# 72-1500-00

Operation Manual Version 1.0.1.9 Automatic Transfer Switch Operation

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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

- 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 <u>C</u> S-	OFNC	-020(	<u>95</u>
Back	2	>	Save

- 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

#### 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	Cindle Dhees	andard 02000me
Single or 3 Phase Voltage		OT CICILII II.
Transition Type	Back	Next
Rated Current		

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

Nominal Voltage	Nominal Frequency
Single / 3 Phase operation	Transition Type
*In-phase Monitoring	*Sync Differential
*Sync Frequency	*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 \* voltage and frequency applied to both sources

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

#### **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.

## **NOTICE: Service Entrance Setup for KEP Models**

Service disconnect on the OEM Kohler Decision-Maker MPAC 1500 has two different operations:

- The older OEM design will signal the generator to start and transfer to the emergency source when service disconnect is active.
- The newer OEM design will transfer to the OFF position when service disconnect is active. Both sources are disconnected and there is no start signal to the generator.

Newer OEM designs can be identified by the decal located near the service disconnect switch on the outside of the cabinet door, as well as newer transformer assemblies. The decal will say the following:

## NOTICE:

## SERVICE DISCONNECT TRANSFERS TO OFF, REMOVING POWER FROM THE LOAD. POWER WILL NOT BE RESTORED UNTIL THE SWITCH IS RETURNED TO AUTO.

If the transfer switch is equipped with the new transformer assembly, kit number GM94796-AA1 or GM94796-AA2 will appear in the accessories section of the transfer switch nameplate on the controller cover. Transfer switches equipped with an original transformer assembly GM69797-KA1 or GM69797-KA2 do not have the transformer kit number printed on the nameplate.

For transfer switches that are equipped with the older transformer assemblies, the programmable input for service disconnect **must** be set to **Remote Test**, so that the transfer switch will signal the generator to start and transfer the load to emergency.

For transfer switches equipped with the new transformer assemblies, the programmable input for service disconnect **must** be set to **Service Disconnect**. This will disconnect both sources and leave the transfer switch in the OFF position.

# Set Menu Navigation

## Set Time/Date

Set Time 12:00	Set Date Tue 01/03/00	Clock Ahead 1 Hour 2nd Sun of Mar	
Back 🔉 > Save	Back 🏠 🖒 Save	Back 🏠 🗦 Save	
Set Exerciser			
Exerciser Event 1 Disable	Exerciser Event 1 Unloaded	Exerciser Event 1 Daily	
Back 🏠 🛛 Next	Back 🏦 🛛 Next	Back 🏦 🛛 Next	
Exerciser Event 1 Repeat Rate 00	Exerciser Event 1 Duration <u>0</u> 00	Exerciser Event 1 Start Date <u>0</u> 0/00/00	
Back 🏦 🛛 Next	Back 🏠 👌 Next	Back 🏠 > Next	
Exerciser Event 1 Start Time <u>0</u> 0:00			
Back 🏩 👌 Save			
Set S1 Time Delays			
Set S1 Time Delays Engine Start	En9ine Start <u>0</u> 0:03		
🐺 🏦 🔀 Back	Back 🏠 🗦 Save		
Set S1 Time Delays Engine Cooldown	Engine Cool Down <u>0</u> 0:05		
🍹 🚖 🔀 Back	Back 🏠 🗦 Save		
Set S1 Time Delays Xfer Pref>Stby	Xfer Pref>Stby 0 <u>0</u> :03		
🍹 🚖 🔀 Back	Back 🏠 🗦 Save		
Set S1 Time Delays Xfer Off>Stby	Xfer Off>Stby 0 <u>0</u> :02		
🍹 🛔 🔀 Back	Back 🏠 🗦 Save		
Set S1 Time Delays Fail to Acquire Pref	Fail to Acquire Pref Enable	Fail to Acquire Pref 01:00	
🍹 🚖 🔀 Back	Back 🏠 🗦 Save	Back 🏠 🗦 Save	
Set S1 Time Delays Control Mode Time Loads to Control: 1	S1 Time Delays Load Control Mode	S1 Time Delays	
Image: Second control of the s	Back 😭 🖒 Save	Back 🏠 🖒 Save	
Set S1 Time Delays Time-Based Control	Time-Based Control Load Control 1	Load 1 Disc N>E Q0:03	Load 1 Rec E>N 20:03
🐺 🏦 🔀 Back	🍹 🛧 🖂 Back	Back 🏠 💙 Next	Back 🏠 🗦 Sa

Save

# Set S2 Time Delays

Set S2 Time Delays Engine Start	Engine Start <u>0</u> 0:03		
🐺 🏦 🔀 Back	Back 🏦 > Save		
Set S2 Time Delays Engine Cool Down	Engine Cool Down 20:05		
🐺 🏦 🔀 Back	Back ☆ > Save		
Set S2 Time Delays Xfer Stby>Pref	Xfer Stby>Pref 0 <u>1</u> :00		
🍹 🟦 🔀 Back	Back 🏦 🔀 Save		
Set S2 Time Delays Xfer Off>Pref	Xfer Off>Pref 0 <u>0</u> :02		
🍹 🏦 🔀 Back	Back ☆ > Save		
Set 52 Time Delays Fail to Acquire Stby	Fail to Acquire Stby Enable	Fail to Acquire Stby 01:00	
🍹 🏦 🔀 Back	Back ☆ > Save	Back 🏦 🔀 Save	
Set S2 Time Delays Control Mode Time Loads to Control: 1 \$ \$ Deck	S2 Time Delays Load Control Mode Time Back î > Save	S2 Time Delays Loads to Control: 1 Back î > Save	
Set 52 Time Delays Time-Based Control	Time-Based Control Load Control 1	Load 1 Disc E>N Q0:03	Load 1 Rec N>E Q0:03
🍹 🟦 🔀 Back	🐺 🏦 🔀 Back	Back 🏠 💈 Next	Back 🏦 > Save
Set Sources			

Phase Rotation	Disable Rotation	BAC Rotation	ABC Rotation
🍹 🚖 🔀 Back	🐺 🟦 Save Back	🐺 🟦 Save Back	🐺 🏦 Save Back
In Phase Monitor	Disable	Enable	
🍹 🏦 🔷 Back	🐺 🛧 Save Back	🐺 🔹 Save Back	
In Phase Angle	10 Degrees		
🍹 🚖 🗦 Back	🍹 🟦 Save Back		
In Phase Xfer Fail	In Phase Xfer Fail Enable	In Phase Xfer Fail 01:00	
🍹 🟦 🖂 Back	Back 🏠 💈 Save	Back 🏠 🖒 Save	

## Set Sources (cont.)

Volt Differential	5 Percent	
🗱 🛔 🔀 Back	🏅 🛔 Save Back	
Freq Differential	1.0 Hz	
🗱 🚖 🗦 Back	🍹 🛔 Save Back	
Preferred Source	Preferred Source Normal	Preferred Source Emergency
🍹 🚖 👌 Back	🍹 🏦 Save Back	🍹 🏦 Save Back

# Applicable for both Normal and Emergency Source

Normal Source	Emergency Source	
🍹 🏦 🔀 Back	🍹 🏦 🔀 Back	
Number of Phases	3 Phase	Single Phase
🐺 🛧 🔀 Back	🍹 🟦 Save Back	🐺 🛧 Save Back
Volta9e	Set Voltage 240 VAC	
🐺 🏦 🗦 Back	Back 🏠 🖒 Save	
Frequency	Set Frequency 60 Hz	
🐺 🛔 🔀 Back	Back 🏦 🥇 Save	
Under Voltage Pickup	Pickup 90 % of Nominal 85-100%	
Under Voltage Dropout T 1 Back	Dropout 90 % of Pickup 75-98% \$ \$ Save Back	
Over Volta9e Pickup ‡ ‡ > Back	Pickup 95 % of Dropout 95-100% \$ 1 Save Back	
Over Voltage Dropout \$ ≜ > Back	Dropout 115 % of Nominal 106-135% \$ \$ Save Back	

# Set Sources (cont.)

Volta9e Debounce \$	Debounce Time 5 Seconds 0.1-9.9 Seconds \$ 1 Save Back	
Volta9e Unbalance Enable/Disable \$ \$ > Back	Volta9e Unbalance Disable \$ \$ Save Back	Voltage Unbalance Enable I Save Back
Volta9e Unbalance Pickup ‡ 1 > Back	Pickup 10 % 3-18% \$ 1 Save Back	
Voltage Unbalance Dropout ‡	Dropout 20 % 5-20% \$ \$ Save Back	
Under Frequency Pickup ‡ 1 > Back	Pickup 90 % of Nominal 80-95% \$ \$ Save Back	
Under Frequency Dropout \$ \$ Dropout	Dropout 99 % of Pickup 95-99% \$ \$ Save Back	
Over Frequency Pickup ∓ ★ > Back	Pickup 110 % of Nominal 105-120% \$ \$ Save Back	
Over Frequency Dropout \$ 1 > 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

Ма	ain Board I/O Inputs		Main Board I/O Input 1			Main Board I/O Input 1								
÷.		>	Back	*	 >	Back	*	.#. .#.	>	Back	*	U1S ‡	abled Save	• Back
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÷		$\rightarrow$	Back	Ť		Save	Back
Ma	in Bo Inpu	ard : t 2	[/0	Ma	ain Bo Inpur	ard I	/0
÷.	ala. ala.	>	Back	Ŧ	Disa ‡	bled Save	Back

Set Inputs/Outputs (cont	.)		
Main Board I/O	Main Board I/O Outputs	Main Board I/O Output 1	Main Board I/O Outeut 1 Disahled
🍹 🚖 🗦 Back	🍹 🟦 🔀 Back	🍹 🛧 🔀 Back	The Back
Auxiliary I/O	Main Board I/O Outputs	Main Board I/O Output 2	Main Board I/O Output 2 Dischlod
🍹 🛓 🔀 Back	🍹 🟦 🔀 Back	🍹 🟦 🔀 Back	Save Back
Auxiliary I/O	Module Inputs	Module Input 1	Module Input 1 Disabled
🍹 🛧 🔀 Back	🐺 🏦 🔀 Back	🍹 🏦 🔀 Back	T Save Back
Auxiliary I/O	Module Outputs	Module Output 1	Module Output 1 Dissblad
🍹 🟦 🔀 Back	🍹 🔹 🗦 Back	🍹 🟦 🔀 Back	The Save Back
Set System			
Source Type	Source Type Util-Gen		
🐺 🛔 🔀 Back	Back 🟦 🛛 Save		
Transition Type	Transition Type Standard	Transition Type Pro9ram	Transition Type Closed
🍹 🛓 🔀 Back	Back 🏦 🔀 Save	Back 🏦 🖒 Save	Back 🏠 🔿 Save
Service Entrance	Service Entrance No	Service Entrance ICCB	Service Entrance MCCB
🍹 🟦 🔀 Back	Back 🏦 🛛 Save	Back 🏦 🛛 Save	Back 🏦 🛛 Save
Rated Current	Rated Current _200 Amps		
🍹 🟦 🔀 Back	Back 🏦 🔀 Save		
3 Src Eng Start Mode			
🍹 🚖 🗦 Back			
Transfer Commit	Transfer Commit Commit	Transfer Commit No Commit	
🍹 🏦 🗦 Back	Back 🏦 🛛 Save	Back 🏦 🛛 Save	
Remote Test Loading	Remote Test Loading Unloaded	Remote Test Loading Loaded	
🐺 🏦 🔀 Back	Back 🏦 🛛 Save	Back 🏦 🛛 Save	
Peak Shave TD Bypass			
🍹 🏦 🗦 Back			

## **Set Communications**

MODBUS Server Port	MODBUS Server Port Enable	MODBUS Server Port Disable
🍹 🟦 🔀 Back	Back 🏠 🛛 Save	Back 🏠 🛛 Save
MODBUS Port Address	MODBUS Port Address 2	
🍹 🛧 🔀 Back	Back 🎓 🌣 Save	
MODBUS Port Baudrate	MODBUS Port Baudrate 19200	
🐺 🛧 🔀 Back	Back 🏠 🛛 Save	
MODBUS Server TCP	MODBUS Server TCP Disable	MODBUS Server TCP Enable
🐺 🛧 🔀 Back	Back 🏠 🛛 Save	Back 🏠 🛛 Save
MODBUS TCP Unit ID	MODBUS TCP Unit ID 3	
🍹 🚖 🔀 Back	Back 2 > Save	
IP Address	IP Address <u>9</u> 00.000.000.000	
🐺 🛧 🔀 Back	Back 🏠 🗦 Save	
Subnet Mask	Subnet Mask 200.000.000.000	
🍹 🛧 🔀 Back	Back 🏠 🗦 Save	
Default Gateway	Default Gateway 200.000.000.000	
🍹 🛧 🔀 Back	Back 🏠 🗦 Save	
DHCP Status	DHCP Status Disable	DHCP Status Enable
🐺 🛔 🔀 Back	Back 🤉 Save	Back 🤉 Save

Set Passwords

Se	tue Pa	asswo	ord	01d New	Pass Pass	word word	8021 6020
÷,		>	Back	Back	Â	>	Save
Te	st Pa	sswor	ъd	Old New	Pass Pass	word word	8021 6020
÷.		>	Back	Back	â	>	Save

## Calibration

Calibrate L-N Voltages	Calibrate L1-LØ Source N	L1-L0 VAC 120 Calibrate 120
uncern Ç 1 > Back	🐺 🏦 🔀 Back	Back 🏦 🗦 Back
	Calibrate L2-L0 Source N	L2-L0 VAC 120 Calibrate 120
	🍹 🛔 🔀 Back	Back 🏠 💈 Back
	Calibrate L3-L0 Source N	L3-L0 VAC 120 Calibrate 120
	🍹 🟦 🔀 Back	Back 🏠 🔀 Back
Calibrate L-N Voltages Source F	Calibrate L1-L0 Source E	L1-L0 VAC 120 Calibrate 120
The second secon	🐺 🟦 📏 Back	Back 🏦 💙 Back
	Calibrate L2-L0 Source E	L2-L0 VAC 120 Calibrate 120
	🐺 🏦 > Back	Back 🏠 💙 Back
	Calibrate L3-L0 Source E	L3-L0 VAC 120 Calibrate 120
	🍹 🟦 🔀 Back	Back 🏦 🔀 Back
Calibrate L-L Voltages	Calibrate L1-L2 Source N	L1-L2 VAC 240 Calibrate 240
v tool cent Back	🍹 🏦 📏 Back	Back 🏦 🦉 Save
	Calibrate L2-L3 Source N	L2-L3 VAC 240 Calibrate 240
	🍹 🏦 📏 Back	Back 🏦 🦉 Save
	Calibrate L3-L1 Source N	L3-L1 VAC 240 Calibrate 240
	🐺 🏦 🗦 Back	Back 🏦 🦉 Save
Calibrate L-L Voltage Source F	Calibrate L1-L2 Source E	L1-L2 VAC 240 Calibrate 240
The second secon	🐺 🏦 > Back	Back 🏦 🦉 Save
	Calibrate L2-L3 Source E	L2-L3 VAC 240 Calibrate 240
	🍹 🛔 📏 Back	Back 🏦 🥇 Save
	Calibrate L3-L1 Source E	L3-L1 VAC 240 Calibrate 240
	💈 🛧 🖂 Back	Back 🌣 🕱 Save

## Set Part Number

KES-DFNA-0200B	KES-DFNA-0200B			
Back Next	Back	â	>	Save
Setup Assist				
240v/60Hz Standard Single Phase 0200Amp				
Back Next				
Update Modules				
Update Modules?	Se No ma	earch odule	in9 dete	00 ected
Back Next				

# Factory Default

Fact	ory.	Defaul	t
Ŧ	.de.	>	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 240U 240U 240U Lamp ∓ ☆ Test Main
Displays Normal L-L
Norm AN BN CN 60Hz 120U 120U 120U Disable \$ \$ Main
Displays Normal L-N
Emer AB BC AC 60Hz 240U 240U 240U
🗶 🛓 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



## Down Button (cont.)



## **Displays Time/Date**

#### Normal Preferred Util-Gen Operation Commit Transfer Main Ţ \* **Displays Source Setup** Program Transition Disable Rotation In-Phase Disable Main \* Ξ Displays System Setup View Button Exercise > Ŧ Mair **Displays Exercise Setup**

# S1 Delays > Main

**Displays S1 Delays** S2 Delays .**.**.... Main 2 **Displays S2 Delays** 

## View Button (cont.)



Initiates an Unloaded Test

## Lamp Test

2

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 the keypad indicators illuminate.

Main

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



XXXF	i9htXSystemsX>	(X
XXXF	i9htXSystemsX>	(X
XXXF	i9htXSystemsX>	X
XXXF	i9htXSystemsX>	X

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	Exerciser Event 1	Exerciser Event 1	Exerciser Event 1
Enable	Loaded	Weekly	Repeat Rate 01
Back 🏠 🛛 Next	Back 🏠 🛛 Next	Back 🏦 🛛 Next	Back 🏠 🛛 Next
Exerciser Event 1	Exerciser Event 1	Exerciser Event 1	
Duration @0:15	Start Date <u>0</u> 1/03/24	Start Time 10:00	
Back 🏩 > Next	Back 🏩 > Next	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-minute 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

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.

If 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.

3:00	2:00	1:00	0	1:00	2:00
Load 2 Disconnect	Transfer Time Delay	Load 1 Disconnect	Transfer	Load 1 Reconnect	Load 2 Reconnect

### 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
K1 (NR) Relay	Close Source 1	Close Source 1	Close Source 1
K2 (ER) Relay	Close Source 2	Close Source 2	Open Source 1
AUXK1 Relay (NR1)	N/A	N/A	Open Source 2
AUXK2 Relay (ER1)	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).

### 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 \* **Emergency Loss of Phase 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 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	<ul> <li>Currently in development</li> </ul>
AOB I/O Module (Alarm)	Fixed Address 5	<ul> <li>Currently in development</li> </ul>
BOB I/O Module (Battery)	Fixed Address 6	<ul> <li>Currently in development</li> </ul>

### 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.

S	System Ready			L1-L2 VAC 235				System Ready				
Norm	235	Emer	0	Uar	100	are	246	9	Norm	240	Emer	0
÷	View	Set	Test	Back	Â		;	Save	Ŧ	View	Set	Test

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**

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 – Disable

# **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			

#### 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

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.

#### 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.

#### Version 1.0.1.2

Added contactor position to output register in switching mechanism

Bug-Fix – Correction to source 2 available in alarm register

Bug-Fix – I2C initialization fix

Bug-Fix - Corrected active time delay not being displayed on screen

Bug-Fix – Bypass Contactor Disabled input polarity inverted.

#### Version 1.0.1.3

Added Peak Shave Mode to the list of programmable inputs.

#### Version 1.0.1.4

Bug-Fix - Exerciser Repeat Rate

Repeat rate of 0, the default setting, has been changed to 1. Repeat rate of 0 caused controller to lock up after exercise had been completed and any other settings were modified.

#### Version 1.0.1.5

Bug Fix - Standard Transition Only: Up to one second delay for Source 2 to close when transferring before alarm **Version 1.0.1.6** 

#### /ersion 1.0.1.6

Bug Fix - Fixed issue preventing immediate retransfer when Source 2 is unavailable.

Correction for S1 and S2 time delay for retransfer rollover to 59 instead of 23.

#### Version 1.0.1.7

Removed option for external battery

Modified Transfer Commit algorithm.

#### Version 1.0.1.8

Modified standard transition algorithm to accommodate larger switchgears.

#### Version 1.0.1.9

Correction – Service Disconnect and Forced Off inputs will now allow MCCB switch types to go to the neutral position when active. Service Disconnect now displays "Service Disconnect" status message when active.