



Technical Reference

Automatic Transfer Switch (ATS) Technical Information

Introduction

This document presents technical information for using an Automatic Transfer Switch (ATS) with Capstone Turbine Corporation® Model C30/C60 MicroTurbine™ systems. At present, the ATS functionality described herein is available through ASCO Power Technologies when equipped with accessory '7E'.

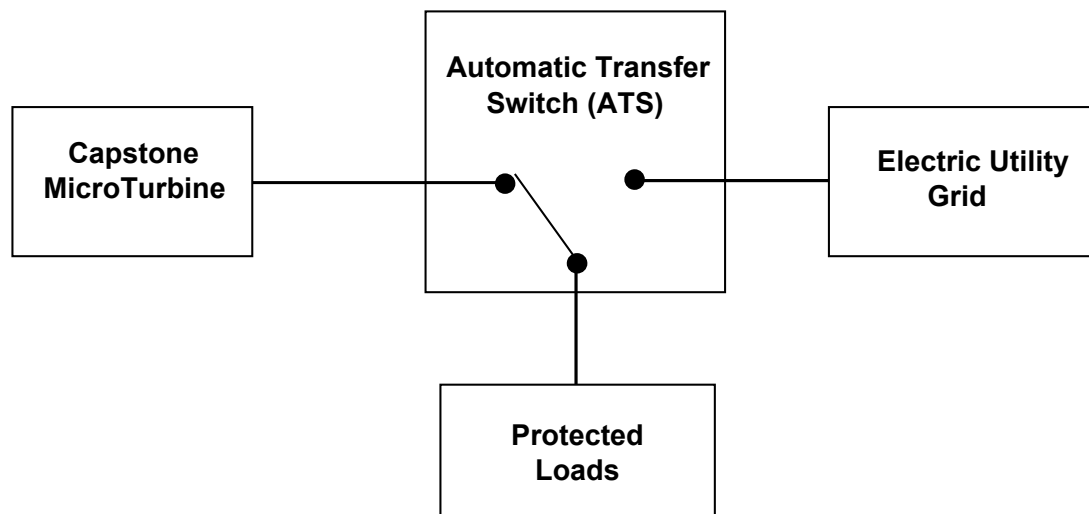
The Automatic Transfer Switch (ATS) enables protected loads to transfer operations between utility power and MicroTurbine power. The ATS contains built-in control logic that continuously monitors the primary source of power to the load. When the primary source fails, the ATS automatically transfers the load to the backup source. Either the MicroTurbine or the utility may be designated the 'primary source'; the other is described as a 'backup source'.

The ATS is different from another Capstone product - the Dual Mode Controller (DMC), in that continuous MicroTurbine-to-load connectivity is provided by the DMC. Both the DMC and ATS have the capacity to automatically switch control to the MicroTurbine in case of power failure. However, the DMC ties the MicroTurbine to the load at all times, using a switch disconnect located on the grid-side. The ATS allows only one source at a time to power the load.

The ATS has additional attractive features:

- Automated MicroTurbine battery charging without load connectivity
- Adjustable time delay to account for momentary transient power surges
- Remote operation for test or peak shaving applications
- Exerciser mode to charge MicroTurbine batteries (while off-line)

The diagram below shows ATS-to-MicroTurbine power connectivity:



Description

The ATS is a 3-pole transfer switch, rated from 100 to 1200 Amp, 480 VAC, offered in type NEMA 1 and NEMA 3R enclosures, and may be opened from the front. The control panel provides LED indicators for switch position and source availability, and includes test and time-delay bypass switches.

The ATS must be equipped with a '7E' accessory ('Wake-up' signal relay) for proper operation. An ATS which is not configured with this accessory will not support operation of the MicroTurbine as the backup source.

The ATS (and front-access control panel) appears as follows:



The ATS enclosure opens to facilitate power and electrical connections, as well as accessibility to the Controller.

Location of the ATS components (reference only) are shown below:



Items shown in the photograph above, with the exception of the ATS Controller, are outside the scope of this document and should only be accessed by a qualified electrical installer.

As shown, the ATS Controller is located on the inside door and contains DIP switches accessible by the user for configuration.

Refer to the MicroTurbine Electrical Installation Technical Reference (410009) for additional details on electrical interconnection.

Operating Modes

The ATS may be utilized with the MicroTurbine in one of two modes:

- Using the MicroTurbine as the primary source with the utility grid as a backup
- Using the utility grid as the primary source with the MicroTurbine as a backup

MicroTurbine as the Primary Source (Utility as Backup)

The MicroTurbine runs continuously when configured as the primary source, transferring control to the utility grid when an outage occurs. As power production resumes in accordance with ATS settings, the load is returned to the MicroTurbine, which then initiates an equalization charge automatically based on an internal 7-day clock.

Utility as the Primary Source (MicroTurbine as Backup)

When using the utility grid as the primary source and the MicroTurbine as backup, the ATS automatically provides 'wakeup' and 'run' signals as required to start the MicroTurbine in event of utility outage.

Exerciser Functionality

The ATS includes a programmable exerciser function, which wakes up the MicroTurbine(s) every seven days and ensures the batteries maintain charge. Battery charging is mandatory if the MicroTurbine will be idle for extended periods. However, this is not an issue if the MicroTurbine is operating as a primary source. ATS exercising may be performed with or without a load, using an ATS switch setting.

The MicroTurbine must perform an equalization charge cycle periodically to maintain an equal charge in all battery cells. This equalization charge must be commanded manually (charges to 100 percent state-of-charge) and will take up to four hours. The MicroTurbine has a 7-day clock that will trigger the start of an equalization charge during an ATS exercise event. However, full equalization completion is not allowed due to the ATS signal being disabled in less than the 4-hour period. For this reason, equalization charging of batteries MUST be performed on a regular interval to ensure MicroTurbine operation. See Standard Maintenance Work Instructions (440000) for recommended battery maintenance intervals.

Exercise Under Load

If "exercise under load" is chosen, the ATS issues 'wakeup' and 'start' commands and transfers the load from the primary source to the MicroTurbine for 20 minutes. After 20 minutes, the load is returned to the primary source, and the MicroTurbine continues to run five additional minutes with no load. The run command is then terminated by the ATS while the MicroTurbine runs for an additional battery recharge and cooldown period (up to 20 minutes), as determined by the battery state-of-charge, before shutting down.

Exercise Under No-Load

If "exercise under no-load" is chosen, the sequence is similar with the exception that the load is not transferred to the MicroTurbine, and the five minute run segment is omitted prior to the MicroTurbine's battery charge/cooldown segment.

ATS Installation

The ATS is installed between protected loads, the MicroTurbine, and the utility grid or local transformer. When the ATS is activated, the power supply is automatically transferred between the electric utility grid and the MicroTurbine.

Installation of the ATS requires the following steps:

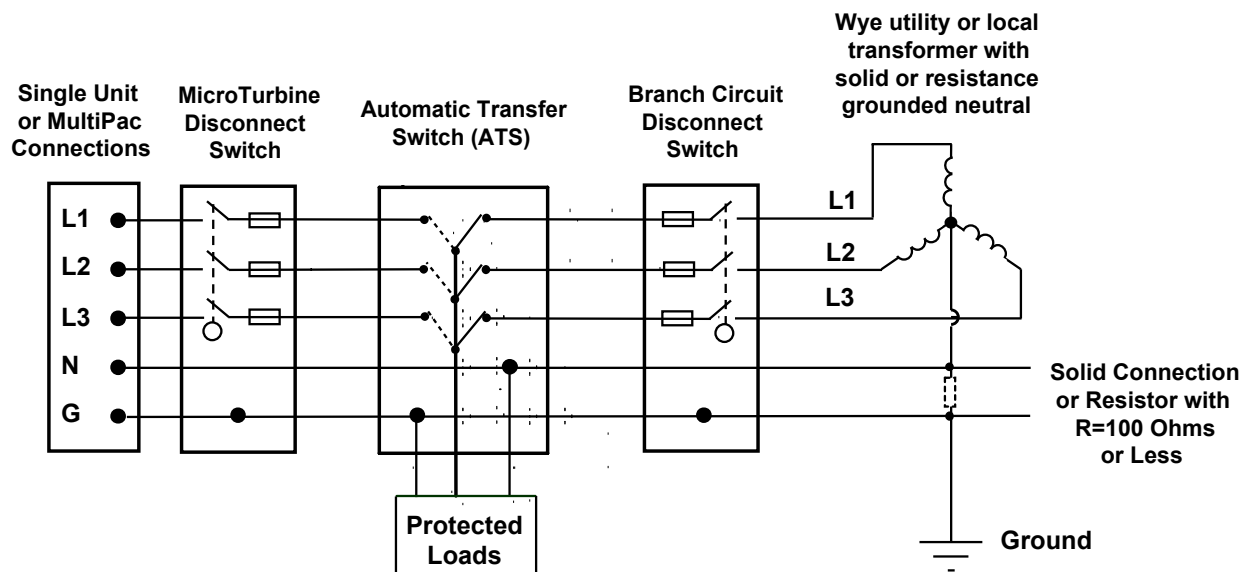
1. A shutdown of the MicroTurbine, followed by a
2. Installation of all electrical connections,
3. A reconfiguration of the interlocks and software and,
4. A restart of the MicroTurbine

Electrical interconnection must be planned with care, particularly the neutral and ground connections. Safety requirements, code requirements and functional requirements must be observed.

Phase rotation connections must be consistent with the utility grid to avert possible MicroTurbine and load damage. Therefore, the output from the ATS must be connected to the utility grid in an L1-L2-L3 counter-clockwise configuration.

For resistance-grounded neutral supply, the protected loads must be compatible, and able to withstand phase-to-phase voltage between any phase and ground, and phase-neutral voltage between neutral to ground. The neutral-to-ground bar **MUST BE** removed from the MicroTurbine User Connection Bay for all MicroTurbines in a single unit or Multipac configuration. A single neutral-to-ground connection **MUST BE** made at the load or local utility.

The figure below shows MicroTurbine to ATS interconnections.



ATS Configuration (MicroTurbine as Backup)

When the MicroTurbine is operating as a backup source, the ATS controls MicroTurbine operation through two separate control circuits: the wake-up signal, and the start/run signal.

Wake-up Signal

The ATS provides a 'wake-up' signal to establish communication with the MicroTurbine. The wake signal is momentary (between 0.1 to 2 seconds). If the wake-up signal is applied for less than 0.1 seconds, the unit may not wake up at all. If the signal is applied to the wake-up contacts for longer than two seconds, the battery may completely discharge.

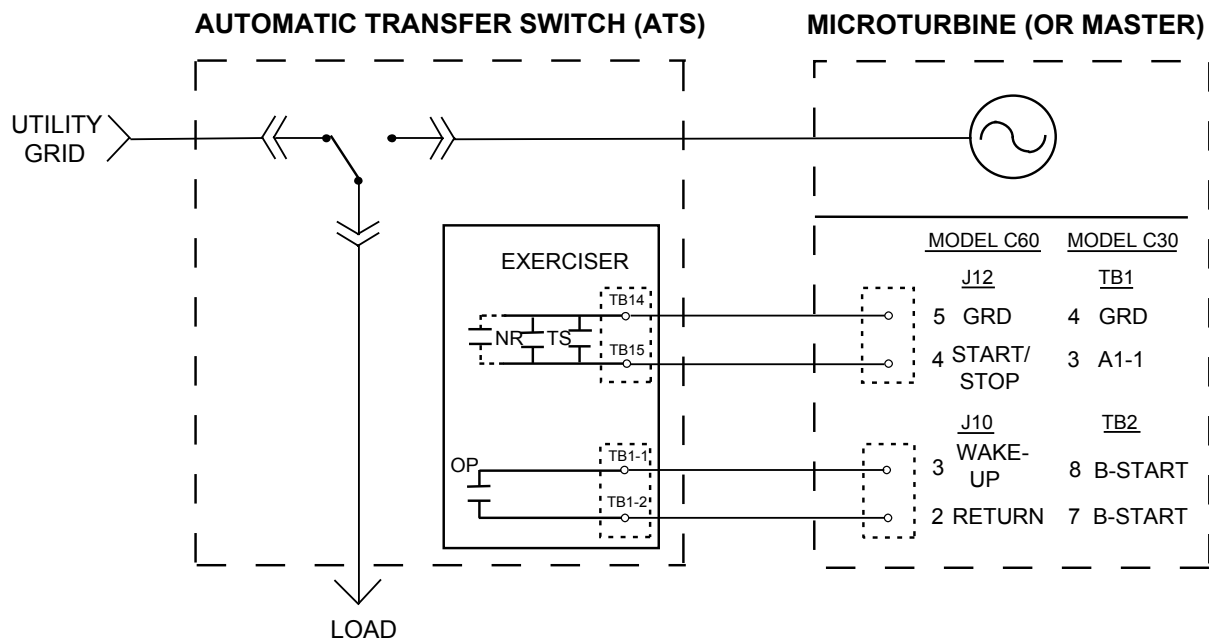
Start/Run Signal

The Start/Run signal (TS, NR, in Exerciser) initiates MicroTurbine operation after the Wake-up signal (Relay OP) resets. The MicroTurbine Start/Run signal resets following retransfer of load to the primary source. The MicroTurbine will then continue to run through its cooldown period.

Exerciser Operation

The ATS exerciser may be set to activate the MicroTurbine with or without a load transfer, or it can be completely disabled. Exerciser functionality is enabled by using the DIP switches located on the ATS Controller circuit board (see ATS Operator manual for details).

The schematic diagram below indicates the MicroTurbine-to-ATS interconnections.



MicroTurbine Configuration

The MicroTurbine requires the following configuration steps:

- ❑ Set the battery isolation switch to ON
- ❑ Electrically jumper the Stand Alone contacts in the UCB/JUCB communications bay
- ❑ Perform electrical connections to enable battery wake-up functionality.

Battery Isolation Switch

Set the battery isolation switch to ON. The isolation switch is located behind the lower kick panel at the front of the C60 model or C30 standard package, or at the rear of C30 industrial package.

Stand Alone Mode Configuration

NOTE

Refer to the Stand Alone Operation Technical Reference (410028) for detailed information relating to Stand Alone configuration and menu selections.

Configure the MicroTurbine to operate in Stand Alone mode as follows:

On the control panel, enter the user password (default is **87712370**), and navigate to: *System Data > System Configuration > Power Connect*. Select Stand Alone mode, and then press the ACCEPT button.

If using CRMS, from the main menu, select *Settings > Control Settings*, and set the Power Connect slider to Stand Alone.

Jumper the UCB/JUCB 5-volt dry circuit contact terminals to reconfigure the MicroTurbine for Stand Alone operation.

	Model C30 (UCB)	Model C60 (JUCB)
Jumper Settings	TB4 – Pin 3 (SA Enable +5V) to Pin 1 (SA Enable Return)	J12 – Pin 2 (SA Enable +5V) to Pin 5 (Ground)

Battery Wake-up

Press the BATT START button at the far left of the Display Panel to manually awaken a MicroTurbine from Sleep mode. Alternately, momentarily closing the battery start contacts in the communications bay for less than 2 seconds will wake up the MicroTurbine. The ATS provides this 'wake-up' signal to establish communication with the MicroTurbine.

Remote Operation

To configure the software to enable remote operation using the ATS as an external switch:

On the control panel, navigate to: *System Data > System Configuration > Start Input*, and select the "Remote" option.

If using CRMS, from the main menu, select *Settings > User Connection Bay Settings*, and set the Start Input slider to Remote Start Priority (Mode 1).

In addition, perform the following ATS to MicroTurbine connections:

ATS Connection	Model C30 (UCB)	Model C60 (JUCB)
TB1-1	TB2 – Pin 8	J10 – Pin 3
TB1-2	TB2 – Pin 7	J10 – Pin 2

Auto Load

Auto Load should be enabled for optimum performance in both cases – using the MicroTurbine in either primary or backup modes. Configure Auto Load as follows:

On the control panel, navigate to: *System Data > Auto Load*, and select Enable.

If using CRMS, from the main menu, select *Settings > Stand Alone Voltage and Frequency*, and then set the Auto Enable Power toggle to ON.

Auto Restart

In normal MicroTurbine day-to-day operations, Capstone recommends enabling Auto Restart to prevent the inconvenience of having to manually start the MicroTurbine after a fault. If Auto Restart is enabled and a MicroTurbine fault condition occurs, a restart counter increments for each failed restart attempt occurring within the first two minutes of the Load state. If five faults are registered, the MicroTurbine disallows further attempts to restart automatically, but may be manually restarted using the Start button.

Potential for an endless loop arises if the MicroTurbine (as the primary source) faults when running under load after the restart counter has been reset to zero. In this scenario, the ATS will transfer the load to the backup source. The MicroTurbine restarts. When a normal MicroTurbine Load state waveform is detected by the ATS, the load is transferred from the backup source back to the MicroTurbine, which again faults. The loop is created by the ATS retransfer time exceeding the MicroTurbine two-minute auto restart time. Therefore, the MicroTurbine restart counter is not allowed to increment to five faults, where it would remain in a fault state.

As a recommended solution, Capstone suggests re-programming the ATS retransfer time to be less than the MicroTurbine auto restart time to allow the MicroTurbine to run under load before its restart counter is reset. Since the MicroTurbine's restart counter resets after approximately two minutes of running in the Load state, an ATS retransfer setting of 1.5 minutes should ensure the counter has time to increment should a fault occur.

Illustrative examples on the following page show how the restart counter reacts to faults occurring before and after the two minute reset window. Summarizing the available recommended solutions, the user may perform one of two options:

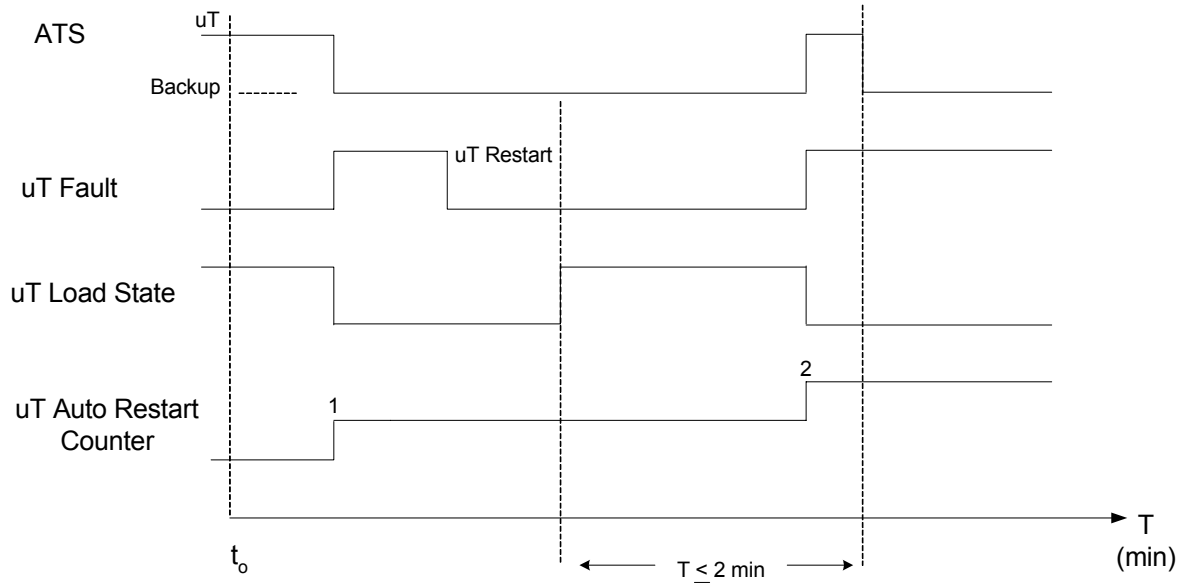
- 1) Set the ATS time between 1.0 and 1.5 minutes, or
- 2) Disable Auto Restart on the MicroTurbine.

To configure Auto Restart to automatically restart the system after system faults, perform the following:

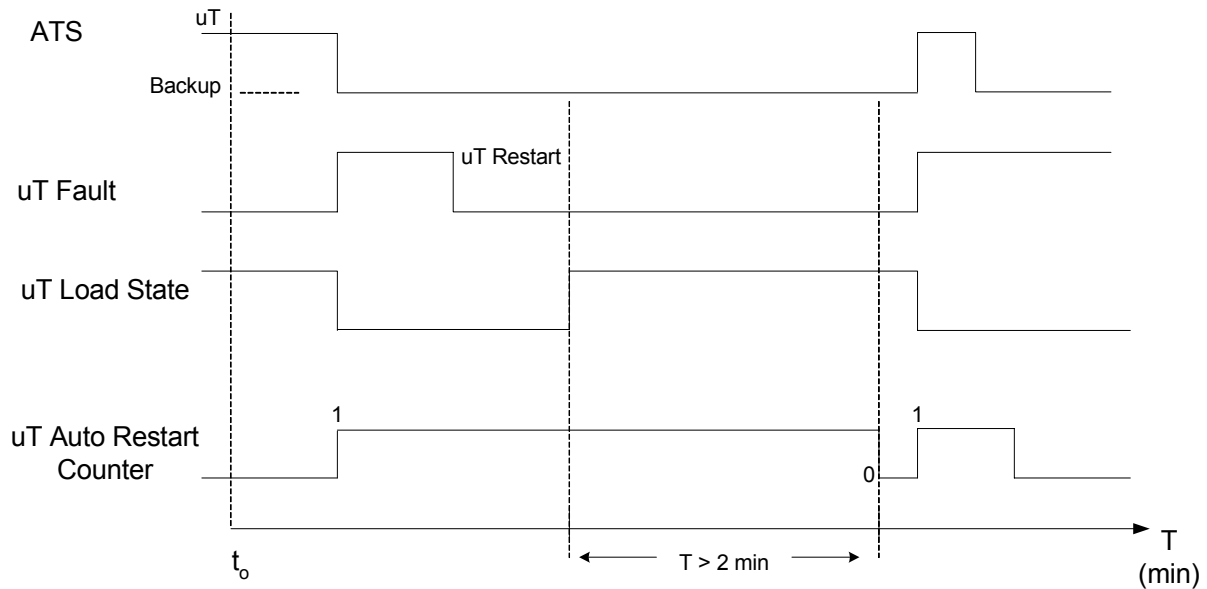
On the control panel, navigate to: *System Data > System Configuration > Auto Restart*, and select ON.

If using CRMS, from the main menu, select *Settings > Control Settings*, and then set Auto Restart to ENABLE.

DESIRED TRANSITION STATES
 (Auto Restart will timeout after 5 attempts)



MIS-TIMED TRANSITION STATES
 (Auto Restart will continue indefinitely)



Capstone Technical Support

If questions or problems arise regarding preventative maintenance or troubleshooting for your ATS unit, please contact Capstone Technical Support for assistance and information.

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