is open or shorted. 2. Check the sensor Deutsch connector for a pushed pin or missing orange pin lock, loose pin crimp or broken wire. 3. Check the sensor using Service Procedure D01A. 4. Check the appropriate CTPx and CTNx pins on the 35 pin microprocessor connector for a pushed pin or loose pin crimp or broken wire. 5. Check the appropriate sensor harness wires with an ohmmeter per Service Procedure H04A. 6. Check the control system using Service Procedure A01A. 7. Moisture in the Deutsch connector or moisture entering the sensor through the sensor leads can cause intermittent operation.

Alarm Code 03 - Failed Return Air Sensor (in Indicated Zone)

Code	Description and Type	Corrective Action (check in order shown)
03	**Failed Return Air Sensor (in Indicated Zone)**. This is a log or shutdown alarm. A problem exists with the sensor or its wiring. The sensor is located on the evaporator blower inlet. The wiring is part of the Evaporator Zone Harness and Controller Harness and is connected to the microprocessor at the 35 pin microprocessor connector. Consult the unit wiring diagrams for complete information. ***NOTE: If all the Sensor Codes (02, 03, 04, 05, 06, 11 and 12) are present, the microprocessor may be defective or a problem may exist with the 35 pin sensor connector at the microprocessor.*** ***CAUTION: If the sensor is replaced, the temperature sensor grade must be re-calibrated using Service Procedure A15A.***	**Operator Help** 1. Manually monitor load temperature. Report this alarm at end of the day. **Technical Help** 1. Display the sensor reading using the Sensor Menu. If the display shows [----], the sensor is defective or the circuit is open or shorted. 2. Check the sensor Deutsch connector for a pushed pin or missing orange pin lock, loose pin crimp or broken wire. 3. Check the sensor using Service Procedure D01A. 4. Check the appropriate RTPx and RTNx pins on the 35 pin microprocessor connector for a pushed pin or loose pin crimp or broken wire. 5. Check the appropriate sensor harness wires with an ohmmeter per Service Procedure H04A. 6. Check the control system using Service Procedure A01A. 7. Moisture in the Deutsch connector or moisture entering the sensor through the sensor leads can cause intermittent operation.

Alarm Code 04 - Failed Discharge Air Sensor (in Indicated Zone)

Code	Description and Type	Corrective Action (check in order shown)
04	**Failed Discharge Air Sensor (in Indicated Zone)**. This is a log or shutdown alarm. A problem exists with the sensor or its wiring. The sensor is located on the evaporator discharge grill. The wiring is part of the Evaporator Zone Harness and Controller Harness and is connected to the microprocessor at the 35 pin microprocessor connector. Consult the unit wiring diagrams for complete information. ***NOTE: If all the Sensor Codes (02, 03, 04, 05, 06, 11 and 12) are present, the microprocessor may be defective or a problem may exist with the 35 pin sensor connector at the microprocessor.*** ***CAUTION: If the sensor is replaced, the temperature sensor grade must be re-calibrated using Service Procedure A15A.***	**Operator Help** 1. Manually monitor load temperature. Report this alarm at end of the day. **Technical Help** 1. Display the sensor reading using the Sensor Menu. If the display shows [----], the sensor is defective or the circuit is open or shorted. 2. Check the sensor Deutsch connector for a pushed pin or missing orange pin lock, loose pin crimp or broken wire. 3. Check the sensor using Service Procedure D01A. 4. Check the appropriate DTPx and DTNx pins on the 35 pin microprocessor connector for a pushed pin or loose pin crimp or broken wire. 5. Check the appropriate sensor harness wires with an ohmmeter per Service Procedure H04A. 6. Check the control system using Service Procedure A01A. 7. Moisture in the Deutsch connector or moisture entering the sensor through the sensor leads can cause intermittent operation.

Alarm Code 05 - Failed Ambient Air Sensor

Code	Description and Type	Corrective Action (check in order shown)
05	**Failed Ambient Air Sensor**. This is a log or shutdown alarm. A problem exists with the sensor or its wiring. The sensor is located behind the condenser grill. The wiring is part of the Controller Harness and is connected to the microprocessor at the 35 pin microprocessor connector. Consult the unit wiring diagrams for complete information. ***NOTE: If all the Sensor Codes (02, 03, 04, 05, 06, 11 and 12) are present, the microprocessor may be defective or a problem may exist with the 35 pin sensor connector at the microprocessor.***	**Operator Help** 1. Report this alarm at end of the day. **Technical Help** 1. Display the sensor reading using the Sensor Menu. If the display shows [----], the sensor is defective or the circuit is open or shorted. 2. Check the sensor Deutsch connector for a pushed pin or missing orange pin lock, loose pin crimp or broken wire. 3. Check the sensor using Service Procedure D01A. 4. Check the appropriate ATPx and ATNx pins on the 35 pin microprocessor connector for a pushed pin or loose pin crimp or broken wire. 5. Check the appropriate sensor harness wires with an ohmmeter per Service Procedure H04A. 6. Check the control system using Service Procedure A01A. 7. Moisture in the Deutsch connector or moisture entering the sensor through the sensor leads can cause intermittent operation.

Alarm Code 06 - Failed Coolant Temp Sensor

Code	Description and Type	Corrective Action (check in order shown)
06	**Failed Coolant Temp Sensor**. This is a log alarm. A problem exists with the sensor or its wiring. The sensor is located in the engine thermostat housing. The wiring is part of the Controller Harness and is connected to the microprocessor at the 35 pin microprocessor connector. Consult the unit wiring diagrams for complete information. ***NOTE: If all the Sensor Codes (02, 03, 04, 05, 06, 11 and 12) are present, the microprocessor may be defective or a problem may exist with the 35 pin sensor connector at the microprocessor.***	**Operator Help** 1. Report this alarm at end of the day. **Technical Help** 1. Display the sensor reading using the Gauges Menu. If the display shows [----], the sensor is defective or the circuit is open or shorted. 2. Check the sensor Deutsch connector for a pushed pin or missing orange pin lock, loose pin crimp or broken wire. 3. Check the sensor using Service Procedure D01A. 4. Check the appropriate WTPx and WTNx pins on the 35 pin microprocessor connector for a pushed pin or loose pin crimp or broken wire. 5. Check the appropriate sensor harness wires with an ohmmeter per Service Procedure H04A. 6. Check the control system using Service Procedure A01A. 7. Moisture in the Deutsch connector or moisture entering the sensor through the sensor leads can cause intermittent operation.

Alarm Code 07 - Failed Engine RPM Sensor

Code	Description and Type	Corrective Action (check in order shown)
07	**Failed Engine RPM Sensor**. This is a log alarm. A problem exists with the sensor, its wiring or its adjustment. The sensor is located on the flywheel housing opposite the starter. The wiring is part of the Interface Harness and is connected to the microprocessor through the Interface Board. Consult the unit wiring diagrams for complete information.	**Operator Help** 1. Report this alarm at end of the day. **Technical Help** 1. Display the sensor reading using the Gauges Menu. If the display shows [----], the sensor is defective or the circuit is open or shorted. 2. Check pins 25 and 26 on the P14 36 pin interface board connector (RPM+ and RPM- wires) for a pushed pin or loose pin crimp or broken wire. 3. Check the harness wires RPM+ and RPM- with an ohmmeter per Service Procedure H04A. 4. Check the control system using Service Procedure A01A.

Alarm Code 09 – High Evaporator Temperature

Code	Description and Type	Corrective Action (check in order shown)
09	**High Evaporator Temperature.** This is a prevent alarm. Evaporator coil temperature as sensed by the evaporator coil sensor, return air sensor and/or discharge air sensor is excessively high. See Alarm Code 02 for location of sensor and wiring.	**Operator Help** 1. Manually monitor load temperature. Report this alarm at end of the day. **Technical Help** 1. Check for Alarm Code 02, 03 and 04. Verify that the sensors are reading properly. 2. Check evaporator fans for proper operation. 3. Check for blocked or dirty evaporator coil. 4. Check for proper operation in heat and defrost mode.

Alarm Code 10 – High Discharge Pressure

Code	Description and Type	Corrective Action (check in order shown)
10	**High Discharge Pressure.** This is a prevent or shutdown alarm. The discharge pressure is excessive as sensed by the high pressure cutout switch HPCO. The high pressure cutout switch is located on the discharge line near the compressor. The wiring is part of the Interface Harness and is connected to the microprocessor through the Interface Board. Consult the unit wiring diagrams for complete information.	**Operator Help** 1. If the unit shuts down on this alarm code and the display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** 1. Check for blocked or dirty condenser coil. 2. Check refrigeration system for high discharge pressure. 3. Check the Deutsch connector at the high pressure cutout switch HPCO for a pushed pin or missing orange pin lock, loose pin crimp or broken wire. 4. Check for a defective high pressure cutout switch HPCO. Switch should be normally closed – opens under excessive discharge pressure. 5. Check pins 18 and 23 on the 36 pin interface board connector for a pushed pin, loose pin crimp or broken wire.

Alarm Code 11 – Unit Controlling on Alternate Sensor (in Indicated Zone)

Code	Description and Type	Corrective Action (check in order shown)
11	**Unit Controlling on Alternate Sensor (in Indicated Zone).** The primary control sensor has failed and the unit is controlling using the alternate sensor. See Alarm Codes 03 and/or 04 above. This is a log alarm. ***NOTE: If all the Sensor Codes (02, 03, 04, 05, 06, 11 and 12) are present, the microprocessor may be defective or a problem may exist with the 35 pin sensor connector at the microprocessor.***	**Operator Help** 1. Manually monitor load temperature. Report this alarm at end of the day. **Technical Help** 1. Check the Return Air Sensor and/or Discharge Air Sensor as shown under Alarm Codes 03 and 04 above. 2. If all sensors read [----], the microprocessor may be defective.

Alarm Code 12 – Sensor Shut Down (in Indicated Zone)

Code	Description and Type	Corrective Action (check in order shown)
12	**Sensor Shut Down (in Indicated Zone)**. This is a check alarm on multi-temp units. A critical problem exists with a combination of the Return Air and Discharge Air Sensors. See Alarm Codes 03 and 04 above. After Alarm Code 03 and/or 04 is repaired, Alarm Code 12 can be cleared. ***NOTE: If all the Sensor Codes (02, 03, 04, 05, 06, 11 and 12) are present, the microprocessor may be defective or a problem may exist with the 35 pin sensor connector at the microprocessor.***	**Operator Help** 1. The indicated zone is no longer able to operate and has been shut down. Repair immediately. **Technical Help** 1. Check the Return Air Sensor and Discharge Air Sensors as shown under Alarm Codes 03 and 04 above. 2. If all sensors read [----], the microprocessor may be defective.

Alarm Code 13 – Sensor Check (in Indicated Zone)

Code	Description and Type	Corrective Action (check in order shown)
13	**Sensor Check (in Indicated Zone)**. This is a log alarm. A critical problem exists with a combination of the Return Air, Discharge Air and/or Coil Sensors. See Alarm Codes 02, 03 and 04 above. After Alarm Code 02, 03 and/or 04 is repaired, Alarm Code 13 can be cleared.	**Operator Help** 1. Manually monitor load temperature. Report this alarm at end of the day. **Technical Help** 1. Check the Return Air Sensor and Discharge Air Sensors as shown under Alarm Codes 03 and 04 above. 2. If all sensors read [----], the microprocessor may be defective.

Alarm Code 15 – Check Glow Plugs or Intake Air Heater

Code	Description and Type	Corrective Action (check in order shown)
15	**Check Glow Plugs**. This is a log, check or shutdown alarm. The glow plugs are drawing too much or too little current. The glow plug current is checked during Pretrip Tests and whenever the engine is started automatically by the microprocessor. The Preheat Relay is located on the interface board and the wiring is located in the High Current Harness via the H circuit. Consult the unit wiring diagrams for complete information.	**Operator Help** 1. If the unit shuts down and the alarm display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** 1. Check the current draw on the glow plugs using the Gauge Menu while pre-heating. The current should be from 26 to 32 amps. 2. Check fuse F6 on the interface board. 3. Check the operation of the Preheat Relay K9 using Interface Board Test Mode in the Maintenance Menu. See Section 4 for details. 4. Check the voltage at the glow plugs. If the voltage is low check the glow plug H circuit for excessive resistance 5. Check the H circuit pin on the P21 8 pin interface board connector for a pushed pin, loose pin crimp or broken wire. 6. Check the glow plugs for continuity to be sure no plugs are open or shorted. A good plug should measure from 1 to 2 ohms. 7. Check battery volts when the glow plugs are energized. The voltage should be greater than 11.2 volts. If not, check the battery and charging circuits. 8. Check the High Current Harness H wire with an ohmmeter for continuity per Service Procedure H04A.

Alarm Code 17 – Engine Failed to Crank

Code	Description and Type	Corrective Action (check in order shown)
17	**Engine Failed to Crank**. This is a log or shutdown alarm. An engine start was attempted but the engine did not crank. The Starter Relay, LED and fuse are located on the Interface Board. The wiring is located in the High Current Harness via the 8S circuit. Consult the unit wiring diagrams for complete information.	**Operator Help** 1. If the unit shuts down and the alarm display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** 1. Check the battery, battery cables and starter. 2. Be sure the Starter Relay fuse F2 is not blown. 3. Check the operation of the Starter Relay K3 using Interface Board Test Mode in the Maintenance Menu. The relay and LED are located on the Interface Board. 4. Check the 8S pin on the P21 8 pin interface board connector for a pushed pin, loose pin crimp or broken wire. 5. Check the High Current Harness 8S wire with an ohmmeter for continuity per Service Procedure H04A.

Alarm Code 18 - High Engine Coolant Temperature

Code	Description and Type	Corrective Action (check in order shown)
18	**High Engine Coolant Temperature**. This is a prevent or shutdown alarm. The engine coolant temperature is excessively high as determined by the Coolant Temperature Sensor. The wiring is part of the Controller Harness and is connected to the microprocessor at the 35 pin microprocessor connector. Consult the unit wiring diagrams for complete information.	**Operator Help** 1. If the unit shuts down and the alarm display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** 1. Check the engine water temperature using the Gauge Menu. If the temperature is above 220°F (104°C) check the engine cooling system to determine the cause of overheating. 2. Check the engine coolant level. Bleed air from the cooling system if necessary. ***CAUTION: Do not open radiator when hot.*** 3. Check the water pump drive belt. 4. Check the radiator for restrictions. 5. Check the Water Temperature Sensor as shown under Alarm Code 06 above.

Alarm Code 19 – Low Engine Oil Pressure

Code	Description and Type	Corrective Action (check in order shown)
19	**Low Engine Oil Pressure**. This is a log or shutdown alarm. The engine oil pressure is low as determined by the Oil Pressure Switch. The wiring is part of the Interface Harness. Consult the unit wiring diagrams for complete information.	**Operator Help** 1. If the unit shuts down and the alarm display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** 1. Check engine oil level. 2. Verify engine oil pressure using an independent oil pressure gauge connected at the oil pressure switch block. 3. Check for Alarm Code 31 as related alarm.

Alarm Code 20 – Engine Failed to Start

Code	Description and Type	Corrective Action (check in order shown)
20	**Engine Failed to Start**. This is a log, check or shutdown alarm. An engine start was attempted and the engine cranked but did not start.	**Operator Help** 1. If the unit shuts down and the alarm display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** 1. Check the unit fuel level. 2. Check fuel solenoid, fuel pump and fuel system. 3. Check for cause of slow start or no start of the engine.

Alarm Code 21 – Cooling Cycle Check (in Indicated Zone)

Code	Description and Type	Corrective Action (check in order shown)
21	**Cooling Cycle Check (in Indicated Zone)**. This is a check alarm. Over a period of time the unit should have been cooling but was not cooling or was actually heating.	**Operator Help** 1. Manually monitor load temperature. Report this alarm at end of the day and repair as required. **Technical Help** 1. Check refrigerant level. 2. Attach gauges and evaluate unit refrigeration system performance. 3. Consult Section 8 for additional refrigeration system information and Service Procedures. 4. Verify that zone temperature sensors are in the correct locations. 5. Verify that zone sensor grades are set correctly. 6. Check for proper air flow. Short cycling caused by a blocked air flow path or a loose bulkhead may generate this code.

Alarm Code 22 – Heating Cycle Check (in Indicated Zone)

Code	Description and Type	Corrective Action (check in order shown)
22	**Heating Cycle Check (in Indicated Zone)**. This is a check alarm. Over a period of time the unit should have been heating but was not heating or was actually cooling.	**Operator Help** 1. Manually monitor load temperature. Report this alarm at end of the day. **Technical Help** 1. Check refrigerant level. 2. Attach gauges and evaluate unit refrigeration system performance. 3. Consult Section 8 for additional refrigeration system information and Service Procedures. 4. Verify that zone temperature sensors are in the correct locations. 5. Verify that zone sensor grades are set correctly. 6. Check for proper air flow. Short cycling caused by a blocked air flow path or a loose bulkhead may generate this code.

Alarm Code 23 – Cooling Cycle Fault (in Indicated Zone)

Code	Description and Type	Corrective Action (check in order shown)
23	**Cooling Cycle Fault (in Indicated Zone)**. On multi-temp units this is a zone check alarm that has shut the zone down. Over an extended period of time the unit should have been cooling but was not cooling or was actually heating. Corrective actions taken by the microprocessor have not been effective and the zone has been shut down.	**Operator Help** 1. The indicated zone is no longer able to operate and has been shut down. Repair immediately. **Technical Help** 1. Check refrigerant level. 2. Attach gauges and evaluate unit refrigeration system performance. 3. Consult Section 8 for additional refrigeration system information and Service Procedures. 4. Verify that zone temperature sensors are in the correct locations. 5. Verify that zone sensor grades are set correctly. 6. Check for proper air flow. Short cycling caused by a blocked air flow path or a loose bulkhead may generate this code.

Alarm Code 24 – Heating Cycle Fault (in Indicated Zone)

Code	Description and Type	Corrective Action (check in order shown)
24	**Heating Cycle Fault (in Indicated Zone)**. On multi-temp units this is a zone check alarm that has shut the zone down. Over an extended period of time the unit should have been heating but was not heating or was actually cooling. Corrective actions taken by the microprocessor have not been effective and the zone has been shut down.	**Operator Help** 1. The indicated zone is no longer able to operate and has been shut down. Repair immediately. **Technical Help** 1. Check refrigerant level. 2. Attach gauges and evaluate unit refrigeration system performance. 3. Consult Section 8 for additional refrigeration system information and Service Procedures. 4. Verify that zone temperature sensors are in the correct locations. 5. Verify that zone sensor grades are set correctly. 6. Check for proper air flow. Short cycling caused by a blocked air flow path or a loose bulkhead may generate this code.

Alarm Code 25 – Alternator Check

Code	Description and Type	Corrective Action (check in order shown)
25	**Alternator Check**. This is a log, check or shutdown alarm. The battery charging system is not functioning properly. The wiring is part of the Interface Harness. Consult the unit wiring diagrams for complete information.	**Operator Help** 1. If the unit shuts down and the alarm display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** 1. Check the alternator/compressor drive belt. 2. Start the engine and check the battery voltage and amperage using the Gauge Display in the Maintenance Menu. The voltage should be greater than 13.2 volts but less than 16 volts. Current flow should be greater than –1.0 amps. Test and repair charging system as required. 3. Check the alternator connections. 4. Check the excitation voltage at the alternator. Excitation voltage should be equal to the battery voltage. 5. Check the sense voltage at the alternator. Sense voltage should be equal to the battery voltage. 6. Check fuse F8 on the Interface Board. 7. Check the operation of the Excitation Relay K1 using Interface Board Test Mode in the Maintenance Menu. The relay and LED are located on the Interface Board. See Section 4 for details. 8. If the unit is connected to the truck battery, check the truck system for proper operation and added options such as electric lift gates.

Alarm Code 26 – Check Refrigeration Capacity (in Indicated Zone)

Code	Description and Type	Corrective Action (check in order shown)
26	**Check Refrigeration Capacity (in Indicated Zone)**. This is a zone check alarm. The unit's cooling or heating performance is impaired. This is determined during normal unit operation by comparing ambient temperature, return air temperature and discharge air temperature.	**Operator Help** 1. Manually monitor load temperature. Report alarm at end of the day. **Technical Help** 1. Check refrigerant level. 2. Attach gauges and evaluate unit refrigeration system performance. 3. Consult Section 8 for additional refrigeration system information and Service Procedures. 4. Verify that zone temperature sensors are in the correct locations. 5. Verify that zone sensor grades are set correctly. 6. Check for proper air flow. Short cycling caused by a blocked air flow path or a loose bulkhead may generate this code.

Alarm Code 28 – Pretrip Abort

Code	Description and Type	Corrective Action (check in order shown)
28	**Pretrip Abort**. This is a shutdown alarm. A shutdown alarm occurred during a Pretrip Test. Alarm codes identifying the problem will be displayed as well as Alarm Code 28. This alarm also occurs any time the Pretrip Test is halted before it is complete. It will occur if a zone or the unit is turned off during the test or if the test is interrupted by a communications request.	**Operator Help** 1. Report alarm at end of the day. **Technical Help** 1. This is a normal alarm any time the Pretrip Test is halted and does not finish with a PASS, CHECK or FAIL screen display. 2. Proceed with corrective actions for any alarm codes that occurred. 3. After repairs, repeat the Pretrip Test from the Operators Menu. See Section 4 for details. 4. If only a 28 code appears, the unit or zone may have been turned off during a Pretrip Test or the test may have been interrupted by a communications request. Clear the alarm and repeat the Pretrip Test.

Alarm Code 31 – Check Oil Pressure Switch

Code	Description and Type	Corrective Action (check in order shown)
31	**Check Oil Pressure Switch.** This is a log or shutdown alarm. The oil pressure switch is not functioning properly. The oil pressure switch should be closed when the engine is not running and open when the engine is running.	**Operator Help** 1. If the unit shuts down and the alarm display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** 1. Display the oil pressure when the unit is not running using the Gauge menu. The oil pressure should show [LOW]. If not, the switch may be stuck open or the switch circuit may be open. 2. Display the oil pressure when the unit is running using the Gauge menu. The oil pressure should be [OK]. If not, the switch may be stuck closed or the switch circuit may be shorted. 3. Connect an oil pressure gauge and confirm that oil pressure is present when the unit is running. 4. Check pin 6 on the 36 pin interface board connector (20B-01 wire) for a pushed pin or loose pin crimp or broken wire. 5. Check the 20B-01 wires in the Interface Harness with an ohmmeter for continuity per Service Procedure H04A. 6. Check the voltage on the 20B-01 wire at pin 6 of the 36 pin interface board connector P14. Battery volts should be present when the engine is running.

Alarm Code 32 – Refrigeration Capacity Shutdown

Code	Description and Type	Corrective Action (check in order shown)
32	**Refrigeration Capacity Shutdown**. On multi-temp units this is a check alarm that has shut the zone down. The unit's cooling or heating performance is considerably impaired and corrective actions such as defrost have failed to improve performance and the zone has been shut down. This is determined during normal unit operation by comparing ambient temperature, return air temperature and discharge air temperature.	**Operator Help** 1. The indicated zone is no longer able to operate and has been shut down. Repair immediately. **Technical Help** 1. Check refrigerant level. 2. Attach gauges and evaluate unit refrigeration system performance. 3. Consult Section 8 for additional refrigeration system information and Service Procedures. 4. Verify that zone temperature sensors are in the correct locations. 5. Verify that zone sensor grades are set correctly. 6. Check for proper air flow. Short cycling caused by a blocked air flow path or a loose bulkhead may generate this code.

Alarm Code 33 – Check Engine RPM

Code	Description and Type	Corrective Action (check in order shown)
33	**Check Engine RPM**. This is a check alarm that occurs only during a Pretrip Test. The engine speed is out of range in either low speed or high speed operation.	**Operator Help** 1. Report this alarm at end of the day. **Technical Help** 1. Check and adjust high speed to 2425 ± 25 RPM. 2. Check and adjust the low speed to 1800 ± 25 RPM. 3. Check for a binding solenoid or disconnected linkage. **Hint:** Use Service Test Mode to run the unit in high speed cool and low speed cool. See Section 4 for details.

Alarm Code 35 – Check Run Relay Circuit

Code	Description and Type	Corrective Action (check in order shown)
35	**Check Run Relay Circuit**. This is a shutdown alarm. The Run Relay did not function properly. The Run Relay, LED and fuse are located on the Interface Board. The wiring is located in the Interface Harness via the 8H wire.	**Operator Help** 1. If the unit shuts down and the alarm display is flashing repair immediately. **Technical Help – All Units** 1. Check fuse F11 on the Interface Board. 2. Check to be sure the K7 Run Relay LED is energized. 3. Check pin 18 on the 36 pin interface board connector (8H-01 wire) for a pushed pin or loose pin crimp or broken wire. 4. Check to be sure the High Pressure Cutout Switch is closed (8H-01 and HPCO-01 circuit). 5. Check the voltage of the HPCO-01 wire at the HPCO switch. Battery volts should be present when the unit is turned on. 6. Check pin 23 on the 36 pin interface board connector (HPCO-01 wire) for a pushed pin or loose pin crimp or broken wire.

Alarm Code 36 – Electric Motor Failed to Run

Code	Description and Type	Corrective Action (check in order shown)
36	**Electric Motor Failed to Run.** This is a log, check or shutdown alarm. The motor failed to operate or the drive belt is loose and slipping. The wiring is located in the 50 Harness. The electric standby circuits are connected to the interface board at connector P16. ***NOTE: Be sure the supply mains are energized and that all phases are present.***	**Operator Help** 1. If the unit shuts down and the alarm display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** 1. Check the motor, motor contactor, overload relay and other associated motor circuitry. The internal pull coil/hold coil circuits in the contactor may be defective requiring replacement of contactor. 2. Check the voltages at the phase detect module. Battery voltage should be present on the 7EH-01 wire and the 8F-01 wire. 3. Check the standby power voltage at the phase detect module. Standby power should be available at L1, L2 and L3. 4. Check the voltage at the motor contactor coils. Battery voltage should be present on either the 7EC or 7EB wire when the motor should be running. 5. Check for reason that the motor fails to turn the alternator, such as slipping belts, clutch, etc. 6. Check the alternator as shown under Code 25. Pay particular attention to the AC signal on the W circuit. From 0.5 to 13.0 volts AC should be present on the W circuit when the alternator is operating.

Alarm Code 37 – Check Engine Coolant Level

Code	Description and Type	Corrective Action (check in order shown)
37	**Check Engine Coolant Level**. This is a log alarm. The engine water level is low. The sensor is located on the side of the radiator tank a few inches below the filler cap. The coolant level must be at or above the sensor location. If the sensor is not submerged in coolant this alarm will be generated after the condition exists for 3 minutes. The alarm self clears automatically if the coolant level rises above the sensor location for 30 seconds. The wiring is located in the Interface Harness via the CLS-01, CHC-01, CLSP-02 circuits.	**Operator Help** 1. Report this alarm at end of the day. **Technical Help** 1. Check the engine coolant level and mixture. ***CAUTION: Exercise extreme care when checking coolant. Be sure coolant is above sensor when the coolant is cold.*** 2. Check the sensor Deutsch connector for a pushed pin or missing orange pin lock, loose pin crimp or broken wire. 3. Check that +5 Vdc is present between the red sensor wire from the microprocessor (CLSP-02) and the black wire (CHC-01). Check pin 23 on the 35 pin microprocessor connector (CLSP-01 wire) for a pushed pin or loose pin crimp or broken wire. 4. Check continuity to ground of the black sensor wire (CHC-01). 5. Check the voltage between the white sensor wire (CLS-01) and the black wire (CHC-01). Voltage should be +5 Vdc when the sensor is submerged in coolant and less than +0.5 Vdc when the sensor is not submerged. Check pin 28 on the 36 pin interface board connector (CLS-01 wire) for a pushed pin or loose pin crimp or broken wire.

Alarm Code 38 – Electric Phase Reversed

Code	Description and Type	Corrective Action (check in order shown)
38	**Electric Phase Reversed.** This is a log or shutdown alarm. Two phases are reversed on 3 phase standby power or the motor is mis-wired, causing the compressor and condenser fan to rotate in the wrong direction.	**Operator Help** 1. If the unit shuts down and the alarm display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** 1. Check motor wiring to be sure phase rotation is correct. 2. Confirm that the 7EC-01 wire is connected to the MCB motor contactor and the 7EB-01 wire is connected to the MCA motor contactor. 3. Check the voltages at the phase detect module. Battery voltage should be present on the 7EH-01 wire and the 8F-01 wire. 4. Check the standby power voltage at the phase detect module. Standby power should be available at L1, L2 and L3. 5. Confirm that the phase wiring between contactor MCA and MCB is correct.

Alarm Code 40 – Check High Speed Circuit

Code	Description and Type	Corrective Action (check in order shown)
40	**Check High Speed Circuit**. This is a check or shutdown alarm that only occurs during a Pretrip Test. A problem exists with the throttle relay, throttle solenoid or the associated circuitry. The K5 Throttle Relay, LED and fuse F18 are located on the Interface Board. The wiring is located in the High Current Harness via the 7D-01 circuit.	**Operator Help** 1. If the unit shuts down and the alarm display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** 1. Check interface board fuse F18. 2. Check the operation of the throttle solenoid using Interface Board Test Mode in the Maintenance Menu. See Section 4 for details. 3. With the throttle solenoid energized using Interface Board Test Mode check the current flow using the Gauge Menu. Current should be from 1-10 amps. 4. With the throttle solenoid energized using Interface Board Test Mode check for 12 volts across the throttle solenoid. 5. Check the throttle solenoid with an ohmmeter for continuity. 6. Check the High Current Harness wire 7D with an ohmmeter for continuity per Service Procedure H04A.

Alarm Code 42 – Unit Forced to Low Speed

Code	Description and Type	Corrective Action (check in order shown)
42	**Unit forced to Low Speed**. This is a prevent alarm. The unit has been forced to low speed operation due to high discharge pressure or high engine coolant temperature. This code will appear with Alarm Code 10 or Alarm Code 18. This is a check alarm that clears automatically when discharge pressure or coolant temperature returns to normal for a period of time.	**Operator Help** 1. Report this alarm at end of the day. **Technical Help** 1. Proceed as directed by Alarm Code 10 or Alarm Code 18.

Alarm Code 45 – Check Hot Gas Bypass Circuit

Code	Description and Type	Corrective Action (check in order shown)
45	**Check Hot Gas Bypass Circuit**. This is a check or shutdown alarm that only occurs during a Pretrip Test. A problem exists with the hot gas bypass output, hot gas bypass valve or the associated circuitry. The hot gas bypass LED and fuse F20 are located on the Interface Board. The wiring is located in the Interface Harness via the HGBP-01 and HGBN-01 circuits.	**Operator Help** 1. If the unit shuts down and the alarm display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** 1. Check interface board fuse F20. 2. Check the operation of the hot gas bypass valve using Interface Board Test Mode in the Maintenance Menu. See Section 4 for details. 3. With the hot gas bypass valve energized using Interface Board Test Mode check the current flow using the Gauge Menu. Current should be from 0.5 – 3.0 amps. 4. With the hot gas bypass valve energized using Interface Board Test Mode check for 12 volts across the hot gas bypass valve connector. 5. Check the hot gas bypass valve coil with an ohmmeter for continuity. 6. Check the Interface Harness wires HGBP-01 and HGBN-01 with an ohmmeter for continuity per Service Procedure H04A.

Alarm Code 50 – Reset Clock

Code	Description and Type	Corrective Action (check in order shown)
50	**Reset Clock**. This is a log alarm. The unit clock may no longer be accurate.	**Operator Help** 1. Report this alarm at end of the day. **Technical Help** 1. Reset clock as required. Consult customer for desired time zone.

Alarm Code 52 – Check Hot Gas Valve (in Indicated Zone)

Code	Description and Type	Corrective Action (check in order shown)
52	**Check Hot Gas Valve Circuit (in Indicated Zone)**. This is a check or shutdown alarm that only occurs during a Pretrip Test. On multi-temp units a hot gas solenoid is located in the remote evaporator for each zone. The affected zone will be identified along with this alarm code. A problem exists with the hot gas relay, hot gas solenoid or the associated circuitry. The zone 1 hot gas relay, LED and fuse F7 are located on the Interface Board. The zone 2 hot gas relay, LED and fuse F200 are located on the Multi-Temp Option Board. The wiring is located in the Controller Harness and Evaporator Zone Harness.	**Operator Help** 1. If the unit shuts down and the alarm display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** 1. Check interface board fuse F7 (Zone 1) or multi-temp option board fuse F200 (Zone 2). 2. Check the operation of the hot gas valve in the appropriate zone using Interface Board Test Mode in the Maintenance Menu. See Section 4 for details. 3. With the hot gas valve energized using Interface Board Test Mode check the current flow using the Gauge Menu. Current should be from 0.5 – 3.0 amps. 4. With the hot gas valve energized using Interface Board Test Mode check for 12 volts across the hot gas valve connector. 5. Check the hot gas valve coil with an ohmmeter for continuity. 6. Check the Controller Harness and Evaporator Zone Harness wires for continuity per Service Procedure H04A. See the wiring diagram for details.

Alarm Code 54 – Test Mode Timeout

Code	Description and Type	Corrective Action (check in order shown)
54	**Test Mode Timeout.** This is a shutdown alarm. The unit was placed in a Service Test Mode function and no other Test Mode function was selected for 15 minutes.	**Operator Help** 1. Report alarm at end of the day. **Technical Help** 1. While in Service Test Mode, if no other function is selected within 15 minutes the unit will shut down and record Alarm Code 54. Clear the alarm and re-enter Service Test Mode if necessary to complete the diagnosis or repair.

Alarm Code 61 – Low Battery Voltage

Code	Description and Type	Corrective Action (check in order shown)
61	**Low Battery Voltage**. This is a log, check or shutdown alarm. The battery voltage is low.	**Operator Help** 1. If the unit shuts down and the alarm display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** 1. Check for discharged (run down) battery. 2. Check the battery terminals for tightness and corrosion. 3. With the engine running check the battery voltage using the Gauge Menu. See Section 4 for details. 4. With the engine running check the battery charge rate using the Gauge Menu. See Section 4 for details. 5. Check alternator operation.

Alarm Code 62 – Ammeter Out of Calibration

Code	Description and Type	Corrective Action (check in order shown)
62	**Ammeter Out of Calibration**. This is a shutdown alarm. The ammeter cannot be properly calibrated and the readings may be incorrect.	**Operator Help** 1. If the unit shuts down and the alarm display is flashing repair immediately. **Technical Help** 1. Check the shunt resister using an ohmmeter. 2. Check the control system using Service Procedure A01A.

Alarm Code 63 – Engine Stopped

Code	Description and Type	Corrective Action (check in order shown)
63	**Engine Stopped**. This is a log or shutdown alarm. Indicates that the unit was running and still should be but has stopped. This alarm may occur as a result of intermittent contact.	**Operator Help** 1. If the unit shuts down and the alarm display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** 1. Perform a Pretrip Test to determine cause for shutdown. 2. Check the fuel level. 3. Check the fuel pump for proper operation. 4. Check the air cleaner and intake hose for obstructions. 5. Check the unit fuses. 6. Check the RPM sensor for proper operation. 7. Check for low battery voltage. 8. Be sure all ground connections on the master ground plate are secure. 9. Check suction pressure regulator and/or throttling valve for proper operation.

Alarm Code 64 – Pretrip Reminder

Code	Description and Type	Corrective Action (check in order shown)
64	**Pretrip Reminder**. This is a log alarm. The unit is due for a Pretrip Test.	**Operator Help** 1. Report this alarm at end of the day. **Technical Help** 1. Perform a Pretrip Test to confirm unit operation. Reset the Pretrip Reminder hourmeter after successful test completion.

Alarm Code 66 – Low Engine Oil Level

Code	Description and Type	Corrective Action (check in order shown)
66	**Low Engine Oil Level**. This is a log or shutdown alarm. Indicates that the engine oil level is low. The switch is located on the side of the engine in the oil pan. The switch is open with full oil level and closed with low oil level. The wiring is located in the Interface Harness via the OLSP-01 and OLSN-01 circuits.	**Operator Help** 1. If the unit shuts down and the alarm display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** 1. Check the engine oil level. 2. Check the switch with an ohmmeter. It should be open when the oil level is satisfactory. 3. Check pins 12 and 29 on the 36 pin Interface Board Connector for a pushed pin, loose pin crimp or broken wire. 4. Check the harness wires OLSP-01 and OLSN-01with an ohmmeter for continuity per Service Procedure H04A.

Alarm Code 67 – Check Liquid Line Solenoid (in Indicated Zone)

Code	Description and Type	Corrective Action (check in order shown)
67	**Check Liquid Line Solenoid Circuit (in Indicated Zone).** This is a check or shutdown alarm that only occurs during a Pretrip Test. On multi-temp units a liquid line solenoid is located in the remote evaporator for each zone. The affected zone will be identified along with this alarm code. A problem exists with the liquid line relay, liquid line solenoid or the associated circuitry. The zone 1 liquid line solenoid relay, LED and fuse F7 are located on the Interface Board. The zone 2 liquid line solenoid relay, LED and fuse F200 are located on the Multi-Temp Option Board. The wiring is located in the Controller Harness and Evaporator Zone Harness.	**Operator Help** 1. If the unit shuts down and the alarm display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** 1. Check interface board fuse F7 (Zone 1) or multi-temp option board fuse F200 (Zone 2). 2. Check the operation of the liquid line solenoid in the appropriate zone using Interface Board Test Mode in the Maintenance Menu. See Section 4 for details. 3. With the liquid line solenoid energized using Interface Board Test Mode check the current flow using the Gauge Menu. Current should be from 0.5 – 3.0 amps. 4. With the liquid line solenoid energized using Interface Board Test Mode check for 12 volts across the liquid line solenoid connector. 5. Check the liquid line solenoid coil with an ohmmeter for continuity. 6. Check the Controller Harness and Evaporator Zone Harness wires for continuity per Service Procedure H04A. See the wiring diagram for details.

Alarm Code 68 – Internal Controller Fault Code

Code	Description and Type	Corrective Action (check in order shown)
68	**Internal Controller Fault Code.** This is a log alarm.	**Operator Help** 1. Report this alarm at end of the day. **Technical Help** 1. Check the control system using Service Procedure A01A.

Alarm Code 70 – Hourmeter Failure

Code	Description and Type	Corrective Action (check in order shown)
70	**Hourmeter Failure.** This is a log alarm. Indicates that the hourmeter exceeds 499,999 hours or that a problem occurred when the microprocessor attempted to write to the hourmeter memory.	**Operator Help** 1. Report this alarm at end of the day. **Technical Help** 1. Check Hourmeters 1, 2 and 3. If the reading is normal, perform a Cold Start per Service Procedure A07A. If the code can now be cleared, proceed with microprocessor setup using Service Procedure A04A. ***CAUTION: The microprocessor must be set up using Service Procedure A04A any time a Cold Start is performed.***

Alarm Code 74 – Controller Reset to Defaults

Code	Description and Type	Corrective Action (check in order shown)
74	**Controller Reset to Defaults**. This is a check alarm. Indicates that all programmable values have been set to the default values.	**Operator Help** 1. Report this alarm at end of the day. **Technical Help** 1. Complete the microprocessor setup using Service Procedure A04A. 2. Alarm code 74 will be cleared during the microprocessor setup using Service Procedure A04A. 3. Verify that interface board Jumper X2 is in the correct position. ***CAUTION: Failure to perform the above setup procedures after a Code 74 alarm will result in the unit failing to perform to customer specifications.***

Alarm Code 79 – Data Log Overflow

Code	Description and Type	Corrective Action (check in order shown)
79	**Data Log Overflow**. This is a log alarm.	**Operator Help** 1. Report this alarm at end of the day. **Technical Help** 1. No corrective action possible. This indicates that an event occurred that was not recorded by the data logger.

Alarm Code 80 – Failed Compressor Temperature Sensor

Code	Description and Type	Corrective Action (check in order shown)
80	**Failed Compressor Temperature Sensor**. This is a check alarm. A problem exists with the sensor or its wiring. The sensor is located in the scroll compressor housing. The wiring is part of the Controller Harness and is connected to the microprocessor at the 35 pin microprocessor connector. Consult the unit wiring diagrams for complete information. ***NOTE: If all the Sensor Codes (02, 03, 04, 05, 06, 11 and 12) are present, the microprocessor may be defective or a problem may exist with the 35 pin sensor connector at the microprocessor.***	**Operator Help** 1. Report this alarm at end of the day. **Technical Help** 1. Check the sensor reading using the Gauges Menu. If the display shows [----], the sensor is defective or the circuit is open or shorted. 2. Check pins 35 and 12 on the J3 35 pin interface board connector (CPTP-01 and CPTN-01 wires) for a pushed pin or loose pin crimp or broken wire. 3. Check the harness wires CPTP-01 and CPTN-01 with an ohmmeter per Service Procedure H04A. 4. Check the control system using Service Procedure A01A.

Alarm Code 82 – High Compressor Temperature Shutdown

Code	Description and Type	Corrective Action (check in order shown)
82	**High Compressor Temperature Shutdown**. This is a prevent alarm. The compressor temperature is excessive as sensed by the compressor temperature sensor. The sensor is located in the scroll compressor housing. The wiring is part of the Interface Harness and is connected to the microprocessor through the Interface Board. Consult the unit wiring diagrams for complete information.	**Operator Help** 1. If the unit shuts down on this alarm code and the display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** 1. Check the refrigerant level. 2. Check for air in the system. 3. Check refrigeration system for proper operation. 4. Check compressor temperature sensor operation as shown under Alarm Code 80.

Alarm Code 84 – Restart Null

Code	Description and Type	Corrective Action (check in order shown)
84	**Restart Null**. This is associated with a prevent alarm. The alarm clears automatically if the condition does not re-occur. This alarm occurs if unit operation is prevented as a result of the associated prevent alarm. For example, if a high discharge pressure condition shuts the unit down, a waiting period is provided to allow system pressures to equalize. A restart will occur when conditions permit.	**Operator Help** 1. Report this alarm at end of the day. **Technical Help** 1. Check for associated alarms and repair as required.

Alarm Code 85 – Forced Unit Operation

Code	Description and Type	Corrective Action (check in order shown)
85	**Forced Unit Operation**. This is associated with a prevent alarm. For example, high coolant temperature may cause the unit to switch to low speed until the coolant temperature falls. The alarm clears automatically if the condition does not re-occur. This alarm occurs if **unit operation is changed as a result of the associated prevent alarm.**	**Operator Help** 1. Report this alarm at end of the day. **Technical Help** 1. Check for associated alarms and repair as required.

Alarm Code 86 – Failed Discharge Pressure Transducer

Code	Description and Type	Corrective Action (check in order shown)
86	**Failed Discharge Pressure Transducer**. This is a check alarm. A problem exists with the sensor or its wiring. The sensor is located near the scroll compressor discharge port. The wiring is part of the Controller Harness and is connected to the microprocessor at the 35 pin microprocessor connector. Consult the unit wiring diagrams for complete information.	**Operator Help** 1. Report this alarm at end of the day. **Technical Help** 1. Check the discharge pressure display using the Gauge Menu. 2. If the discharge pressure is not displayed by the microprocessor unplug the transducer and check for +5 Vdc between DPP-01 and DPN-01. If 5 volts is not present check the microprocessor using Service Procedure A01A. 3. Check the harness wires DPP-01, DPN-01 and DP-01 for continuity using an ohmmeter. 4. Connect refrigeration gauges to verify that transducer is not displaying the correct pressure. Replace the transducer.

Alarm Code 87 – Failed Suction Pressure Transducer

Code	Description and Type	Corrective Action (check in order shown)
87	**Failed Suction Pressure Transducer**. This is a check alarm. A problem exists with the sensor or its wiring. The sensor is located on the throttling valve at the scroll compressor. The wiring is part of the Controller Harness and is connected to the microprocessor at the 35 pin microprocessor connector. Consult the unit wiring diagrams for complete information.	**Operator Help** 1. Report this alarm at end of the day. **Technical Help** 1. Check the suction pressure display using the Gauge Menu. 2. If the suction pressure is not displayed by the microprocessor unplug the transducer and check for +5 Vdc between SPP-01 and SPN-01. If 5 volts is not present check the control system using Service Procedure A01A. 3. Check the harness wires SPP-01, SPN-01 and SP-01 for continuity using an ohmmeter. 4. Connect refrigeration gauges to verify that transducer is not displaying the correct pressure. Replace the transducer.

Alarm Code 90 – Electric Overload

Code	Description and Type	Corrective Action (check in order shown)
90	**Electric Overload**. This is a log, check or shutdown alarm.	**Operator Help** 1. If the unit shuts down and the alarm display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** ***CAUTION: High voltage is present any time the unit is connected to standby power. Exercise extreme care.*** 1. Check the electric motor for current draw. Refer to the motor nameplate for the Full Load Amperage rating (FLA) of the motor. 2. Check the setting of the motor overload relay. It should be 10% greater than full load rating of the motor. 3. Check the throttling valve and suction pressure regulators for the correct settings. 4. Check the EOL-01 Circuit for continuity from P16 on the interface board to the overload relay. 5. Check for continuity between the overload relay terminals 95 and 96. The contacts should be normally closed. 6. Check the EOL-02 Circuit for continuity to chassis ground. 7. If the EOL-01 circuit is grounded test the control system per Service Procedure A01A.

Alarm Code 91 – Check Electric Ready Input

Code	Description and Type	Corrective Action (check in order shown)
91	**Check Electric Ready Input**. This is a log, check or shutdown alarm.	**Operator Help** 1. If the unit shuts down and the alarm display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** ***CAUTION: High voltage is present any time the unit is connected to standby power. Exercise extreme care.*** 1. Confirm the LED on the phase detect module is on when standby power is connected to the unit. 2. Check the ER-01 Circuit from the phase detect module for 12 volts to chassis ground when standby power is connected to the unit. 3. Check the 8F-01 circuit at the phase detect module for 12 volts. 4. Check to be sure standby power of the correct voltage is present at L1, L2 and L3 on the phase detect module. 5. Check the ER-01 Circuit for continuity from P16 on the interface board to the phase detect module. 6. If steps 1-5 above are correct, check the control system using Service Procedure A01A. 7. If steps 1, 2, 4 or 5 above are not correct replace the phase detect module.

Alarm Code 92 – Sensor Grade not Set

Code	Description and Type	Corrective Action (check in order shown)
92	**Sensor Grades Not Set**. This is a log alarm that only occurs during a Pretrip Test. The sensor grades of the graded sensors are set to grade 5H. This indicates they have not been properly set.	**Operator Help** 1. Report this alarm at end of the day. **Technical Help** 1. Verify actual sensor grades for all graded sensors. 2. Using this information, calibrate the sensors using the Sensor Calibration feature in the Maintenance Menu. See Section 4 for details.

Alarm Code 93 – Low Compressor Suction Pressure

Code	Description and Type	Corrective Action (check in order shown)
93	**Low Compressor Suction Pressure**. This is a prevent alarm. Compressor suction pressure is less than or equal to 0 PSIG.	**Operator Help** 1. If the unit shuts down on this alarm code and the display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** 1. Install gauge set and confirm that suction pressure is low and matches the reading shown on the Gauge Menu. See Section 4 for more information on using the Gauge Menu. 2. If suction pressure is low diagnose the refrigeration system as required. 3. If the suction pressure displayed by the Gauge Menu is incorrect, check the suction pressure transducer as shown in Alarm Code 87.

Alarm Code 106 – Check Purge Valve Circuit

Code	Description and Type	Corrective Action (check in order shown)
106	**Check Purge Valve Circuit.** This is a check or shutdown alarm that only occurs during a Pretrip Test. A problem exists with the purge valve output, purge valve or the associated circuitry. The purge valve LED and fuse F17 are located on the Interface Board. The wiring is located in the Interface Harness via the PVP-01 and PVN-01 circuits.	**Operator Help** 1. If the unit shuts down and the alarm display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** 1. Check interface board fuse F17. 2. Check the operation of the purge valve using Interface Board Test Mode in the Maintenance Menu. See Section 4 for details. 3. With the purge valve energized using Interface Board Test Mode check the current flow using the Gauge Menu. Current should be from 0.5 – 3.0 amps. 4. With the purge valve energized using Interface Board Test Mode check for 12 volts across the purge valve connector. 5. Check the purge valve coil with an ohmmeter for continuity. 6. Check the Interface Harness wires PVP-01 and PVN-01 with an ohmmeter for continuity per Service Procedure H04A.

Alarm Code 107 – Check Condenser Inlet Solenoid Circuit

Code	Description and Type	Corrective Action (check in order shown)
107	**Check Condenser Inlet Solenoid Circuit.** This is a check or shutdown alarm that only occurs during a Pretrip Test. A problem exists with the condenser inlet solenoid output, condenser inlet solenoid or the associated circuitry. The condenser inlet solenoid LED and fuse F21 are located on the Interface Board. The wiring is located in the Interface Harness via the CISP-01 and CISN-01 circuits.	**Operator Help** 1. If the unit shuts down and the alarm display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** 1. Check interface board fuse F21. 2. Check the operation of the condenser inlet solenoid using Interface Board Test Mode in the Maintenance Menu. See Section 4 for details. 3. With the condenser inlet solenoid energized using Interface Board Test Mode check the current flow using the Gauge Menu. Current should be from 0.5 – 3.0 amps. 4. With the condenser inlet solenoid energized using Interface Board Test Mode check for 12 volts across the condenser inlet solenoid connector. 5. Check the condenser inlet solenoid coil with an ohmmeter for continuity. 6. Check the Interface Harness wires CISP-01 and CISN-01 with an ohmmeter for continuity per Service Procedure H04A.

Alarm Code 108 – Door Open Timeout

Code	Description and Type	Corrective Action (check in order shown)
108	**Door Open Timeout**. This is a check alarm. The door or doors equipped with door switches were open longer than the programmed time interval.	**Operator Help** 1. Close doors. Report this alarm at end of the day. **Technical Help** 1. Check operation of door switches.

Alarm Code 110 – Check Suction Line Solenoid (in Indicated Zone)

Code	Description and Type	Corrective Action (check in order shown)
110	**Check Suction Line Solenoid Circuit (in Indicated Zone).** This is a check or shutdown alarm that only occurs during a Pretrip Test. On multi-temp units a suction line solenoid is located in the remote evaporator for each zone. The affected zone will be identified along with this alarm code. A problem exists with the suction line relay, suction line solenoid or the associated circuitry. The zone 1 suction line solenoid relay, LED and fuse F7 are located on the Interface Board. The zone 2 suction line solenoid relay, LED and fuse F200 are located on the Multi-Temp Option Board. The wiring is located in the Controller Harness and Evaporator Zone Harness.	**Operator Help** 1. If the unit shuts down and the alarm display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** 1. Check interface board fuse F7 (Zone 1) or multi-temp option board fuse F200 (Zone 2). 2. Check the operation of the suction line solenoid in the appropriate zone using Interface Board Test Mode in the Maintenance Menu. See Section 4 for details. 3. With the suction line solenoid energized using Interface Board Test Mode check the current flow using the Gauge Menu. Current should be from 0.5 – 3.0 amps. 4. With the suction line solenoid energized using Interface Board Test Mode check for 12 volts across the suction line solenoid connector. 5. Check the suction line solenoid coil with an ohmmeter for continuity. 6. Check the Controller Harness and Evaporator Zone Harness wires for continuity per Service Procedure H04A. See the wiring diagram for details.

Alarm Code 111 – Unit Not Configured Correctly

Code	Description and Type	Corrective Action (check in order shown)
111	**Unit Not Configured Correctly**. This is a log or check alarm that only occurs during a Pretrip Test. Components have been detected during a Pretrip Test that are not configured.	**Operator Help** 1. Report this alarm at end of the day. **Technical Help** 1. Verify actual unit configuration. 2. Set the unit configuration using the Unit Configuration sub-menu of the Programming Menu as shown in Service Procedure A04A.

Alarm Code 112 – Check Remote Fans (in Indicated Zone)

Code	Description and Type	Corrective Action (check in order shown)
112	**Check Remote Fans (in Indicated Zone).** This is a check or shutdown alarm that only occurs during a Pretrip Test. On multi-temp units fan motors are located in the remote evaporator for each zone. The affected zone will be identified along with this alarm code. A problem exists with the fan motor relay, fan motor or the associated circuitry. The zone 1 fan motor relay and LED are located on the Interface Board. The zone 2 fan motor relay and LED are located on the Multi-Temp Option Board. The wiring is located in the Zone Fan Harness and Evaporator Fan Harness. The fuses are in-line fuses located in the evaporator fan harness.	**Operator Help** 1. If the unit shuts down and the alarm display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** 1. Check the motor fuses for the affected zone. 2. Check the operation of the fan motor relay in the appropriate zone using Interface Board Test Mode in the Maintenance Menu. See Section 4 for details. 3. With the fan motor relay energized using Interface Board Test Mode check the current flow using the Gauge Menu. Current should be greater than 0.5 amps. 4. With the fan motor relay energized using Interface Board Test Mode check for 12 volts across the fan motor. 5. Check the fan motors for proper operation. 6. Check the Zone Fan Harness and Evaporator Fan Harness wires for continuity per Service Procedure H04A. See the wiring diagram for details.

Alarm Code 114 – Multiple Alarms, Can Not Run

Code	Description and Type	Corrective Action (check in order shown)
114	**Multiple Alarms, Can Not Run.** This is a shutdown alarm. The unit cannot run because of multiple unit shutdown alarms or because check alarms exist that have shut down all zones.	**Operator Help** 1. If the unit is shut down and the alarm display is flashing repair immediately. **Technical Help** 1. Check for associated alarms and repair as required.

Alarm Code 115 – High Pressure Cutout Switch Failure

Code	Description and Type	Corrective Action (check in order shown)
115	**High Pressure Cut Out Switch Failure.** This is a prevent alarm.	**Operator Help** 1. If the unit is shut down and the display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** 1. Check the high pressure cutout switch with an ohmmeter. The contacts should be closed with normal pressures and open if the system pressure is excessive.

Alarm Code 117 – Auto Switched from Diesel To Electric

Code	Description and Type	Corrective Action (check in order shown)
117	**Auto Switched from Diesel to Electric**. This is a log alarm. The unit switched from diesel to electric mode operation during a Pretrip Test.	**Operator Help** 1. Report this alarm at end of the day. **Technical Help** 1. Information only. No action required.

Alarm Code 118 – Auto Switched from Electric to Diesel

Code	Description and Type	Corrective Action (check in order shown)
118	**Auto Switched from Electric to Diesel**. This is a log alarm. The unit switched from diesel to electric mode operation during a Pretrip Test.	**Operator Help** 1. Report this alarm at end of the day. **Technical Help** 1. Information only. No action required.

Alarm Code 120 – Check Alternator Excite Circuit

Code	Description and Type	Corrective Action (check in order shown)
120	**Check Alternator Excite Circuit.** This is a check or shutdown alarm that only occurs during a Pretrip Test. A problem exists with the alternator excite relay or the associated circuitry. The alternator excite relay, LED and fuse F8 are located on the Interface Board. The wiring is located in the Interface Harness via the EXC-01 circuits.	**Operator Help** 1. If the unit shuts down and the alarm display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** 1. Check interface board fuse F8. 2. Check the operation of the alternator excite relay using Interface Board Test Mode in the Maintenance Menu. See Section 4 for details. 3. With the alternator excite relay energized using Interface Board Test Mode, check the current flow using the Gauge Menu. Current should be from 0.25 – 3.0 amps. 4. With the alternator excite relay energized using Interface Board Test Mode check for 12 volts at the alternator excite terminal. 5. Check the Interface Harness wires EXC-01 with an ohmmeter for continuity per Service Procedure H04A.

Alarm Code 121 – Check Liquid Injection Circuit

Code	Description and Type	Corrective Action (check in order shown)
121	**Check Liquid Injection Circuit.** This is a check or shutdown alarm that only occurs during a Pretrip Test. A problem exists with the liquid injection valve relay, liquid injection valve or the associated circuitry. The liquid injection valve LED and fuse F22 are located on the Interface Board. The wiring is located in the Interface Harness via the LIQP-01 and LIQN-01 circuits.	**Operator Help** 1. If the unit shuts down and the alarm display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** 1. Check interface board fuse F22. 2. Check the operation of the liquid injection valve using Interface Board Test Mode in the Maintenance Menu. See Section 4 for details. 3. With the liquid injection valve energized using Interface Board Test Mode check the current flow using the Gauge Menu. Current should be from 0.5 – 3.0 amps. 4. With the liquid injection valve energized using Interface Board Test Mode check for 12 volts across the liquid injection valve connector. 5. Check the liquid injection valve coil with an ohmmeter for continuity. 6. Check the Interface Harness wires LIQP-01 and LIQN-01 with an ohmmeter for continuity per Service Procedure H04A.

Alarm Code 122 – Check Diesel/Electric Circuit

Code	Description and Type	Corrective Action (check in order shown)
122	**Check Diesel/Electric Circuit.** This is a check or shutdown alarm that only occurs during a Pretrip Test. A problem exists with the diesel/electric relay or the associated circuitry. The diesel/electric relay and LED are located on the Interface Board. The wiring is located in the 50 Harness via the 7EH-01 circuits.	**Operator Help** 1. If the unit shuts down and the alarm display is flashing repair immediately. Otherwise, report this alarm at end of the day. **Technical Help** 1. Check the operation of the diesel/electric relay using Interface Board Test Mode in the Maintenance Menu. See Section 4 for details. 2. With the diesel/electric relay energized using Interface Board Test Mode, check the current flow using the Gauge Menu. Current should be from 0.25 – 3.0 amps. 3. Check the 50 Harness wires 7EH-01 with an ohmmeter for continuity per Service Procedure H04A.

Alarm Code 127 – Setpoint Not Entered (in Indicated Zone)

Code	Description and Type	Corrective Action (check in order shown)
127	**Setpoint Not Entered (in Indicated Zone)**. This is a check alarm. The setpoint was changed but was not loaded by pressing the Yes/No keys.	**Operator Help** 1. Be sure the setpoint is adjusted to the required temperature. **Technical Help** 1. Information only. Be sure setpoint is adjusted properly.

Alarm Code 128 – Engine Run Time Maintenance Reminder #1

Code	Description and Type	Corrective Action (check in order shown)
128	**Engine Run Time Maintenance Reminder #1.** This is a log alarm. The indicated hourmeter has exceeded the programmed time limit.	**Operator Help** 1. Report this alarm at end of the day. **Technical Help** 1. Perform required maintenance as dictated by owner requirements. Reset hourmeter limit after completion using Maintenance Hourmeter menu. See Section 4 for details.

Alarm Code 129 – Engine Run Time Maintenance Reminder #2

Code	Description and Type	Corrective Action (check in order shown)
129	**Engine Run Time Maintenance Reminder #2.** This is a log alarm. The indicated hourmeter has exceeded the programmed time limit.	**Operator Help** 1. Report this alarm at end of the day. **Technical Help** 1. Perform required maintenance as dictated by owner requirements. Reset hourmeter limit after completion using Maintenance Hourmeter menu. See Section 4 for details.

Alarm Code 130 – Electric Run Time Maintenance Reminder #1

Code	Description and Type	Corrective Action (check in order shown)
130	**Electric Run Time Maintenance Reminder #1.** This is a log alarm. The indicated hourmeter has exceeded the programmed time limit.	**Operator Help** 1. Report this alarm at end of the day. **Technical Help** Perform required maintenance as dictated by owner requirements. Reset hourmeter limit after completion using Maintenance Hourmeter menu. See Section 4 for details.

Alarm Code 131 – Electric Run Time Maintenance Reminder #2

Code	Description and Type	Corrective Action (check in order shown)
131	**Electric Run Time Maintenance Reminder #2.** This is a log alarm. The indicated hourmeter has exceeded the programmed time limit.	**Operator Help** 1. Report this alarm at end of the day. **Technical Help** 1. Perform required maintenance as dictated by owner requirements. Reset hourmeter limit after completion using Maintenance Hourmeter menu. See Section 4 for details.

Alarm Code 132 – Total Unit Run Time Maintenance Reminder #1

Code	Description and Type	Corrective Action (check in order shown)
132	**Total Unit Run Time Maintenance Reminder #1.** This is a log alarm. The indicated hourmeter has exceeded the programmed time limit.	**Operator Help** 1. Report this alarm at end of the day. **Technical Help** 1. Perform required maintenance as dictated by owner requirements. Reset hourmeter limit after completion using Maintenance Hourmeter menu. See Section 4 for details.

Alarm Code 133 – Total Unit Run Time Maintenance Reminder #2

Code	Description and Type	Corrective Action (check in order shown)
133	**Total Unit Run Time Maintenance Reminder #2.** This is a log alarm. The indicated hourmeter has exceeded the programmed time limit.	**Operator Help** 1. Report this alarm at end of the day. **Technical Help** 1. Perform required maintenance as dictated by owner requirements. Reset hourmeter limit after completion using Maintenance Hourmeter menu. See Section 4 for details.

Alarm Code 134 – Controller Power On Hours

Code	Description and Type	Corrective Action (check in order shown)
134	**Controller Power On Hours.** This is a log alarm. The indicated hourmeter has exceeded the programmed time limit.	**Operator Help** 1. Report this alarm at end of the day. **Technical Help** 1. Perform required maintenance as dictated by owner requirements. Reset hourmeter limit after completion using Maintenance Hourmeter menu. See Section 4 for details.

Section 6 — SPECTRUM Service Procedure Index

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A01B HMI Control Panel Functional Test

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H04A Wiring Harness Continuity Test

Control System Functional Test

Where Used

All SPECTRUM Multi-Temp units

Purpose

To confirm operation of the microprocessor, interface board and 5 Vdc power supply assembly.

Table of Contents

Materials Required

- Fluke Digital Multimeter.

Operation

The microprocessor, interface board, HMI Control Panel and 5 Vdc power supply operate as a control assembly and must be tested as such. The following procedure allows the technician to determine if the microprocessor or interface board requires replacement.

Important Notes

- Replace only one component at a time to be certain the problem component is correctly identified.
- If a fuse is installed on the interface board in position F5 as part of the diagnostic routine, be sure it is removed before the unit is released for service.

Service Procedure A01A

Diagnostic Procedure

Step	Action	Result	Comments
1.	Test for battery voltage (12 Vdc or higher) at the 2 and CH terminals on the interface board.	If this voltage is low or missing check the following to determine the cause: Unit battery. 60 amp fuse at the unit battery. Continuity of the 2 and CH circuits to the interface board.	
2.	Turn on the unit On/Off switch (the rocker switch on the side of the unit) and test for battery voltage at the #8 circuit on the interface board.	If this voltage is low or missing check the following to determine the cause: Fuse F16 on the interface board. Unit On/Off rocker switch and its wiring.	
3.	Press the On key on the HMI Control Panel.	The red LED on the 5 Vdc power supply board should turn on.	The 5 Vdc power supply board is located at the lower right portion of the interface board.
4.	If the red LED on the power supply board is not lit temporarily install a 5 amp fuse in the F5 fuse holder on the interface board. **CAUTION: This should cause the unit to start and run.**	The red LED on the 5 Vdc power supply board should turn on.	This supplies test battery voltage to the 5 Vdc power supply board.

Step	Action	Result	Comments
5.	If the red LED on the power supply board is now lit check the HMI Control Panel as shown in Service Procedure A01B. If the red LED on the 5 Vdc power supply board is still not lit replace the 5 Vdc power supply board.		The correct orientation of the board is with the LED at the bottom and the printing readable.
6.	If the red LED on the power supply board is lit the Run Relay LED should be lit and the unit should start and run.	If the unit does not start and run replace the microprocessor.	Several other LEDs will be lit as well. See Service Procedure A03A to remove and replace the control system components.
7.	If the unit still does not start and run with the new microprocessor installed, reinstall the original microprocessor and replace the interface board.		See Service Procedure A03A to remove and replace the control system components.
8.	After diagnostics are complete remove the 5 amp fuse from position F5 on the interface board.		Be sure all connections and harnesses are secure and held in place with cable ties.

HMI Control Panel Functional Test

Where Used

All SPECTRUM Multi-Temp units with HMI Control Panels

Purpose

To confirm operation of the HMI Control Panel.

Table of Contents

Materials Required

- Fluke Digital Multimeter.

Operation

The HMI Control Panel receives power directly from the unit battery via the 2A circuit.

CAUTION: Power is present on the HMI Control Panel even if the unit On/Off switch is turned off.

The following procedure allows the technician to determine if the HMI Control Panel requires replacement.

Important Notes

- Replace only one component at a time to be certain the problem component is correctly identified.
- If a fuse is installed on the interface board in position F5 as part of the diagnostic routine be sure it is removed before the unit is released for service.

Service Procedure A01B

Diagnostic Procedure

Step	Action	Result	Comments
1.	Perform an HMI Control Panel Self Test as shown in Section 4 of this manual.		If the HMI Control Panel passes the test it can be assumed to be functional.
2.	If the HMI Control Panel does not power up, check the voltage from fuse F15 to CH.	Battery voltage should be present at fuse F15. If battery voltage is not present check the 2A circuit.	
3.	If battery voltage is present at fuse F15 and the HMI Control Panel does not power up, disconnect the harness connector at the rear of the HMI Control Panel.	Battery voltage should be present on the harness connector between pin P1 (2A Power) and pin P2 (CH). If battery voltage is not present check the HMI Control Panel harness.	
4.	If battery voltage is present on the harness connector between pin P1 (2A Power) and pin P2 (CH) and the HMI Control Panel does not power up when connected, the HMI Control Panel must be replaced.		

Step	Action	Result	Comments
5.	Perform the HMI Control Panel Self Test as shown in Section 4.	The HMI Control Panel must pass the test.	This confirms proper unit operation.
6.	After diagnostics are complete remove the 5 amp fuse from position F5 on the interface board.		Be sure all connections and harnesses are secure and held in place with cable ties.

Recording Existing Microprocessor Settings

Where Used

All SPECTRUM Multi-Temp units

Purpose

To retrieve and record the current settings of a microprocessor

Table of Contents

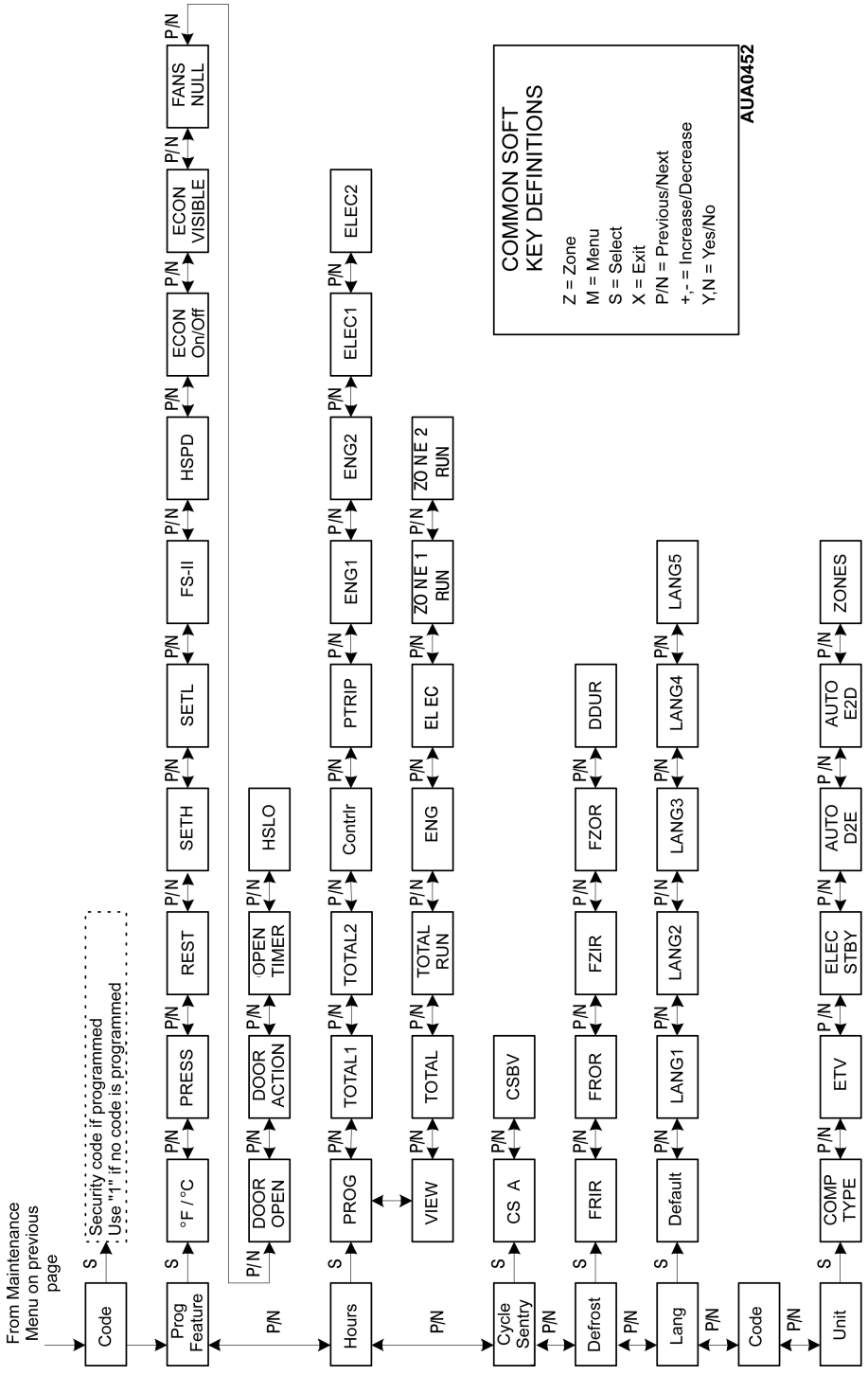
Materials Required

- Prepare a copy of the Setup Sheet at the back of this Service Procedure.

Operation

- The settings of the programmable features must be retrieved before replacing a microprocessor or performing a Cold Start. These settings will then be duplicated in the replacement microprocessor or after the Cold Start.
- The Guarded Access Menu Overview on the next page may prove helpful.
- See Section 3 for a complete description of programmable features.
- The default settings are shown on the Setup Sheet at the back of this Service Procedure.
- If a sensor grade is not shown on the setup sheet physically check the sensor to determine the grade. It is important that sensor grades be set properly.

Guarded Access Menu Overview



Procedure

Consult the Programming Menu Overview on the previous page for specific menu information.

Step	Action	Result	Comments
1.	Turn the unit on.		
2.	Press the MENU key.	The Operator Menu appears.	
3.	Press the NEXT key as required to display the Hourmeter Display Menu.	The Hourmeter Display Menu appears.	
4.	When the Hourmeter Display Menu is shown press the SELECT key to access the Hourmeter Display Menu.	Total Hours (or the first viewable hourmeter reading) and the current reading appear. Record the reading on the Setup Sheet.	
5.	Use the NEXT and/or PREVIOUS keys to scroll through all viewable hourmeters.	Record the reading of each hourmeter on the Setup Sheet.	Only hourmeters programmed to be viewable in the Viewable Hourmeter Submenu will appear.
6.	When all hourmeter readings have been recorded press the EXIT key to return to the Operator Menu.		
7.	Press and hold both the EXIT and unlabeled key for 5 seconds.	The Maintenance Menu appears.	
8.	Press the NEXT key as required to display the Sensor Calibration Menu.	The Sensor Calibration Menu appears.	

Step	Action	Result	Comments
9.	When the Sensor Calibration Menu is shown press the SELECT key to access the Sensor Calibration Menu.	Zone 1 Return Air Sensor Grade and the current grade appear. Record the grade on the Setup Sheet.	
10.	Use the NEXT and/or PREVIOUS keys to scroll through all sensors.	Record the grade of each sensor on the Setup Sheet.	
11.	When all sensor grades have been recorded press the EXIT key to return to the Maintenance Menu.		
12.	Press the NEXT key as required to display the Revision Menu.		
13.	Use the NEXT and/or PREVIOUS keys to scroll through the HMI Control Panel and Microprocessor software revisions.	Record the software revisions on the Setup Sheet.	
14.	When the software revisions have been recorded press the EXIT key to return to the Maintenance Menu.		
15.	Press the NEXT key as required to display the Time and Date Menu.		

Step	Action	Result	Comments
16.	Check the Time to determine the time zone used by the customer.	Record the time zone on the Setup Sheet.	Compare local time to unit time to determine time zone.
17.	When the time and date have been checked press the NEXT key to reach the end of the Maintenance Menu.	The NEXT soft key will disappear and only the PREVIOUS key will be shown.	
18.	Press and hold both the EXIT and unlabeled key for 5 seconds.	The Access Code Challenge appears.	
19.	Enter “1” or the required Access Code.	The Programmable Features Menu appears.	Most units will be “1”.
20.	Record the Access Code on the Setup Sheet.		
21.	Press the SELECT key to access the Programmable Features Setup Menu.	Temperature Units appears.	
22.	Use the NEXT and/or PREVIOUS keys to scroll through all features in the Programmable Features Setup Menu.	Record all Programmable Features settings on the Setup Sheet.	
23.	When all Programmable Features have been recorded press the EXIT key to return to the Programmable Features Setup Menu.		

Step	Action	Result	Comments
24.	Press the NEXT key to display the Hourmeter Setup Menu.	The Hourmeter Setup Menu appears.	
25.	When the Hourmeter Setup Menu is shown press the SELECT key to access the Program Hourmeter Submenu.	The Program Hourmeter Submenu appears.	
26.	Press the SELECT key to access the Program Hourmeter Submenu.	Total Run Time Reminder #1 appears.	
27.	Use the NEXT and/or PREVIOUS keys to scroll through all the Program Hourmeter Submenu features.	Record the setting of each Program Hourmeter Submenu feature on the Setup Sheet.	
28.	When all Program Hourmeter Submenu features have been recorded press the EXIT key to return to the Program Hourmeter Submenu.	The Program Hourmeter Submenu appears.	
29.	When the Program Hourmeter Submenu is shown press the NEXT key to chose the Viewable Hourmeter Submenu.	The Viewable Hourmeter Submenu appears.	
30.	Press the SELECT key to access the Viewable Hourmeter Submenu.	Total Run Hours Viewing appears.	

Step	Action	Result	Comments
31.	Use the NEXT and/or PREVIOUS keys to scroll through all the Viewable Hourmeter Submenu features.	Record the setting of each Viewable Hourmeter Submenu feature on the Setup Sheet.	
32.	When all Viewable Hourmeter Submenu features have been recorded press the EXIT key to return to the Viewable Hourmeter Submenu.	The Viewable Hourmeter Submenu appears.	
33.	Press the EXIT key again to return to the Hourmeter Setup Menu.	The Hourmeter Setup Menu appears.	
34.	When the Hourmeter Setup Menu is shown press the NEXT key to access the Cycle Sentry Setup Menu.	The Cycle Sentry Setup Menu appears.	
35.	When the Cycle Sentry Setup Menu is shown press the SELECT key to access the Cycle Sentry Setup Menu.	The Cycle Sentry Amps will appear.	
36.	Use the NEXT and/or PREVIOUS keys to scroll through the Cycle Sentry features.	Record the setting of each Cycle Sentry feature on the Setup Sheet.	
37.	When all Cycle Sentry features have been recorded press the EXIT key to return to the Cycle Sentry Setup Menu.		

Step	Action	Result	Comments
38.	When the Cycle Sentry Setup Menu is shown press the NEXT key to access the Defrost Setup Menu.		
39.	When the Defrost Menu is shown press the SELECT key to access the Defrost Setup Menu.	The Defrost Interval In Range - Fresh Setpoint will appear.	
40.	Use the NEXT and/or PREVIOUS keys to scroll through the Defrost features.	Record the setting of each Defrost feature on the Setup Sheet.	
41.	When all Defrost features have been recorded press the EXIT key to return to the Defrost Setup Menu.		
42.	When the Defrost Setup Menu is shown press the NEXT key to access the Language Setup Menu.		
43.	When the Language Setup Menu is shown press the SELECT key to access the Language Setup Menu.	The Default Language will appear.	
44.	Use the NEXT and/or PREVIOUS keys to scroll through the Language features.	Record the setting of each Language feature on the Setup Sheet.	

Step	Action	Result	Comments
45.	When all Language features have been recorded press the EXIT key to return to the Language Setup Menu.		
46.	When the Language Setup Menu is shown press the NEXT key to access the Access Code Setup Menu.	The Access Code has already been recorded.	
47.	Press the NEXT key again to access the Unit Configuration Setup Menu.		
48.	When the Unit Configuration Setup Menu is shown press the SELECT key to access the Unit Configuration Setup Menu.	The Compressor Type will appear.	
49.	Use the NEXT and/or PREVIOUS keys to scroll through the Unit Configuration features.	Record the setting of each Unit Configuration feature on the Setup Sheet.	
50.	When all Unit Configuration features have been recorded press the EXIT key to return to the Unit Configuration Setup Menu.		
51.	Press the EXIT key again to return to the Maintenance Menu.		
52.	Press the EXIT key again to return to the Standard Display.		

Service Procedure A02A

Setup Sheet

Hourmeters

Function	Default Setting	Recorded Setting
Total Hours	Actual	
Total Run Time Hours	Actual	
Engine Run Time Hours	Actual	
Electric Run Time Hours	Actual	
Zone 1 Run Time Hours	Actual	
Zone 2 Run Time Hours	Actual	
Total Run Time Reminder 1	Actual	
Total Run Time Reminder 2	Actual	
Controller Power On Hours	Actual	
Pretrip Reminder	100 Hours	
Engine Hours Reminder 1	100 Hours	
Engine Hours Reminder 2	100 Hours	
Electric Hours Reminder 1	100 Hours	
Electric Hours Reminder 2	100 Hours	

Sensor Calibration Settings

Function	Default Setting	Recorded Setting
Return Air Sensor Zone 1	5H	
Discharge Air Sensor Zone 1	5H	
Return Air Sensor Zone 2	5H	
Discharge Air Sensor Zone 2	5H	
Spare Sensor	5H	

Software Revision

Function	Default Setting	Recorded Setting
HMI Control Panel Software Revision	None	
Microprocessor Software Revision	None	

Set Date and Time

Compare local time to unit time to determine time zone.

Function	Default Setting	Recorded Setting
Time Zone	As specified by customer	

Access Code

“1” or as specified by customer

Function	Default Setting	Recorded Setting
Access Code	1	

(Guarded Access) Programmable Features Setup Menu

Function	Default Setting	Recorded Setting
Temperature Units	FAHRENHEIT	
Pressure Units	PSI	
Restarts after Shutdown	YES	
Setpoint High Limit	80°F	
Setpoint Low Limit	-20°F	
Fuel Saver II	NO	
High Speed Pull Down	YES	
Economy Mode	DISABLED	
Economy Mode Visible	YES	
Running Fans in Null	DISABLED	
Door Open	DISABLED	
Door Action	RUNNING IN NULL	
Door Open Timer	1 HOUR	
High Speed Lockout Key	YES	

Program Hourmeter Submenu

Function	Default Setting	Recorded Setting
Total Run Time Reminder # 1	100 HOURS	
Total Run Time Reminder # 2	100 HOURS	
Controller Power On Hours	100 HOURS	
Pretrip Reminder Hours	100 HOURS	
Engine Run Time Reminder # 1	100 HOURS	
Engine Run Time Reminder # 2	100 HOURS	
Electric Run Time Reminder # 1	100 HOURS	
Electric Run Time Reminder # 2	100 HOURS	

Viewable Hourmeter Submenu

Function	Default Setting	Recorded Setting
Total Hours Viewing		
Total Run Hours Viewing		
Controller Power On Hours Viewing		
Engine Run Time Viewing		
Electric Run Time Viewing		
Zone 1 Run Time Viewing		
Zone 2 Run Time Viewing		

Cycle Sentry Setup Menu

Function	Default Setting	Recorded Setting
Cycle Sentry Amperes Level	5 AMPS	
Battery Sentry Voltage Level	12.2 VOLTS	

Defrost Setup Menu

Function	Default Setting	Recorded Setting
Defrost Interval In Range with Fresh Setpoint	6 HOURS	
Defrost Interval Not In Range with Fresh Setpoint	4 HOURS	
Defrost Interval In Range with Frozen Setpoint	6 HOURS	
Defrost Interval Not In Range with Frozen Setpoint	4 HOURS	
Maximum Defrost Duration	45 MINUTES	

Language Setup Menu

Function	Default Setting	Recorded Setting
Default Language	ENGLISH	
Enable Language English	ENABLED	
Enable Language Spanish	DISABLED	
Enable Language French	DISABLED	
Enable Language German	DISABLED	
Enable Language Italian	DISABLED	

Access Code Setup Menu

Function	Default Setting	Recorded Setting
Enter Access Code	1	

Unit Configuration Setup Menu

Function	Default Setting	Recorded Setting
Compressor Type	SCROLL	
Number of ETVs (Electronic Throttling Valves)	NO ETVS	
Electric Standby Equipped	YES	
Auto Switch Diesel to Electric	YES	
Auto Switch Electric to Diesel Yes or No	NO	
Zones	2	

Replacement of the Microprocessor, Interface Board, Multi-Temperature Option Board or Power Supply Board

Where Used

All SPECTRUM Multi-Temp units

Purpose

To replace the microprocessor or interface board

Table of Contents

Materials Required

- Cable ties

Operation

The microprocessor, interface board, multi-temp option board and power supply board are removed from the control box as an assembly. They are separated on the bench and the defective component is replaced.

Important Note

- Be sure the harnesses are reconnected properly and do not place excessive strain on the connectors. Secure the harnesses with cable ties as required.

Service Procedure A03A

Diagnostic Procedure

Step	Action	Result	Comments
1.	If possible, log existing microprocessor setting using Service Procedure A02A.		This information will be used to set up the replacement microprocessor.
2.	Turn the unit off.	The display should be “dead”.	
3.	Disconnect standby power, if connected.		
4.	Disconnect the unit battery.		
5.	Disconnect all harness connectors from the microprocessor and interface board assembly.		
6.	Remove the screws securing the microprocessor to the control box and remove the microprocessor and interface board assembly from the control box.		
7.	Place the microprocessor and interface board assembly on a clean bench for further disassembly.		

Step	Action	Result	Comments
8.	To remove the power supply board from the interface board, remove the two power supply board screws and pull the power supply board straight back from the connectors.		Carefully note board orientation and hardware used to mount the board.
9.	To remove the multi-temp option board from the interface board, disconnect the interconnect cable. Then remove the five screws securing the multi-temp option board to the interface board.		Carefully note board orientation and hardware used to mount the board.
10.	To remove the interface board from the microprocessor, remove the eight interface board screws and pull the interface board straight back from the microprocessor.		Carefully note board orientation and hardware used to mount the board.
11.	Reassemble the components in the reverse order, using any replacement parts required. Be sure to use the correct hardware, as some screw lengths may vary.		
12.	Install the microprocessor and interface board assembly in the control box.		

Step	Action	Result	Comments
13.	Reconnect all harness connectors from the microprocessor and interface board assembly.		Be sure all connectors are securely mated and secure the harnesses with cable ties as required.
14.	Reconnect the standby power if needed.		
15.	Reconnect the unit battery.		
16.	Turn the unit on.		
17.	Clear any alarm codes as shown in Section 4.		
18.	Set up all programmable features using Service Procedure A04A.		
19.	Run a Pretrip Test as shown in Section 4 to verify proper unit operation.		

Microprocessor Setup

Where Used

All SPECTRUM Multi-Temp units

Purpose

To program sensor grades and programmable features to customer specifications

Table of Contents

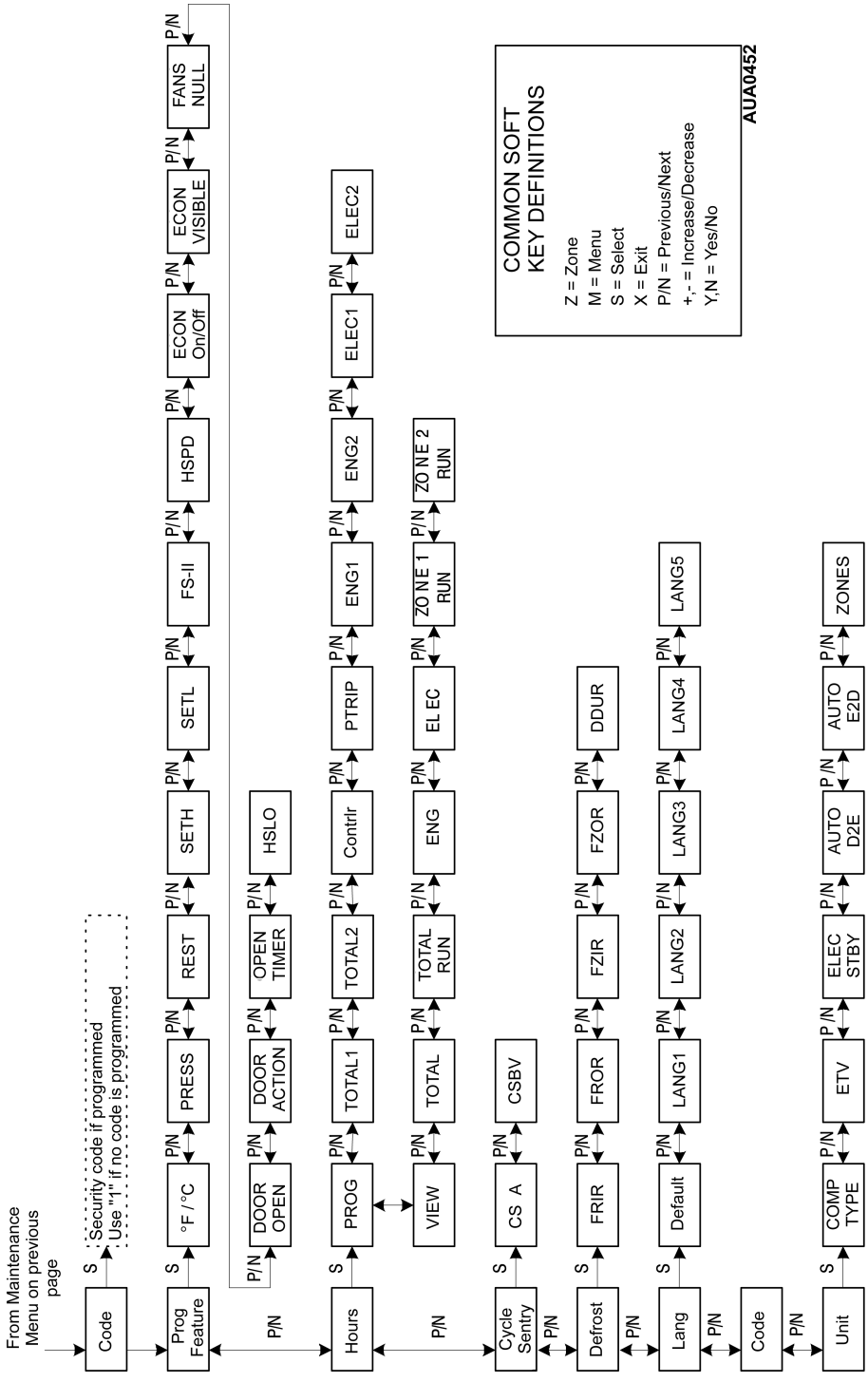
Materials Required

- A completed copy of the Setup Sheet at the back of Service Procedure A02A Recording Existing Microprocessor Settings.

Operation

- The settings of the programmable features must be programmed after replacing a microprocessor or performing a Cold Start.
- The Guarded Access Menu Overview on the next page may prove helpful.
- See Section 3 for a complete description of programmable features.
- The default settings are shown on the Setup Sheet at the back of Service Procedure A02A Recording Existing Microprocessor Settings.
- If a sensor grade is not shown on the setup sheet physically check the sensor to determine the grade. It is important that sensor grades be set properly.

Guarded Access Menu Overview



Procedure

Consult the Programming Menu Overview on the previous page for specific menu information.

Step	Action	Result	Comments
1.	Turn the unit on.		
2.	Press the MENU key.	The Operator Menu appears.	
3.	Press and hold both the EXIT and unlabeled key for 5 seconds.	The Maintenance Menu appears.	
4.	Press the NEXT key as required to display the Sensor Calibration Menu.	The Sensor Calibration Menu appears.	
5.	When the Sensor Calibration Menu is shown press the SELECT key to access the Sensor Calibration Menu.	Zone 1 Return Air Sensor Grade and the current grade appear. Set the grade to the grade on the Setup Sheet and confirm by pressing the YES key.	If the grade is not shown physically check the sensor to determine the grade. It is important that sensor grades be set properly.
6.	Use the NEXT and/or PREVIOUS keys to scroll through all sensors.	Set the grade of each sensor as shown on the Setup Sheet.	If the grade is not shown physically check the sensor to determine the grade. It is important that sensor grades be set properly.
7.	When all sensor grades have been recorded press the EXIT key to return to the Maintenance Menu.		

Step	Action	Result	Comments
8.	Press the NEXT key as required to display the Revision Menu.		
9.	Use the NEXT and/or PREVIOUS keys to scroll through the HMI Control Panel and Microprocessor software revisions.	The software revision should be the same or later than that shown on the Setup Sheet.	
10.	When the software revisions have been checked press the EXIT key to return to the Maintenance Menu.		
11.	Press the NEXT key as required to display the Time and Date Menu.		
12.	Set the time and date to the correct time.	Use the time zone shown on the Setup Sheet.	See Section 3 for details of setting time and date.
13.	When the time and date have been set press the NEXT key to reach the end of the Maintenance Menu.	The NEXT soft key will disappear and only the PREVIOUS key will be shown.	
14.	Press and hold both the EXIT and unlabeled key for 5 seconds.	The Access Code Challenge appears.	
15.	Enter “1” or the required Access Code as shown on the Setup Sheet.	The Programmable Features Menu appears.	Most in-service units and all new microprocessors will be “1”.

Step	Action	Result	Comments
16.	Press the SELECT key to access the Programmable Features Setup Menu.	Temperature Units appears.	
17.	Use the NEXT and/or PREVIOUS keys to scroll through all features in the Programmable Features Setup Menu.	Set all Programmable Features to the settings shown on the Setup Sheet.	
18.	When all Programmable Features have been set press the EXIT key to return to the Programmable Features Setup Menu.		
19.	Press the NEXT key to display the Hourmeter Setup Menu.	The Hourmeter Setup Menu appears.	
20.	When the Hourmeter Setup Menu is shown press the SELECT key to access the Program Hourmeter Submenu.	The Program Hourmeter Submenu appears.	
21.	Press the SELECT key to access the Program Hourmeter Submenu.	Total Run Time Reminder #1 appears.	
22.	Use the NEXT and/or PREVIOUS keys to scroll through all the Program Hourmeter Submenu features.	Set all Program Hourmeter Submenu features as shown on the Setup Sheet.	

Step	Action	Result	Comments
23.	When all Program Hourmeter Submenu features have been set press the EXIT key to return to the Program Hourmeter Submenu.	The Program Hourmeter Submenu appears.	
24.	When the Program Hourmeter Submenu is shown press the NEXT key to chose the Viewable Hourmeter Submenu.	The Viewable Hourmeter Submenu appears.	
25.	Press the SELECT key to access the Viewable Hourmeter Submenu.	Total Run Hours Viewing appears.	
26.	Use the NEXT and/or PREVIOUS keys to scroll through all the Viewable Hourmeter Submenu features.	Set all Viewable Hourmeter Submenu features as shown on the Setup Sheet.	
27.	When all Viewable Hourmeter Submenu features have been set press the EXIT key to return to the Viewable Hourmeter Submenu.	The Viewable Hourmeter Submenu appears.	
28.	Press the EXIT key again to return to the Hourmeter Setup Menu.	The Hourmeter Setup Menu appears.	
29.	When the Hourmeter Setup Menu is shown press the NEXT key to access the Cycle Sentry Setup Menu.	The Cycle Sentry Setup Menu appears.	

Step	Action	Result	Comments
30.	When the Cycle Sentry Setup Menu is shown press the SELECT key to access the Cycle Sentry Setup Menu.	The Cycle Sentry Amps will appear.	
31.	Use the NEXT and/or PREVIOUS keys to scroll through the Cycle Sentry features.	Set each Cycle Sentry feature as shown on the Setup Sheet.	
32.	When all Cycle Sentry features have been set press the EXIT key to return to the Cycle Sentry Setup Menu.		
33.	When the Cycle Sentry Setup Menu is shown press the NEXT key to access the Defrost Setup Menu.		
34.	When the Defrost Menu is shown press the SELECT key to access the Defrost Setup Menu.	The Defrost Interval In Range - Fresh Setpoint will appear.	
35.	Use the NEXT and/or PREVIOUS keys to scroll through the Defrost features.	Set each Defrost feature as shown on the Setup Sheet.	
36.	When all Defrost features have been set press the EXIT key to return to the Defrost Setup Menu.		

Step	Action	Result	Comments
37.	When the Defrost Setup Menu is shown press the NEXT key to access the Language Setup Menu.		
38.	When the Language Setup Menu is shown press the SELECT key to access the Language Setup Menu.	The Default Language will appear.	
39.	Use the NEXT and/or PREVIOUS keys to scroll through the Language features.	Set each Language feature as shown on the Setup Sheet.	
40.	When all Language features have been set press the EXIT key to return to the Language Setup Menu.		
41.	When the Language Setup Menu is shown press the Select key to access the Access Code Setup Menu.	The Access Code Setup Menu will appear.	
42.		Set the Access Code as shown on the Setup Sheet.	
43.	When the Access Code has been set press the NEXT key to access the Unit Configuration Setup Menu.		

Step	Action	Result	Comments
44.	When the Unit Configuration Setup Menu is shown press the Select key to access the Unit Configuration Setup Menu.	The Compressor Type will appear.	
45.	Use the NEXT and/or PREVIOUS keys to scroll through the Unit Configuration features.	Set each Unit Configuration feature as shown on the Setup Sheet.	
46.	When all Unit Configuration features have been set press the EXIT key to return to the Unit Configuration Setup Menu.		
47.	Press the EXIT key again to return to the Maintenance Menu.		
48.	Press the EXIT key again to return to the Standard Display.		

Performing a Cold Start

Where Used

All SPECTRUM Multi-Temp units

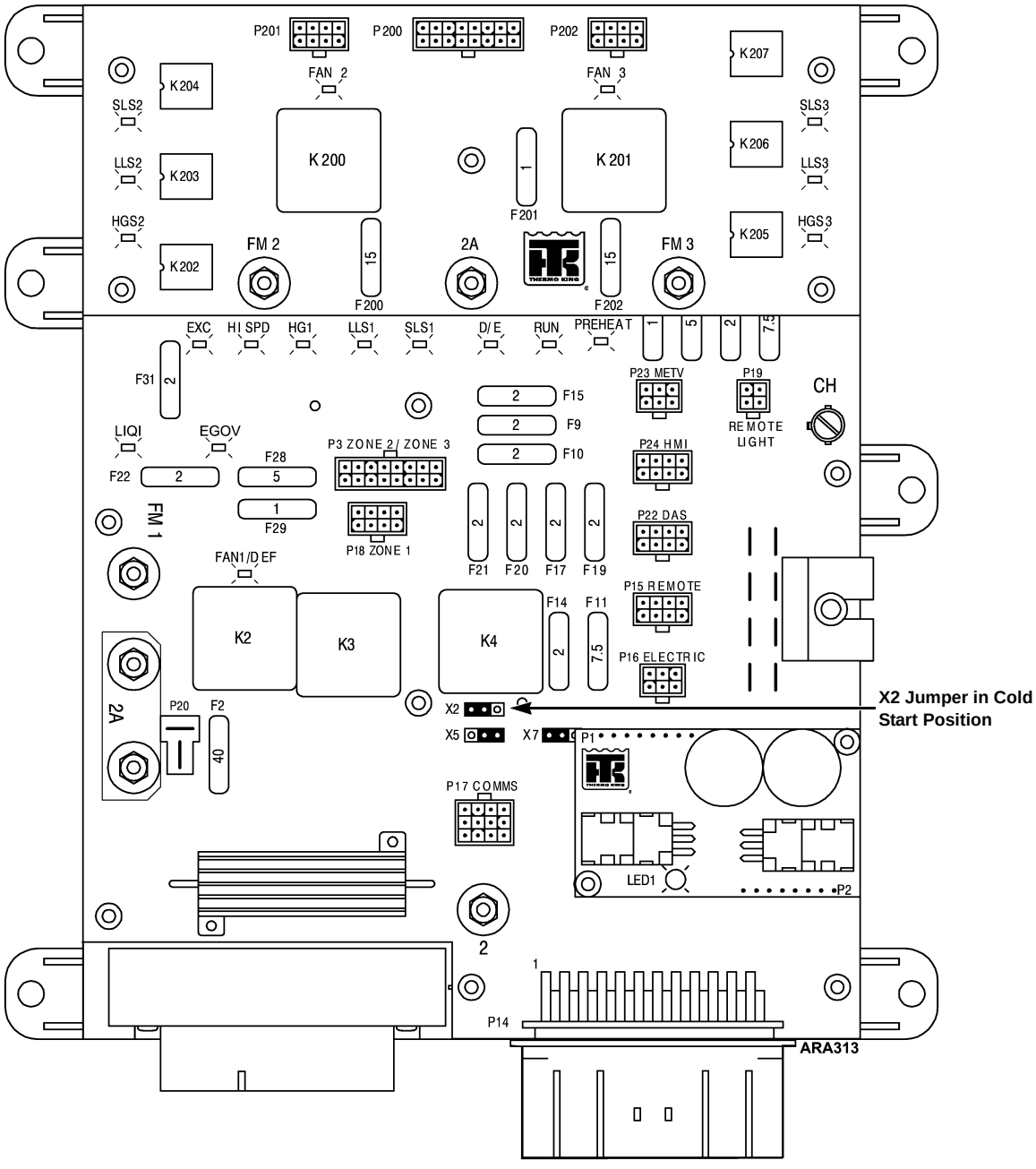
Purpose

A Cold Start is a special procedure to be used to reset a microprocessor to the standard (default) settings. This procedure should only be used when specifically required.

Table of Contents

Important Notes

- All programmable features such as sensor calibration, defrost settings and feature settings will be returned to the standard (default) settings. They must be set up using Service Procedure A04A after performing a Cold Start or the unit may not operate to the customer’s requirements.
- Hourmeters will not be reset.



Interface Board with X2 Jumper in Cold Start Position

Procedure

Step	Action	Result	Comments
1.	Log existing microprocessor settings using Service Procedure A02A.	This information will be used to set up the microprocessor after performing the Cold Start.	If the information can not be retrieved, the customer specified settings must be used.
2.	Download the maintenance data logger.		
3.	Press the unit Off key and turn off the microprocessor On/Off switch.	The display must be blank.	
4.	Locate the jumpers on the interface board.	They are located just above plug P17 at the lower center of the interface board.	See the illustration on the previous page.
5.	Remove the upper X2 jumper from the center pin and the right side pin, and place it over the center pin and the left side pin.		
6.	Turn on the microprocessor On/Off switch and press the unit On key.	The display screen will turn on and the Alarm message will appear.	This performs the Cold Start.
7.	Go to the Alarm Menu and scroll through the alarms.	Alarm Code 74 must be present indicating a successful Cold Start has been performed.	Other alarms may also be present. This is normal. If Alarm Code 74 is not present the Cold Start was not successful and steps 3 through 6 must be repeated.

Step	Action	Result	Comments
8.	Press the unit Off key and turn off the microprocessor On/Off switch.		
9.	Remove the upper X2 jumper from the center pin and the left side pin, and place it over the center pin and the right side pin.		
10.	Turn on the microprocessor On/Off switch and press the unit On key.		
11.	Go to the Alarm Menu and clear the alarm codes.	Code 74 can not be cleared in the conventional manner. It must be cleared using Service Procedure A04A.	
12.	Set up all programmable features using Service Procedure A04A.		***NOTE: All programmable microprocessor functions except the hourmeters will be returned to the standard (default) settings. They must be set up using Service Procedure A04A after performing a Cold Start.***
13.	Send a Start of Trip to the Data Logger (DAS if equipped).		

Temperature Sensor Grade Calibration

Where Used

All SPECTRUM Multi-Temp units

Purpose

To calibrate the sensor grades of replacement Return Air Sensors and Discharge Air Sensors

Table of Contents

Materials Required

- None

Operation

The return air temperature sensor and discharge air temperature sensors are graded sensors. Any time these sensors are replaced the grade of the new sensor must be correctly entered to insure optimum performance of the unit. The sensor grade is stamped on the barrel of each replacement sensor.

Important Note

- Always record the sensor grade of any replacement return or discharge temperature sensors. The grade is required to complete the sensor calibration procedure.

Service Procedure A15A

Diagnostic Procedure

Step	Action	Result	Comments
1.	Verify the sensor grades by physically checking the sensors. Record the grades of the Return Air and/or Discharge sensors.		
2.	Turn the unit on.		
3.	Press the MENU key.	The Operator Menu appears.	
4.	Press and hold both the EXIT and unlabeled key for 5 seconds.	The Maintenance Menu appears.	
5.	Press the NEXT key as required to display the Sensor Calibration Menu.	The Sensor Calibration Menu appears.	
6.	When the Sensor Calibration key is shown press the SELECT key to access the Sensor Calibration Menu.	Zone 1 Return Air Sensor Grade and the current grade appear.	
7.	Use the NEXT and/or PREVIOUS keys to select the sensor to be calibrated.	These keys scroll through all graded sensors installed on the unit.	Be sure the correct zone is selected.
8.	When the sensor to be calibrated is shown on the display, press the SELECT key.	The Sensor Change menu for the selected sensor will appear.	

Step	Action	Result	Comments
9.	Use the “+” and “-“ keys to change the sensor grade to match the grade stamped on the sensor.		
10.	When the correct grade is shown press the YES key to confirm the choice.		
11.	If necessary, repeat steps 7 – 10 to change any other sensor grades that are not correct.		
12.	When finished, press the EXIT key or turn the unit off to exit the Sensor Calibration Menu.		
13.	Record the new sensor(s) grade on the Sensor Calibration and Access Parameter Nameplate.	Be sure the information is correct.	

Download Data Logger and Display Data

Where Used

All SPECTRUM Multi-Temp units

Purpose

Download data logger and display data for the Thermo King SPECTRUM microprocessor using a computer and Wintrac 4.2 or later software.

Table of Contents

Materials Required

The following materials are required to perform a flash load.

- Thermo King Wintrac 4.2 or later software loaded on a PC computer.
- Interconnect Cable, Thermo King Service Part Number TK 44-9417 (20 foot, 6 meter) or TK 44-9418 (50 foot, 15 meter).
- Adapter Cable 1E05179G01, 15 Pin “D” connector to 12 pin Mini-Mate.

Connecting the Cables

The same cables used for downloading are required to perform a flash load. Typically two cables are used to connect the computer to the microprocessor as shown below.

Data Cable: The data cable has a 9 pin “D” connector installed on one end to attach to the computer and a 15 pin “D” connector on the other end. The cable is available as either a 20 foot or 50 foot cable as shown below.

Data Cable

20 feet (6 meters)	TK 44-9417
50 feet (15 meters)	TK 44-9418

Adapter Cable: An adapter cable is required to complete the connection to the microprocessor or data logger. This cable has a 15 pin “D” connector on one end and a 12 pin Mini-Mate connector on the other end. The 15 pin “D” connector is attached to the 15 pin “D” connector on the data cable and the 12 pin Mini-Mate connector is attached to connector P17 on the Interface Board. If another harness is connected at the P17 connector it must be disconnected to perform the flash load.

Adapter Cable

1 foot (0.3 meters)	TK 204-1093

Procedure

The following procedure should be followed to download the data logger using a direct connection to the microprocessor. Consult the Wintrac Operating Manual that is included with the software for a full description of the use of the Wintrac software.

Step	Action	Result	Comments
1.	Connect the data cables from the PC to the unit as described above.		
2.	Connect a power source to the PC computer.		Do not rely on a laptop battery as low power may cause communications to be lost and the download to fail.
3.	Start Wintrac 4.2 or later as shown in the Wintrac Operating Manual.		Consult the Wintrac Operating Manual that is included with the Wintrac software.
4.	Turn the unit on.		The unit must remain on and connections must not be disturbed during the download process.
5.	Follow the instructions in the Wintrac Operating Manual to download the data logger and display the data.		Consult the Wintrac Operating Manual that is included with the Wintrac software.

Welding on Units Equipped with SPECTRUM Microprocessors

Where Used

All SPECTRUM Multi-Temp units

Purpose

To prevent damage to the microprocessor during welding operations

Table of Contents

Materials Required

- None

Operation

Electric welding generates extremely high amperage currents which can damage electrical and electronic components. In order to minimize the possibility of damage the following procedures must be followed.

Service Procedure A26A

Before Welding

Step	Action	Result	Comments
1.	Turn the unit off.		
2.	Disconnect standby power, if connected.		
3.	Remove both the battery cables.		
4.	Connect the welder ground cable as close as possible to the area where the welding is to be performed. Move the welder ground cable as required.		

After Welding

Step	Action	Result	Comments
1.	Reconnect the battery cables.		
2.	Reconnect the standby power if needed.		
3.	Perform a Pretrip Test as shown in Section 4 to confirm operation.		

Flash Loading Microprocessor Software

Where Used

All SPECTRUM Multi-Temp units

Purpose

To change or update software for the Thermo King SPECTRUM microprocessor using a computer and Wintrac 4.2 or later software.

Table of Contents

Materials Required

The following materials are required to perform a flash load.

- Thermo King Wintrac 4.2 or later software loaded on a PC computer.
- Interconnect Cable, Thermo King Service Part Number TK 44-9417 (20 foot, 6 meter) or TK 44-9418 (50 foot, 15 meter).
- Adapter Cable TK 204-1093, 15 Pin “D” connector to 12 pin Mini-Mate.
- The correct version Flash Load file.

Service Procedure A46A

Obtaining Flash Load Files and Preparing Them for Use

A file containing the new software is required in order to perform a flash load. These files are supplied in the following format:

SPECTRUM-xxxx.exe where xxxx = software version

Software flash load files can be obtained in a number of different ways.

- The Thermo King web site www.thermoking.com/.
- An attachment to a Lotus Notes message.
- An attachment to an e-mail message.
- On a floppy disk.

Create a sub-directory and detach or download the necessary file or files. The files must then be prepared for use.

Preparing Flash Load Files for Use by Wintrac

Flash load files must be prepared for use before the Wintrac flash load process can be started. To prepare the files proceed as follows:

1. Using Windows Explorer locate the sub-directory containing the files. The files will be in the format SPECTRUM-xxxx.exe where xxxx = the software revision.

2. Double click the desired file. The file will be uncompressed and installed in the sub-directory Wintrac\Flashload\yyyy where the yyyy sub-directory is named after the device the software is for (SPECTRUM). If this directory does not exist it will be created automatically. There will be three files in this sub-directory.

The software files are now ready for flash loading using Wintrac.

Connecting the Cables

The same cables used for downloading are required to perform a flash load. Typically two cables are used to connect the computer to the microprocessor as shown below.

Data Cable: The data cable has a 9 pin “D” connector installed on one end to attach to the computer and a 15 pin “D” connector on the other end. The cable is available as either a 20 foot or 50 foot cable as shown below.

Data Cable

20 feet (6 meters)	TK 44-9417
50 feet (15 meters)	TK 44-9418

Adapter Cable: An adapter cable is required to complete the connection to the microprocessor or data logger. This cable has a 15 pin “D” connector on one end and a 12 pin Mini-Mate connector on the other end. The 15 pin “D” connector is attached to the 15 pin “D” connector on the data cable and the 12 pin Mini-Mate connector is attached to connector P17 on the Interface Board. If another harness is connected at the P17 connector it must be disconnected to perform the flash load.

Adapter Cable

1 foot (0.3 meters)	TK 204-1093

Flash Load Recovery

If the power or data connections are disturbed during flash load, the microprocessor will "freeze" in flash load mode. The display will show [FLASH] and the microprocessor will not function. This occurs since only partial software exists in the microprocessor's memory and it is no longer able to communicate. The HMI Control Panel will display the message LOST COMMUNICATIONS.

If this happens, retry the flash load procedure several times as shown below. If prompts appear always select the prompt that allows the flash load to proceed. Replacement of the microprocessor may be necessary if communications cannot be re-established.

Service Procedure A46A

Flash Load Procedure

The following procedure should be followed to flash load software using a direct connection to the microprocessor.

Step	Action	Result	Comments
1.	Obtain and prepare the flash load files as described above.		
2.	Connect the data cables from the PC to the unit as described above.		
3.	Connect a power source to the PC computer.		**Do not rely on a laptop battery as low power may cause communications to be lost and the flash load to fail.** See Flash Load Recovery on the previous page.
4.	Start Wintrac 4.2 or later as shown in the Wintrac manual.		
5.	Turn the unit on.		**The unit must remain on and connections must not be disturbed during the flash load process.** See Flash Load Recovery on previous page if the process is interrupted.
6.	Log all existing microprocessor settings using Service Procedure A02A.		This information will be used to set up the new software.

Step	Action	Result	Comments
7.	If the Wintrac menu bar does not show TOOLS, press and hold the computers “Ctrl” and “Shift” keys and then press the “T” key.	The TOOLS menu will appear in the Wintrac menu bar.	If the Tools menu does not appear the Wintrac User Access Level must be changed as shown by the readme.txt file supplied with Wintrac.
8.	Left click “Tools”.	The TOOLS menu will appear.	
9.	From the Tools menu left click “Flash Load”.	A download data warning menu appears.	
10.	Left click “Yes” to continue.	A directory containing the flash load files appears.	
11.	Double click the flash load directory and locate the correct flash load file.		
12.	Double click the flash load file	A confirmation message will appear.	
13.	If the information shown is correct, left click “Yes” to continue.	The flash load will proceed automatically. A flash load confirmation will appear in the device display screen. The flash load will take several minutes.	**The unit must remain on and connections must not be disturbed during the flash load process.** See Flash Load Recovery on previous page if the process is interrupted.
14.	When the flash load is complete a message appears confirming a successful flash load.		

Step	Action	Result	Comments
15.	Left click “OK” to complete the flash load.		
16.	Set up the Clock/Calendar as shown in Section 4.		
17.	Clear any alarm codes using the Code and Clear keys.		
18.	Set up all programmable features using Service Procedure A04A.		
19.	Turn off the unit and cycle the Unit Power Switch off and back on. Restart the unit.		This loads all changes to the HMI Control Panel.
20.	Run a Full Pretrip as shown in Section 4.		This confirms proper unit operation.

A48A
Phase Detect Module Operation and Diagnostics

Where Used

All SPECTRUM Multi-Temp units equipped with electric standby

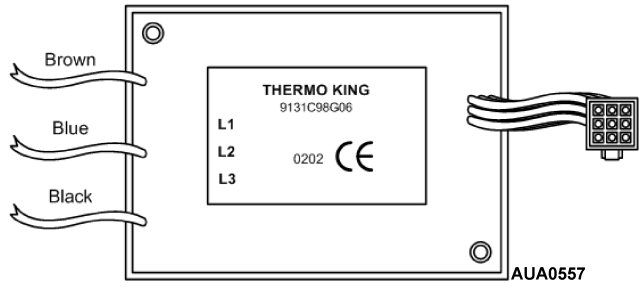
Purpose

To understand phase detect module operation and diagnostic procedures

Table of Contents

Description

The phase detect module is designed to monitor both single and 3 phase voltages from 160 volts AC through 510 volts AC.



Service Procedure A48A

Operation

The brown, blue and black wires are used to sample the power at L1, L2 and L3 respectively. Operating power from 12 Vdc is supplied to the module via the 8F-01 wire and CHP-01 wire.

When the voltage sensed rises above 180 volts AC and all three phases are present, the module ER-01 wire will output 12 Vdc after the conditions exist for 2 to 4 seconds. This signal informs the microprocessor that electric standby operation is possible. If the voltage drops below 160 volts AC or a phase is lost, the output is turned off after the condition exists for 8 to 10 seconds. The module continues to monitor the power and will again output 12 Vdc within 2 to 4 seconds after the voltage rises above 180 volts AC and all three phases are present.

If phase rotation is L1, L2, L3 the 7EB-01 wire will supply 12 Vdc to energize the appropriate phase rotation contactor. If phase rotation is L1, L3, L2 the 7EC-01 wire will supply 12 Vdc to energize the appropriate phase rotation contactor. The 7EB-01 and 7EC-01 wires are interlocked to prevent both phase contactors from being energized at once.

Connections

Connections to the module are shown in the tables below.

Power Connections

Input	Description
8F-01	Supplies nominal 12 volt DC power to the phase detect module.
CHP-01	Chassis ground

Inputs

Input	Description
L1	This brown wire supplies standby power L1 to the phase detect module.
L2	This blue wire supplies standby power L2 to the phase detect module.
L3	This black wire supplies standby power L3 to the phase detect module.

Outputs

Output	Description
7EH-01	With 12 Vdc supplied, then outputs 7EB-01 or 7EC-01 will be at 12 Vdc.
7EB-01	If phase rotation is L1, L2, L3 then this wire will provide 12 Vdc to energize the appropriate phase rotation contactor. The 7EC-01 wire is interlocked to prevent both phase contactors from being energized at once.
7EC-01	If phase rotation is L1, L3, L2 then this wire will provide 12 Vdc to energize the appropriate phase rotation contactor. The 7EB-01 wire is interlocked to prevent both phase contactors from being energized at once.
ER-01	This wire will output 12 Vdc 2 to 4 seconds after the voltage rises above 180 volts AC and all three phases are present. If the voltage drops below 160 volts AC or a phase is lost and the condition remains for 8 to 10 seconds, the output is turned off. The module continues to monitor and will again output 12 Vdc 2 to 4 seconds after the power returns to normal (voltage rises above 180 volts AC and all three phases are present).

Connector Pinout

Pin	Wire	Description
1	8F-01	Power to Module
2	CHP-01	Chassis ground
3	ER-01	AC Power OK
4	7EH-01	Switches the 7EC and 7EB from grounding to power logic
5	7EB-01	Phase L1-L2-L3
6	7EC-01	Phase L1-L3-L2
7	Unused	
8	Unused	
9	Unused	

Service Procedure A48A

Removal and Replacement

1. Turn the unit off.
2. Disconnect the unit battery.
3. Disconnect the standby power.
4. Remove the high voltage cover.
5. Disconnect the three wires from the phase detect module at the motor contactor.
6. Unplug the phase detect module harness.
7. Remove the old phase detect module.
8. Install the new phase detect module.
9. Connect the new phase detect module wires to the upper contactor as follows:
10. Connect the brown wire to L1 on the contactor.
11. Connect the blue wire to L2 on the contactor.
12. Connect the black wire to L3 on the contactor.
13. Use crimp-on terminals as required.
14. Connect the plug on the short harness from the phase detect module.
15. Install the high voltage cover.
16. Secure wires and wire harnesses as required using cable ties.
17. Connect the unit battery.
18. Connect standby power.
19. Perform a Pretrip Test to verify proper operation.

Diagnostics

Step	Action	Result	Comments
1.	Plug the standby power cord into a known good power supply and turn the unit on. (Set zone thermostats to -20 F [-29 C].)		
2.	Using a Fluke Meter, test the L1, L2, and L3 circuits at the input to the terminals where the Brown, Blue and Black wires are connected.	The voltage should be between 200 - 500 VAC between circuits. If not, repair as necessary to supply the needed voltage to the unit.	
3.	Check the 8F and CHP circuits to the phase detect module. 12 Vdc must be present from 8F to CHP.	If this power is not present, check the 8 circuit from the On/Off switch.	
4.	If correct power is present in the tests above then the ER circuit on the interface board should have 12 Vdc present.	If power is not present replace the phase detect module.	Removal and replacement of the phase detect module is detailed on a previous page.
5.	If LED 6 on the interface board is on then the 7EH circuit should have 12 Vdc present.	If power is not present check the Diesel/Electric Relay circuit on the interface board.	
6.	If the unit is calling for operation (LED 6 is on) one of the phase select contactors should be energized.	If neither contactor is energized check for 12 Vdc on 7EC or 7EB. If voltage is not present replace the phase detect module.	Removal and replacement of the phase detect module is detailed on a previous page.

Temperature Sensor Test

Where Used

All SPECTRUM Multi-Temp units

Purpose

To confirm the proper operation of the unit temperature sensors

Table of Contents

Materials Required

- Fluke Digital Multimeter.

Operation

Both graded and ungraded sensors are used on SPECTRUM Multi-temp applications. Graded sensors are used to sense return air and discharge air temperature. Ungraded sensors are used to sense coil and ambient air temperature. Both graded and ungraded sensors are checked in the same manner.

Service Procedure D01A

Diagnostic Procedure

Step	Action	Result	Comments
1.			**Note:** Polarity must be considered when connecting temperature sensors. If the sensors are connected backwards, the display will show dashes (----). Consult the schematic diagram or wiring diagram for the correct connections.
2.	Turn the unit off.		
3.	Disconnect the sensor at the plug next to the sensor.		
4.	Turn the unit on.	The Standard Display will appear.	
5.	Access the Gauge submenu in the Maintenance Menu and display the disconnected sensor.	The display for the disconnected sensor should show dashes [----].	If all the temperature sensors show dashes [----] without being disconnected, the microprocessor is defective.
6.	Using a high quality meter check the voltage at the sensor plug on the harness.	The voltage must be from 4.90 to 5.10 Vdc.	
7.	If the voltage at the harness connector is correct, disassemble and check the sensor plug.	If there are no broken wires or pushed pins in the plug, replace the sensor.	

Step	Action	Result	Comments
8.	If the voltage measured in Step 6 above is incorrect, recheck the voltage in the same circuit of the J3 connector on the microprocessor.	The voltage must be from 4.90 to 5.10 Vdc.	See Wiring Diagram for pin numbers.
9.	If the voltage is correct at Step 8 and incorrect at Step 6, the problem is in the wiring harness.	Repair the harness as required.	
10.	If the voltage is incorrect in both Steps 6 and 8, the problem is in the microprocessor.	Replace the microprocessor.	

Pressure Sensor Test

Where Used

All SPECTRUM Multi-Temp units

Purpose

To confirm the proper operation of the suction or discharge pressure sensors

Table of Contents

Materials Required

- Fluke Digital Multimeter.

Service Procedure D03A

Diagnostic Procedure

Step	Action	Result	Comments
1.	Turn the unit on.		
2.	Access the Gauge submenu in the Maintenance Menu and display the suction pressure or discharge pressure.	The display should show the pressure reading for the sensor. If the sensor reading is obviously incorrect or the display shows [----], proceed as shown below.	Confirm reading with refrigeration gauges as necessary. If all sensors show dashes [----] without being disconnected, the microprocessor is defective.
3.	Turn the unit off and disconnect the suction or discharge pressure transducer at the transducer plug.		
4.	Turn the unit on.		
5.	Check the voltage at the sensor harness connector.	The voltage between wires DPN and DPP (Discharge Pressure) or SPN and SPP (Suction Pressure) must be from 4.90 to 5.10 Vdc. check the microprocessor using Service Procedure A01A.	
6.	Check harness continuity of the DP or SP wire.		

Step	Action	Result	Comments
7.	If the voltage at Step 5 is present and the DP or SP wire has continuity replace the sensor in question.		
8.	If the voltage at Step 5 is not present, check the continuity of harness wire DPN, DPP, SPN and/or SPP.	If the harness is good, replace the microprocessor.	

Checking and Replacing the Oil Level Switch

Where Used

All SPECTRUM Multi-Temp units

Purpose

To test the oil level switch for proper operation

Table of Contents

Materials Required

- Fluke Digital Multimeter.

Operation

The switch is open with the float up (indicating full oil level). The switch is closed with the float down (indicating low oil level). Disconnecting the switch will disable the circuit and prevent Alarm Code 66.

Service Procedure F01A

Diagnostic Procedure

Step	Action	Result	Comments
1.	Turn the unit off.		
2.	Disconnect the Deutsch connector at the switch.		The oil level switch is located on the top of the oil pan.
3.	Use an ohmmeter to check switch continuity.	With the oil above the "add" mark, the switch should be open. If the engine is 6 or more quarts (5.7 or more liters) low the switch should be closed.	This check can be performed while changing oil.
4.	Reconnect the Deutsch connector.		

Replacing the Switch – Press In Applications

Step	Action	Result	Comments
1.	Turn the unit off.		
2.	Disconnect the Deutsch connector at the switch.		The oil level switch is located on the top of the oil pan.
3.	Carefully pry the switch up using a screwdriver and light hand pressure. Twist and rock the switch as necessary to release it from the rubber seal.		

Step	Action	Result	Comments
4.	Remove the old switch seal from the mounting hole.		
5.	Remove the rubber seal from the replacement switch and insert it lip up in the opening in the oil pan.		**CAUTION: Do not attempt to install the switch and seal at the same time. The seal must be installed first. When the switch is installed it expands the seal to create a leak proof installation.**
6.	Lightly oil the seal to aid in installing the switch and press the switch into place using hand pressure only.		
7.	Reconnect the Deutsch switch connector.		

Service Procedure F01A

Replacing the Switch – Screw In Applications

Step	Action	Result	Comments
1.	Turn the unit off.		
2.	Disconnect the Deutsch connector at the switch.		The oil level switch is located on the top of the oil pan.
3.	Unscrew and remove the old switch.		
4.	Apply Teflon tape to the threads on the new switch.		
5.	Screw the new switch into the hole in the oil pan.		
6.	Tighten until snug. Do not over-tighten or the switch may be damaged.		
7.	Reconnect the Deutsch switch connector.		

Checking the Oil Pressure Switch

Where Used

All SPECTRUM Multi-Temp units

Purpose

To test the oil pressure shutdown switch for proper operation.

Table of Contents

Materials Required

- Fluke Digital Multimeter.

Service Procedure F05A

Diagnostic Procedure

Step	Action	Result	Comments
1.	Connect a multimeter set for DC Volts between the 20B wire at the oil pressure shutdown switch and chassis ground.		
2.	Turn the unit on and observe the meter reading.	The voltage with the unit on and the engine not running should be 0. If there is voltage present the switch is defective.	
3.	Start the engine and observe the meter reading.	Battery voltage should be present when the engine is running. If the voltage is low or is 0, proceed to Step 4.	
4.	With the unit running, disconnect the 20B wire from the switch. Measure the voltage from the 20B wire to chassis ground.	If the battery voltage is present on the wire, the switch is defective and should be replaced.	The oil pressure switch should be installed horizontally to minimize water penetration.
		If the voltage on the 20B wire is low or 0, there is a problem in the 20B circuit.	Check the 20B circuit as required to determine the cause.

Coolant Level Sensor Test

Where Used

All SPECTRUM Multi-Temp units

Purpose

To confirm proper operation of the coolant level sensor.

Table of Contents

Materials Required

- Fluke Digital Multimeter.

Operation

An optical sensor is used to determine the coolant level. This three wire sensor is supplied with +5 Vdc from the microprocessor.

Service Procedure F07A

Diagnostic Procedure

Step	Action	Result	Comments
1.	Check the voltage between the red and black wires at the sensor harness connector for + 5 Vdc.	+ 5 Vdc should be present between the red and black wires. If not, check the harness and connectors as required to determine the cause.	
2.	If + 5 Vdc is present at the sensor, check the voltage on the white wire at the sensor harness connector.	Less than 0.5 Vdc should be present when the sensor is not immersed in coolant and +5 Vdc should be present when the sensor is submersed in coolant. If these voltages are not present the senor must be replaced.	

Coolant Temperature Sensor Test

Where Used

All SPECTRUM Multi-Temp units

Purpose

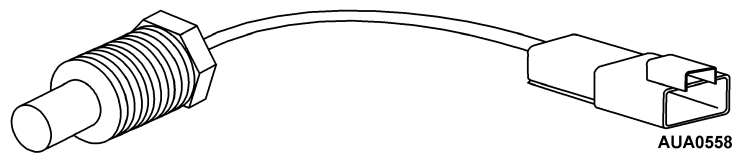
To test the coolant temperature sensor for proper operation.

Table of Contents

Materials Required

- Fluke Digital Multimeter.

Coolant Temperature Sensor



Service Procedure F08A

Diagnostic Procedure

Step	Action	Result	Comments
1.			**Note:** Polarity must be considered when connecting temperature sensors. If the sensors are connected backwards, the display will show dashes (----). Consult the schematic diagram or wiring diagram for the correct connections.
2.	Turn the unit off.		
3.	Disconnect the sensor at the plug next to the sensor.		
4.	Turn the unit on.	The Standard Display will appear.	
5.	Access the Gauge submenu in the Maintenance Menu and display Engine Coolant Temperature.	The display for the Engine Coolant Temperature sensor should show dashes [----].	If all the temperature sensors show dashes [----] without being disconnected, the microprocessor is defective.
6.	Using a high quality meter check the voltage at the sensor plug on the harness.	The voltage must be from 4.90 to 5.10 Vdc.	
7.	If the voltage at the harness connector is correct, disassemble and check the coolant sensor plug.	If there are no broken wires or pushed pins in the plug, replace the sensor.	

Step	Action	Result	Comments
8.	If the voltage measured in Step 6 above is incorrect, recheck the voltage in the same circuit at pins 15 and 26 of the J3 connector on the microprocessor.	The voltage must be from 4.90 to 5.10 Vdc.	
9.	If the voltage is correct at Step 8 and incorrect at Step 6, the problem is in the wiring harness.	Repair the harness as required.	
10.	If the voltage is incorrect in both Steps 6 and 8, the problem is in the microprocessor.	Replace the microprocessor.	

RPM Sensor Test and Adjustment

Where Used

All SPECTRUM Multi-Temp units

Purpose

To test and adjust the RPM sensor.

Table of Contents

Materials Required

- Fluke Digital Multimeter.

Operation

The RPM sensor rarely fails but may require adjustment for proper operation.

Service Procedure F09A

Diagnostic Procedure

Step	Action	Result	Comments
1.	Turn the unit off.		
2.	Remove the FS1 and FS2 wires from the sensor.		
3.	Check the sensor resistance using a high quality multimeter.	The sensor resistance should be 250 to 300 ohms with the wires removed. If not, the sensor should be replaced.	
4.	Loosen the lock nut, turn the sensor in until it contacts the ring gear on the flywheel, then back it out ½ turn and tighten the lock nut.		
5.	Reattach the FS1 and FS2 wires to the sensor.		Polarity is not important.
6.	Start the unit.		
7.	Access the Gauge submenu in the Maintenance Menu and display Engine RPM.	The display should show the engine RPM.	
8.	If the RPM reading does not appear in the display, remove the FS1 and FS2 wires from the sensor.		

Step	Action	Result	Comments
9.	Using Service Test Mode, place the unit in high speed cool [HSC].		For information on Service Test Mode see Section 4.
10.	Check the voltage across the sensor terminals with the FS1 and FS2 wires removed.	The voltage in high speed should read from 1.0 to 5.0 volts ac.	Set the meter to read AC volts.
11.	If the required voltage is not present, replace the RPM sensor. If the required voltage is present, check the harness wires and repair as required.		
12.	Reattach the FS1 and FS2 wires to the sensor.		Polarity is not important.

Wiring Harness Continuity Test

Where Used

All SPECTRUM Multi-Temp units

Purpose

To illustrate the correct procedures for checking harness continuity on equipment utilizing solid state devices

Table of Contents

Materials Required

- Fluke Digital Multimeter.
- Jumper Wires as Required

Important Notes

- Do not use battery and light test tools to check continuity.
- Do not check to see if a circuit is energized by tapping a circuit wire to ground and watching for a spark.

Service Procedure H04A

Diagnostic Procedure

Step	Action	Result	Comments
1.	Do not use battery and light test tools to check continuity.		Using such devices may present excessive voltage or current to solid state devices. In many cases the device will be damaged or destroyed.
2.	Use a high quality digital multimeter or an analog meter with high input impedance.		Older analog (needle type meter movement) meters and some inexpensive “mechanic tool box” meters present a large load to the circuit being tested. This can significantly alter the meter reading, especially when measuring small voltages or currents.
3.	Never test a circuit to see if it is energized by tapping the circuit wire to ground and watching for a spark.		This will damage solid state components or blow a fuse.
4.	Locate the suspect circuit on the appropriate wiring diagram.		

Step	Action	Result	Comments
5.	Isolate both ends of the circuit using the following methods as required. • Disconnect the appropriate connector at the microprocessor. • Disconnect the device connector at the device. • Disconnect the appropriate connector at the relay board. • Remove the wire from the device terminal.		Harness connections are identified in the Service Procedures appropriate to the device in question. They may also be determined by consulting the wiring diagrams. **CAUTION: Failure to isolate both ends may cause misleading results.**
6.	Using jumpers as required, connect each end of the circuit to a high quality multimeter.	The meter must show a very low resistance (less than 1.0 ohm), indicating circuit continuity. If not, the circuit is open or has excessive resistance. Troubleshoot the circuit to determine the cause using the wiring diagrams.	Be certain the ohmmeter battery is good and the meter zeros with the leads held together to prevent misleading results.
7.	After determining that the circuit passes a continuity test, remove one lead and connect it to chassis ground to check for a short to ground.	The meter should indicate an open circuit. If not, the circuit is shorted to ground. Trouble-shoot the circuit to determine the cause using the wiring diagrams.	

Section 7—SPECTRUM Information

Section 7—SPECTRUM Information

Software Features and Interchange

Where Used

All SPECTRUM Microprocessors with Revision 25xx Software

To identify the software revision, see Section 4 Checking Software Revision.

CAUTION: The software on a "used" microprocessor should always be checked as the software may have been changed and therefore different from that shown on the label.

SPECTRUM Microprocessor Software

Software Revision	Features	Interchange with:
95xx	Pre-production releases	Upgrade to 2500
2500	Production release	Replaces all 95XX

SPECTRUM HMI Control Panel Software

Software Revision	Features	Interchange with:
A0xx	Pre-production releases	Upgrade to 6500
6500	Production release	Replaces all A0xx

Microprocessor Features and Interchange

Where Used

All Thermo King SPECTRUM Microprocessors

SPECTRUM Microprocessor

Engineering Number	Features	Where Used	Interchange With	Service Parts Number
5D55341G01	Production units	SPECTRUM truck units		45-1951

SPECTRUM HMI Control Panel

Engineering Number	Features	Where Used	Interchange With	Service Parts Number
2C44130G01	Production units	SPECTRUM truck units		41-4150

SPECTRUM Interface Board

Engineering Number	Features	Where Used	Interchange With	Service Parts Number
5D55077G01	Production units	SPECTRUM truck units		41-4098

SPECTRUM Multi-Temp Option Board

Engineering Number	Features	Where Used	Interchange With	Service Parts Number
2C43668G01	Production units	SPECTRUM truck units		41-4097

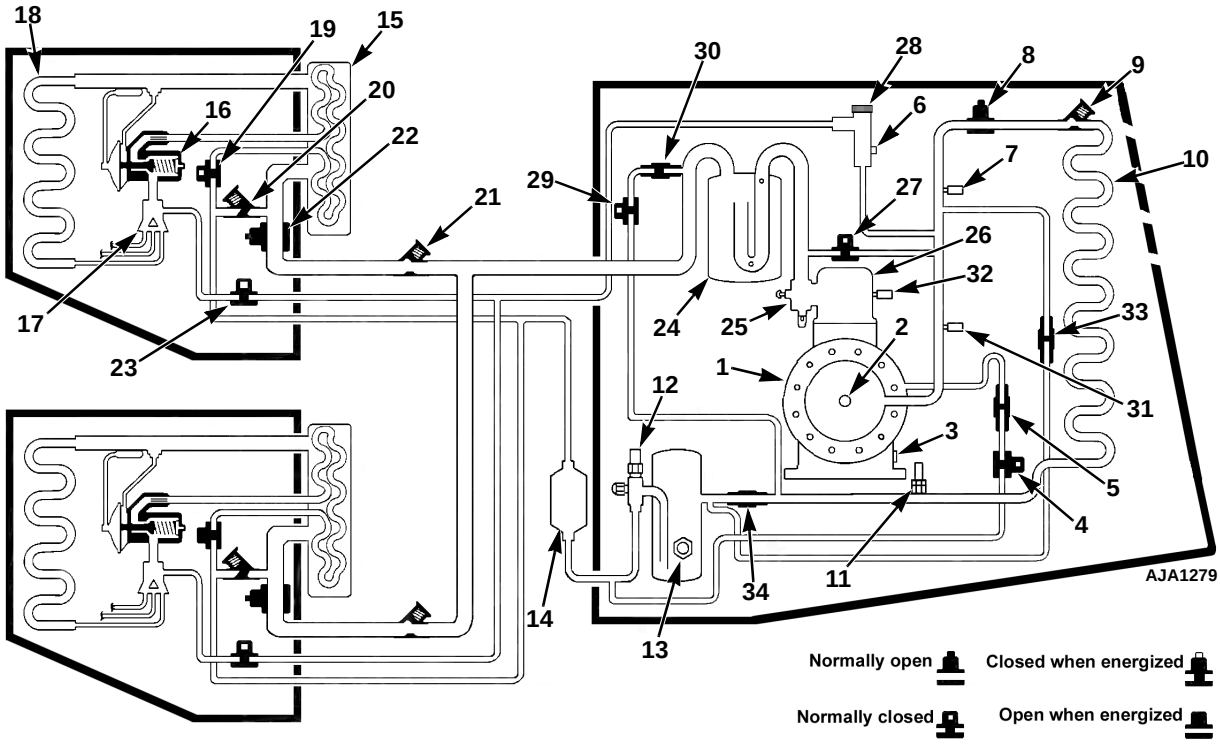
SPECTRUM Power Supply Board

Engineering Number	Features	Where Used	Interchange With	Service Parts Number
5D50930G01	Production units	SPECTRUM truck units		41-4096

Section 8 — SPECTRUM Refrigeration Procedures

Section 8 — SPECTRUM Refrigeration Procedures

SPECTRUM TS Refrigeration System



1.	Scroll Compressor	18.	Evaporator Coil
2.	Thermister	19.	Liquid Line Solenoid
3.	Compressor Oil Sight Glass	20.	Liquid Return Check Valve
4.	Liquid Injection Solenoid	21.	Suction Line Check Valve
5.	Liquid Injection Check Valve	22.	Suction Line Solenoid
6.	Discharge Service Port	23.	Hot Gas Solenoid
7.	High Pressure Cutout Switch	24.	Accumulator Tank
8.	Condenser Inlet Solenoid	25.	Suction Service Valve
9.	Condenser Inlet Check Valve	26.	Throttling Valve
10.	Condenser Coil	27.	Hot Gas Bypass Valve
11.	High Pressure Relief Valve	28.	Discharge Pressure Regulator Valve
12.	Receiver Outlet Valve	29.	Purge Valve
13.	Receiver Sight Glass	30.	Purge Check Valve
14.	Dehydrator	31.	Discharge Pressure Transducer
15.	Heat Exchanger	32.	Suction Pressure Transducer
16.	Expansion Valve	33.	Receiver Tank Pressure Check Valve
17.	Distributor	34.	Condenser Check Valve

Refrigeration System Diagram

SPECTRUM Refrigeration System Operation

General Description

TCI (Invertible) Systems

If a zone is capable of reverse cycle operation it is said to be invertible. Reverse cycle means that the evaporator coil in that zone is used as the condenser coil during heat operation as long as at least one other zone is operating in cool mode. All TCI systems are capable maintaining any temperature in any zone and can also heat or cool in any zone at any time.

Hot Gas Solenoids Open During Start

The unit is programmed to open the hot gas solenoids for the first 30 seconds (approximately) after the unit starts. This sweeps the oil out of the evaporators and returns the oil to the compressor. During this time the suction line solenoids will also be open, and one or both of the liquid line solenoids will be closed. At the end of the 30-second interval the solenoids will switch to their normal positions for cool, heat, or defrost as determined by the controller setpoints and compartment temperatures.

Condenser Evacuation Mode

The unit is programmed to keep the suction line solenoid open for the first 2 minutes (approximately) after a zone shifts from cool to heat. This is called the condenser evacuation mode. Because the purge valve is open when any zone is in heat, the refrigerant moves out of the condenser and into the accumulator. This improves unit performance. At the end of the 2-minute interval the suction line solenoid closes (in the zone that is in heat) and the zone that is in heat acts as the condenser for the zone that is in cool (see “One Zone Cooling One Zone Heating” on page 8-6).

SPECTRUM Unit Solenoids and Valves

These components serve all zones. They are located in the condenser section of the unit and are controlled by unit requirements.

Condenser Inlet Solenoid (CIS)

This valve controls the flow of refrigerant to the condenser. This solenoid is energized (closed) when any compartment is operating in heat or defrost mode. It will be de-energized if the discharge pressure becomes excessive to prevent unit shutdown. This valve is normally open. This component is located between the discharge line and the condenser.

Purge Valve (PV)

This valve is energized (open) during heat or defrost when discharge pressure is low to be sure adequate refrigerant is available to heat or defrost the zone. This valve is normally closed. This component is located between the condenser check valve and the condenser outlet line in the condenser section of the unit.

Liquid Injection Valve (LIV)

This valve helps control the temperature of the scroll compressor. It is energized or pulsed (open) when the scroll compressor temperature exceeds a set value to inject liquid refrigerant into the compressor. The liquid refrigerant flashes to a gas to effectively cool the compressor. This valve is normally closed. This component is located between the liquid line and the compressor in the condenser section of the unit.

Hot Gas Bypass Valve (HGB)

This valve helps control suction pressure. If the suction pressure falls below a set limit this valve is energized (open) to allow hot refrigerant gas to flow to the suction line until the suction pressure rises to an acceptable level. This valve is normally closed. This component is located in the hot gas bypass line next to the compressor.

Discharge Pressure Regulator (DPR)

This component is a mechanical control device used to increase the discharge pressure during heat and defrost. The valve controls discharge pressure mechanically based on temperature and the actual system pressure. This valve is normally closed and opens when the set pressure is reached. This component is located in the hot gas line in the condenser section of the unit.

Zone Components

These components are required for each zone. They are located in the remote evaporator of each zone and are controlled by zone requirements.

Liquid Line Solenoid (LLS)

This valve is energized (open) any time cooling, heating or defrosting is required in its zone. The valve is de-energized when the zone is in null to stop refrigerant flow in that zone. This valve is normally closed.

Hot Gas Solenoid (HGS)

This valve is energized (open) any time heating or defrosting is required in the zone. This valve is normally closed.

Suction Line Solenoid (SLS)

The suction line solenoid is energized (closed) when its compartment is operating in heat mode (but not defrost) as long as at least one other zone is operating in cool mode. This valve is normally open. The suction line solenoid in an S-3 evaporator has a bleed orifice. This is used to maintain refrigerant flow to the compressor when the SLS is closed.

Transducers & Switches

Discharge Pressure Transducer

This transducer supplies the discharge pressure at the compressor to the microprocessor.

Suction Pressure Transducer

This transducer supplies the suction pressure to the microprocessor. It should be noted that the suction pressure transducer is located on the throttle valve. As a result, the suction pressure displayed is compressor suction pressure, not system suction pressure.

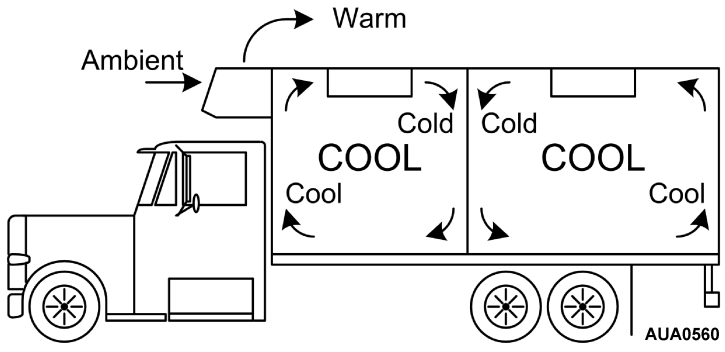
High Pressure Cutout Switch

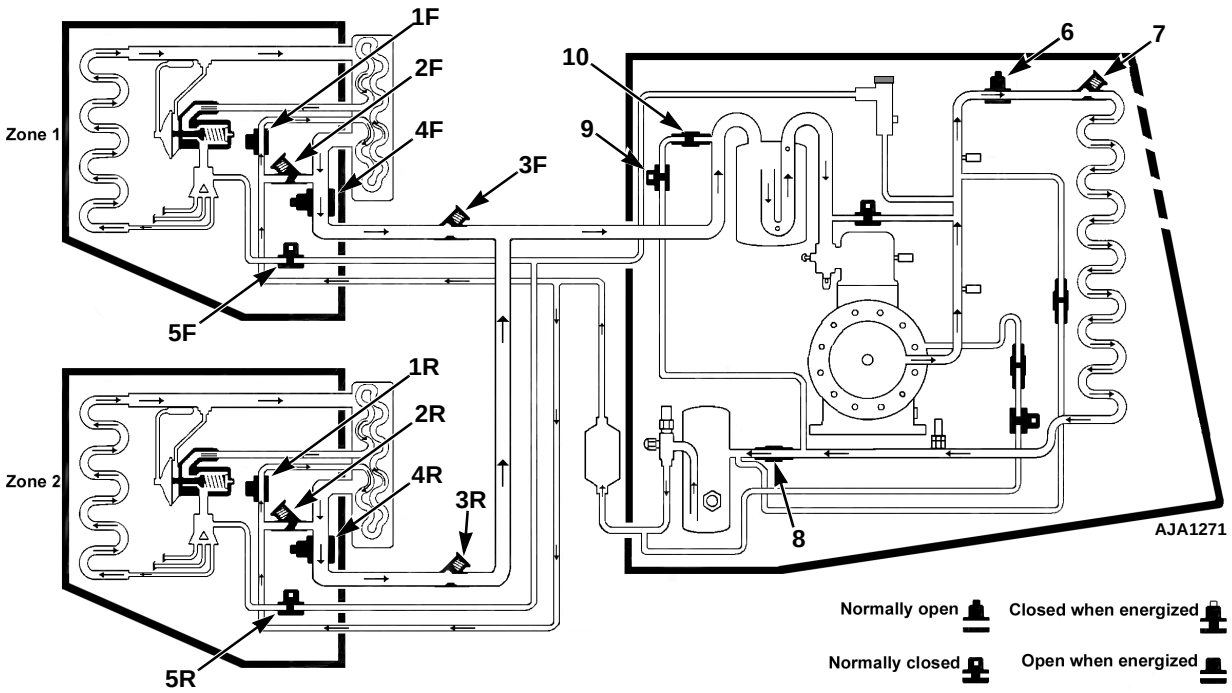
The high pressure cutout switch monitors the discharge pressure at the compressor. The switch is closed with normal pressures and open with excessive pressures. The switch will open and close at pressures determined by the refrigerant used in the unit. The high pressure cutout is located on the compressor discharge line.

SPECTRUM Multi-Temp Operation

All Zones Cooling

When all zones are cooling the unit condenser is used to eliminate the heat from all zones. This is a Conventional Cooling Cycle.





Zone 1 Cool and Zone 2 Cool

Zone 1 Cool and Zone 2 Cool

High pressure refrigerant vapor leaves the compressor and flows through the open CIS to the condenser where the refrigerant condenses into high pressure liquid. The liquid refrigerant flows through the receiver tank into the liquid lines.

The LLS1 is open so some of the refrigerant flows through the Zone 1 expansion valve into the Zone 1 evaporator. There, liquid refrigerant cools the Zone 1 evaporator as it evaporates into low pressure vapor. The refrigerant returns to the compressor through the SLS1, the suction line, SLCV1 and the accumulator.

The LLS2 is also open so some of the refrigerant flows through the Zone 2 expansion valve into the Zone 2 evaporator. There, liquid refrigerant cools the Zone 2 evaporator as it evaporates into low pressure vapor. The refrigerant returns to the compressor through the SLS2, the second suction line, the SLCV2 and the accumulator.

Zone 1 Evaporator

1F. Zone 1 Liquid Line Solenoid (LLS1)-Open

2F. Zone 1 Liquid Return Check Valve (LRCV1)-Closed

3F. Zone 1 Suction Line Check Valve (SLCV1)-Open

4F. Zone 1 Suction Line Solenoid (SLS1)-Open

5F. Zone 1 Hot Gas Solenoid (HGS1)-Closed

Zone 2 Evaporator

1R. Zone 2 Liquid Line Solenoid (LLS2)-Open

2R. Zone 2 Liquid Return Check Valve (LRCV2)-Closed

3R. Zone 2 Suction Line Check Valve (SLCV2)-Open

4R. Zone 2 Suction Line Solenoid (SLS2)-Open

5R. Zone 2 Hot Gas Solenoid (HGS2)-Closed

Condensing Unit

6. Condenser Inlet Solenoid (CIS)-Open

7. Condenser Inlet Check Valve (CICV)-Open

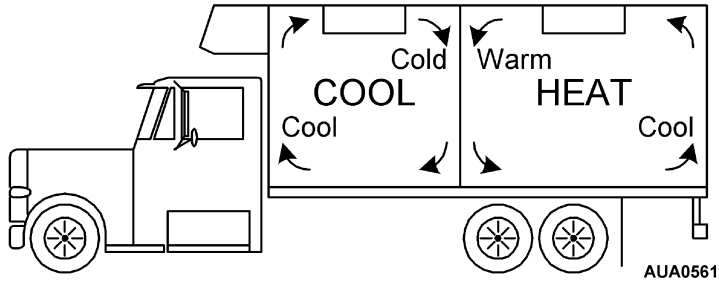
8. Condenser Check Valve (CCV)-Open

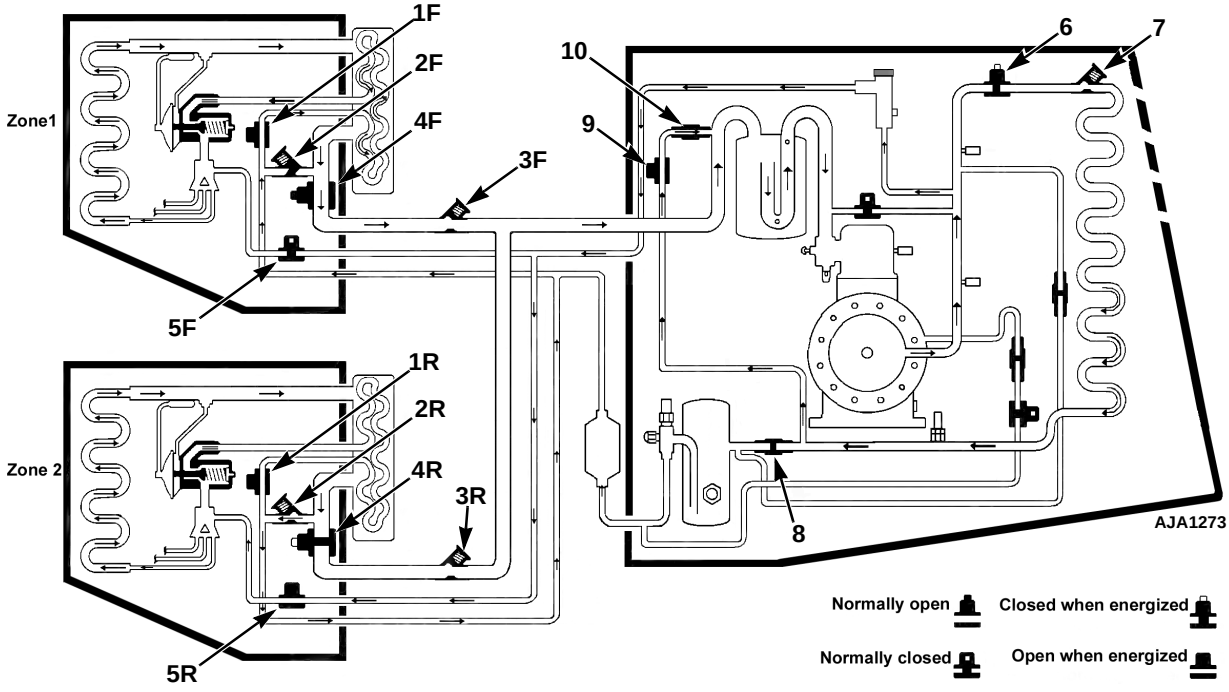
9. Purge Valve (PV)-Closed

10. Purge Check Valve (PCV)-Closed

One Zone Cooling
One Zone Heating

When at least one zone is cooling and another zone is heating, the evaporator in the heating zone may used as a condenser to remove the heat from the zone that is cooling. The unit condenser is not used. This is Reverse Cycle operation.





Zone 1 Cool and Zone 2 Heat

Zone 1 Cool and Zone 2 Heat

The CIS is closed so high pressure refrigerant vapor leaves the compressor and flows through the DPR to the Zone 2 hot gas line and the open HGS2 into the Zone 2 evaporator. There, the refrigerant heats the Zone 2 evaporator and condenses into high pressure liquid. Because the SLS2 is closed, the liquid refrigerant flows through the LRCV2 and the liquid line to the LLS1.

The LLS1 is open so the refrigerant flows through the Zone 1 expansion valve into the Zone 1 evaporator. There, the liquid refrigerant cools the Zone 1 evaporator as it evaporates into low pressure vapor. The refrigerant returns to the compressor through the SLS1, Suction Line, SLCV1 and the accumulator.

In the condensing unit the DPR valve is used to regulate head pressure. The purge valve is opened continuously during heat to drain the condenser coil. The CIS valve is closed, but can be opened if the discharge pressure is too high.

Zone 1 Evaporator

1F. Zone 1 Liquid Line Solenoid (LLS1)-Open

2F. Zone 1 Liquid Return Check Valve (LRCV1)-Closed

3F. Zone 1 Suction Line Check Valve (SLCV1)-Open

4F. Zone 1 Suction Line Solenoid (SLS1)-Open

5F. Zone 1 Hot Gas Solenoid (HGS1)-Closed

Zone 2 Evaporator

1R. Zone 2 Liquid Line Solenoid (LLS2)-Open

2R. Zone 2 Liquid Return Check Valve (LRCV2)-Open

3R. Zone 2 Suction Line Check Valve (SLCV2)-Closed

4R. Zone 2 Suction Line Solenoid (SLS2)-Closed

5R. Zone 2 Hot Gas Solenoid (HGS2)-Open

Condensing Unit

6. Condenser Inlet Solenoid (CIS)-Closed/Open (Pressure Dependent)

7. Condenser Inlet Check Valve (CICV)-Closed/Open

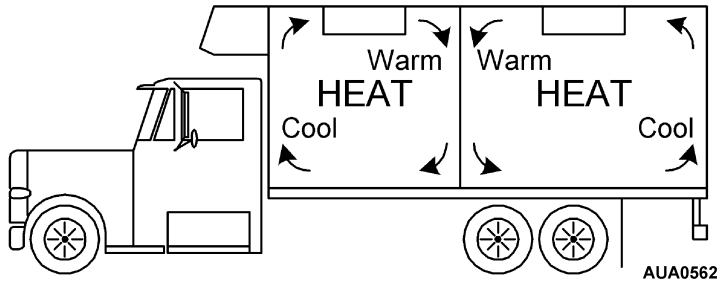
8. Condenser Check Valve (CCV)-Closed

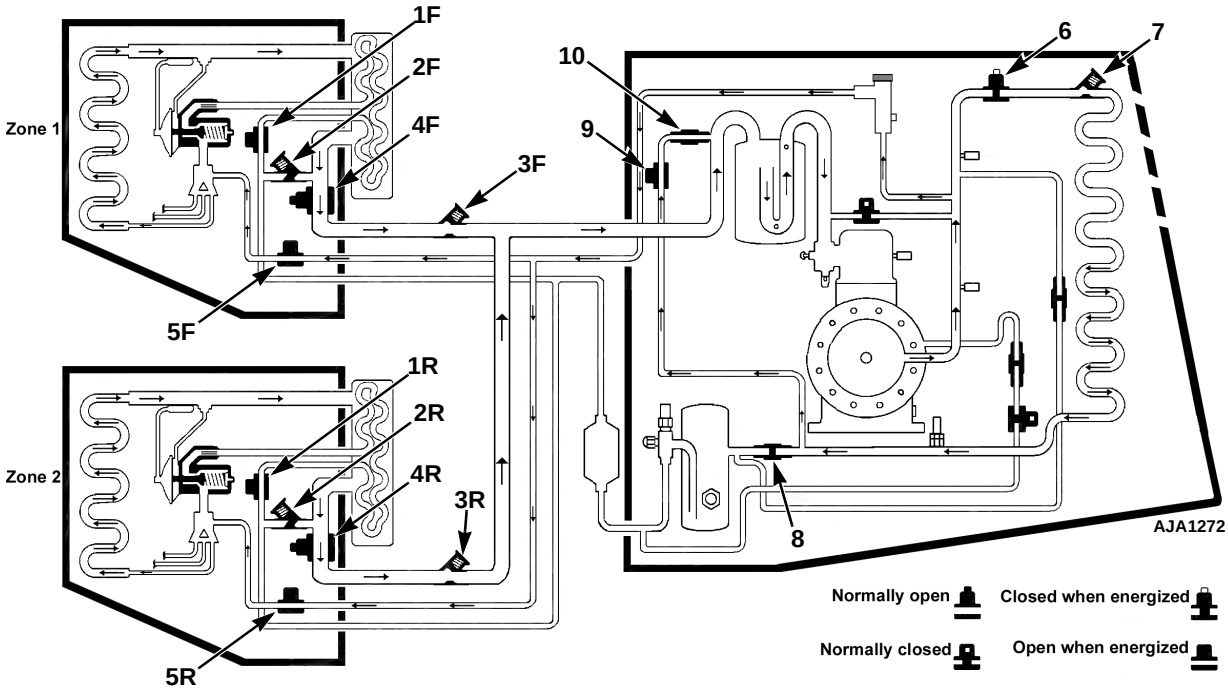
9. Purge Valve (PV)-Open

10. Purge Check Valve (PCV)-Open

All Zones Heating

When all zones are heating the unit condenser is not used. This is Hot Gas Heat operation.





Zone 1 Heat and Zone 2 Heat

Zone 1 Heat and Zone 2 Heat

The CIS is closed so high pressure refrigerant vapor leaves the compressor and flows through the DPR to Zone 1 and Zone 2 hot gas lines and through HGS1 and HGS2 into both evaporators. There, the refrigerant heats both evaporators and condenses into high pressure liquid. The refrigerant flows through the open suction line solenoids and back to the accumulator.

In the condensing unit the DPR valve is used to regulate head pressure. The purge valve is opened continuously during heat to drain the condenser coil. The CIS valve is closed, and opens if the discharge pressure is too high.

Zone 1 Evaporator

1F. Zone 1 Liquid Line Solenoid (LLS1)-Open

2F. Zone 1 Liquid Return Check Valve (LRCV1)-Closed

3F. Zone 1 Suction Line Check Valve (SLCV1)-Open

4F. Zone 1 Suction Line Solenoid (SLS1)-Open

5F. Zone 1 Hot Gas Solenoid (HGS1)-Open

Zone 2 Evaporator

1R. Zone 2 Liquid Line Solenoid (LLS2)-Open

2R. Zone 2 Liquid Return Check Valve (LRCV2)-Closed

3R. Zone 2 Suction Line Check Valve (SLCV2)-Open

4R. Zone 2 Suction Line Solenoid (SLS2)-Open

5R. Zone 2 Hot Gas Solenoid (HGS2)-Open

Condensing Unit

6. Condenser Inlet Solenoid (CIS)-Closed/Open (Pressure Dependent)

7. Condenser Inlet Check Valve (CICV)-Closed/Open

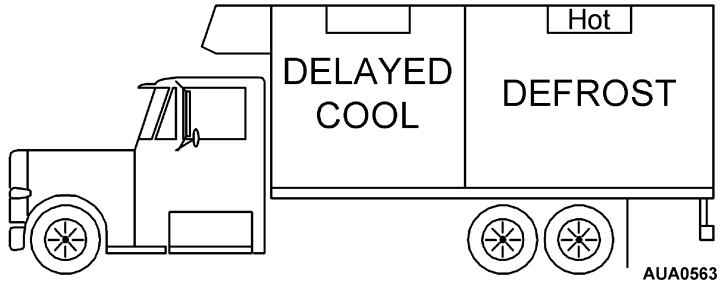
8. Condenser Check Valve (CCV)-Closed

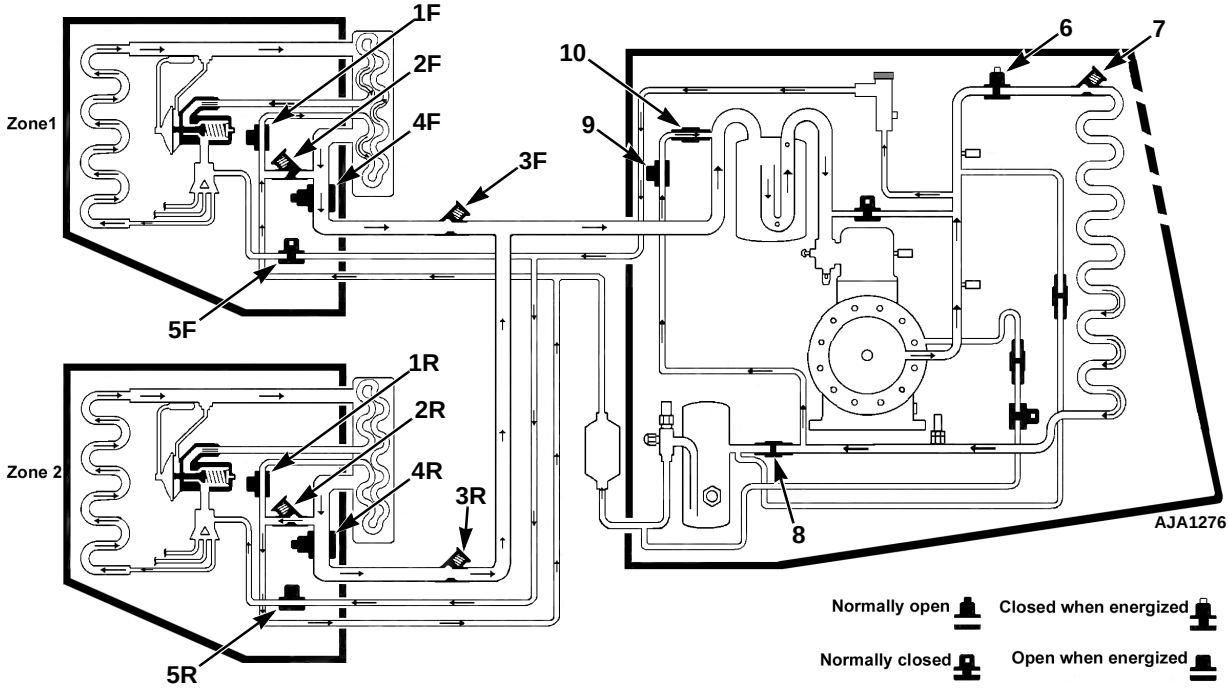
9. Purge Valve (PV)-Open

10. Purge Check Valve (PCV)-Open

Any Zone Defrosting

When any zone enters defrost, zones that are cooling or heating are placed in Delayed Cool/Heat mode. The unit condenser is not used. Defrost is accomplished by means of Hot Gas Heat.





Zone 1 Delayed Cool and Zone 2 Defrost

Zone 1 Delayed Cool and Zone 2 Defrost

The CIS is closed so high pressure refrigerant vapor leaves the compressor and flows through the DPR to the Zone 2 hot gas line and the open HGS2 into the Zone 2 evaporator. There, the refrigerant heats the Zone 2 evaporator and condenses into high pressure liquid. Because the SLS2 is open, the liquid refrigerant returns to the compressor through the SLS2, the second suction line, SLCV2 and the accumulator. The fans stay off in the Zone 2 evaporator, allowing the coil to defrost without warming the load.

Due to the low pressure in the second suction line, little or no refrigerant goes through the Zone 1 evaporator.

In the condensing unit the DPR valve is used to regulate head pressure. The purge valve is opened continuously during defrost to drain the condenser coil. The CIS valve is closed, but can be opened if the discharge pressure is too high.

Zone 1 Evaporator

1F. Zone 1 Liquid Line Solenoid (LLS1)-Open

2F. Zone 1 Liquid Return Check Valve (LRCV1)-Closed

3F. Zone 1 Suction Line Check Valve (SLCV1)-Open

4F. Zone 1 Suction Line Solenoid (SLS1)-Open

5F. Zone 1 Hot Gas Solenoid (HGS1)-Closed

Zone 2 Evaporator

1R. Zone 2 Liquid Line Solenoid (LLS2)-Open

2R. Zone 2 Liquid Return Check Valve (LRCV2)-Open

3R. Zone 2 Suction Line Check Valve (SLCV2)-Open

4R. Zone 2 Suction Line Solenoid (SLS2)-Open

5R. Zone 2 Hot Gas Solenoid (HGS2)-Open

Condensing Unit

6. Condenser Inlet Solenoid (CIS)-Closed/Open (Pressure Dependent)

7. Condenser Inlet Check Valve (CICV)-Closed/Open

8.Condenser Check Valve (CCV)-Closed

9. Purge Valve (PV)-Open

10. Purge Check Valve (PCV)-Open

Operation of Multi-Temperature Unit Solenoids and Valves

Energized means that the microprocessor and interface board is supplying battery voltage to the device.

Item	ID	Type	Cool	Heat	Defrost	Reverse Cycle
Condenser Inlet Solenoid (Note 1)	CIS	NO		Energized (closed)	Energized (closed)	Energized (closed)
Purge Valve (Note 1)	PV	NC		Energized (open)	Energized (open)	Energized (open)
Liquid Line Solenoid	LLS	NC	Energized (open)	Energized (open)	Energized (open)	Energized (open)
Hot Gas Solenoid	HGS	NC		Energized (open)	Energized (open)	Energized (open)
Hot Gas Bypass Valve (Note 1)	HGB	NC	Cycles			
Liquid Injection Valve (Note 2)	LIV	NC	Cycles			
Discharge Pressure Regulator (Note 3)	DPR	NC		Regulates	Regulates	Regulates
Suction Line Solenoid	SLS	NO				Energized (closed)

Note 1 = Influenced by the pressure transducers

Note 2 = Influenced by the compressor temperature

Note 3 = Mechanical device

Summary

- When a zone is cooling the Liquid Line Solenoid (LLS) is energized (open).
- When a zone is heating or defrosting the Liquid Line Solenoid (LLS) is energized (open) and the Hot Gas Solenoid (HGS) is energized (open).
- When a zone is in reverse cycle heat the Liquid Line Solenoid (LLS) is energized (open), the Hot Gas Solenoid (HGS) is energized (open) and the Suction Line Solenoid (SLS) is energized (closed).

When any zone is heating or defrosting the discharge pressure regulator is controlling discharge pressure.

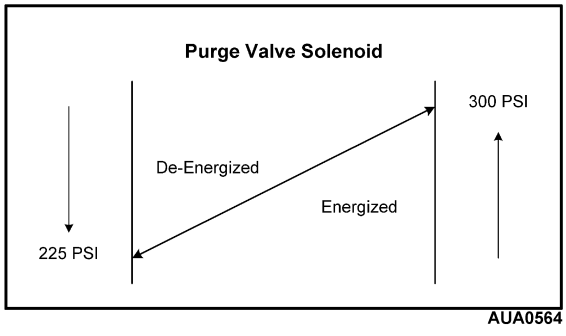
Transducer Pressure Control

SPECTRUM Multi-Temperature microprocessors monitor the discharge and suction pressure of the compressor using the pressure transducers. This information is used to control unit operation as shown below.

Purge Valve Solenoid

When any zone is in heat mode the Purge Valve is energized continuously.

When any zone is in defrost mode the microprocessor will energize the Purge Valve until the discharge pressure exceeds 300 psig (2068 kPa). At that time the unit will de-energize the solenoid. This controls the amount of refrigerant that is available during heat or defrost operation. When the discharge pressure drops below 225 psig (1551 kPa) the microprocessor will again energize the Purge Valve to add additional refrigerant to the system.

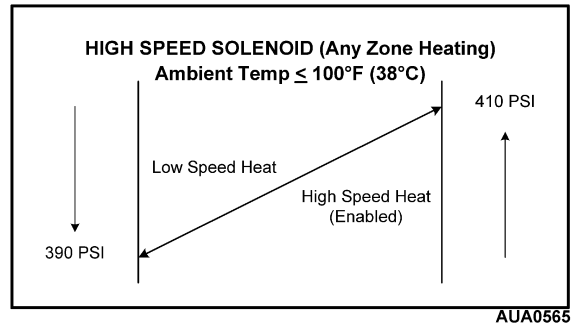


Purge Valve Solenoid

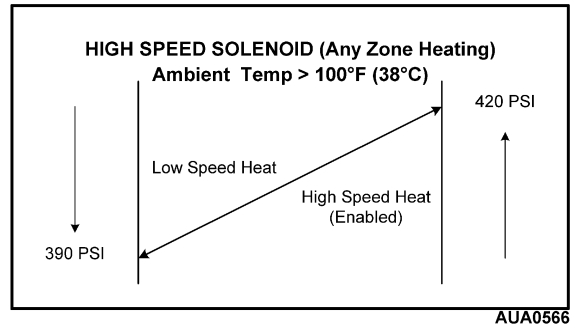
High Speed Solenoid (Any Zone Heating)

When any zone is in heat mode the microprocessor will enable the unit to run in high speed heat if required until the discharge pressure exceeds 410 psig (2827 kPa). At that time the unit will be forced to low speed heat to prevent a shut down on high discharge pressure. When the discharge pressure drops below 390 psig (2689 kPa) the controller will enable the unit to go back to high speed heat if required.

The second chart shows the values for high ambient temperature conditions (ambient temperature > 100°F (38°C).



High Speed Solenoid - Any Zone Heating

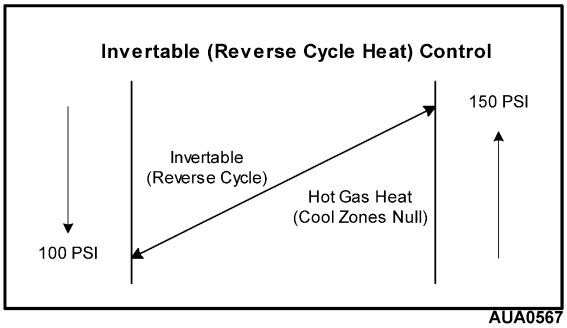


High Speed Solenoid - Any Zone Heating – High Ambient Temperatures

Invertible (Reverse Cycle Heat) Control

When one zone requests heat and another zone is cooling the microprocessor will leave the heating zone in cool for one minute but will energize the purge valve. For the next two minutes the unit will energize the hot gas solenoid. The suction line solenoid is then energized for the zone in heat. At that time the unit will be operating in inverted or reverse cycle heat. This allows the system to develop proper pressures to insure adequate performance when the heating zone's evaporator coil is acting as the condenser coil for the zone(s) that is cooling.

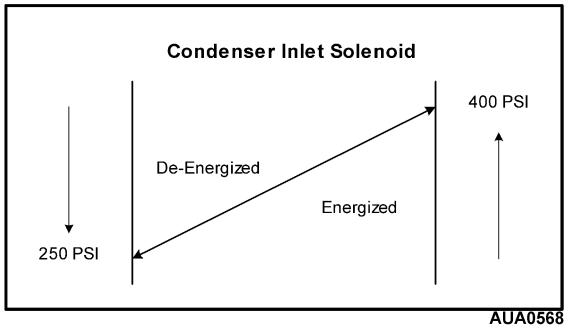
If the discharge pressure drops below 100 psig (689 kPa) the microprocessor will put the cooling zone in null and the heating zone in hot gas heat.



Invertible (Reverse Cycle Heat) Control

Condenser Inlet Solenoid

When any zone is in heat or defrost mode the microprocessor will energize the condenser inlet solenoid until the discharge pressure exceeds 400 psig (2758 kPa). At that time the condenser inlet solenoid is de-energized to prevent a shut down on high discharge pressure. This is to prevent shutdown for high discharge pressure during heat or defrost operation. When the discharge pressure drops below 250 psig (1724 kPa) the controller will again energize the condenser inlet solenoid if required.



Condenser Inlet Solenoid

(R01A) System Evacuation, Charging and Checking Charge

Where Used:

All SPECTRUM Multi-Temp units

Purpose

To evacuate and charge a SPECTRUM Multi-Temp refrigeration system.

NOTE: When finished with this Refrigeration Service Procedure return all service valves to the normal operating positions before releasing the unit for service or performing another Refrigeration Service Procedure.

Evacuating the System

STEP	ACTION	RESULTS	COMMENTS
1.	Be sure all refrigerant has been recovered from the unit. Connect vacuum pump and dual gauge manifold for 3 point evacuation from suction service valve, discharge service port and receiver tank outlet valve.		
2.	Verify proper operation of the Evacuation Station as shown in the Evacuation Station Operation Manual (TK 40612).		
3.	Connect the Evacuation Station for 3 point evacuation from the suction service valve, discharge service port and receiver tank outlet valve.		

Evacuating the System (continued)

STEP	ACTION	RESULTS	COMMENTS
4.	Connect a battery charger to unit battery.	The battery charger must be capable of at least 15 amperes output. This will maintain the charge level of the battery during the time required to evacuate and charge the unit.	Evacuation Mode is used to open the unit valves for evacuation. Failure to connect a battery charger may result in the battery voltage falling too low to reliably operate the microprocessor and valves.
5.	Turn the unit on.		
6.	Enter Evacuation Mode as shown in Section 4 of this manual.		
7.	Start the evacuation pump and mid-seat the suction service valve and receiver tank outlet valves.		
8.	Install service valve stem caps with seals and tighten. Valve stems should remain capped while evacuating unit.		
9.	Evacuate the unit to 500 microns.		
10.	Continue to evacuate for one additional hour after reaching 500 microns. This insures complete evacuation of the remote evaporators and lines.		

Evacuating the System (continued)

STEP	ACTION	RESULTS	COMMENTS
11.	Close the Evacuation Station valve nearest the vacuum pump to isolate the pump from the system. Turn the pump off.		
12.	Observe vacuum gauge.	The system pressure should remain below 2000 microns for 5 minutes.	If the pressure does not hold check for leaks (if a leak is suspected) or continue evacuation (if system is not dry).
13.	Restart the pump, open the Evacuation Station valve nearest the pump and repeat Steps 9, 11 and 12 as required until system pressure remains below 2000 microns for 5 minutes.		
14.	When system pressure remains below 2000 microns for 5 minutes, restart the pump, open the Evacuation Station valve nearest the pump and back seat the suction service valve while the evacuation pump is still operating. Replace the valve cap, re-close the Evacuation Station valve “D” (nearest the pump) and stop the evacuation pump.		Do not exercise the service valves with the unit in a deep vacuum unless the evacuation pump is operating.
15.	Proceed with Charging the System as shown on the next page.		

Charging the System

STEP	ACTION	RESULTS	COMMENTS
1.	Ensure that all compartment bulkheads are open.		Ceiling mounted bulkheads should not be stored close to the evaporator outlets as this will restrict airflow.
2.	Determine the correct charge for the unit as configured.		This information is shown in the Maintenance Manual for the unit. Actual weight of charge may vary somewhat due to length of refrigerant lines.
3.	Connect refrigerant supply as shown in the Evacuation Station Operation Manual (TK 40612).		
4.	The unit should still be in Evacuation Mode. Add as much of the charge as possible as liquid through the discharge service port and receiver outlet valve.		
5.	Back seat the receiver outlet service valve.		
6.	Exit Evacuation Mode.		

Charging the System (continued)

STEP	ACTION	RESULTS	COMMENTS
7.	Remove the evacuation station from the unit.		
8.	Install a gauge set and reconnect refrigerant supply.		
9.	Turn all zones on and set all zone setpoints for the lowest possible temperature to insure that all zones run in Cool Mode. Allow the unit to start.		
10.	Cover the condenser as required to maintain discharge pressure from 325 psig to 400 psig (2241 kPa to 2758 kPa) and add the remaining charge by weight as liquid through the Suction Service Valve.		
11.	If necessary, continue to add refrigerant until the ball in the receiver tank sight glass is floating but is no higher than 1/2 way up the glass. If the system is overcharged, remove refrigerant until the ball in the receiver tank sight glass is floating but is no higher than 1/2 way up the glass.		

Charging the System (continued)

STEP	ACTION	RESULTS	COMMENTS
12.	Continue to operate the unit and monitor the sight glass until all compartment temperatures are at or below 0°F (-18°C).		
13.	If the receiver tank sight glass level drops add additional refrigerant as required to maintain refrigerant in the bottom 1/2 of the sight glass.		
14.	When refrigerant level is correct back seat all service valves, remove gauges and securely replace valve stem covers with seals and service port caps before returning unit to service.		

Checking the Refrigerant Charge

STEP	ACTION	RESULTS	COMMENTS
1.	Ensure that all compartment bulkheads are open.		Ceiling mounted bulkheads should not be stored close to the evaporator outlets as this will restrict airflow.
2.	Turn all zones on and set all zone setpoints for the lowest possible temperature to insure that all zones run in Cool Mode. Allow the unit to start.		

Checking the Refrigerant Charge (continued)

STEP	ACTION	RESULTS	COMMENTS
3.	Cover the condenser as required to maintain discharge pressure from 325 psig to 400 psig (2241 kPa to 2758 kPa).		
4.	If necessary, add refrigerant until the ball in the receiver tank sight glass is floating but is no higher than 1/2 way up the glass. If the system is overcharged, remove refrigerant until the ball in the receiver tank sight glass is floating but is no higher than 1/2 way up the glass.		
5.	Continue to operate the unit and monitor the sight glass until all compartment temperatures are at or below 0°F (-18°C).		
6.	If the receiver tank sight glass level drops add additional refrigerant as required to maintain refrigerant in the bottom 1/2 of the sight glass.		

Checking the Refrigerant Charge (continued)

STEP	ACTION	RESULTS	COMMENTS
7.	When refrigerant level is correct back seat all service valves, remove gauges and securely replace valve stem covers with seals and service port caps before returning unit to service.		

(R02A) Low Side Pumpdown Test

Where Used

All SPECTRUM Multi-Temp units

Purpose

To perform a low side pumpdown on a SPECTRUM Multi-Temp refrigeration system to test internal seals.

NOTE: When finished with this Refrigeration Service Procedure return all service valves to the normal operating positions before releasing the unit for service or performing another Refrigeration Service Procedure.

Low Side Pumpdown Test

STEP	ACTION	RESULTS	COMMENTS
1.	Attach gauge set.		
2.	Disconnect the Hot Gas Bypass Valve connector at the solenoid.		
3.	Set all zone setpoints for the lowest possible temperature to insure that all zones run in Cool Mode.		
4.	Start and run all zones in Cool Mode for 10 minutes. Discharge pressure should be greater than 325 psig (2241 kPa) with R-404A.		Failure to operate unit to normal temperature and pressure may yield unreliable results.
5.	Front seat the receiver tank outlet valve and perform a low side pumpdown to 5 to 10 inch vacuum (-17 kPa to -34 kPa).		***CAUTION: Do not allow the compressor to run in a vacuum for more than 1 minute.***

Low Side Pumpdown Test (continued)

STEP	ACTION	RESULTS	COMMENTS
6.	Shut the unit down and observe gauges. The low side should not rise above 0 psig (0 kPa) in less than 2 minutes.	If low side pressure does not hold check: Receiver Tank Outlet Valve, Hot Gas Solenoids in all zones, Hot Gas Bypass Valve or Purge Valve.	
7.	If low side pressure holds proceed with desired test.		
8.	When test is complete reconnect the Hot Gas Bypass Valve connector at the solenoid.		

(R03A) Hot Gas Solenoid Test

Where Used

All SPECTRUM Multi-Temp units

Purpose

To test the Hot Gas Solenoid on a SPECTRUM Multi-Temp refrigeration system.

NOTE: When finished with this Refrigeration Service Procedure return all service valves to the normal operating positions before releasing the unit for service or performing another Refrigeration Service Procedure.

Hot Gas Solenoid Test

STEP	ACTION	RESULTS	COMMENTS
1.	Attach gauge set.		
2.	Disconnect the Hot Gas Bypass Valve connector at the solenoid.		
3.	Set all zone setpoints for the lowest possible temperature to insure that all zones run in Cool Mode.		
4.	Start and run all zones in Cool Mode for 10 minutes. Discharge pressure should be greater than 325 psig (2241 kPa) with R-404A.		
5.	Front seat the receiver tank outlet valve and perform a low side pumpdown to 5 to 10 inch vacuum (-17 kPa to -34 kPa).		***CAUTION: Do not allow the compressor to run in a vacuum for more than 1 minute.***
6.	Shut the unit down and observe gauges. The low side should not rise above 0 psig (0 kPa) in less than 2 minutes. If low side pressure holds proceed with test.	If low side pressure does not hold check: Receiver Tank Outlet Valve, Hot Gas Solenoids in all zones, Hot Gas Bypass Valve or Purge Valve.	

Hot Gas Solenoid Test (continued)

STEP	ACTION	RESULTS	COMMENTS
7.	Enter Interface Board Test Mode as shown in Section 4.		See Section 4 for more information on using Interface Board Test Mode.
8.	From Interface Board Test select the Zone 1 Hot Gas Solenoid.		See Section 4 for more information on using Interface Board Test Mode.
9.	Momentarily energize the valve (for less than 1 second).	The low side gauge should rise slightly. If low side pressure does not rise check the Hot Gas Solenoid for Zone 1. If the low side pressure rises proceed with test.	See Section 4 for more information on using Interface Board Test Mode.
10.	From Interface Board Test select the Zone 2 Hot Gas Solenoid.		See Section 4 for more information on using Interface Board Test Mode.
11.	Momentarily energize the valve (for less than 1 second).	The low side gauge should rise slightly. If low side pressure does not rise check the Hot Gas Solenoid for Zone 2. If the low side pressure rises proceed with test.	See Section 4 for more information on using Interface Board Test Mode.
12.	Exit the Interface Board Test.		See Section 4 for more information on using Interface Board Test Mode.
13.	If no further testing is required remove gauges, backseat all service valves and securely replace valve stem covers with seals and service port caps before returning unit to service.		
14.	When test is complete reconnect the Hot Gas Bypass Valve connector at the solenoid.		

(R04A) Liquid Line Solenoid & Liquid Return Check Valve Test

Where Used

All SPECTRUM Multi-Temp units

Purpose

To test the Liquid Line Solenoid on a SPECTRUM Multi-Temp refrigeration system.

NOTE: When finished with this Refrigeration Service Procedure return all service valves to the normal operating positions before releasing the unit for service or performing another Refrigeration Service Procedure.

Liquid Line Solenoid & Liquid Return Check Valve Test

STEP	ACTION	RESULTS	COMMENTS
1.	Attach gauge set.		
2.	Disconnect the Hot Gas Bypass Valve connector at the solenoid.		
3.	Set all zone setpoints for the lowest possible temperature to insure that all zones run in Cool Mode.		
4.	Start and run all zones in Cool Mode for 10 minutes. Discharge pressure should be greater than 325 psig (2241 kPa) with R-404A.		
5.	Front seat the receiver tank outlet valve and perform a low side pumpdown to 5 to 10 inch vacuum (-17 kPa to -34 kPa).		***CAUTION: Do not allow the compressor to run in a vacuum for more than 1 minute.***

Liquid Line Solenoid & Liquid Return Check Valve Test (continued)

STEP	ACTION	RESULTS	COMMENTS
6.	Shut the unit down and observe gauges. The low side should not rise above 0 psig (0 kPa) in less than 2 minutes. If the low side pressure holds proceed with desired test.	If low side pressure does not hold check: Receiver Tank Outlet Valve, Hot Gas Solenoids in all zones, Hot Gas Bypass Valve or Purge Valve.	
7.	Open receiver tank outlet valve and observe gauges. If the low side pressure holds proceed with test.	The low side should not rise. If low side pressure does not hold check: Liquid Line Solenoids & Liquid Return Check Valves in all zones.	Leaking Liquid Return Check Valves will cause cooling problems. Leaking Liquid Line Solenoids may allow cooling during null operation.
8.	Enter Interface Board Test Mode as shown in Section 4.		See Section 4 for more information on using Interface Board Test Mode.
9.	From Interface Board Test select the Zone 1 Liquid Line Solenoid.		See Section 4 for more information on using Interface Board Test Mode.
10.	Momentarily energize the valve (for less than 1 second).	The low side gauge should rise slightly. If low side pressure does not rise check the Liquid Line Solenoid for Zone 1. If the low side pressure rises proceed with test.	See Section 4 for more information on using Interface Board Test Mode.
11.	From Interface Board Test select the Zone 2 Liquid Line Solenoid.		See Section 4 for more information on using Interface Board Test Mode.

Liquid Line Solenoid & Liquid Return Check Valve Test (continued)

STEP	ACTION	RESULTS	COMMENTS
12.	Momentarily energize the valve (for less than 1 second).	The low side gauge should rise slightly. If low side pressure does not rise check the Liquid Line Solenoid for Zone 2. If the low side pressure rises proceed with test.	See Section 4 for more information on using Interface Board Test Mode.
13.	Exit the Interface Board Test.		See Section 4 for more information on using Interface Board Test Mode.
14.	If no further testing is required remove gauges, backseat all service valves and securely replace valve stem covers with seals and service port caps before returning unit to service.		
15.	When test is complete reconnect the Hot Gas Bypass Valve connector at the solenoid.		

(R06A) Suction Line Check Valve Test

Where Used

All SPECTRUM Multi-Temp units

Purpose

To test the Suction Line Check Valves on a SPECTRUM Multi-Temp refrigeration system.

NOTE: When finished with this Refrigeration Service Procedure return all service valves to the normal operating positions before releasing the unit for service or performing another Refrigeration Service Procedure.

Suction Line Check Valve Test

STEP	ACTION	RESULTS	COMMENTS
1.	Attach gauge set.		
2.	Disconnect the Hot Gas Bypass Valve connector at the solenoid.		
3.	Set all zone setpoints for the lowest possible temperature to insure that all zones run in Cool Mode.		
4.	Start and run all zones in Cool Mode for 10 minutes or until stable - discharge pressure should be greater than 325 psig (224 kPa) with R-404A.		
5.	Front seat the receiver tank outlet valve and perform a low side pumpdown to 5 to 10 inch vacuum (-17 kPa to -34 kPa).		***CAUTION: Do not allow the compressor to run in a vacuum for more than 1 minute.***

Suction Line Check Valve Test (continued)

STEP	ACTION	RESULTS	COMMENTS
6.	Shut the unit down and observe gauges. The low side should not rise above 0 psig (0 kPa) in less than 2 minutes. If the low side pressure holds proceed with desired test.	If low side pressure does not hold check: Receiver Tank Outlet Valve, Hot Gas Solenoids in all zones, Hot Gas Bypass Valve or Purge Valve.	
7.	Bleed through the gauge manifold to the low side and establish a pressure of 5 to 20 psig (34 kPa to 138 kPa). Close the hand valves on the gauge set.		
8.	Observe the low pressure gauge.	If the pressure drops within 2 minutes check the Suction Line Check Valves for leaks under low pressure.	
9.	If the low side pressure holds for 2 minutes proceed with test.		
10.	Equalize the system through the gauge manifold to the low side. Close the hand valves on the gauge set.		
11.	Observe the low pressure gauge.	If pressure drops within 2 minutes check the Suction Line Check Valves for leaks under high pressure.	

Suction Line Check Valve Test (continued)

STEP	ACTION	RESULTS	COMMENTS
12.	If no further testing is required remove gauges, backseat all service valves and securely replace valve stem covers with seals and service port caps before returning unit to service.		
13.	When test is complete reconnect the Hot Gas Bypass Valve connector at the solenoid.		

(R07A) Purge Valve Test

Where Used

All SPECTRUM Multi-Temp units

Purpose

To test the Purge Valve on a SPECTRUM Multi-Temp refrigeration system.

NOTE: When finished with this Refrigeration Service Procedure return all service valves to the normal operating positions before releasing the unit for service or performing another Refrigeration Service Procedure.

Purge Valve Test

STEP	ACTION	RESULTS	COMMENTS
1.	Attach gauge set.		
2.	Disconnect the Hot Gas Bypass Valve connector at the solenoid.		
3.	Set all zone setpoints for the lowest possible temperature to insure that all zones run in Cool Mode.		
4.	Start and run all zones in Cool Mode for 10 minutes or until stable - discharge pressure should be greater than 325 psig (2241 kPa) with R-404A.		
5.	Front seat the receiver tank outlet valve and perform a low side pumpdown to 5 to 10 inch vacuum (-17 kPa to -34 kPa).		***CAUTION: Do not allow the compressor to run in a vacuum for more than 1 minute.***

Purge Valve Test (continued)

STEP	ACTION	RESULTS	COMMENTS
6.	Shut the unit down and observe gauges. The low side should not rise above 0 psig (0 kPa) in less than 2 minutes. If low side pressure holds proceed with desired test.	If low side pressure does not hold check: Receiver Tank Outlet Valve, Hot Gas Solenoids in all zones, Hot Gas Bypass Valve or Purge Valve.	
7.	Enter Interface Board Test Mode as shown in Section 4.		See Section 4 for more information on using Interface Board Test Mode.
8.	From Interface Board Test select the Purge Valve.		See Section 4 for more information on using Interface Board Test Mode.
9.	Momentarily energize the valve (for less than 1 second).	The low side gauge should rise slightly. If the low side pressure does not rise check the Purge Valve.	See Section 4 for more information on using Interface Board Test Mode.
10.	Exit the Interface Board Test.		See Section 4 for more information on using Interface Board Test Mode.
11.	If no further testing is required remove gauges, backseat all service valves and securely replace valve stem covers with seals and service port caps before returning unit to service.		
12.	When test is complete reconnect the Hot Gas Bypass Valve connector at the solenoid.		

(R08A) Condenser Inlet Solenoid, Receiver Tank Check Valve & Purge Check Valve Test

Where Used

All SPECTRUM Multi-Temp units

Purpose

To test the Condenser Inlet Solenoid, Receiver Tank Check Valve and Purge Check Valve on a SPECTRUM Multi-Temp refrigeration system.

IMPORTANT: This test will require the removal of some refrigerant using a recovery machine

NOTE: When finished with this Refrigeration Service Procedure return all service valves to the normal operating positions before releasing the unit for service or performing another Refrigeration Service Procedure.

Condenser Inlet Solenoid, Receiver Tank Check Valve & Purge Check Valve Test

STEP	ACTION	RESULTS	COMMENTS
1.	Verify that the Hot Gas Solenoids in all zones and the Hot Gas Bypass Valve are in good working condition.		
2.	Attach gauge set.		
3.	Disconnect the Hot Gas Bypass Valve connector at the solenoid.		
4.	Attach a recovery machine to the receiver outlet service valve port using a manifold gauge set to allow monitoring receiver tank pressure.		

Condenser Inlet Solenoid, Receiver Tank Check Valve & Purge Check Valve Test (continued)

STEP	ACTION	RESULTS	COMMENTS
5.	Set all zone setpoints for the lowest possible temperature to insure that all zones run in Cool Mode.		
6.	Start and run all zones in Cool Mode for 10 minutes or until stable - discharge pressure should be greater than 325 psig (2241 kPa) with R-404A.		
7.	Front seat the receiver tank outlet valve and perform a low side pumpdown to 5 to 10 inch vacuum (-17 kPa to -34 kPa).		***CAUTION: Do not allow the compressor to run in a vacuum for more than 1 minute.***
8.	Shut the unit down and observe gauges. The low side should not rise above 0 psig (0 kPa) in less than 2 minutes. If low side pressure holds proceed with desired test.	If low side pressure does not hold check: Receiver Tank Outlet Valve, Hot Gas Solenoids in all zones, Hot Gas Bypass Valve or Purge Valve.	
	Condenser Inlet Solenoid and Receiver Tank Check Valve Test		
9.	Enter Interface Board Test Mode as shown in Section 4.		See Section 4 for more information on using Interface Board Test Mode.

Condenser Inlet Solenoid, Receiver Tank Check Valve & Purge Check Valve Test (continued)

STEP	ACTION	RESULTS	COMMENTS
10.	From Interface Board Test select the Condenser Inlet Solenoid.		See Section 4 for more information on using Interface Board Test Mode.
11.	Lock the valve on.	The Condenser Inlet Solenoid will remain energized for a maximum 15 minute timeout - if the test time is expected to exceed 15 minutes this step must be repeated about every ten minutes to prevent timeout.	See Section 4 for more information on using Interface Board Test Mode.
12.	Start the recovery machine to remove refrigerant from the condenser and receiver tank and observe the high side gauge. Remove refrigerant until there is a 50 to 100 psig (345 to 689 kPa) difference between receiver tank pressure and the high side pressure. The high side pressure should not change.	If high side pressure does not hold check the Condenser Inlet Solenoid and Receiver Tank Check Valve.	
13.	If the high side pressure holds proceed with the test.		
	Purge Check Valve Test		
14.	From Interface Board Test select the Condenser Inlet Solenoid.		See Section 4 for more information on using Interface Board Test Mode.

Condenser Inlet Solenoid, Receiver Tank Check Valve & Purge Check Valve Test (continued)

STEP	ACTION	RESULTS	COMMENTS
15.	Lock the valve on.	The Condenser Inlet Solenoid will remain energized for a maximum 15 minute timeout - if the test time is expected to exceed 15 minutes this step must be repeated about every ten minutes to prevent timeout.	See Section 4 for more information on using Interface Board Test Mode.
16.	Pressurize the low side of the system using the refrigerant recovered earlier and observe the Receiver Tank Pressure Gauge. The pressure should not change.	If the receiver tank pressure changes check the Purge Check Valve.	
17.	Exit the Interface Board Test.		See Section 4 for more information on using Interface Board Test Mode.
18.	If no further testing is required remove gauges, backseat all service valves and securely replace valve stem covers with seals and service port caps before returning unit to service.		
19.	When test is complete reconnect the Hot Gas Bypass Valve connector at the solenoid.		

(R09A) Service Pumpdown

Where Used

All SPECTRUM Multi-Temp units

Purpose

To perform a service pumpdown on a SPECTRUM Multi-Temp refrigeration system to allow service of all low side components, compressor, suction transducer, drier, liquid line solenoids, suction line solenoids, suction line check valve and expansion valve.

NOTE: When finished with this Refrigeration Service Procedure return all service valves to the normal operating positions before releasing the unit for service or performing another Refrigeration Service Procedure.

Low Side Pumpdown

STEP	ACTION	RESULTS	COMMENTS
1.	Attach gauge set.		
2.	Disconnect the Hot Gas Bypass Valve connector at the solenoid.		
3.	Set all zone setpoints for the lowest possible temperature to insure that all zones run in Cool Mode.		
4.	Start and run all zones in Cool Mode for 10 minutes or until stable.		
5.	Front seat the receiver tank outlet valve and perform a low side pumpdown to 0 to 5 inch vacuum (0 to -17 kPa).		***CAUTION: Do not allow the compressor to run in a vacuum for more than 1 minute.***

Low Side Pumpdown (continued)

STEP	ACTION	RESULTS	COMMENTS
6.	Shut the unit down and observe gauges. The low side should not rise above 5 psig (34 kPa) in less than 2 minutes.	If low side pressure does not hold check: Receiver Tank Outlet Valve, Hot Gas Solenoids in all zones, Hot Gas Bypass Valve or Purge Valve.	If the low side pressure can not be maintained below 15 psig, (103 kPa) the refrigerant must be recovered as shown in Refrigeration Service Procedure R10A before opening the system.
7.	Before opening the low side for service, use the gauge manifold to equalize the pressure in the low side to slightly positive.		
8.	If all zones are slightly greater than 0 psig (0 kPa), work can proceed on low side components.		
9.	When service is complete perform a low side evacuation per Refrigeration Service Procedure R11A, backseat all service valves, remove gauges and securely replace valve stem covers with seals and service port caps before returning unit to service.		
10.	When test is complete reconnect the Hot Gas Bypass Valve connector at the solenoid.		

(R10A) SPECTRUM Multi-Temp Refrigerant Recovery

Where Used

All SPECTRUM Multi-Temp units

Purpose

To recover the refrigerant charge from a SPECTRUM Multi-Temp refrigeration system.

NOTE: When finished with this Refrigeration Service Procedure return all service valves to the normal operating positions before performing another Refrigeration Service Procedure.

Recovering Refrigerant from Unit with Operating Compressor

STEP	ACTION	RESULTS	COMMENTS
1.	Connect recovery machine for recovery from discharge service port and receiver tank outlet valve.		
2.	If the compressor is operable, perform a low side pumpdown per Refrigeration Service Procedure R02A.		
3.	Recover the liquid refrigerant from the receiver tank.		
4.	Continue to recover the refrigerant as a vapor from both points.		

Recovering Refrigerant from Unit with Failed Compressor

STEP	ACTION	RESULTS	COMMENTS
1.	Connect recovery machine for recovery from discharge service port and receiver tank outlet valve.		
2.	Midseat the receiver tank outlet valve.		
3.	Connect the unit battery and install battery charger on battery. The battery charger must be capable of at least 15 amperes output.	This will maintain the charge level of the battery during the time required to evacuate and charge the unit.	Evacuation Mode is used to open valves as required for evacuation. Failure to connect a battery charger may result in the battery voltage falling too low to reliably operate the valves.
4.	Enter Evacuation Mode as shown in Section 4.	All normally closed valves will be energized.	See Section 4 for more information on using Interface Board Test Mode.
5.	Recover the refrigerant as a liquid/vapor from both points.		

(R12A) Hot Gas Bypass Valve Test

Where Used

All SPECTRUM Multi-Temp units

Purpose

To test the Hot Gas Bypass Valve on a SPECTRUM Multi-Temp refrigeration system.

NOTE: When finished with this Refrigeration Service Procedure return all service valves to the normal operating positions before releasing the unit for service or performing another Refrigeration Service Procedure.

Hot Gas Bypass Valve Test

STEP	ACTION	RESULTS	COMMENTS
1.	Attach gauge set.		
2.	Disconnect the Hot Gas Bypass Valve connector at the solenoid.		
3.	Set all zone setpoints for the lowest possible temperature to insure that all zones run in Cool Mode.		
4.	Start and run all zones in Cool Mode for 10 minutes or until stable - discharge pressure should be greater than 325 psig (2241 kPa) with R-404A.		
5.	Front seat the receiver tank outlet valve and perform a low side pumpdown to 5 to 10 inch vacuum (-17 kPa to -34 kPa).		***CAUTION: Do not allow the compressor to run in a vacuum for more than 1 minute.***

Hot Gas Bypass Valve Test (continued)

STEP	ACTION	RESULTS	COMMENTS
6.	Shut the unit down and observe gauges. The low side should not rise above 0 psig (0 kPa) in less than 2 minutes. If low side pressure holds proceed with the next step.	If low side pressure does not hold check: Receiver Tank Outlet Valve, Hot Gas Solenoids in all zones, Hot Gas Bypass Valve or Purge Valve.	
7.	Reconnect the Hot Gas Bypass Valve connector at the solenoid.		
8.	Enter Interface Board Test Mode as shown in Section 4.		See Section 4 for more information on using Interface Board Test Mode.
9.	From Interface Board Test select the Hot Gas Bypass Valve.		See Section 4 for more information on using Interface Board Test Mode.
10.	Momentarily energize the valve (for less than 1 second).	The low side gauge should rise slightly. If the low side pressure does not rise check the Hot Gas Bypass Valve.	See Section 4 for more information on using Interface Board Test Mode.
11.	Exit the Interface Board Test.		See Section 4 for more information on using Interface Board Test Mode.
12.	If no further testing is required remove gauges, backseat all service valves and securely replace valve stem covers with seals and service port caps before returning unit to service.		

(R13A) Liquid Injection Valve Test

Where Used

All SPECTRUM Multi-Temp units

Purpose

To test the Liquid Injection Valve on a SPECTRUM Multi-Temp refrigeration system.

NOTE: When finished with this Refrigeration Service Procedure return all service valves to the normal operating positions before releasing the unit for service or performing another Refrigeration Service Procedure.

Liquid Injection Valve Test

STEP	ACTION	RESULTS	COMMENTS
1.	Attach gauge set.		
2.	Disconnect the Hot Gas Bypass Valve connector at the solenoid.		
3.	Set all zone setpoints for the lowest possible temperature to insure that all zones run in Cool Mode.		
4.	Start and run all zones in Cool Mode for 10 minutes or until stable - discharge pressure should be greater than 325 psig (2241 kPa) with R-404A.		
5.	Front seat the compressor suction service valve and perform a compressor pumpdown to 5 to 10 inch vacuum (-17 to -34 kPa).		***CAUTION: Do not allow the compressor to run in a vacuum for more than 1 minute.***

Liquid Injection Valve Test (continued)

STEP	ACTION	RESULTS	COMMENTS
6.	Shut the unit down and observe gauges. The low side should not rise above 0 psig (0 kPa) in less than 2 minutes. If low side pressure holds proceed with desired test.	If low side pressure does not hold check: Receiver Tank Outlet Valve, Hot Gas Solenoids in all zones, Hot Gas Bypass Valve or Purge Valve.	
7.	Enter Interface Board Test Mode as shown in Section 4.		See Section 4 for more information on using Interface Board Test Mode.
8.	From Interface Board Test select the Liquid Injection Valve.		See Section 4 for more information on using Interface Board Test Mode.
9.	Momentarily energize the valve (for less than 1 second).	The low side gauge should rise slightly. If the low side pressure does not rise check the Liquid Injection Valve.	See Section 4 for more information on using Interface Board Test Mode.
10.	Exit the Interface Board Test.		See Section 4 for more information on using Interface Board Test Mode.
11.	If no further testing is required remove gauges, backseat all service valves and securely replace valve stem covers with seals and service port caps before returning unit to service.		

Liquid Injection Valve Test (continued)

STEP	ACTION	RESULTS	COMMENTS
12.	When test is complete reconnect the Hot Gas Bypass Valve connector at the solenoid.		

Diagnostic Data Collection Procedure

The information shown on the Data Collection Form at the back of this procedure is helpful when diagnosing Thermo King multi-temp units that suffer from reduced cooling or heating capacity. This data presents a comprehensive picture of unit operating conditions and allows the technician or service representative to accurately assess the situation. The Data Collection Form should be completed before contacting Thermo King Service.

Diagnostic Recommendations

The following recommendations will aid in performing an accurate diagnosis in a timely manner. They also insure that accurate data is recorded on the Data Collection Form.

- Always record all alarm codes that exist. Often they provide a direct path to the source of a problem. Consult Section 5 for a complete list of alarms and the recommended corrective actions for each alarm.
- Always perform a Pretrip Test. In almost every instance, if a problem exists an alarm code (or codes) will be generated by the Pretrip Test that point to the source of the problem.
- If suspect, confirm the accuracy of the suction and discharge pressure transducers by installing a calibrated refrigeration gauge set. It should be noted that the suction pressure transducer is located on the throttle valve. As a result, the suction pressure displayed is compressor suction pressure, not system suction pressure.
- If suspect, confirm the accuracy of unit temperature sensors with a calibrated thermometer. Be sure all sensor grades are properly set.
- Be sure no airflow restrictions are present. Check the evaporator and condenser coils for cleanliness.
- Be sure the engine rpm is set to specification and the drive belt is properly adjusted.
- If indicated, check refrigerant charge, compressor oil level, throttle valve setting and system efficiency.
- Be sure the box door seals and insulation are in good condition and compartment bulkheads are properly installed and leak free.

Completing the Data Collection Form

Verify accuracy of unit pressure transducers and temperatures sensors as required before collecting data.

Use Service Test Mode in the Maintenance Menu to place the unit in the required modes of operation as shown on the Data Collection Form. Service Test Mode displays the return air and discharge air temperature sensors and calculates temperature differential. Consult Section 4 for additional information on using Service Test Mode.

Record the values requested on the Data Collection Form at the beginning of each test and again 10 minutes later after unit operation in the specified modes has stabilized. Then proceed with the next test shown on the Data Collection Form.

Cover the condenser as required to maintain discharge pressure at the level experienced with a 100°F (38°C) ambient temperature. With R-404A refrigerant discharge pressure should be from 350 to 375 psig (2413 kPa to 2586 kPa).

It will be helpful to note any extraordinary conditions such as very high or very low ambient temperature.

SPECTRUM Multi-Temp Unit Data Collection Form

Always complete the first three sections of this form.

	Zone 1 High Speed Cool			Zone 2 High Speed Cool				
Time	Return Air Temp	Discharge Air Temp	Temp Differential	Return Air Temp	Discharge Air Temp	Temp Differential	Suction Pressure	Discharge Pressure

	Zone 1 High Speed Cool			Zone 2 High Speed Heat				
Time	Return Air Temp	Discharge Air Temp	Temp Differential	Return Air Temp	Discharge Air Temp	Temp Differential	Suction Pressure	Discharge Pressure

	Zone 1 High Speed Heat			Zone 2 High Speed Cool				
Time	Return Air Temp	Discharge Air Temp	Temp Differential	Return Air Temp	Discharge Air Temp	Temp Differential	Suction Pressure	Discharge Pressure

Complete these four sections if the unit is experiencing reduced cooling or heating capacity.

	Zone 1 High Speed Cool			Zone 2 Null				
Time	Return Air Temp	Discharge Air Temp	Temp Differential	Return Air Temp	Discharge Air Temp	Temp Differential	Suction Pressure	Discharge Pressure

	Zone 1 Null			Zone 2 High Speed Cool				
Time	Return Air Temp	Discharge Air Temp	Temp Differential	Return Air Temp	Discharge Air Temp	Temp Differential	Suction Pressure	Discharge Pressure

	Zone 1 High Speed Heat			Zone 2 Null				
Time	Return Air Temp	Discharge Air Temp	Temp Differential	Return Air Temp	Discharge Air Temp	Temp Differential	Suction Pressure	Discharge Pressure

	Zone 1 Null			Zone 2 High Speed Cool				
Time	Return Air Temp	Discharge Air Temp	Temp Differential	Return Air Temp	Discharge Air Temp	Temp Differential	Suction Pressure	Discharge Pressure

Section 9 – SPECTRUM Drawings

CHANGES AND COMMENTS

You are invited to comment on this manual so it can be updated and improved to better meet your needs. Any corrections or comments are welcome. Please complete the following information:

Manual Form Number _____

Section and Page # _____

Your Name _____

Company Name _____

Phone Number _____

Corrections and comments _____

_____

_____

_____

_____

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_____

_____

_____

Return to: **THERMO KING CORPORATION**
314 West 90th Street
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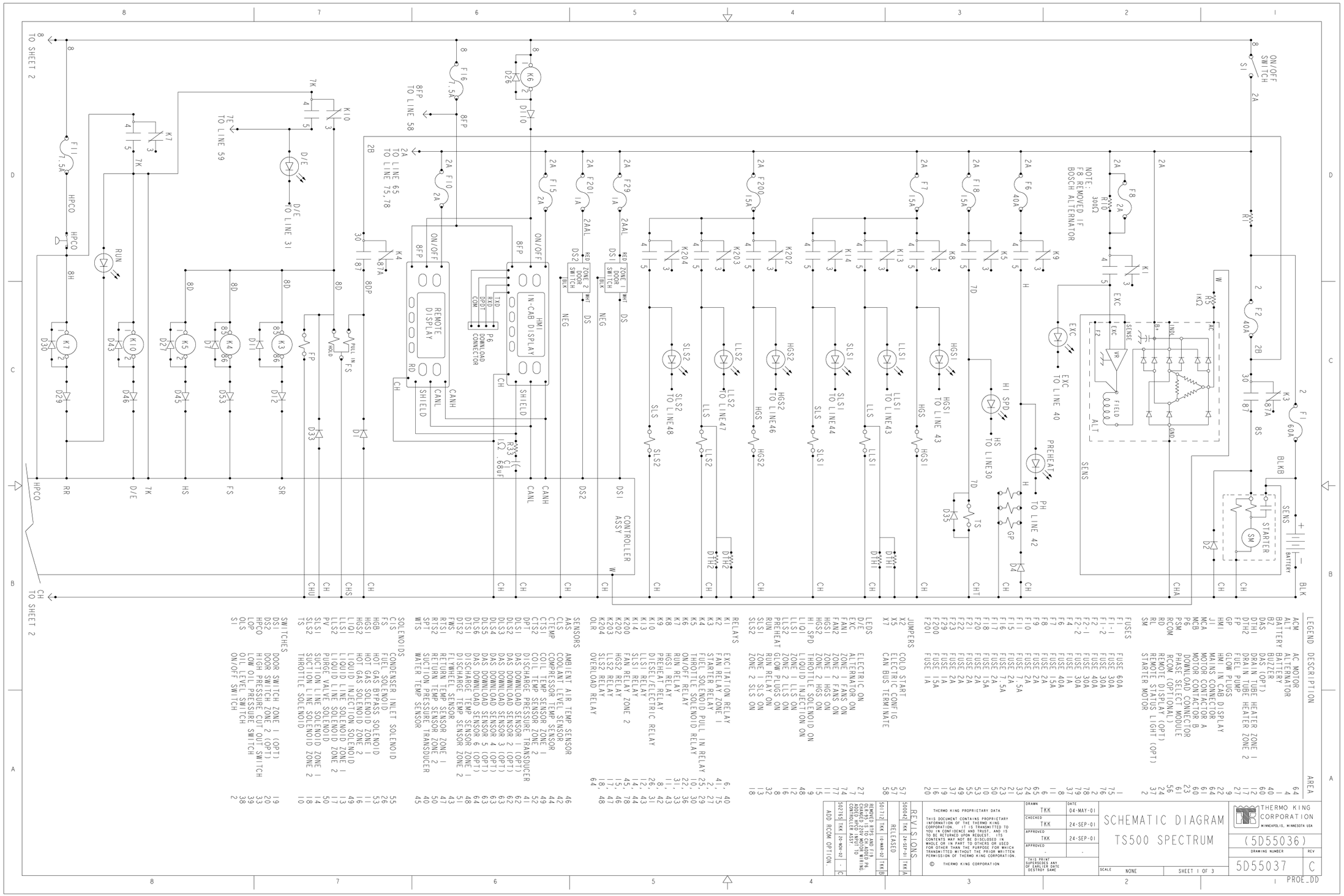
TS 500 SPECTRUM Schematic Diagram — Page 1 of 3



LEGEND DESCRIPTION

		AREA
ACM	AC MOTOR	64
ALT	ALTERNATOR	4
BATTERY	BATTERY	40
BUZZER	BUZZER	60
DAS	DAS (OPT)	12
DTH1	DRAIN TUBE HEATER ZONE 1	12
DTH2	DRAIN TUBE HEATER ZONE 2	12
FP	FUEL PUMP	27
GP	GLOW PLUGS	22
HMI	HMI IN CAB DISPLAY	64
MCA	MAINS CONNECTOR	64
MCB	MOTOR CONTACTOR A	64
P6	MOTOR CONTACTOR B	60
PSM	DOWNLOAD CONNECTOR	23
RCOM	PHASE SELECT MODULE	61
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RL	REMOTE DISPLAY (OPT)	24
SM	REMOTE STATUS LIGHT (OPT)	37
	STARTER MOTOR	2

FUSES

F1	FUSE 60A	1
F1-1	FUSE 30A	75
F1-2	FUSE 30A	76
F2	FUSE 30A	2
F2-1	FUSE 40A	78
F2-2	FUSE 30A	79
F4	FUSE 40A	37
F6	FUSE IA	8
F7	FUSE 15A	11
F8	FUSE 2A	6
F9	FUSE 2A	65
F10	FUSE 2A	24
F11	FUSE 7.5A	33
F15	FUSE 2A	21
F16	FUSE 7.5A	23
F17	FUSE 2A	50
F18	FUSE 15A	10
F20	FUSE 15A	53
F21	FUSE 2A	55
F22	FUSE 2A	49
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F201	FUSE IA	20

JUMPERS

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LEDS

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HI SPD	THROTTLE SOLENOID ON	9
LIQUID INJ	LIQUID INJECTION ON	48
ZONE 1 LLS	ZONE 1 LLS ON	12
ZONE 2 LLS	ZONE 2 LLS ON	16
PREHEAT	GLOW PLUGS ON	8
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ZONE 2 SLS	ZONE 2 SLS ON	18

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K14	SLS1 RELAY	14, 44
K200	FAN RELAY ZONE 2	45, 78
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K203	LLS2 RELAY	17, 47
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OLR	OVERLOAD RELAY	64

SENSORS

AAS	AMBIENT AIR TEMP SENSOR	46
CAS	COOLANT LEVEL SENSOR	42
CTEMP	COMPRESSOR TEMP SENSOR	46
CTS1	COIL TEMP SENSOR ZONE 1	49
CTS2	COIL TEMP SENSOR ZONE 2	52
DPT	DISCHARGE PRESSURE TRANSDUCER	41
DS1	DAS DOWNLOAD SENSOR 1 (OPT)	62
DS2	DAS DOWNLOAD SENSOR 2 (OPT)	62
DS3	DAS DOWNLOAD SENSOR 3 (OPT)	63
DS4	DAS DOWNLOAD SENSOR 4 (OPT)	63
DS5	DAS DOWNLOAD SENSOR 5 (OPT)	63
DS6	DAS DOWNLOAD SENSOR 6 (OPT)	64
DTS1	DISCHARGE TEMP SENSOR ZONE 1	48
DTS2	DISCHARGE TEMP SENSOR ZONE 2	64
FWS	FLYWHEEL SENSOR	51
RTS1	RETURN TEMP SENSOR ZONE 1	43
RTS2	RETURN TEMP SENSOR ZONE 2	47
SPT	SUCTION PRESSURE TRANSDUCER	50
WTS	WATER TEMP SENSOR	40

SOLENOIDS

CLS	CONDENSER INLET SOLENOID	55
FS	FUEL SOLENOID	26
HGB	HOT GAS BYPASS SOLENOID	53
HGS1	HOT GAS SOLENOID ZONE 1	11
HGS2	HOT GAS SOLENOID ZONE 2	16
LIQI	LIQUID INJECTION SOLENOID	49
LLS1	LIQUID LINE SOLENOID ZONE 1	13
LLS2	LIQUID LINE SOLENOID ZONE 2	17
PV	PURGE VALVE SOLENOID	50
SLS1	SUCTION LINE SOLENOID ZONE 1	14
SLS2	SUCTION LINE SOLENOID ZONE 2	18
TS	THROTTLE SOLENOID	10

SWITCHES

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HPCO	HIGH PRESSURE CUT OUT SWITCH	33
LOP	LOW OIL PRESSURE SWITCH	33
OLS	OIL LEVEL SWITCH	38
SI	ON/OFF SWITCH	2

REVISIONS			
58004②	TKK	24-SEP-01	TKK A
RELEASED			
50017②	TKK	10-MAY-02	TKK B
REMOVED RTS AND F19. CHANGED S3TO NORMALLY PB. ADDED AMCO INPUT TO CONTROLLER ASST.			
50215①	TKK	26-NOV-02	- C
ADD RCOM OPTION.			

DRAWN	TKK	04-MAY-01
CHECKED	TKK	24-SEP-01
APPROVED	TKK	24-SEP-01
APPROVED	-	

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SCHEMATIC DIAGRAM
TS500 SPECTRUM

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THERMO KING CORPORATION
MINNEAPOLIS, MINNESOTA USA

(5D55036)

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5D55037	C

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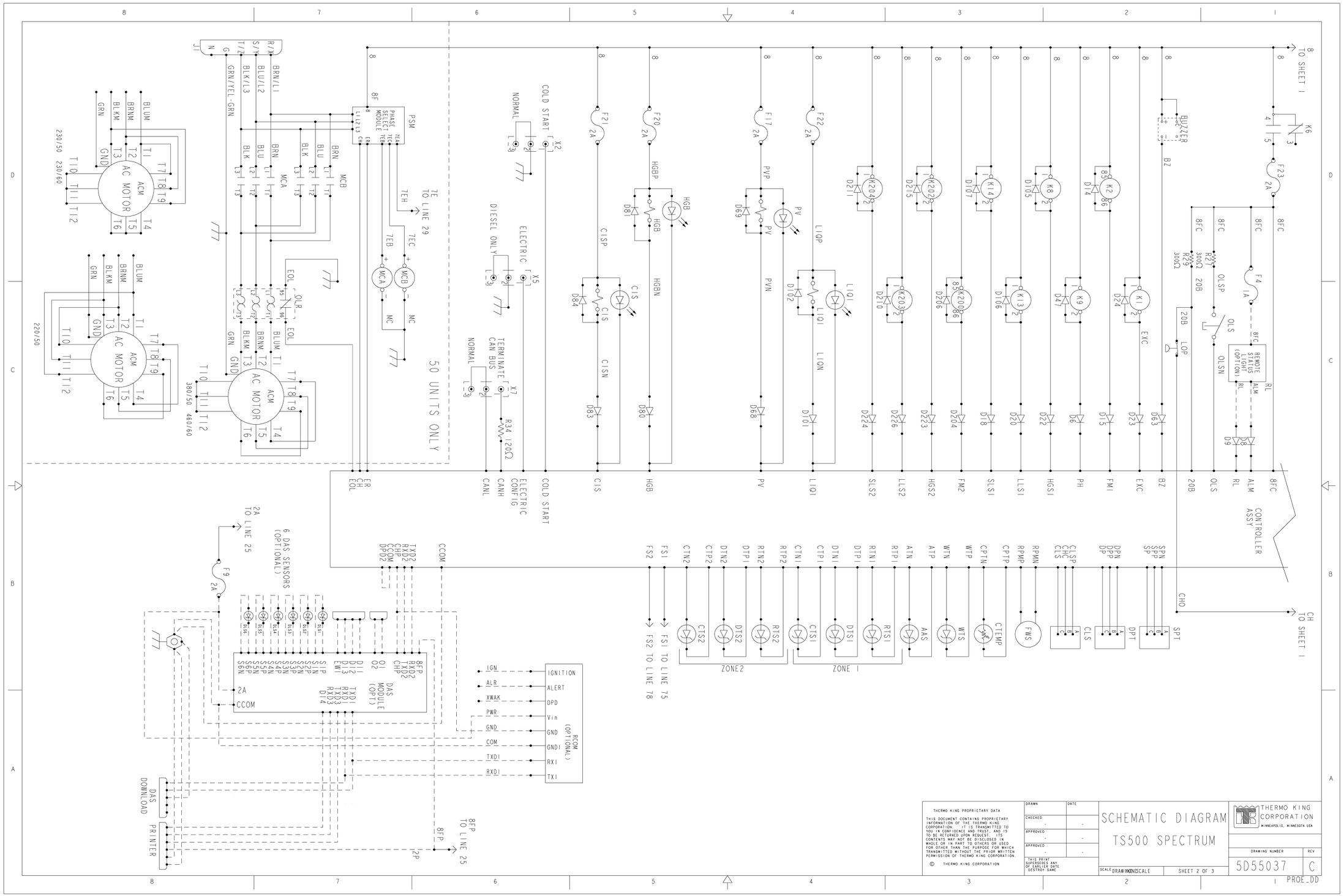
TS 500 SPECTRUM Schematic Diagram — Page 2 of 3



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SCHEMATIC DIAGRAM

TS500 SPECTRUM

SCALE DRAWING IS NOT TO SCALE — SHEET 2 OF 3

THERMO KING CORPORATION
MINNEAPOLIS, MINNESOTA USA

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5D55037	C

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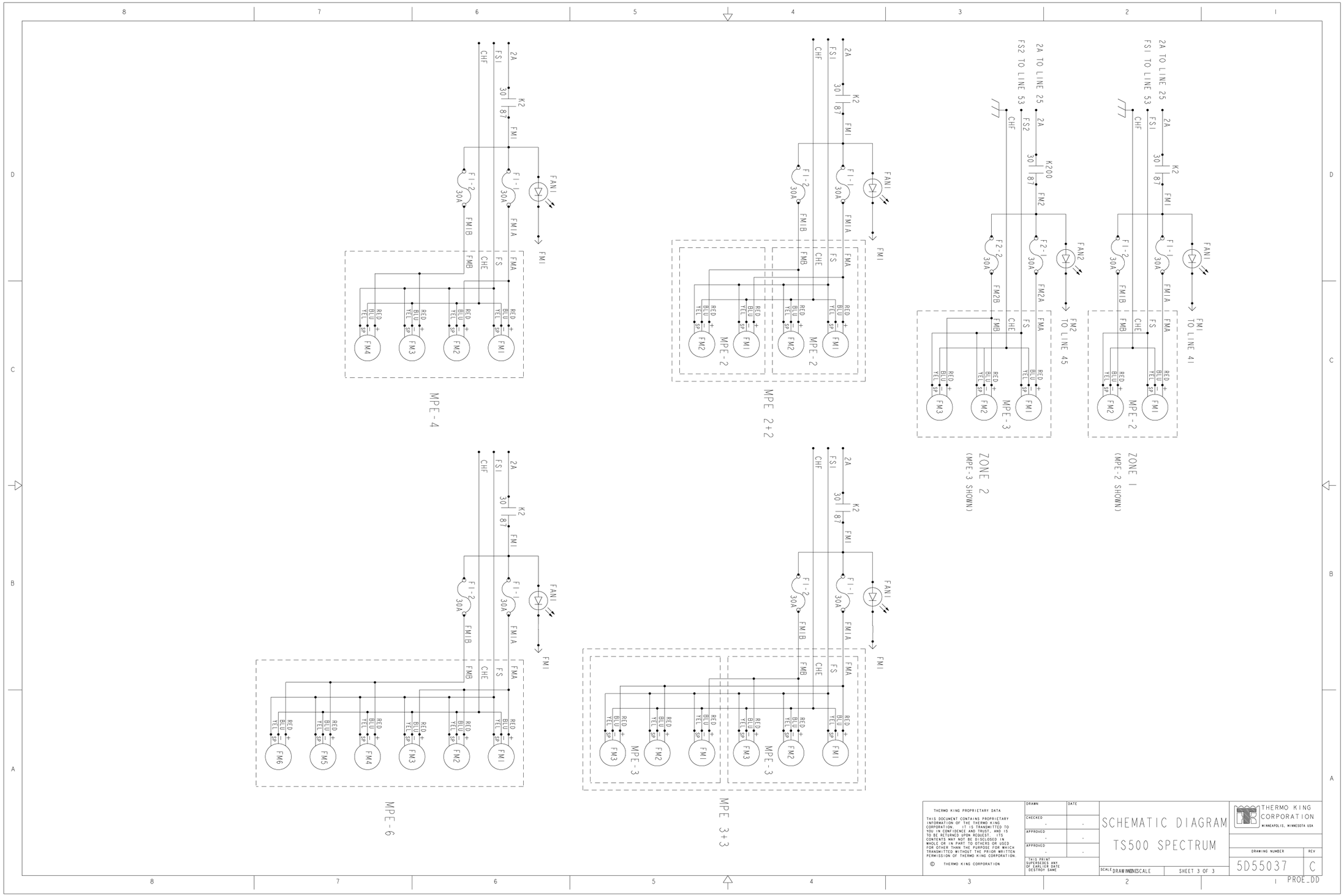
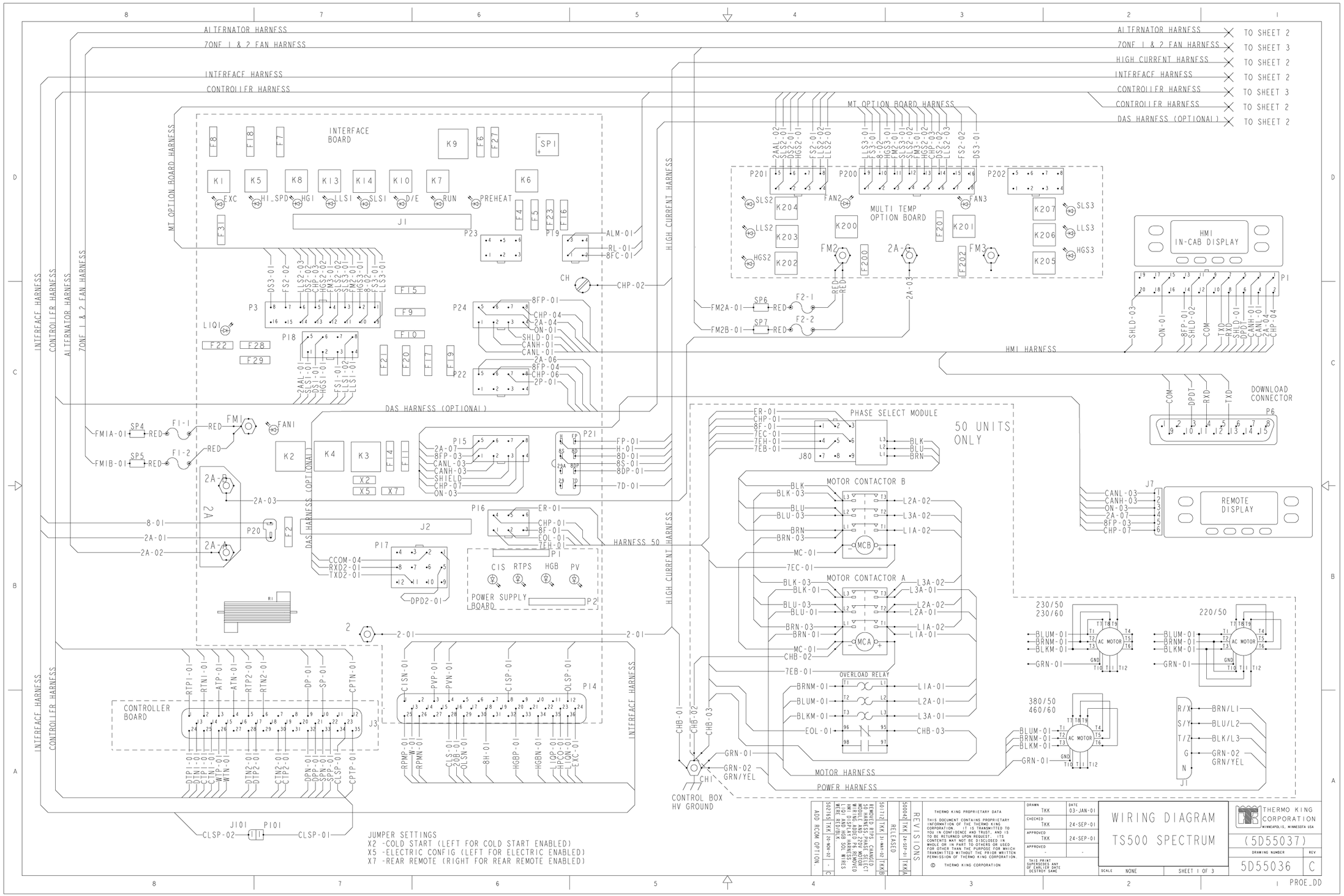
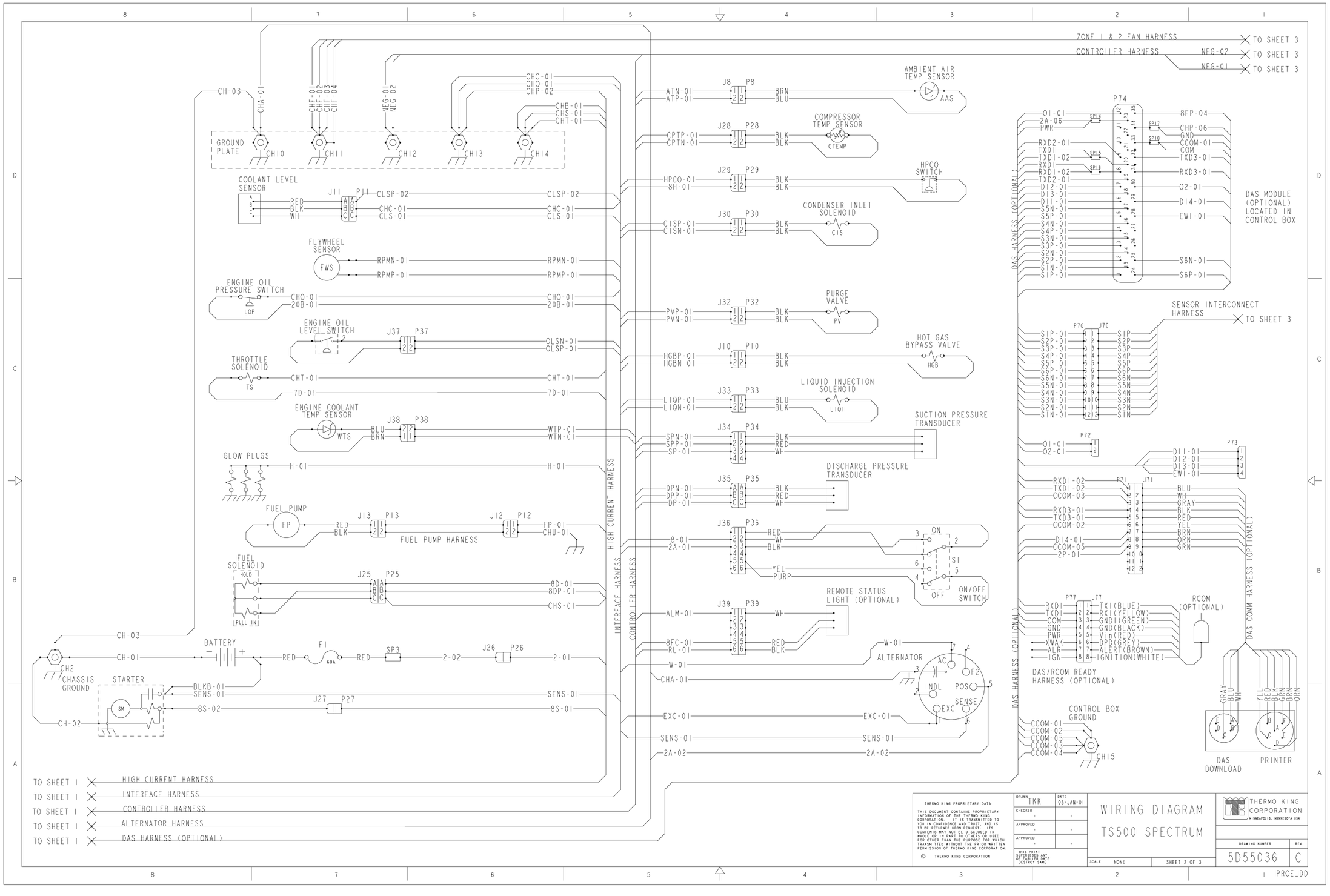
TS 500 SPECTRUM Schematic Diagram — Page 3 of 3



TS 500 SPECTRUM Wiring Diagram — Page 1 of 3




ZONE 1 & 2 FAN HARNESS
CONTROLLER HARNESS
NEG-02
NEG-01
TO SHEET 3
CH-03
CHA-01
CHF-01
CHF-02
CHF-03
CHF-04
NEG-01
NEG-02
CHC-01
CHD-01
CHP-02
CHB-01
CHS-01
CHT-01
GROUND PLATE
CH10
CH11
CH12
CH13
CH14
COOLANT LEVEL SENSOR
J11
P11
RED
BLK
WH
CLSP-02
CHC-01
CLS-01
FLYWHEEL SENSOR
FWS
RPMN-01
RPMP-01
ENGINE OIL PRESSURE SWITCH
LOP
CHD-01
20B-01
ENGINE OIL LEVEL SWITCH
J37
P37
OLSN-01
OLSP-01
THROTTLE SOLENOID
TS
CHT-01
7D-01
ENGINE COOLANT TEMP SENSOR
WTS
J38
P38
BLU
BRN
WTP-01
WTN-01
GLOW PLUGS
H-01
FUEL PUMP
FP
J13
P13
J12
P12
FP-01
CHU-01
FUEL PUMP HARNESS
FUEL SOLENOID
HOLD
PULL IN
J25
P25
8D-01
8DP-01
CHS-01
CH-03
CH-01
CH2
CHASSIS GROUND
BATTERY
F1
60A
SP3
J26
P26
2-02
2-01
STARTER
SM
BLKB-01
SENS-01
8S-02
J27
P27
8S-01
CH-02
HIGH CURRENT HARNESS
INTERFACE HARNESS
CONTROLLER HARNESS
AMBIENT AIR TEMP SENSOR
AAS
ATN-01
ATP-01
J8
P8
COMPRESSOR TEMP SENSOR
CTEMP
CPTP-01
CPTN-01
J28
P28
HPCO SWITCH
HPCO-01
8H-01
J29
P29
CONDENSER INLET SOLENOID
CIS
CISP-01
CISN-01
J30
P30
PURGE VALVE
PV
PVP-01
PVN-01
J32
P32
HOT GAS BYPASS VALVE
HGB
HGBP-01
HGBN-01
J10
P10
LIQUID INJECTION SOLENOID
LIQI
LIQP-01
LIQN-01
J33
P33
SUCTION PRESSURE TRANSDUCER
SPN-01
SPP-01
SP-01
J34
P34
DISCHARGE PRESSURE TRANSDUCER
DPN-01
DPP-01
DP-01
J35
P35
J36
P36
ON/OFF SWITCH
ON
OFF
SI
REMOTE STATUS LIGHT (OPTIONAL)
ALM-01
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RXI(YELLOW)
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GND(BLACK)
Vin(RED)
DPD(GREY)
ALERT(BROWN)
IGNITION(WHITE)
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PRINTER
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CONTROLLER HARNESS
ALTERNATOR HARNESS
DAS HARNESS (OPTIONAL)
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THERMO KING CORPORATION
MINNEAPOLIS, MINNESOTA USA
DRAWING NUMBER
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C
SCALE NONE
SHEET 2 OF 3
PROE_DD

TS 500 SPECTRUM Wiring Diagram — Page 3 of 3