

# **72-1500-00**

Operation Manual Version 1.0.1.1  
Automatic Transfer Switch Operation

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## Overview

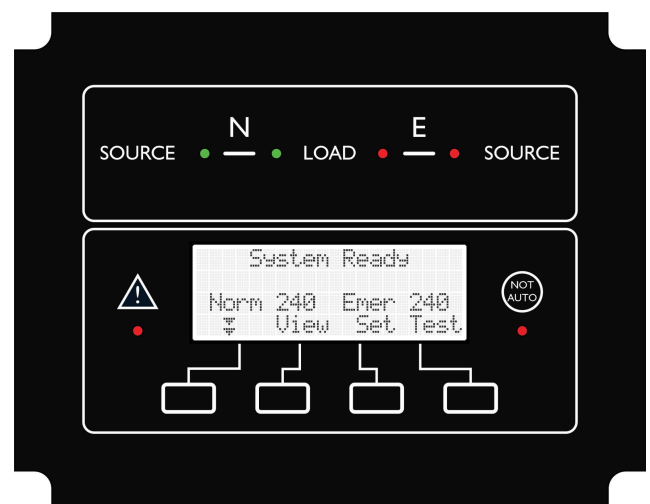
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The 72-1500-00 is a drop-in replacement for the Kohler MPAC 1500/1200. The firmware has been designed to make a transition from the OEM controller to the Flight Systems Replacement as transparent as possible. The human machine interface (HMI) is programmed so that settings and display functions are similar, if not identical, to the MPAC HMI. Customers that have used the MPAC 1500 HMI will find the navigation to be very familiar. In addition to this manual the original MPAC operation manual can be used as a reference. The replacement control is sold as 2 versions to accommodate each case style.

## Features

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- Voltage ranges from 120VAC to 600VAC; 50 or 60Hz operation.
- Voltage and frequency settings compatible with the MPAC 1500.
- In-phase and phase rotation monitoring.
- Standard, programmed, and closed transition operation modes.
- Utility to generator operation.
- Source 1 and Source 2 time delays compatible with the MPAC 1500.
- 16 exercise cycles with settings compatible with the MPAC 1500.
- Programmable alarms.
- 2 Programmable inputs and outputs.
- I/O module support for additional I/O.
- Modbus communications.
- Modbus TCP
- Assisted setup by part number.
- Assisted setup by voltage and transition.

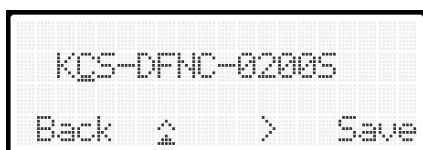


## Device Setup

Several methods are available to do the initial setup of the replacement control. You may prefer the manual setup or either of the 2 options for assistance. The 72-1500-00 replacement control is a feature rich controller and it is very easy to overlook an option that may prevent correct operation of the transfer switch. It is recommended that either of the assisted methods be used to be sure that safe default settings are installed for your application.

### Setup by Part Number (New Feature)

From the main menu, press **SET**, enter the default password '**0000**' and select **NEXT**. Use the navigation keys to select Set Part Number and press **NEXT**. Set the part number of the OEM transfer switch. Below is an example of Kohler MPAC ATS model number and its configuration.



**K** – Model (Kohler)

**C** – Mechanism (Standard, Any breaker)

**S** – Transition (Standard)

-

**D** – Controls (MPAC 1500 Automatic)

**F** – Voltage (240V/60Hz)

**N** – Poles (2 Pole, 3 Wire, Solid Neutral)

**C** – Enclosure (NEMA 3R)

-

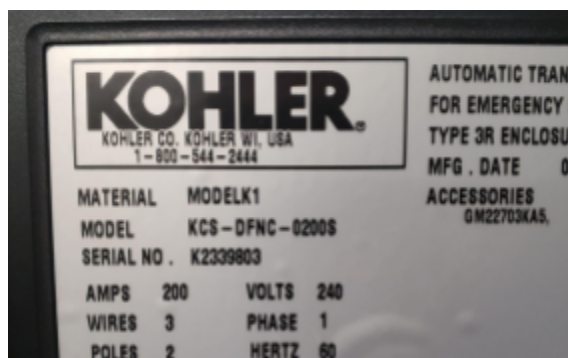
**0** – Amps x1000

**2** – Amps x100

**0** – Amps x10

**0** – Amps x1

**S** – Connections (Standard Connection)



Example Transfer Switch Data Sticker

Press **SAVE** to commit these settings to memory. A copy of the last part number will remain in memory but does not directly reflect the settings that are currently stored in memory. Manually overriding any setting after entering the part number will not overwrite the currently set part number. In addition to the part number, the following defaults will be overwritten and committed to memory.

#### Nominal Voltage

Single/3 phase operation

\*In-phase monitoring

\*Sync Frequency

#### Nominal Frequency

Transition Type

\*Sync Differential

\*Sync Angle

*\* settings applied based on transition type, in-phase monitoring is enabled by default for standard and closed transition.*

## Device Setup (cont.)

### Setup Assist (New Feature)

Similar to Setup by Part Number, this will apply a set of safe default settings based on the user's knowledge of the installation. You will be required to enter the correct settings for basic information about the transfer switch. A list of required information is provided below. From the main menu, press **SET**, enter the default password '0000' and press **NEXT**. Use the navigation keys to select Setup Assist and press **NEXT**. Follow the prompt and enter the correct information for your installation.

**Nominal Voltage**  
**Nominal Frequency**  
**Single or 3 Phase Voltage**  
**Transition Type**  
**Rated Current**



240v/60Hz Standard  
Single Phase 0200Amp  
Back Next

Press **SAVE** to commit settings to memory. This will overwrite the following settings for both sources.

**Nominal Voltage**  
**Single / 3 Phase operation**  
**\*In-phase Monitoring**  
**\*Sync Frequency**

**Nominal Frequency**  
**Transition Type**  
**\*Sync Differential**  
**\*Sync Angle**

*\* settings applied based on transition type, in-phase monitoring is enabled by default for closed transition.*

The factory defaults for the following settings will also be applied. All other settings, exercise, load control, I/O, etc. will not be altered.

Operation – Utility - Generator  
Engine Start Delay – 3 Seconds  
Standby to Preferred – 60 Seconds  
Preferred to Standby – 3 Seconds  
Off to Preferred – 2 Seconds  
Off to Standby – 2 Seconds  
Fail to Acquire – 60 Seconds  
Fail to Sync – 60 Seconds

Over Frequency Dropout – 101% of Pickup  
Over Frequency Pickup – 110% of Nominal  
Under Frequency Dropout – 99% of Pickup  
Under Frequency Pickup – 90% of Nominal  
Over Voltage Dropout – 115% of Nominal  
Over Voltage Pickup – 95% of Dropout  
Under Voltage Pickup – 90% of Nominal  
Under Voltage Dropout – 90% of Pickup

*\* voltage and frequency applied to both sources*

### Manual Setup

Manual setup can be lengthy and tedious; it is recommended that either Setup by Part Number or Setup Assist is run prior to making manual adjustments. If either of the previous methods have been executed, and the default settings are satisfactory, Set Sources and Set System can be skipped.

## Set Menu Navigation

---

### Set Time/Date

Set Time 12:00 Back  > Save	Set Date Tye 01/03/00 Back  > Save	Clock Ahead 1 Hour 2nd Sun of Mar Back  > Save
---	---	---

### Set Exerciser

Exerciser Event 1 Disable Back  Next	Exerciser Event 1 Unloaded Back  Next	Exerciser Event 1 Daily Back  Next
Exerciser Event 1 Repeat Rate 00 Back  Next	Exerciser Event 1 Duration 00:00 Hours:Minutes Back  > Next	Exerciser Event 1 Start Date 00/00/00 Back  > Next
Exerciser Event 1 Start Time 00:00 Back  > Save		

### Set S1 Time Delays

Set S1 Time Delays Engine Start ▼  > Back	Engine Start 00:03 Back  > Save	
Set S1 Time Delays Engine Cooldown ▼  > Back	Engine Cool Down 00:05 Back  > Save	
Set S1 Time Delays Xfer Pref>Stby ▼  > Back	Xfer Pref>Stby 00:03 Back  > Save	
Set S1 Time Delays Xfer Off>Stby ▼  > Back	Xfer Off>Stby 00:02 Back  > Save	
Set S1 Time Delays Fail to Acquire Pref ▼  > Back	Fail to Acquire Pref Enable Back  > Save	Fail to Acquire Pref 01:00 Back  > Save
Set S1 Time Delays Control Mode Time Loads to Control: 1 ▼  > Back	S1 Time Delays Load Control Mode Time Back  > Save	S1 Time Delays Loads to Control: 1 Back  > Save
Set S1 Time Delays Time-Based Control ▼  > Back	Time-Based Control Load Control 1 ▼  > Back	Load 1 Disc N>E 00:03 Back  > Next
		Load 1 Rec E>N 00:03 Back  > Save

## Set Menu Navigation (cont.)

### Set S2 Time Delays

Set S2 Time Delays Engine Start ⏮ ⏭ > Back	Engine Start 00:03 Back ⏭ > Save	
Set S2 Time Delays Engine Cool Down ⏮ ⏭ > Back	Engine Cool Down 00:05 Back ⏭ > Save	
Set S2 Time Delays Xfer Stby>Pref ⏮ ⏭ > Back	Xfer Stby>Pref 01:00 Back ⏭ > Save	
Set S2 Time Delays Xfer Off>Pref ⏮ ⏭ > Back	Xfer Off>Pref 00:02 Back ⏭ > Save	
Set S2 Time Delays Fail to Acquire Stby ⏮ ⏭ > Back	Fail to Acquire Stby Enable Back ⏭ > Save	Fail to Acquire Stby 01:00 Back ⏭ > Save
Set S2 Time Delays Control Mode Time Loads to Control: 1 ⏮ ⏭ > Back	S2 Time Delays Load Control Mode Time Back ⏭ > Save	S2 Time Delays Loads to Control: 1 Back ⏭ > Save
Set S2 Time Delays Time-Based Control ⏮ ⏭ > Back	Time-Based Control Load Control 1 ⏮ ⏭ > Back	Load 1 Disc E>N 00:03 Back ⏭ > Next
		Load 1 Rec N>E 00:03 Back ⏭ > Save

### Set Sources

Phase Rotation ⏮ ⏭ > Back	Disable Rotation ⏮ ⏭ Save Back	BAC Rotation ⏮ ⏭ Save Back	ABC Rotation ⏮ ⏭ Save Back
In Phase Monitor ⏮ ⏭ > Back	Disable ⏮ ⏭ Save Back	Enable ⏮ ⏭ Save Back	
In Phase Angle ⏮ ⏭ > Back	10 Degrees ⏮ ⏭ Save Back		
In Phase Xfer Fail ⏮ ⏭ > Back	In Phase Xfer Fail Enable Back ⏭ > Save	In Phase Xfer Fail 01:00 Back ⏭ > Save	

## Set Menu Navigation (cont.)

---

### Set Sources (cont.)

Volt Differential ⏮ ⏭ > Back	5 Percent ⏮ ⏭ Save Back	
Freq Differential ⏮ ⏭ > Back	1.0 Hz ⏮ ⏭ Save Back	
Preferred Source ⏮ ⏭ > Back	Preferred Source Normal ⏮ ⏭ Save Back	Preferred Source Emergency ⏮ ⏭ Save Back

### Applicable for both Normal and Emergency Source

Normal Source ⏮ ⏭ > Back	Emergency Source ⏮ ⏭ > Back	
Number of Phases ⏮ ⏭ > Back	3 Phase ⏮ ⏭ Save Back	Single Phase ⏮ ⏭ Save Back
Voltage ⏮ ⏭ > Back	Set Voltage 240 VAC Back ⏭ > Save	
Frequency ⏮ ⏭ > Back	Set Frequency 60 Hz Back ⏭ ⏮ Save	
Under Voltage Pickup ⏮ ⏭ > Back	Pickup 90 % of Nominal 85-100% ⏮ ⏭ Save Back	
Under Voltage Dropout ⏮ ⏭ > Back	Dropout 90 % of Pickup 75-98% ⏮ ⏭ Save Back	
Over Voltage Pickup ⏮ ⏭ > Back	Pickup 95 % of Dropout 95-100% ⏮ ⏭ Save Back	
Over Voltage Dropout ⏮ ⏭ > Back	Dropout 115 % of Nominal 106-135% ⏮ ⏭ Save Back	



## Set Menu Navigation (cont.)

### Set Sources (cont.)

Voltage Debounce ↓ ↑ > Back	Debounce Time 5 Seconds 0.1-9.9 Seconds ↓ ↑ Save Back	
Voltage Unbalance Enable/Disable ↓ ↑ > Back	Voltage Unbalance Disable ↓ ↑ Save Back	Voltage Unbalance Enable ↓ ↑ Save Back
Voltage Unbalance Pickup ↓ ↑ > Back	Pickup 10 % 3-18% ↓ ↑ Save Back	
Voltage Unbalance Dropout ↓ ↑ > Back	Dropout 20 % 5-20% ↓ ↑ Save Back	
Under Frequency Pickup ↓ ↑ > Back	Pickup 90 % of Nominal 80-95% ↓ ↑ Save Back	
Under Frequency Dropout ↓ ↑ > Back	Dropout 99 % of Pickup 95-99% ↓ ↑ Save Back	
Over Frequency Pickup ↓ ↑ > Back	Pickup 110 % of Nominal 105-120% ↓ ↑ Save Back	
Over Frequency Dropout ↓ ↑ > Back	Dropout 101 % of Pickup 101-115% Nominal ↓ ↑ Save Back	
Freq Debounce ↓ ↑ > Back	Debounce Time 3 Seconds 0.1-15.0 Seconds ↓ ↑ Save Back	

### Set Inputs/Outputs

Main Board I/O ↓ ↑ > Back	Main Board I/O Inputs ↓ ↑ > Back	Main Board I/O Input 1 ↓ ↑ > Back	Main Board I/O Input 1 Disabled ↓ ↑ Save Back
		Main Board I/O Input 2 ↓ ↑ > Back	Main Board I/O Input 2 Disabled ↓ ↑ Save Back

## Set Menu Navigation (cont.)

### Set Inputs/Outputs (cont.)

Main Board I/O ⏮ ⏪ ⏩ ⏭ Back	Main Board I/O Outputs ⏮ ⏪ ⏩ ⏭ Back	Main Board I/O Output 1 ⏮ ⏪ ⏩ ⏭ Back	Main Board I/O Output 1 Disabled ⏮ ⏪ ⏩ Save Back
Auxiliary I/O ⏮ ⏪ ⏩ ⏭ Back	Main Board I/O Outputs ⏮ ⏪ ⏩ ⏭ Back	Main Board I/O Output 2 ⏮ ⏪ ⏩ ⏭ Back	Main Board I/O Output 2 Disabled ⏮ ⏪ ⏩ Save Back
Auxiliary I/O ⏮ ⏪ ⏩ ⏭ Back	Module Inputs ⏮ ⏪ ⏩ ⏭ Back	Module Input 1 ⏮ ⏪ ⏩ ⏭ Back	Module Input 1 Disabled ⏮ ⏪ ⏩ Save Back
Auxiliary I/O ⏮ ⏪ ⏩ ⏭ Back	Module Outputs ⏮ ⏪ ⏩ ⏭ Back	Module Output 1 ⏮ ⏪ ⏩ ⏭ Back	Module Output 1 Disabled ⏮ ⏪ ⏩ Save Back

### Set System

Source Type ⏮ ⏪ ⏩ ⏭ Back	Source Type Util-Gen Back ⏪ ⏩ Save		
Transition Type ⏮ ⏪ ⏩ ⏭ Back	Transition Type Standard Back ⏪ ⏩ Save	Transition Type Program Back ⏪ ⏩ Save	Transition Type Closed Back ⏪ ⏩ Save
Service Entrance ⏮ ⏪ ⏩ ⏭ Back	Service Entrance No Back ⏪ ⏩ Save	Service Entrance ICCB Back ⏪ ⏩ Save	Service Entrance MCCB Back ⏪ ⏩ Save
Rated Current ⏮ ⏪ ⏩ ⏭ Back	Rated Current _200 Amps Back ⏪ ⏩ Save		
3 Src Eng Start Mode ⏮ ⏪ ⏩ ⏭ Back			
Transfer Commit ⏮ ⏪ ⏩ ⏭ Back	Transfer Commit Commit Back ⏪ ⏩ Save	Transfer Commit No Commit Back ⏪ ⏩ Save	
Remote Test Loading ⏮ ⏪ ⏩ ⏭ Back	Remote Test Loading Unloaded Back ⏪ ⏩ Save	Remote Test Loading Loaded Back ⏪ ⏩ Save	
Peak Shave TD Bypass ⏮ ⏪ ⏩ ⏭ Back			

## Set Menu Navigation (cont.)

### Set Communications

MODBUS Server Port ▼ ▲ > Back	MODBUS Server Port Enable Back ▲ Save	MODBUS Server Port Disable Back ▲ Save
MODBUS Port Address ▼ ▲ > Back	MODBUS Port Address 2 Back ▲ ▼ Save	
MODBUS Port Baudrate ▼ ▲ > Back	MODBUS Port Baudrate 19200 Back ▲ Save	
MODBUS Server TCP ▼ ▲ > Back	MODBUS Server TCP Disable Back ▲ Save	MODBUS Server TCP Enable Back ▲ Save
MODBUS TCP Unit ID ▼ ▲ > Back	MODBUS TCP Unit ID 3 Back ▲ > Save	
IP Address ▼ ▲ > Back	IP Address 000.000.000.000 Back ▲ > Save	
Subnet Mask ▼ ▲ > Back	Subnet Mask 000.000.000.000 Back ▲ > Save	
Default Gateway ▼ ▲ > Back	Default Gateway 000.000.000.000 Back ▲ > Save	
DHCP Status ▼ ▲ > Back	DHCP Status Disable Back ▲ Save	DHCP Status Enable Back ▲ Save

### Set Passwords

Setup Password ▼ ▲ > Back	Old Password 8021 New Password 6020 Back ▲ > Save
Test Password ▼ ▲ > Back	Old Password 8021 New Password 6020 Back ▲ > Save

## Set Menu Navigation (cont.)

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

### Calibration

Calibrate L-N Voltages Source N ⏮ ⏭ > Back	Calibrate L1-L0 Source N ⏮ ⏭ > Back	L1-L0 VAC 120 Calibrate 120 Back ⏭ > Back
	Calibrate L2-L0 Source N ⏮ ⏭ > Back	L2-L0 VAC 120 Calibrate 120 Back ⏭ > Back
	Calibrate L3-L0 Source N ⏮ ⏭ > Back	L3-L0 VAC 120 Calibrate 120 Back ⏭ > Back
Calibrate L-N Voltages Source E ⏮ ⏭ > Back	Calibrate L1-L0 Source E ⏮ ⏭ > Back	L1-L0 VAC 120 Calibrate 120 Back ⏭ > Back
	Calibrate L2-L0 Source E ⏮ ⏭ > Back	L2-L0 VAC 120 Calibrate 120 Back ⏭ > Back
	Calibrate L3-L0 Source E ⏮ ⏭ > Back	L3-L0 VAC 120 Calibrate 120 Back ⏭ > Back
Calibrate L-L Voltages Source N ⏮ ⏭ > Back	Calibrate L1-L2 Source N ⏮ ⏭ > Back	L1-L2 VAC 240 Calibrate 240 Back ⏭ ⏮ Save
	Calibrate L2-L3 Source N ⏮ ⏭ > Back	L2-L3 VAC 240 Calibrate 240 Back ⏭ ⏮ Save
	Calibrate L3-L1 Source N ⏮ ⏭ > Back	L3-L1 VAC 240 Calibrate 240 Back ⏭ ⏮ Save
Calibrate L-L Voltage Source E ⏮ ⏭ > Back	Calibrate L1-L2 Source E ⏮ ⏭ > Back	L1-L2 VAC 240 Calibrate 240 Back ⏭ ⏮ Save
	Calibrate L2-L3 Source E ⏮ ⏭ > Back	L2-L3 VAC 240 Calibrate 240 Back ⏭ ⏮ Save
	Calibrate L3-L1 Source E ⏮ ⏭ > Back	L3-L1 VAC 240 Calibrate 240 Back ⏭ ⏮ Save

## Set Menu Navigation (cont.)

---

### Set Part Number

KES-DFNA-0200B	KES-DFNA-0200B
Back                      Next	Back   >   Save

### Setup Assist

240v/60Hz Standard Single Phase 0200Amp
Back                      Next

### Update Modules

Update Modules?	Searching... 00 No module detected
Back                      Next	

### Factory Default

Factory Default
  >   Back

# Display Settings

## Main Menu

Use the left 2 buttons to navigate through the main menu. The main display will cycle through 6 to 9 screens to display various parameters and alternate functions.

### Down Button

```
System Ready
Norm 240 Emer 240
View Set Test
```

Displays current status, active time delay, and faults

```
Norm AB BC AC
60Hz 240V 240V 240V
Lamp
Test Main
```

Displays Normal L-L

```
Norm AN BN CN
60Hz 120V 120V 120V
Disable
Main
```

Displays Normal L-N

```
Emer AB BC AC
60Hz 240V 240V 240V
Main
```

Displays Emergency L-L

```
Emer AN BN CN
60Hz 120V 120V 120V
Disable
Main
```

Displays Emergency L-N

```
Amps LA LB LC
100 100 100
Main
```

Displays Current

### Down Button (cont.)

```
Time/date
Tue 12:00 01/03/00
Main
```

Displays Time/Date

```
Normal Preferred
Util-Gen Operation
Commit Transfer
Main
```

Displays Source Setup

```
Program Transition
Disable Rotation
In-Phase Disable
Main
```

Displays System Setup

### View Button

```
Exercise
Main
```

Displays Exercise Setup

```
S1 Delays
Main
```

Displays S1 Delays

```
S2 Delays
Main
```

Displays S2 Delays

### View Button (cont.)

```
Sources
Main
```

Displays Source Setup

```
Inputs/Outputs
Main
```

Displays I/O Setup

```
System
Main
```

Displays System Setup

### Test Button

```
Type of Test
Sync Test
Main
```

Initiates a Sync Test

```
Type of Test
Loaded
Main
```

Initiates a Loaded Test

```
Type of Test
Unloaded
Main
```

Initiates an Unloaded Test

## Lamp Test

Press the down arrow to access main display screen 2. Press button 3, LAMP TEST to temporarily illuminate all LEDs and characters on the display.

## Contrast Adjustment

Press and hold VIEW for 2 seconds until all of the keypad indicators illuminate.

Use the 2 left buttons to adjust the screen contrast. Press Back to exit the contrast adjustment.

```
Contrast
*****
View Left Right Back
```

```
XXXFlightXSystemsXXX
XXXFlightXSystemsXXX
XXXFlightXSystemsXXX
XXXFlightXSystemsXXX
```

## Exercise Settings

The 72-1500-00 supports up to 16 exercise cycles. Each exercise cycle is entered as an event. When the control board is initially powered on it first searches all saved events to determine if they have already passed. All expired events are automatically updated to their next valid cycle and saved in eeprom. Each exercise event has several parameters that must be set correctly to function properly. Even if an event is disabled and left to expire it will be updated to its next valid exercise time upon enabling the cycle.

### Example Exercise Setup:

Exerciser Event 1 Enable Back ⬅      Next ➡	Exerciser Event 1 Loaded Back ⬅      Next ➡	Exerciser Event 1 Weekly Back ⬅      Next ➡	Exerciser Event 1 Repeat Rate 01 Back ⬅      Next ➡
Exerciser Event 1 Duration 00:15 Back ⬅      >      Next ➡	Exerciser Event 1 Start Date 01/03/24 Back ⬅      >      Next ➡	Exerciser Event 1 Start Time 10:00 Back ⬅      >      Save	

The above exercise cycle would begin Wednesday January 3, 2024 @ 10:00. It would run a loaded exercise cycle for 15 minutes before transferring to normal, executing all transition delays in addition to the 15 minutes exercise cycle. With a repeat rate of one it would wait 1 week before exercising again on Wednesday January 10, 2024. If the repeat rate was set to 2, it would wait 2 weeks.

If the unit was powered down due to a malfunction or removed from service, then put back into service on March 18, 2024 it would immediately update the exercise event to March 20, 2024. Providing the exercise event was set to enabled.

If the exercise interval was set for Monthly with a repeat rate of 1, the exercise event would cycle once per month. With the interval set for daily and the repeat rate at 4, it would exercise every 4 days.

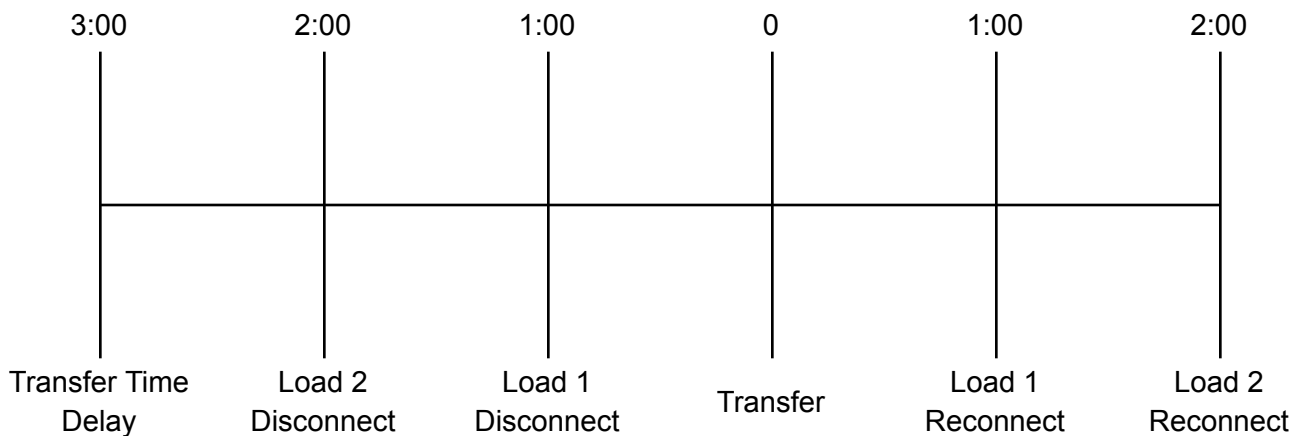
## Load Control

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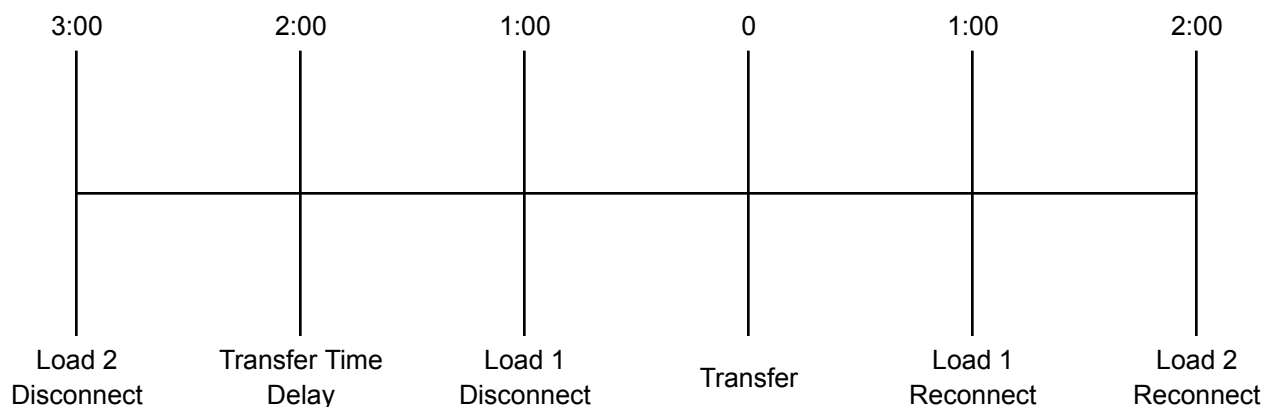
The 72-1500-00 control supports up to 9 different load control outputs. The main board only supports 2 programmable outputs so the optional auxiliary I/O board is required for setting up more than 2 load control outputs. Each load control output has a programmable disconnect and reconnect time for both source 1 and source 2 independently. Current based load disconnect is not currently supported in v1.0.0.9.

In the event that the load control disconnect delay is set longer than the transfer delay, the controller will respect whichever delay is longer. It is good practice to keep the longest pre-transfer delay shorter than the transfer delay.

**Transfer time delay is set longer than the load control delays.**



**One or more load control delays are set longer than the transfer time delay.**





### Sequence of Operation for Standard Transition

1. Preferred source fails.
2. Engine start delay expires and remote start contacts close.
3. Standby power is available.
4. Preferred to standby time delay expires.
5. K2 (ER) relay energizes. Contactor transfers to standby position.
6. Load control reconnect timers expire and load control contacts close.
7. Preferred source returns.
8. Standby to preferred time delay expires.
9. Load control disconnects.
10. In-phase monitor is activated, if enabled.
11. K1 (NR) relay energizes. Contactor transfers to preferred position.
12. Load control reconnect timers expire and load control contacts close.
13. Cool down timer expires and the generator shuts down.

### Sequence of Operation for Closed Transition

1. Preferred source fails.
2. Engine start delay expires and remote start contacts close.
3. Standby power is available.
4. Preferred to off time delay expires.
5. K2 (ER) relay energizes. Contactor transfers to neutral position.
6. Off to standby time delay expires.
7. AUXK2 (ER1) relay energizes. Contactor transfers to standby position.
8. Load control reconnect timers expire and load control contacts close.
9. Preferred source returns.
10. Standby to preferred time delay expires.
11. Load control disconnects.
12. In-phase monitor is activated
13. K1 (NR) relay energizes. Contactor transfers to preferred position. Sources will be paralleled for no longer than 100ms
14. AUXK1 (NR1) relay energizes. Contactor transfers to off position.
15. Load control reconnect timers expire and load control contacts close.
16. Cool down timer expires and the generator shuts down.

## Transitions (cont.)

---

### Sequence of Operation for Programmed Transition

1. Preferred source fails.
2. Engine start delay expires and remote start contacts close.
3. Standby power is available.
4. Preferred to off time delay expires.
5. K2 (ER) relay energizes. Contactor transfers to neutral position.
6. Off to standby time delay expires.
7. AUXK2 (ER1) relay energizes. Contactor transfers to standby position.
8. Load control reconnect timers expire and load control contacts close.
9. Preferred source returns.
10. Standby to off time delay expires.
11. Load control disconnects.
12. AUXK1 (NR1) relay energizes. Contactor transfers to off position.
13. Off to preferred time delay expires.
14. K1 (NR) relay energizes. Contactor transfers to preferred position.
15. Load control reconnect timers expire and load control contacts close.
16. Cool down timer expires and the generator shuts down.

### Relay Functions per Switch Type

	Standard/Open Transition	Closed Transition	Programmed Transition
<b>K1 (NR) Relay</b>	Close Source 1	Close Source 1	Close Source 1
<b>K2 (ER) Relay</b>	Close Source 2	Close Source 2	Open Source 1
<b>AUXK1 Relay (NR1)</b>	N/A	N/A	Open Source 2
<b>AUXK2 Relay (ER1)</b>	N/A	N/A	Close Source 2

*K1 and K2 are located on the main logic board.*

*AUXK1 and AUXK2 are located on the programmed-transition interface board (PTIB).*

## I/O Options Programmable Inputs and Outputs

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### Main Board I/O

There are 2 inputs and 2 outputs available on the controller. Additional I/O can be added through the auxiliary I/O module.

#### Inputs Functions

- Bypass Contactor Disabled
- Forced to OFF
- Inhibit Transfer
- Low Battery Voltage \***
- Peak Shave Mode \***
- Remote End Time Delay
- Remote Common Alarm
- Remote Test
- Remote Monitor 1-4 \***
- Service Disconnect
- 3-Source System Disable \***

#### Output Functions

- 3-Source System Disable \***
- Alarm Silenced \***
- Audible Alarm
- Aux Switch Fault
- Aux Switch Open
- Common Alarm 1 \***
- Common Alarm 2 \***
- Contactor in OFF
- Contactor in Preferred
- Contactor in Source E
- Contactor in Source N
- Contactor in Standby
- Exerciser Active
- Fail to Acquire Preferred
- Fail to Acquire Standby
- Fail to Transfer
- Fail to Open Source 1
- Fail to Close Source 1
- Fail to Open Source 2
- Fail to Close Source 2
- Lost Communication \***
- In-phase Monitor

#### Output Functions (cont.)

- Load Bank Active \***
- Load Control Active
- Load Control 1-9
- Low Battery \***
- Non-emergency Transfer
- Not in Auto Mode
- Peak Shave Active \***
- Preferred Source Available
- RDO 1-4 \***
- Service Disconnect
- Emergency Rotation Error
- Emergency Loss of Phase
- Emergency Over Frequency
- Emergency Over Voltage
- Emergency Start
- Emergency Under Frequency
- Emergency Under Voltage
- Emergency Unbalanced
- Normal Rotation Error
- Normal Loss of Phase
- Normal Over Frequency
- Normal Over Voltage
- Normal Start
- Normal Under Frequency
- Normal Under Voltage
- Normal Unbalanced
- Normal Standby Available
- Test Mode Active

\* features currently in development v1.0.1.1

# Alarms

The common fault is available as a programmable output. A latching fault must be cleared from the main display by pressing **RESET**. Alarm groups are not supported in v1.0.1.1

- Alarm Group 1 – Currently in development
- Alarm Group 2 – Currently in development

## Auxiliary I/O Module

### Install

Installation of the optional modules is slightly different from the OEM. From the main display, press **SET**, enter the default password ‘0000’ and press **NEXT**. Navigate to the Detect New Modules option and press **NEXT**. The controller will search the available addresses for accessories and temporarily display them on the screen. After a module has been detected, it is saved to memory. A loss of communication with a previously detected module will result in a latching alarm.

Supported Modules v1.0.0.9		
SOB I/O Module (Low Power)	Address 1-4	– Supported
POB I/O Module (High Power)	Address 1-4	– Currently in development
AOB I/O Module (Alarm)	Fixed Address 5	– Currently in development
BOB I/O Module (Battery)	Fixed Address 6	– Currently in development

### Uninstall

To uninstall a module the device needs to be physically removed. After removal, the Detect New Modules feature must be executed and any latching faults should be cleared from the main display by pressing **RESET**.

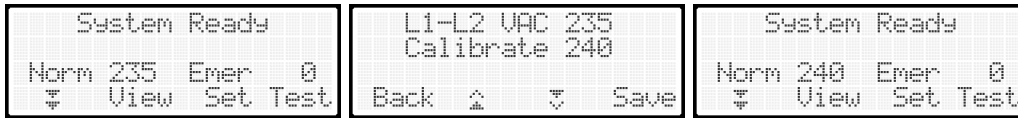
### Setting Auxiliary I/O

Setting up an external module requires accessing the setup menu under **Set I/O > Auxiliary I/O**. Inputs and Outputs can be assigned with or without a module present. Settings are saved in memory and will be applied when the correct module address is detected.

- Address 1 – Inputs (1, 2) Outputs (1, 2, 3, 4, 5, 6)
- Address 2 – Inputs (3, 4) Outputs (7, 8, 9, 10, 11, 12)
- Address 3 – Inputs (5, 6) Outputs (13, 14, 15, 16, 17, 18)
- Address 4 – Inputs (7, 8) Outputs (19, 20, 21, 22, 23, 24)

## Calibration

Should the controller require calibration, the calibration function can be accessed from the main menu > **SET** > **CALIBRATION**. Proper calibration will require taking a physical measurement from line to line. See page 12 for the calibration menu screens.



The current reading is displayed on top and the adjusted reading can be entered below. Enter the corrected reading for each of the relevant measurements. Press **SAVE** and return to the main menu.

## Factory Default Settings

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Factory defaults can be set by navigating to the Set Factory Defaults entry in the SET menu. Applying factory defaults will overwrite all previous parameters and clear all exercise cycles, load control configurations for source 1 and source 2, all I/O settings, and calibration settings returned to default.

Preferred Source – Normal  
In-Phase – Enabled  
S1 / S2 Control Mode – Time  
S1 / S2 Loads to Control – 0  
Sync Differential Voltage – 5%  
Sync Differential Frequency – 0.1Hz  
Sync Angle – 10 degrees  
S1 / S2 Nominal Voltage – 240  
S1 / S2 Nominal Frequency – 60  
S1 / S2 Phases – Single Phase  
Rated Amps – 200  
Operation – Utility to Generator  
Set Password – 0000  
Test Password – 0000  
S1 / S2 Engine Start – 3 Seconds  
S1 / S2 Engine Cool Down – Disabled  
Standby to Preferred – 60 Seconds  
Preferred to Standby – 3 Seconds  
Off to Preferred – 2 Seconds  
Off to Standby – 2 Seconds  
Over Voltage Dropout – 115% of Nominal  
Over Voltage Pickup – 95% of Dropout  
Under Voltage Pickup – 90% of Nominal  
Under Voltage Dropout – 90% of Pickup  
Over Frequency Dropout – 101% of Pickup  
Over Frequency Pickup – 110% of Nominal  
Under Frequency Dropout – 99% of Pickup  
Under Frequency Pickup – 90% of Nominal  
S1 / S2 Unbalance – Disabled  
S1 / S2 Unbalance Dropout – 20%  
S1 / S2 Unbalance Pickup – 10%  
Rotation Expected – A B C  
S1 / S2 Fail to Acquire – 60 Seconds  
Fail to Sync – 60 Seconds  
Fail to Sync Fallback – Disabled

## Modbus Communications

### Supported Registers v1.0.0.4

40001	System Overview	RO	40063	Normal Cool Down Delay	RW
40002	Source N Line-Neutral L1-L0	RO	40064	Emergency Cool Down Delay	RW
40003	Source N Line-Neutral L2-L0	RO	40065	Standby to Preferred Delay	RW
40004	Source N Line-Neutral L3-L0	RO	40066	Preferred to Standby Delay	RW
40005	Source E Line-Neutral L1-L0	RO	40067	Off to Standby Delay	RW
40006	Source E Line-Neutral L2-L0	RO	40068	Off to Preferred Delay	RW
40007	Source E Line-Neutral L3-L0	RO	40069	Fail to Acquire Preferred	RW
40008	Source N Line-Line L1-L2	RO	40070	Fail to Acquire Standby	RW
40009	Source N Line-Line L2-L3	RO	40071	Fail to Synchronize	RW
40010	Source N Line-Line L3-L1	RO	40072	Fail to Sync Enabled	RW
40011	Source E Line-Line L1-L2	RO	40073	RESERVED	
40012	Source E Line-Line L2-L3	RO	40074	RESERVED	
40013	Source E Line-Line L3-L1	RO	40075	Active Time Delay	RO
40014	Source N Frequency	RO	40076	Active Time Delay Remaining	RO
40015	Source E Frequency	RO	40077	Active Time Delay Preset	RO
40016	Current L1	RO	40078	Normal Over Voltage Dropout	RW
40017	Current L2	RO	40079	Normal Over Voltage Pickup	RW
40018	Current L3	RO	40080	Normal Under Voltage Pickup	RW
40019	Closed Transition In-Phase Delta	RO	40081	Normal Under Voltage Dropout	RW
40020-40038	RESERVED		40082	Normal Unbalance Enabled	RW
40039	Closed-Programmed Transition Override Mode	RW	40083	Normal Unbalance Voltage Dropout	RW
40040	Password	WO	40084	Normal Unbalance Voltage Pickup	RW
40041	Synchronous Voltage Phase Angle	RO	40085	Normal Voltage Debounce	RW
40042	Synchronous Voltage Differential	RW	40086	Emergency Over Voltage Dropout	RW
40043	Synchronous Frequency Differential	RW	40087	Emergency Over Voltage Pickup	RW
40044	Service Entrance Type	RW	40088	Emergency Under Voltage Pickup	RW
40045	Phase Rotation Actual	RO	40089	Emergency Under Voltage Dropout	RW
40046	Phase Rotation Expected	RW	40090	Emergency Unbalance Enabled	RW
40047	Nominal Normal Voltage	RW	40091	Emergency Unbalance Voltage Dropout	RW
40048	Nominal Emergency Voltage	RW	40092	Emergency Unbalance Voltage Pickup	RW
40049	Nominal Normal Frequency	RW	40093	Emergency Voltage Debounce	RW
40050	Nominal Emergency Frequency	RW	40094	Normal Over Frequency Dropout	RW
40051	Normal Number of Phases	RW	40095	Normal Over Frequency Pickup	RW
40052	Emergency Number of Phases	RW	40096	Normal Under Frequency Dropout	RW
40053	Rated Amps	RW	40097	Normal Under Frequency Pickup	RW
40054-40056	RESERVED		40098	Normal Frequency Dropout Time	RW
40057	Transition Mode Mode of Operation Auto/Manual	RW	40099	Emergency Over Frequency Dropout	RW
40058	Password	WO	40100	Emergency Over Frequency Pickup	RW
40059	Normal Engine Start Delay	RW	40101	Emergency Under Frequency Dropout	RW
40060	Emergency Engine Start Delay	RW	40102	Emergency Under Frequency Pickup	RW
40061	Normal Ext Start Delay	RW	40103	Emergency Frequency Dropout Time	RW
40062	Emergency Ext Start Delay	RW			

# Firmware Revisions

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## **Version 1.0.0.1**

Calibration Settings – New factory default settings for calibration.

Bug-Fix – Correction to calibration settings. Emergency source using calibration points from Normal for L1-L0 and L2-L0.

## **Version 1.0.0.2 (New Features)**

Contrast Adjustment – Indicators set on to indicate when contrast adjustment is active.

Contrast Adjustment – Setting removed from factory defaults for replacement display with negative voltage generator.

Factory Defaults – Minor changes to factory defaults settings.

Setup by Part Number – Write settings for voltage and frequency. Does not interfere with exercise, load control, or I/O settings.

Setup Assist – New function to change default settings based on system information.

## **Version 1.0.0.3**

Bug-Fix – In-phase not being respected on standard transition

Bug-Fix – Monthly exercise not updating correctly.

## **Version 1.0.0.4**

Expansion Modules – Initialize previously saved expansion modules on start-up.

Factory Defaults – Change to factory default setting to standard transition.

## **Version 1.0.0.5**

Bug-Fix – Fail to acquire alarm not activating correctly.

Bug-Fix – Correction to over-voltage pickup and dropout.

## **Version 1.0.0.6 (New Features)**

Force to Off Position

Audible Alarm

Remote Test

Voltage Unbalanced

Calibration via Modbus

Clock adjustment via Modbus

## **Version 1.0.0.7 (New Features)**

Bypass Contactor input

View Settings menu

Not in Auto indicator

Modbus registers remapped for compatibility.

## **Version 1.0.0.8 (New Features)**

Options for MCCB and ICCB

Breaker tripped and service disconnect.

Force to off position disabled if service entrance is set for MCCB.

Setup by Part number options added for KEP models.

## **Version 1.0.0.9**

Bug-Fix – Option for day of month removed from exercise menu

Exercise duration labeled with hour and minute for clarity

Internal watchdog enabled to prevent lockup due to invalid settings.



## Firmware Revisions (cont.)

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### Version 1.0.1.0 (New Features)

Communications menu enabled for Port 0 Modbus.

Contrast adjustment displays value.

Bug-Fix – Closed Transition

In open source 1 and 2, fail-safe for opposite source being left connected.

In sync test, return false if source not available.

S1 and S2 start, fail-safe if either source is missing.

Setup assist and set by part number default settings changed to in-phase disabled and rotation disabled. Only for standard and programmed transition.

Bug-Fix – Open Source 1 while not in position 2 changed to while in position 1.

Transition delay reduced to 5ms between limit switch test for MCCB switch. Max 10s before fail.

Transition delay reduced to 50ms between limit switch test for contactors. Max 300ms before fail.

### Version 1.0.1.1

In main menu, any timer overflow will now display '+' with an incrementing timer.

Bug-Fix – Load Disconnect Timer

Test to see if timer was bypassed; if not, disconnect before timeout ends.

Bug-Fix – In-phase transfer fail

Correction to menu; back button not working.

Bug-Fix – S1 and S2 load disconnect timer swapped / corrected.

Correction to set up by part number. Service entrance adjusted by last 2 characters.

Contrast adjustment will now roll over to 0.