Pika T701 Turbine

Installation and Service Manual

Pika ENERGY

www.pika-energy.com

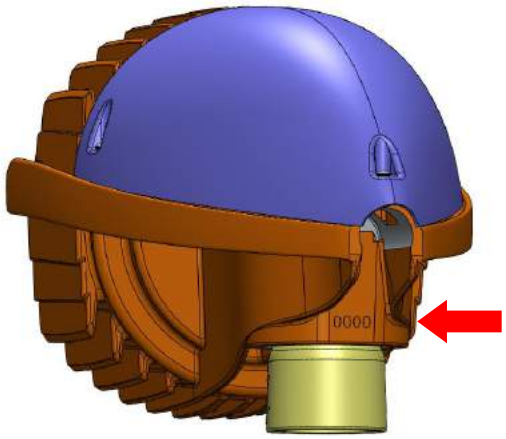
Installation & Service Manual

Revision 1.6

PLACE DEVICE I.D. CARD HERE

Turbine Serial Number

The serial number of the turbine is also stamped or scribed into the nacelle casting at the base of the tail pocket.



Contents

Introduction

Congratulations on your purchase of the T701 wind turbine! This manual will guide the installer through proper installation and setup of the Pika Energy T701 turbine, as well as maintenance and troubleshooting of the unit.

It is important to carefully and thoroughly read the entire manual in a comfortable setting, before venturing out in the field to install the turbine.

Symbols used in this document

Throughout the manual, the following symbols highlight important information:

	**DANGER:** Hazards that could cause death or serious injury
	**WARNING:** Actions or situations that could permanently damage or destroy the T701 turbine or other system components
	**NOTE:** Helpful tips and points of interest
	**CHECKMARK:** installation checklist requires a check at this step
	**TAKE A PHOTO:** installation manual requires a photo at this step
	**EARTH GROUND:** Relates to proper grounding of the system, critical for safety and lightning protection.

Turbine Specifications

Parameter	**Value**
Turbine Type	3-blade HAWT, upwind free yaw
Rotor diameter	3.016 m
Swept area	7.01 m^2
Blade type	Optimum twist-taper injection-molded glass-reinforced polypropylene resin
Speed control	Digitally-controlled alternator torque
Redundant control	One-shot centripetal overspeed brake
Towertop mass	45 kg
Rated power (approx.)	1500W @ 11 m/s
Peak power	1700W @ 13 m/s
Annual output (approx.)	2,420 kWh at 5 m/s avg. (Rayleigh)
Cut-in windspeed	3.3 m/s
Survival windspeed	60 m/s
Turbine electrical output	REbus™ DC nanogrid: regulated +/-190VDC
Electrical parameters	**Nominal (Maximum)**
REbus Power	1575 W (1785 W)
REbus voltage	380 V (420 V)
REbus current	4.7 A (6.7 A)

1 Turbine overview

The T701 turbine is a horizontal-axis, three-blade, passive-yaw upwind turbine with a rotor diameter of 3.0 meters and a peak output of approximately 1.7kW. The turbine features high-performance molded blades and a quiet, efficient permanent-magnet alternator. Rotor speed is maintained within a safe operating range by the alternator through active load control, with an exclusive patent-pending mechanical overspeed brake that is entirely independent of the primary load control. The basic elements of the T701 wind turbine are illustrated below.

The T701 turbine produces a regulated DC current output, and is designed exclusively for connection to a REbus DC nanogrid. REbus is an advanced DC nanogrid platform developed by Pika Energy for small-scale wind, solar, and hybrid systems. ***Read and understand the accompanying REbus Nanogrid Introduction and Design Guide for more information on setting up a REbus nanogrid.***

	**DANGER:** The REbus nanogrid operates with a differential voltage of up to 420 VDC. The T701 turbine incorporates advanced safety features; however, like 120/240VAC home wiring, the REbus presents the hazard of potentially lethal voltages. All wiring should be performed up to local code standards by a fully licensed and properly trained electrician.
	**WARNING:** Do NOT attempt to connect the turbine directly to AC wiring - permanent damage may result. Do NOT attempt to connect the turbine directly to a low-voltage DC system (e.g. 12VDC, 24VDC, 48VDC). The T701 turbine should only be connected to a properly installed and tested REbus nanogrid. Read and understand this manual before attempting to install the T701 turbine.
	**NOTE:** Pika Energy recommends storing this manual in a sealed waterproof container located near the inverter for ready access.

What is REbus™?

The underlying technology behind Pika Energy's X3001 Inverter and B801 Battery Charge Controller is an innovative energy management platform or 'smart nanogrid' called REbus™. REbus™ is a DC energy network that operates alongside the existing AC infrastructure, enabling customers to build cost-effective, scalable renewable energy systems. The REbus™ network is designed to serve as an open interconnection standard for networking next-generation energy technology – like Wi-Fi or USB for green energy.

2 Turbine System Design

To give good performance, the T701 turbine must be installed as part of a well-thought-out system, designed in accordance with industry best practices.

2.1 Applications

Grid-Tie Wind System:

T701 Wind Turbine + X3001 Inverter

The 3kW-rated model X3001 serves as the gateway between the utility grid and the REbus™ DC Nanogrid. The Pika Grid-Tie Hybrid Inverter efficiently converts the power output of your Pika Energy system from 380VDC to 240VAC so it can be used on-site or exported to the utility grid. The ideal companion to the Pika T701 Wind Turbine for grid-tied systems, the Pika Grid-Tie Hybrid Inverter's 380VDC input can run on economical 12 AWG wire with less than 2% transmission loss up to a quarter-mile.Built-in WiFi communication provides monitoring with the REview™ online dashboard.

Grid Tie Wind/PV Hybrid System:

T701 Wind Turbine + PV Link + X3001 Inverter

Pika Energy offers a PV hybrid option with unmatched performance and flexibility. Up to 8 standard PV modules can be connected to the X3001 inverter in parallel with the T701 turbine through Pika's PV Link maximum powerpoint tracking converter. The X3001 makes hybrid solar/wind systems simple and smart with universal inputs and bidirectional power flow.

Off-grid Wind System:

T701 Wind Turbine + B801 Battery Charge Controller

The T701 Wind Turbine can be used in off-grid applications when combined with Pika's advanced 80 amp B801 Battery Charge Controller and standard 24-48 volt battery bank. The B801 is the high-efficiency gateway between Pika Energy's REbus™ DC Nanogrid and conventional battery banks, converting 380VDC power from your solar array and wind turbine to 24V or 48V charging.

Off-grid Wind/PV Hybrid System:

T701 Wind Turbine + PV Link + B801 Battery Charge Controller

Pika Energy offers a wind and PV hybrid option with unmatched performance and flexibility for off-grid applications. The T701 Wind Turbine can be combined with 3-4 kW of PV (12-16 standard PV modules) in off-grid applications when combined with a B801 Battery Charge Controller. Using the Pika Battery Charge Controller and Pika PV Link, put an off-grid home's solar array and wind turbine on the same bus, for ultimate control, efficiency, and simplicity.

Other system designs

The REbus nanogrid is designed to be a very flexible infrastructure that allows many configurations including multiple wind turbines on the same inverter. Visit Pika-Energy.com for a current list of REbus products and system configurations, including the Pika Energy Island, which provides seamless battery backup for grid-tie systems.

2.2 Siting and Towers

	**DANGER:** Obtain training from the tower manufacturer before attempting to install a tower or turbine. See Section 3 '*T701 Turbine Installation*' for important tower safety information.
	**DANGER:** Do not climb any tower without manufacturer-approved safety equipment. Never climb a tower that was not designed to be climbed. Carefully inspect the tower and all safety equipment before climbing.
	**WARNING:** Because the dynamic interaction between the tower and the turbine can cause damaging vibrations, the T701 turbine must be installed on a Pika-approved tower. Failure to use a tower approved in writing by Pika Energy will void the turbine warranty.

The most important factor in the performance of any wind turbine is the quality of the wind resource *at the location of the turbine.* Just as solar panels must be installed in a sunny location, wind turbines must be installed where there is unimpeded access to a good wind resource. One of the most common causes of poor performance is installation on a tower that is too short. **For acceptable performance the tower must be *at least* 10 meters (30 feet) taller than surrounding obstacles within a 100m (300 ft) radius. This is a minimum requirement,** and more height exposure is better. Remember that trees grow rapidly in height, and are likely to significantly decrease the wind exposure of nearby turbines over a few years. If in doubt, choose a taller tower.

There are two basic types of towers, guyed and un-guyed towers. In either case, access to the turbine for service is an important consideration. ***Pika Energy strongly recommends the use of tilt-up or climbable towers, in case the turbine requires service.*** Fixed, non-climbable towers significantly increase the cost of inspection and repair.

Guyed Towers

Guyed towers are supported at intervals by cables (guy wires), which help the tower withstand side loading from the wind. Guyed towers require more open space than freestanding towers, but are more structurally efficient, so they are often lighter and less expensive than monopole towers for a given height. Depending on soil conditions, guyed towers can often be installed without concrete. The anchoring system required for each guy depends on the turbine size and soil conditions. Common anchors include screw-in earth augers, expanding anchors, and poured-in-place concrete anchors. The central column will typically sit on a light metal spreader base or a small concrete pad.

Some guyed towers are designed to be tilted into place using a gin pole; others are designed to be raised with a crane, with subsequent maintenance performed by climbing.

Freestanding Towers

Freestanding towers support both the weight of the turbine and the sideways force of the wind through the strength of the tower itself. Freestanding towers require significantly less open space than guyed towers, but will likely be heavier and require a more substantial foundation – typically cast-in-place reinforced concrete. Just

as the trunk of a tree must be larger near the ground than at the top to withstand the force of the wind, freestanding towers nearly always taper, being smaller at the top and largest where they connect to the ground. Common types of freestanding towers include the tapered tubular monopole and the open tapered lattice type. Monopole type towers present a cleaner appearance, but may be heavier than an open lattice type tower. Many freestanding towers may be raised with a winch and gin pole.

Foundations and Anchoring

A tower is only as secure as its foundation. Follow the tower manufacturer's instructions in all cases when installing a foundation. Ensure the correct grade, size, and placement of reinforcing bars ('rebar'), use the recommended grade of concrete, and the correct reinforcing fiber if specified. Concrete must be tamped or vibrated per the instructions of the tower designer. Excavated soil must be tamped back into place per the tower manufacturer's recommendations, particularly when installing expanding (e.g. "bust") anchors, which depend on well-compacted soil for much of their holding power.

Observe tower manufacturer recommendations for installation on sloped sites. Non-planar (lumpy) sites are especially dangerous for guyed towers. Raising a tilt-up guyed tower on a convex site can result in rapidly increasing guy tension as the tower is raised, resulting in catastrophic collapse via buckling. Raising a tilt-up guyed tower on a concave site can result in slack guy lines, leading to an unsupported tower and catastrophic collapse.

Unconventional Mounting Situations

Historically, the best-performing wind turbines are installed on ground-mounted towers in open, exposed terrain. **Pika Energy strongly advises against mounting a wind turbine directly to the structure of a home.** Failure to use a Pika-approved tower will void the turbine warranty. Building-mounted wind turbines have a history of poor performance, noise issues, and significant downtime. Consult with an experienced structural engineer before mounting a T701 turbine to a steel or reinforced-concrete commercial building, to address structural issues, noise, vibration, and potential leaks. Attachment to a building does not substitute for a tower! Poor performance is virtually guaranteed if the turbine does not project at least 10 meters above surrounding obstacles (including buildings) within a 100m radius.

2.3 DC wire gauge and type, grounding, and lightning protection

The T701 wind turbine features Rebus, a plug-and-play nanogrid standard developed by Pika Energy. See the accompanying **REbus Nanogrid Introduction and Design Guide** and **REbus Quickstart Guide** for important information before designing your REbus system. Contact Pika Energy regarding availability of additional REbus nanogrid products to expand your home energy system.

All site wiring must be installed and grounded in accordance with local building codes. Local codes may require a disconnect or other additional safety hardware.

For most applications 12-14 AWG wire is appropriate. For installations with very long wire run distances (greater than 1000 feet), 10 AWG wire is recommended to reduce energy losses. The following tables indicate wire sizes needed for varying average wind speeds and run lengths. The indicated run length is the measured distance along the path of the wire from the inverter to the turbine, and should include the height of the tower. Note that the total wire length will be 2X this distance. ***The tables below are for a single turbine installation***; consult Pika Energy for wiring requirements for dual-turbine and hybrid systems.

2% Energy Loss Table: Wire gauge for less than 2% loss (one-way wire length vs. average wind speed)

	100m 328ft	150m 492ft	200m 656ft	250m 820ft	300m 984ft	350m 1148ft	400m 1312ft
5m/s	14	14	14	12	12	12	10*
6m/s	14	14	12	12	10*	10*	10*
7m/s	14	14	12	12	10*	10*	10*

4% Energy Loss Table: Wire gauge for less than 4% loss (one-way wire length vs. average wind speed)

	100m 328ft	150m 492ft	200m 656ft	250m 820ft	300m 984ft	350m 1148ft	400m 1312ft
5m/s	14	14	14	14	14	14	14
6m/s	14	14	14	14	14	12	12
7m/s	14	14	14	14	12	12	12

***NOTE:** The T701 wind turbine can only accept 12-2+g or 14-2+g AWG type UF ("Underground Feeder") wire through the yaw into the nacelle. If 10 AWG wire is used to get from the inverter to the tower base because of a very long wire run distance, it should be transitioned at the tower base to 12-2 or 14-2 AWG type UF wire in a junction box.

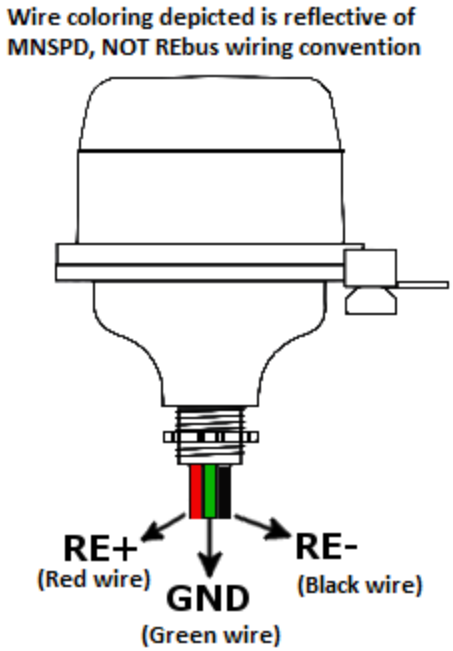
Grounding and Lightning Protection

Turbines, towers, and inverters must be securely connected to earth ground per manufacturers' instructions. At a minimum, the tower should be grounded at its base by an eight foot long copper-clad steel grounding rod driven vertically into the soil and bonded securely to the tower. Non-conductive towers require a heavy-gage copper ground wire connecting the steel towertop flange with the foundation grounding system.

	**NOTE:** ***Grounding turbines in arid regions*** presents special challenges. In many cases the standard grounding rod will not provide a sufficient low-resistance path to earth ground where soil is dry. Consult experienced electrical professionals in your area for best practices.

Pika Energy recommends the use of lightning arrestors at the tower base and inverter, to prevent damage from lightning. However, no protection system can entirely eliminate the risk of damage from a direct lightning strike. Pika Energy recommends the use of the Midnight Solar MNSPD-300-DC Surge Protection Device (or equivalent) for protection on all REbus devices. The surge protection device should always be installed as close as possible to the hardware it is intended to protect.

Figure 2.1 – Midnight Solar MNSPD-300-DC Surge Protection Device wiring diagram:

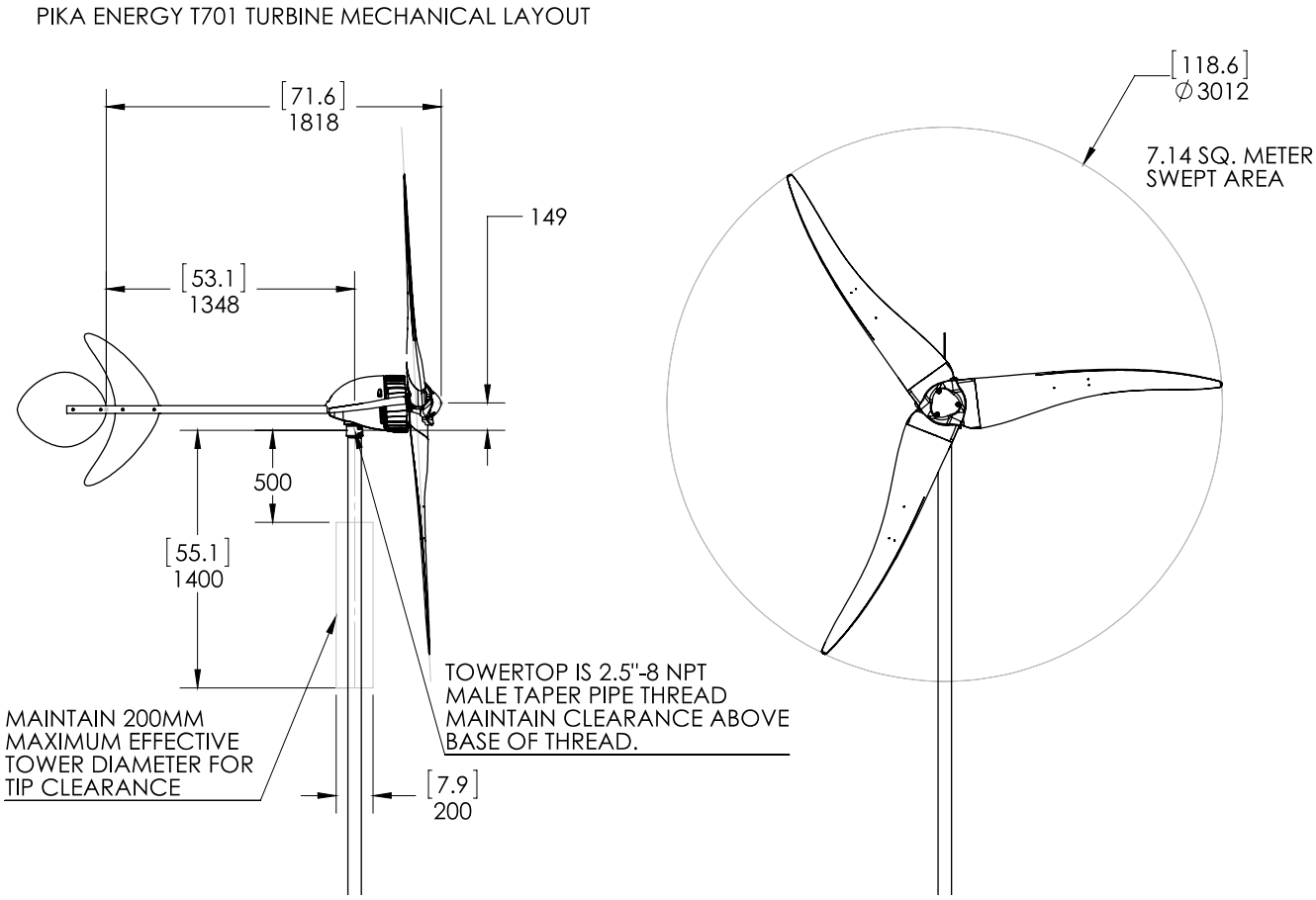


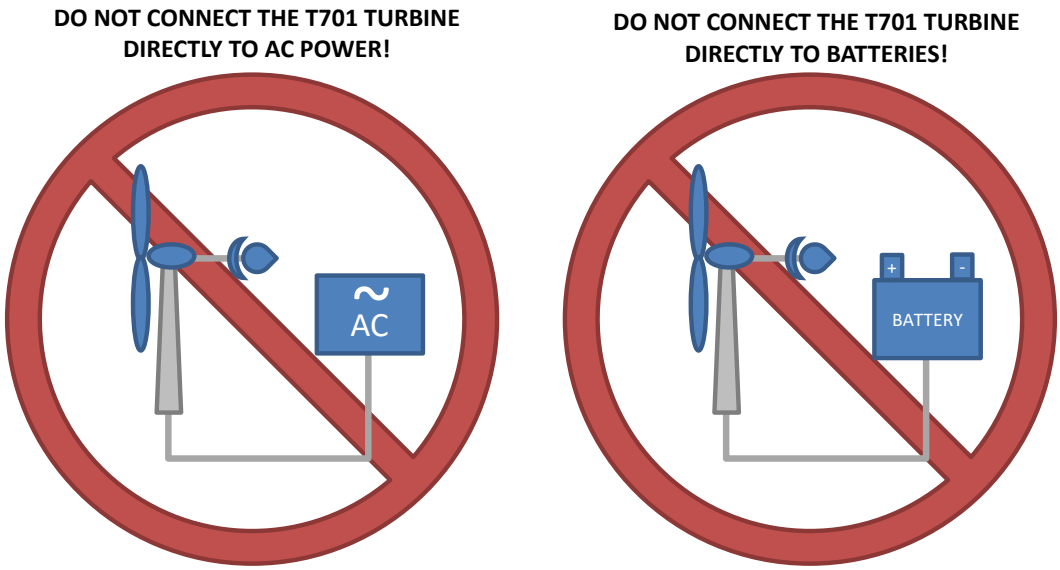
3 T701 Turbine Installation

The T701 turbine has been designed to be fast and simple to install. However, it is important to carefully follow the instructions in this manual as well as the tower manufacturer's manual.

	**DANGER:** Do not install a T701 turbine unless you have read this entire installation manual and watched *Installing the Pika Energy T701 Turbine*, available at http://vimeo.com/104006485.
	**DANGER:** Always wear appropriate OSHA-approved Personal Protective Equipment, including Hard hat, Steel-toed boots, Safety Glasses, Gloves
	**DANGER:** Pika Energy does not recommend working alone when installing or servicing turbines or towers.
	**WARNING:** Never remove the front plate unless specially trained in alternator service. The T701 alternator contains powerful magnets which may cause tools and fasteners to fly and shatter. The magnets also attract metal particles from clothes, skin, and hair, and these particles may damage the alternator. Credit cards or other forms of magnetic storage may be erased or irreparably damaged if brought in close proximity to the alternator.
	**NOTE:** Professional or third party installers are required to go through Pika training before installing the T701 turbine for customers.
	**USE THE CHECKLIST:** A signed, completed checklist with the required photos must be filed with Pika Energy for warranty registration.
	**TAKE PHOTOS:** Photos of key installation steps are required for warranty registration.

3.1 Turbine Mechanical Diagram

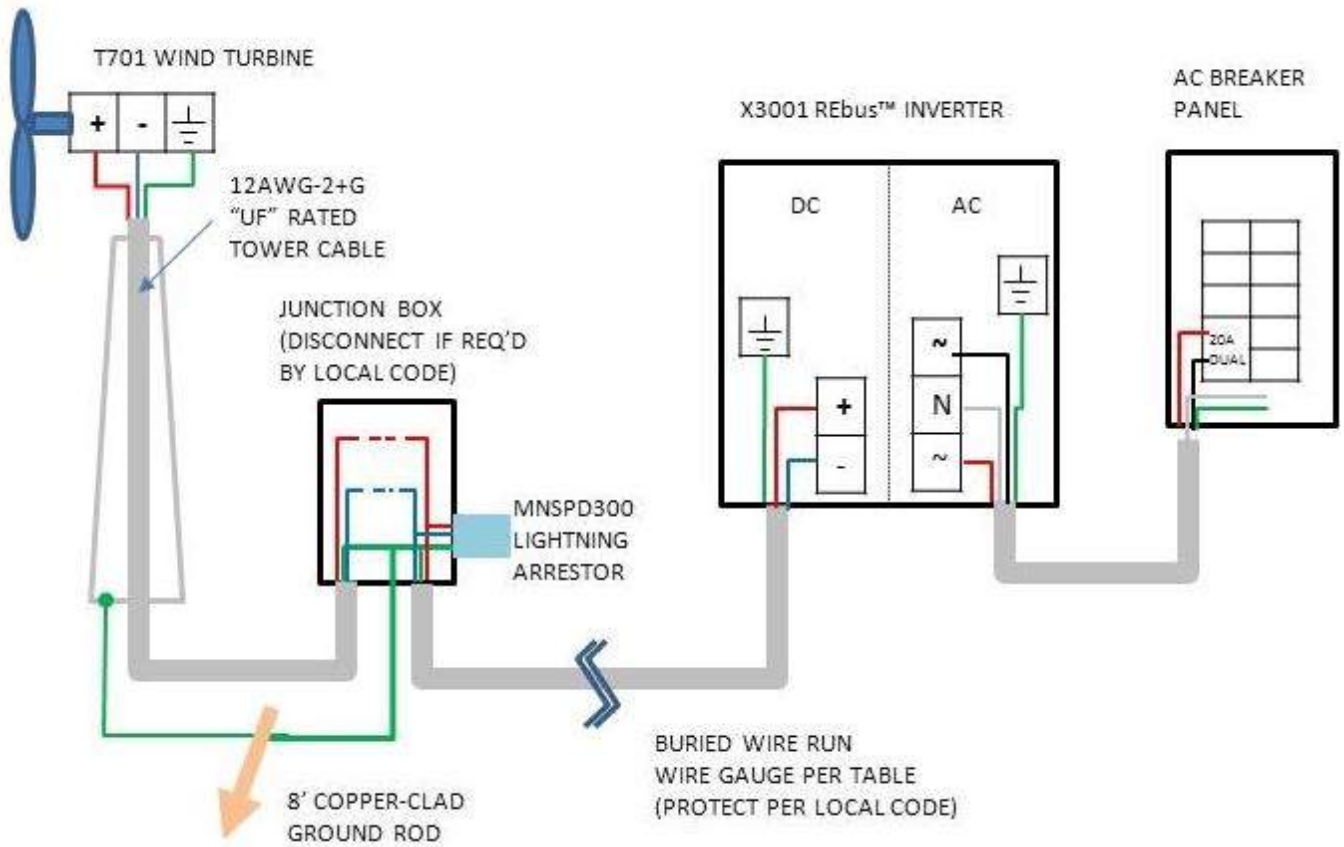




3.2 Wiring Diagrams

The following wiring diagram is for the basic system design including a T701 Wind Turbine and a X3001 REbus Inverter. For other system configurations, consult the **REbus Nanogrid Design and Installation Manual**. Under no circumstances should a T701 Wind Turbine be connected directly to AC or DC sources/sinks other than REbus-compatible devices.

	**DANGER:** Never connect a T701 Wind Turbine directly to AC wiring.
	**DANGER:** Never connect a T701 Wind Turbine directly to a battery.
	**WARNING:** Do not install a 'shorting switch' across the output of the turbine. Shorting the REbus may cause damage to the turbine and/or inverter.

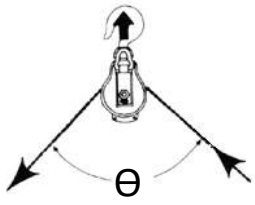


3.3 Foundation, tower, and field wiring installation

1. **Install the tower and foundation per tower manufacturer's instructions.**

The Pika Energy T701 turbine must be installed on an approved tower. If questions arise, consult with the tower manufacturer's customer service department. Be sure to observe recommended curing times for concrete, and carefully backfill and tamp disturbed soil around earth anchors as required.

	**DANGER:** Raising, climbing, and working around towers exposes workers to a number of hazards, including but not limited to injury and death from falling objects, recoil from snapping cables, pinch points, and spinning blades. Do not install the T701 wind turbine without professional training. In all cases, do not rush, but work carefully and deliberately, and use common sense.
	**DANGER:** No personnel should stand within the drop zone of the tower while the tower is being raised or lowered, and bystanders should be held far back from the turbine area.
	**DANGER:** Pika Energy strongly recommends against the use of over-the-road vehicles to raise or lower towers. A high-quality winch with ample load rating should be used.
	**DANGER:** Refer to the tower manufacturer's documentation to determine the raising line tension. In most cases the raising line tension will be greater than the weight of the turbine and tower. Ensure that the winch has a Working Load Limit (WLL) greater than the raising line tension.
	**DANGER:** Redirection links (blocks and pulleys) used in a lifting line system can be subjected to total loads greatly different from the lifting line tension. The total load varies with the angle between the incoming and departing lines to the redirection equipment. Ensure that ALL links in the tower raising system have a Working Load Limit (WLL) greater than the raising line tension multiplied by the angle factors listed in the table below.



Angle Factor Multipliers for Redirection Links			
Angle (Θ)	Factor	Angle (Θ)	Factor
0°	2	60°	1.73
30°	1.93	90°	1.41
45°	1.84	120°	1

2. **Test-raise the tower before installing the turbine.**

	**NOTE:** Pika Energy strongly recommends raising the tower without the turbine installed, prior to installation of the turbine. This puts less hardware at risk in case of a malfunction.

Pika Energy recommends the use of a heavy-duty worm-drive (non-backdrivable) winch with a Working Load Limit (WLL) greater than the maximum raising line tension. Check the duty cycle rating on the winch to be used, as many consumer-grade bumper winches are not rated for continuous duty, and may overheat if used for more than a few seconds at a time.

	**DANGER:** Be aware that some equipment (including hardware intended for rock climbing) is rated by the actual failure strength, rather than working load. Confirm the Working Load Limit of all load-line elements before raising the tower.

3. **Lower the tower nearly to the ground, and prop it up on a sturdy support** (such as a strong sawhorse) at a comfortable working height, at least 36" off the ground.

4. **Install gield wiring and grounding system** per the wiring diagram above. Install at least one grounding rod at the tower base. Pika Energy recommends installation of a high quality lightning arrestor at the tower base. A junction box may be mounted to the tower foundation, if none is provided by the tower manufacturer. Local codes may require a DC disconnect (380VDC rated) at the tower base, or at another location between the turbine and the inverter.

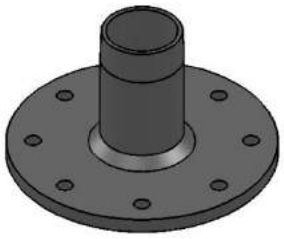
	**NOTE:** Pika Energy has observed that mice, snakes, and other small animals love the dry, protected spaces inside tower bases and wiring boxes. Pika recommends filling all unused knockouts with metal plugs, and stuffing stainless steel wool in any openings ¼" in diameter or greater.

5. **Install chafing gear on tower wire.** Pika Energy recommends the use of chafing gear to protect the wire from sharp edges that may exist inside the tower. Chafing gear may be improvised by applying short sections of tubular foam pipe insulation to the wire, and securing with high-quality electrical or duct tape, before fishing the wire through the tower. Pay special attention to the area where the wire passes through the base of a tilt-up tower. In many situations it is necessary to run the tower wire through a short stretch of flexible conduit at the base of the tower to adequately protect it during tower raising/lowering.

	**NOTE:** The REbus wiring that runs in the tower may be installed in the tower either before or after installing the turbine to the tower, depending on which approach is more convenient.
	**WARNING:** The T701 turbine features an integrated cable clamp in the wiring compartment (under the blue shroud), which is designed to clamp 12-2+g or 14-2+g UF (underground feeder) wire. Attempts to use types of tower wire other than type "UF" may result in the wire slipping through the clamp, or the clamp crushing the wires, leading to an open circuit, short circuit, or other dangerous condition.

6. **Pull tower wire through tower.**Take care to avoid pinching or damaging the wire while installing the turbine. Leave at least 2' of wire projecting from the top of the tower. The REbus wiring that runs in the tower may be installed in the tower either before or after installing the turbine to the tower, depending on which approach is more convenient. If pulling wire after installing the turbine, feed a fish tape down through the yaw and pull the wire from below.
7. **Install a Towertop Adapter** if necessary to provide a 2.5" male NPT (national pipe thread) at the towertop. Follow manufacturer's instructions; use loctite or locking fasteners on all fasteners unless specifically advised otherwise.

ADAPTER FOR
XL.1-TYPE TOWER



ADAPTER FOR
SKYSTREAM TYPE TOWER

3.4 Prepare to Install the Turbine

Use of checklists

Pika Energy strongly recommends using checklists to ensure that the installation is efficient and complete. **The installation checklist and associated installation photos are mandatory for warranty coverage.**

Materials Checklist

Got it!	Component	Comment
	T701 Turbine (3 boxes)	Turbine, blades, tail vanes
	B801 REcharge Battery Charge Controller	for off-grid systems
	X3001 REbus inverter/converter (or other Pika inverter)	for grid-tie systems
	Tower adapter (including hardware)	if needed, depending on tower type
	Tower wire - UF 2+g (underground feeder)	see table on page 9 for minimum AWG size
	Chafing protection for tower wire	½" pipe insulation is good
	Duct tape	for securing chafing protection
	1" conduit and fittings	for trench and connection to inverter
	5 feet of flexible 1" conduit	for wire coming out of tower base
	Ground rod(s)	if not supplied with tower
	4 AWG grounding wire, clamps and lugs	if not supplied with tower
	grounding wire of same guage as tower conductors	for grounding tower to lightning arrester
	Lightning arrester(s)	in nacelle box
	6"x6" junction box	for lightning arrester at tower base
	Wire nuts	for connecting lightning arrester
	Circuit breaker (for inverter installations)	see inverter manual for correct size
	Red and blue electrical tape	for wiring the brush puck and lightning arrester (in hardware kit bag)

Turbine Packing List

The standard T701 shipment consists of three packages. Please verify that all three packages are complete before beginning the installation.

Nacelle Package contents:

Got it!	Nacelle Package
	Nacelle assembly
	Blade hub
	Manual
	Hardware kit
	Lightning arrester

Got it!	Blade Package
	3 blades
	Tail boom
	Nose cone

Got it!	Tail Vane Package
	Fore tail piece
	Aft tail piece

Tools Checklist

Got it!	Tool	Comment
	Personal Protective Equipment (PPE) including hardhats, safety glasses, gloves, and steel-toed boots	
	Digital camera	For photo documentation for warranty
	Sawhorse, cribwork, or other tower support	
	#2 Phillips Screwdriver	
	Chain Wrench, 4.5” capacity or 3.5” pipe wrench with cheater bar	24” minimum length for torqueing yaw onto tower top.
	Second pipe or chain wrench	For counter torque on tower adapter during yaw tightening
	Fish tape	For fishing tower wire though assembled tower
	Messenger line	For pulling wire through conduit to inverter
	Utility knife	
	Wire strippers	
	Needlenose pliers	
	Metric ratchet, ⅜” drive or larger	For turbine assembly
	Ratchet extension	Required for tail boom attachment
	Metric sockets (10mm, 13mm, 19mm)	For turbine assembly
	Torque wrench (5-65 ft-lb)	For turbine assembly
	Torque screwdriver (4-15 in-lb.)	For turbine assembly
	Metric allen wrench set	Ball-end preferred for brake locking screw removal and plug installation (6mm hex key)
	Flashlight	
	Light cord (3/32”) or string	for pulling wire through tower and for prusik knots for pulling on guys wires.
	Wooden stakes or flagging	For tower anchor layout
	Tower installation tools	Refer to tower installation manual
	Tower raising equipment	Winch/ grip hoist, anchoring chain for lifting device, shiv, shackles
	Tarp or other ground cover	For working on the ground under blade rotor
	Round, flat, and triangle files	For repairing damaged threads etc.

Copy of Turbine Installation Checklist

Submission of a properly completed checklist and the 8 required photos is <u>mandatory</u> for warranty coverage.

Name of Owner:	Turbine serial number (see inside cover of manual:
Installation Address:	Tower Make/Model and Notes:
Mailing Address if Different:	Wireless Router Make/Model: Circle One: Broadband Satellite Dial-Up HotSpot
E-mail:	Phone:
Name of Installer:	Installation Finish Date:

Initials	Step Description	Comment
☑	Install tower and foundation *<u>per manufacturer's instructions</u>*	
☑	15 blade bolts torqued to 25 Nm (18 ft-lb)	
☑	Yaw threads tightened 1-2 turns past hand tight	
☑	Yaw jam screw torqued to 18 Nm (13 ft-lb)	
📷	PHOTO of yaw, showing threads and set screw	
☑	Brake locking screws removed **IN CORRECT ORDER** and replaced with plug screws	
📷	PHOTO of plug screws in the place of brake locking screws	
☑	2 clamp bar screws torqued to 0.4 Nm (4 in-lb)	
☑	3 tower wire leads torqued to 1.5 Nm (13 in-lb)	
📷	PHOTO of brush block, showing completed wiring (see front cover photo for example)	
☑	Blade bolts re-torqued to 25 Nm (18 ft-lb) at least 30 minutes after initial tightening	
📷📷	2 PHOTOS of blades installed on hub (1 photo for each side)	
☑	Hub nut installed with Loctite and torqued ***counterclockwise*** to 76 Nm (56 ft-lb)	
📷	PHOTO of nut, washer and blade assembly on shaft	
☑	Nosecone screws attached and torqued to 0.4 Nm (4 in-lb)	
☑	Tail vane nuts torqued to 7 Nm (5 ft-lb)	
☑	Tail boom bolts torqued to 25 Nm (18 ft-lb)	
☑	Shroud attach screws installed and torqued until rubber bulges slightly	
☑	Spin test procedure completed per instructions	
☑	Turbine started up and ran normally	
📷	PHOTO of the completed turbine installation (from the gin pole side)	
📷	PHOTO of the tower base after completion of turbine installation	

I certify that this installation was performed in accordance with the T701 Turbine Installation manual.

Signed_____ Date_____

<u>Please use this box to provide suggestions to improve Pika's products</u>. Thank You!

Torque Specification Table

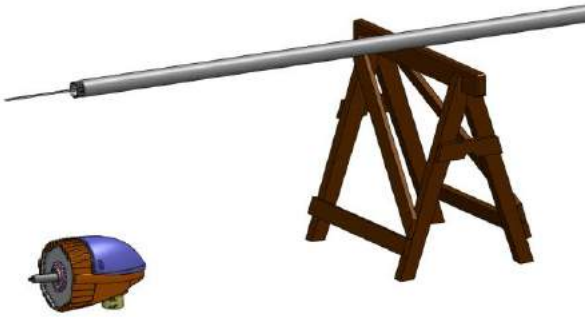
The following table of fastener torques is provided for the convenience of the installer. This table is not a replacement for the full assembly instructions on the following pages. When tightening, **DO NOT GUESS. Use a torque wrench.**

Component	Fastener type	Tools needed	Torque (Nm)	Torque (ft-lb)	Notes
Yaw casting	2½" NPT	***at least*** a 24" chain wrench and a 3" pipe wrench with extension to oppose torque on the tower	**Apx. 540**	**Apx. 400**	Hand tighten the yaw while someone supports the weight of the turbine. Then **apply 200 pounds of force at the end of a 24" wrench** until the yaw will not tighten any further.
Yaw jam screw	M8 set screw	4mm hex-bit socket (preferred) or 4mm hex wrench	**18**	**13**	A standard 4mm hex wrench will be at its limit when torque is reached.
Wire clamp bar screws	M4 pan head	#2 phillips	**0.4**	**0.3 (4 in-lb)**	
Tower wire leads	M4 truss head	#2 phillips	**1.5**	**1.1**	
Blade-hub	M8 bolt	13mm socket	**25**	**18**	(**re-torque at least ½ hr after initial tightening**)
Bladehub retention nut	M12 left-hand	19mm socket, small hex or screwdriver	**76**	**56**	Install with supplied Loctite 263
Nose cone screws	M4 truss head	#2 phillips	**0.4**	**0.3 (4 in-lb)**	
Tail vane nuts	M6 pan head + nylon-insert nut	10mm socket and #3 phillips	**7**	**5**	
Tail boom bolts	M8 hex cap screws	13mm socket and extension	**25**	**18**	
Shroud attach screws	M4 truss head	#2 phillips	Tighten until rubber washer bulges slightly (see page 28.)		Apply hand pressure to shroud to help seal against gasket.

WARNING: Be sure to tighten the yaw to the tower adapter with ***at least 200 pounds of force at the end of a 24" wrench*** while sufficient counter torque is being applied to the tower by a crew member, to prevent the tower from rotating. Failure to properly torque the yaw could lead to the turbine falling off the tower.

3.5 Turbine assembly

Before beginning the installation, carefully unpack and verify the contents against the nacelle box and remove the hardware kit, verifying that all components of the packing list are present. The T701 turbine ships in 3 boxes - one for the nacelle, one for the blades and tail boom, and one for the tail vanes.

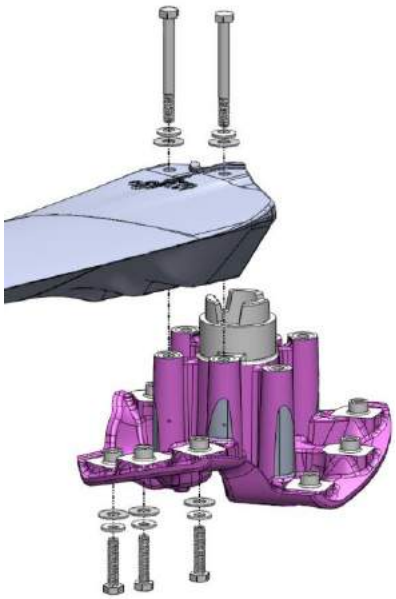


Build Blade Assembly

	**NOTE:** Trailing edges of blades can be sharp. Pika Energy recommends wearing gloves while handling the blades.

The blade-hub assembly should be completed before assembling other turbine components to allow for adequate time for a two-step blade bolt torqueing procedure. Perform the following steps to assemble the blades and hub:

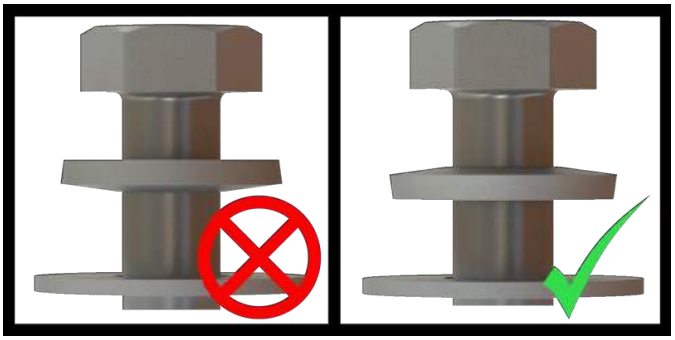
	**NOTE:** Gentle manual pressure may be required to fit the blade to the hub, but if excessive force is required, remove the blade and check the assembly for issues.
	**WARNING:** Dirt or grit on the greased main shaft and blade hub shaft bore surfaces can damage those precision surfaces. Assemble the blade rotor on a clean surface and, if necessary, use tape to mask off the blade hub bore.



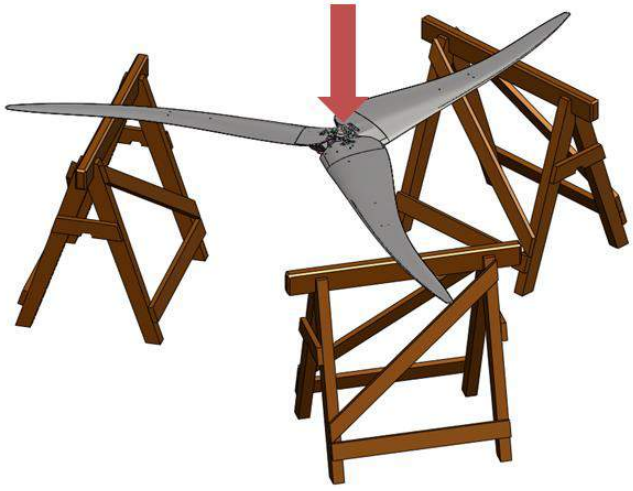
1. **Unpack the blades** from the blade box. Use caution to prevent damage, especially to the thin trailing edges of the blades. Blades come from the factory pre-balanced. The order of the blades does not matter.
2. Unpack the nacelle and **remove the blade hub** from the main shaft. It's very important that the greased surfaces on the main shaft and in the blade hub bore do not pick up dirt or grit. Use a clean sheet of cardboard or tarp to assemble the blade rotor on to keep the hub out of the dirt. If the wind is blowing dirt into the work area, it may be necessary to protect the blade hub by masking the shaft bore with tape.
3. **Orient the blade hub** so that the side with three-lobed spline around the shaft is facing up.
4. **Assemble blade to hub:** Begin assembly by carefully fitting the three large holes on the blade to three bosses on the hub. It does not matter which blade goes in which position. Firm gentle pressure should seat the bosses fully in the mating holes. Do not force the blades onto the hub.

5. **Install the two long downwind blade bolts**, paying careful attention to the order of the washers. Put the conical washer on the bolt first with the cone side pointed toward the head of the bolt (see image below). The flat washer goes on the bolt after the conical washer. Install the two 80mm M8 bolts and washers. Tighten the bolts just enough to ensure that the blade is fully seated on the hub, but ***wait to fully torque the bolts until all of the blade bolts have been installed***.

	**NOTE:** Proper orientation of the conical (Belleville) washer is critical. Be sure the cone (convex) side is pointed toward the head of the bolt.



6. **Repeat** for two more blades.
7. **Flip the assembled rotor over.** Use caution when flipping the rotor to avoid damaging the thin trailing edges or tips of the blades.
8. **Install and torque three short upwind blade bolts.** Insert three 25mm M8 bolts, paying close attention to the order and orientation of the washers. Put the conical washer on the bolt first with the cone side pointed toward the head of the bolt. The flat washer goes on the bolt after the conical washer. Torque each bolt to 25 Nm (18 ft-lb) with a reliable torque wrench.
9. **Take photo**: Take a digital photo of the upwind side of the blade rotor.
10. **Flip the assembled rotor over** for a second time to access the previously installed bolts for proper torqueing. The blade rotor should be supported near the blade tips as shown in the image to the right. This allows for the downwind edge of the blade root opening to bear against the hub. Torque to 25 Nm (18 ft-lbs).
11. **Take photo:** Take a digital photo of the downwind side of the completed blade assembly.
12. **Set the assembled rotor aside** in a safe place.



The torque on the blade bolts will need to be checked again at least 30 minutes after the initial torqueing, but for now set the assembled blade rotor aside in a safe place where it won't get dirty or damaged during the next steps.

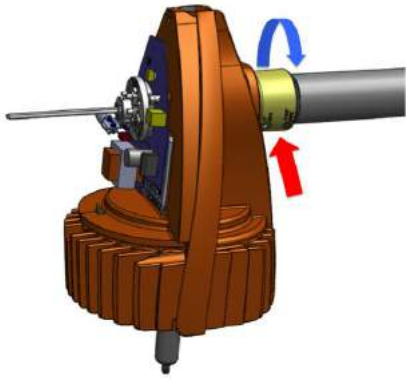
	**TAKE A PHOTO:** Take digital photos of the upwind and downwind sides of the completed blade assembly.

Attach Nacelle to Tower Top

1. **Check cable length:** Ensure that at least 24" of tower cable extends beyond the top of the tower.
2. **Remove the rear shroud** (blue) from the turbine and carefully set it aside. The rear shroud is secured with tape for shipping. ***Exercise caution to prevent damage to the control circuit board.***

	**WARNING:** the control circuit board contains fragile components that can be damaged by rough handling. Avoid contact with the circuit board or its components. **Two people should handle the nacelle to prevent damage.**

3. **Remove the bladehub** from the mainshaft and carefully set it aside. Avoid getting dirt inside the mainshaft bore.
4. **Position the nacelle:** Taking care not to pinch or damage the wire, lift the nacelle and position the threaded socket of the yaw casting near the towertop. ***Two people should handle the nacelle to prevent damage to the circuit board.***
5. **Feed the tower wire:** Pass the free end of the tower wire upward through the hole in the yaw casting, feeding any loop or excess slack through the yaw. Ensure that the wire is not twisted, kinked, or jammed. It may be necessary to guide the wire past the curved strain relief bracket.
6. **Thread yaw onto tower:** Position the socket of the yaw casting over the threaded top of the tower and rotate the yaw gently to engage the thread. One person must support the weight of the turbine, while another adjusts the alignment and threads the parts together. The yaw should rotate 4-5 full turns by hand, so long as the bulk of the turbine's weight is supported to prevent jamming. Ensure that the tower wire rotates freely within the yaw casting to prevent excessive twist.



	**WARNING:** Take care to ensure that the yaw is not cross-threaded on the towertop.

7. **Wrench-tighten the yaw:** Once the threaded engagement is hand-tight, tighten using a chain-type pipe wrench at least 24" in length **and apply 400 foot pounds of torque**. This is the equivalent of a 200lb. person putting all of their weight on the end of a 24" wrench until the yaw stops threading onto the tower. This should be 1½ to 2 turns beyond hand tight. If no member of the installation crew is heavy

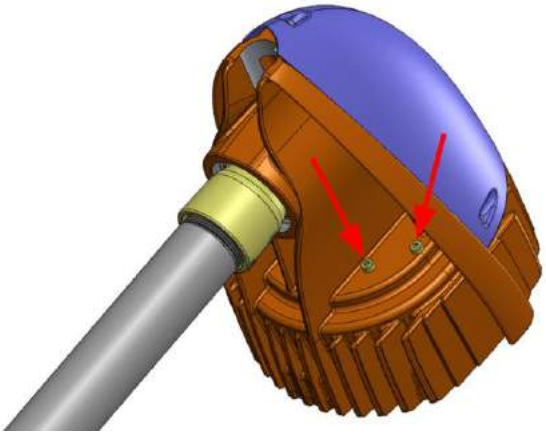
enough, two people should work the chain wrench to ensure sufficient torque is applied. It will be necessary to use a second wrench to apply opposing torque to the tower top to prevent the sections of tower from rotating. A 3" capacity pipe wrench with an extension will be sufficient for a second person to oppose the torqueing of the yaw.

	**WARNING:** After torqueing the yaw on to the tower, check that the guy plates are still properly aligned with the gin pole (if using a tilt-up guyed tower). Yaw torqueing can result in inadvertent rotation of guy plates if tower sections are not held fast.

8. **Tighten yaw jam screw:** Once the yaw is secured to the tower, install the jam-screw from the hardware kit. It threads into the tapped hole on the side of the yaw casting. Tighten the screw until it binds into the tower top threads. Torque to 18 Nm (13 ft-lb). The jam screw has pre-applied threadlocker compound to prevent loosening over time. Wipe off any excess grease from the threaded towertop.

	**NOTE:** Consult Pika Energy before using a non-approved tower design.
	**TAKE A PHOTO:** Take a digital photo of the towertop, yaw, and jam screw in position

9. **Take a Photo** showing the connection between the towertop and the yaw casting, and showing the yaw set screw locked in place.
10. **Remove the brake locking screws** from the nacelle IN THE CORRECT ORDER by following the instructions on the tag. Replace them with the provided plug screws that are affixed to the tag (M8 x 12mm socket cap screws with anti-loosening compound) and rubber washers using a 6mm ball end hex wrench. The brake locking screws ensure the overspeed brake does not accidentally deploy during shipping.



	**WARNING:** The brake locking screws must be removed **IN THE CORRECT ORDER.**
	**WARNING:** Never remove brake locking screws while blade hub is on main shaft. Removal of screws in the incorrect order combined with rotation of the blade hub could result in inadvetant and undetectable deployment of overspeed brake!
	**WARNING:** The brake locking screws must be removed and replaced with the supplied plug screws prior to installing the blade rotor. The blades will not rotate with the brake lock screws in place, and they could shear the brake locking screw.

	**TAKE A PHOTO:** Take a digital photo of the plug screws installed in place of the brake locking screws.

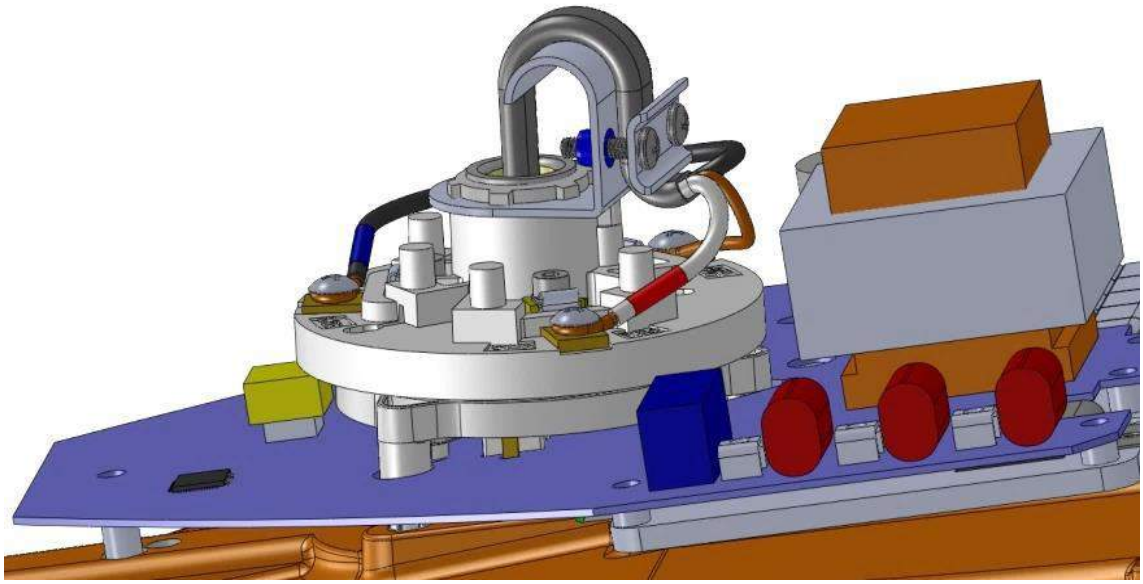
11. **Take a Photo** of the plug screws installed in place of the brake locking screws.

Wire the Brush Disk

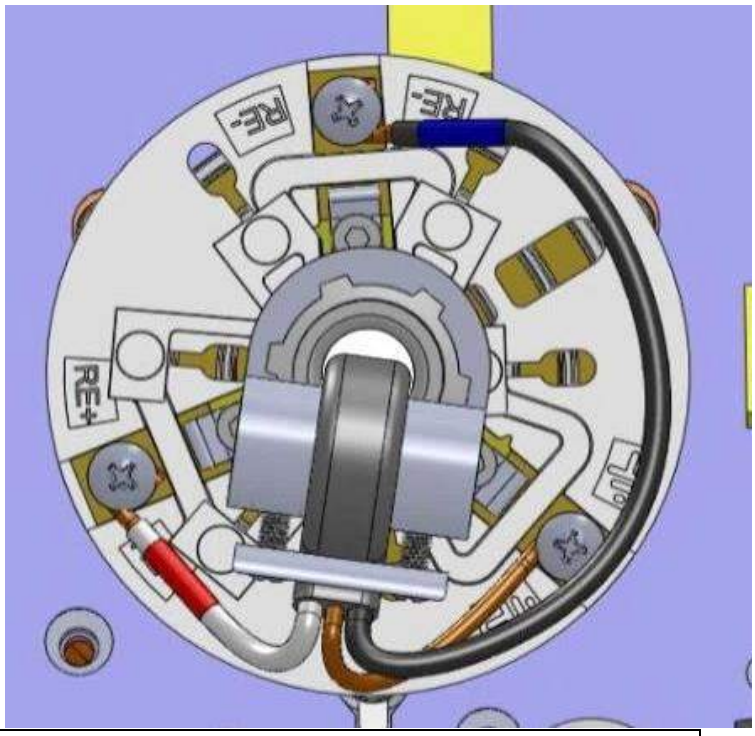
Once the turbine is secured to the top of the tower and the tower wire is in place, complete the tower wiring by executing the following steps:

	**DANGER:** Ensure that the tower wiring is de-energized before wiring the turbine.
	**WARNING:** Be very careful not to damage the circuit board, especially when attaching the wires to the brush disk.
	**NOTE:** The T701 turbine features dual brushes on each channel of the turbine output. There are six brushes, but only three conductors to wire.

1. **Fit the tower cable:** Form the tower cable carefully over the half-turn support on the strain relief bracket, and mark the position of the cable clamp bar.
2. **Strip outer insulation:** Remove the cable clear of the strain relief bracket and carefully strip the outer insulation back to ¼-½" beyond the mark with a sharp utility knife.
3. **Secure wire under clamp:** Re-position the wire over the strain relief bracket and tighten the 2 M4 pan-head screws to secure the wire snugly to the bracket using the clamp bar. Alternate back and forth between screws to ensure even clamping. Ensure that the clamp bar bears only on the gray wire insulation, not the black and white insulation of the individual conductors. Torque the two M4 clamp bar screws to 0.4Nm (4 in-lb). **DO NOT OVER-TIGHTEN** to prevent damage to wire.



4. **Connect Ground Lead:** Route the bare copper ground wire to the ground screw (marked with the GROUND symbol), trim to length, and form a clockwise loop in the end of the wire, slip the loop under the head of the ground screw, and torque to 1.5Nm (1.1 ft-lb or 13 in-lb).
5. **Connect Positive REbus Lead:** Mark the white wire with red electrical tape, route it to the "RE+" terminal, trim to length, and strip approximately 20mm (¾"). Form a clockwise loop in the end of the wire, slip the loop under the head of the screw, and torque to 1.5Nm (1.1 ft-lb or 13 in-lb).



⚠	**WARNING:** The T70 brush disk uses captive nuts with built-in anti-vibration locking features. DO NOT use thread-locking compound. Common threadlockers (e.g. Loctite) contain chemicals that will severely damage the polycarbonate brush block.
⚠	**WARNING:** Do not tighten, loosen, or adjust the brush fasteners (hex head screws closer to center of brush block).

6. **Connect Negative REbus Lead:** Mark the black wire with blue electrical tape, route it to the "RE-" terminal, trim to length, and strip approximately 20mm (¾"). Form a clockwise loop in the end of the wire, slip the loop under the head of the screw, and torque to 1.5Nm (1.1 ft-lb or 13 in-lb).
7. **Form wires within safe volume:** Ensure that none of the three conductors extend beyond the diameter of the brush disk, and that they do not extend above the top of the strain relief bracket. If necessary, gently form the wires into place around the brush disk.

📷	**TAKE A PHOTO:** Take a digital photo of the brush disk after wiring is complete. See the front cover phoot of this manual for an example of proper brush puck wiring.

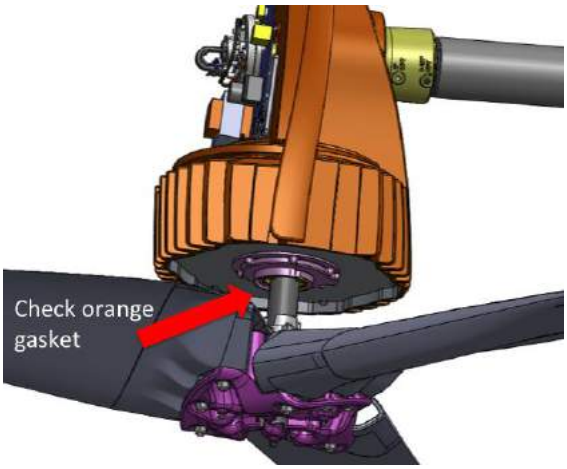
8. **Take a digital photo** of the completed brush disk wiring.

Install Blade Assembly

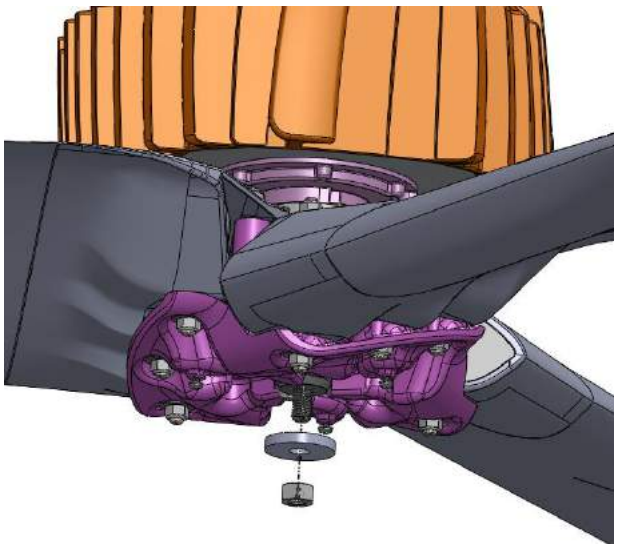
	**NOTE:** Trailing edges of blades can be sharp. Pika Energy recommends wearing gloves while handling the blades.
	**NOTE:** The torque on the blade bolts **must be rechecked** at least 30 minutes **after** the initial torqueing. All blade fasteners should be torqued to 25 N-m (18 ft-lbs).

The blade-hub assembly must be completed before attachment to the turbine. Perform the following steps to recheck the torque on the blade rotor and install the blades onto the main shaft:

1. **Check the torque on the blade bolts**: At least 30 minutes after the initial bolt-tightening, use a torque wrench to ensure that the bolt torque on all 15 blade bolts is 25 N-m (18ft-lbs). It is normal to find that the torque has relaxed in the 30 minutes since the initial torqueing.
2. **Check O-ring:** Check that the orange O-ring gasket is in place in the shaft seal rotor, where it emerges from the front of the turbine.
3. **Wipe and lubricate mainshaft:** Wipe the mainshaft with a paper towel or clean rag, and then apply a thin layer of the grease (provided in the hardware kit) to the mainshaft. The layer should be thin enough that the color of the grease should not be visible.



4. **Install bladehub:** Position the bladerotor assembly directly under the nacelle. Rotate the rotor to align the three tangs of the spline on the turbine with the three gaps in the spline on the bladehub. With two people supporting the bladerotor assembly from both sides, carefully align the mainshaft with the bore on the bladehub, and slide the hub onto the shaft, engaging the spline and compressing the O-ring.
5. **Install nut and washer:** With one person holding the bladerotor upward, install the thick stainless washer and ***reverse-threaded*** M12 hub retention nut onto the threaded stud in the end of the shaft. **Be sure to use the supplied red Loctite on the reverse-threaded stud.**
6. **Torque hub retention nut:** Using a 19mm socket and torque wrench, torque the nut to 76 Nm (56 ft-lb). It may be necessary to insert a hex key (size M5) or other small tool into the hole in the shaft to prevent rotation.



	**NOTE:** It may be necessary to insert a hex key or small screwdriver in the cross-drilled hole at the end of the shaft to prevent the shaft from spinning.

7. **Double-check gasket:** Check that the orange gasket O-ring is in place and compressed but visible around the full diameter.
8. **Take photos:** Take digital photos of the assembled hub on the turbine, from upwind and downwind directions.

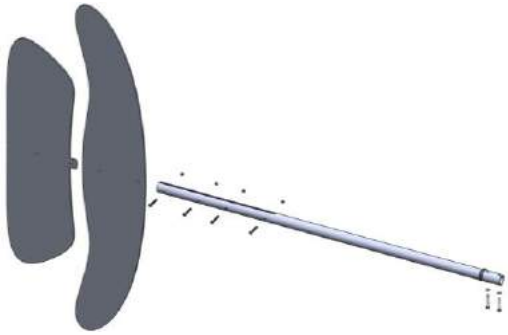
	**TAKE A PHOTO:** Take digital photos of the assembled hub on the turbine, from upwind and downwind directions.

9. **Install the nosecone** by aligning the stepped features with the surface of the blades, then fine-tuning the alignment of the holes in the nosecone with the threaded holes in the hub casting. Secure the nosecone with three M4 truss-head screws from the hardware kit. Thread-locking compound has been pre-applied to the screws. **DO NOT use rubber washers on the nosecone.** Torque the screws to 0.4 Nm (4 in-lb).

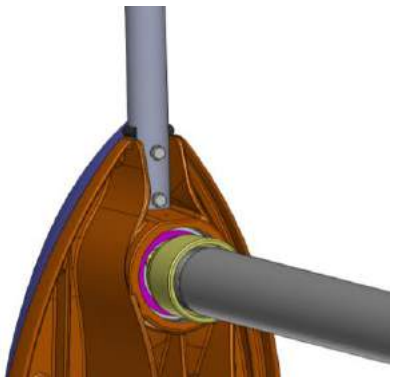
Install Tail Assembly and Shroud

	**WARNING:** ***It is critical to install both tail vanes. The turbine will not balance or orient properly without a complete tail.***

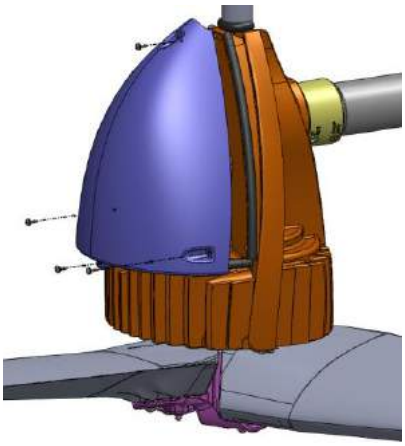
Install the tail assembly by performing the following steps:



1. **Assemble upwind vane to boom:** Slide the larger crescent-shaped tail vane into the slot in the tail boom, as oriented in the illustration at right, and align with the forward holes. Secure with two M6 phillips pan head screws and nylon insert locknuts from the hardware kit. *Do not remove anti-seize tape* that has been pre-applied to the screws.Torque to 7 Nm (5 ft-lb).
2. **Assemble downwind vane to boom:** Slide the smaller tail vane into the slot in the tail boom, as oriented in the illustration at right, and align with the rearward holes. Secure with two M6 phillips pan head screws and nylon insert locknuts from the hardware kit. Torque to 7 Nm (5 ft-lb).
3. **Install tail assembly:** Insert the tail boom into the tail socket in the nacelle casting. ***The black rubber bulb gasket should face upwards.*** Secure the tail to the nacelle with two M8 hex bolts and small 8mm washers. Adjust the rotation of the tail boom to ensure that the tail vanes will be parallel with the tower when the turbine is raised. Thread-locking compound has been pre-applied to the hex bolts. Torque to 25 Nm (18 ft-lb).



4. **Stabilize yaw axis:** Using stakes and light cord, stabilize the yaw axis to prevent rotation, in such a way that the blades can still spin freely.
5. **Check mainshaft rotation:** Wearing gloves and standing clear of the swept area, rotate the blades slowly by hand. You should feel a smooth resistance. If scraping, grinding, or squeaking sounds are observed, stop and correct the issue before proceeding.
6. **Position the shroud:** Position the rear (blue) shroud loosely place over the circuit board assembly, with the front edge of the shroud downwind of the heat dissipation fins.
7. **Align mounting holes:** Using a flashlight, gently guide the rear shroud into alignment with the four threaded holes in the nacelle casting.
8. **Install shroud fasteners:** Install **four** M4 truss-head phillips machine screws with black rubber gasket washers to secure the shroud. Apply manual pressure to the shroud while tightening screws to ensure that the shroud is well-seated. Tighten the screws until the washers bulge slightly, but do not allow them to distort significantly or squirt out from under the screw head.



3.6 Complete connections and perform pre-flight checks

	**NOTE:** The following instructions are for installations with REbus inverters. For some installations another REbus device (e.g. B801 charge controller) may be used instead.

1. Read and understand Section 5 relating to turbine operating modes before raising the turbine.
2. Complete the connections between the turbine and the X3001 inverter or B801 battery charge controller before raising the tower, according to the wiring diagrams. ***Observe all local and national code requirements.***

	**DANGER:** Be sure to install the rear shroud before powering up the inverter or REbus nanogrid.

	**NOTE:** For off-grid systems, the B801 Battery Charge Controller must be configured before it can be enabled and before pre-flight checks can be completed on the turbine. Refer to the *B801 Charge Controller and Installation Manual* to configure the charge controller.

3. Once wiring is complete and all covers are in place, position the inverter circuit breaker to the 'ON' position or close the DC breaker to the charge controller. Toggle the power switch (on the bottom of the enclosure) to the 'ON' position to power up the inverter or charge controller.
4. Using the front panel display, scroll to the "**Pika X3001 Inverter"** or "**Pika B801 Charge Controller"** device and **'**ENABLE' the device**.** Observe that the REbus nanogrid voltage rises above 300V. The inverter is programmed at the factory to power up in the 'disabled' state when first energized.
5. Scroll to the **"WTLink"** device (wind turbine). It should be automatically added to the device list if wired correctly. The wind turbine should arrive from the factory disabled by default.
6. With the inverter or charge controller enabled and the turbine disabled at the front panel display, don gloves and stand well clear of the swept area of the blade rotor while rotating the blades slowly by hand. Significant resistance should be felt, even at low speed.

	**NOTE:** It is easiest to have one person at the inverter or charge controller and one person at the turbine communicationg by phone or radio when conducting pre-flight checks.

7. Enable the **"WTLink"** from the front panel display. The blades should now spin noticeably more freely. Listen carefully for any clicking or scraping sounds while the blades spin. If the motion is not completely smooth, do not raise the turbine. Stop, investigate, and correct the issue.
8. At the inverter or charge controller front panel display, ***disable the "WTLInk" before raising the tower*** to prevent the turbine from spinning up with the tower partially raised. It is recommended to turn off the AC disconnect and power down the inverter while raising the turbine.

	**NOTE:** Wiring will remain live if inverter is powered up and enabled, even if turbine is not spinning!

3.7 Raising and Securing the Tower

Raise and secure the tower according to manufacturer's instructions. Once the tower is raised and secured, perform any additional connections (e.g. tower grounding) as recommended by the tower manufacturer.

The following are general recommendations; tower manufacturer's instructions shall take precedence.

	**DANGER:** Obtain training from the tower manufacturer before attempting to install a tower or turbine. See the 'T701 Turbine Installation' section for important tower safety information.
	**DANGER:** All personnel should wear appropriate PPE as recommended by the tower manufacturer, including hard hats, steel-toed boots, safety glasses, work gloves, and other equipment as appropriate.
	**DANGER:** Do not work on turbines or raise towers if electrical storms are nearby. Lightning can strike many miles from the center of a storm.
	**DANGER:** No personnel should be within the fall zone while the tower is raised or lowered. Bystanders should keep well back from tower.
	**DANGER:** Do not use over-the-road vehicles to raise towers. Pika Energy recommends the use of a high-quality non-backdrivable worm-drive winch, with a safe working load limit (WLL) rating well in excess of the maximum tension encountered at any point while raising the tower.
	**WARNING:** Do not raise towers in strong winds. Observe manufacturer recommendations concerning maximum windspeed for installation.
	**WARNING:** Double-check the torque of all tower fasteners, guy wire tension, and other key parameters before enabling the turbine.

4 Turbine System Operation

4.1 How to Use the Front Panel Display

Most T701 Wind Turbine installations will include a REbus system component with a user interface for assessing the state of the wind turbine controller. This section describes interfacing with the turbine from the front panel display of the X3001 Inverter or B801 Battery Charge Controller. Please consult the *Pika X3001 Inverter Operation Manual* (page 13) or *B801 Battery Charge Controller Installation and Operation Manual* (page 8) for instructions on using this interface.

4.2 Turbine Startup

Quickstart Summary (assuming turbine installation is complete and tested):

- ***Once the tower is raised and secured, double check all wiring, ensure the enclosure lid is secured with the mounting screws, then turn on AC power to the inverter at the breaker panel (and close the AC disconnect if present)***
- ***For off-grid systems, turn on the DC disconnect to the battery charge controller.***
- ***Toggle the inverter or charge controller switch to ON (switch is on underside of encolsure)***
- ***Enable the inverter front panel display***
- ***For off-grid systems, configure the charge controller prior to enabling it***

In order to start up, the turbine must be properly installed, and connected to an active REbus™ nanogrid. If power is disconnected to the inverter or charge controller, if either is disabled, or a fault is detected in the REbus nanogrid, the turbine will not come up to speed.

Turn on AC power to the inverter or DC disconnect to the charge controller by switching on the circuit breaker (and AC disconnect, if present). When power is restored to the X3001 inverter or B801 charge controller, it resumes its previous state of operation from before the power interruption.

When the T701 turbine's internal controller becomes active, it resumes its previous state of operation from before the power interruption. The turbine is programmed at the factory to power up in the 'disabled' state when first energized, and was disabled prior to raising the tower.

Enable the T701 turbine from the inverter front panel display by selecting the T701 turbine device in the device menu, then selecting 'enable' and confirming the selection. If the wind exceeds 3.5 m/s (about 8 miles per hour), the turbine will start spinning. Depending on the temperature, it may take a few minutes for the bearings to warm up before the blades 'catch' and come up to speed.

The T701 turbine generates power at rotational speeds between 120 and 420 RPM. Verify that the turbine is producing power by scrolling to the turbine page on the inverter front panel display and observing the real-time power output.

4.3 Setting the Altitude

For installations at altitudes above 300m (1,000ft), the control algorithm should be adjusted for optimal performance. From the front panel display of the inverter or charge controller, scroll to the **'MOD. SETTINGS'** option for the "WTLink" device, and adjust the altitude value in meters.

4.4 Normal Operation

Light Winds

In winds below 3m/s, the wind does not provide enough torque to spin the blades. The wind turbine page on the inverter front panel display will report 'LOW WIND'. Light winds do not contain much energy. Every doubling of windspeed results in an 8X increase in energy, so in most sites the turbine will capture the majority of its energy output in winds above 6.5 m/s (15 mph).

Moderate Winds

The T701 wind turbine will start in windspeeds of 3-4 m/s (7-9 mph), and will produce a small amount of power in winds as light as 2.5m/s (6 mph). The wind turbine page on the inverter front panel display will report 'Making Power'.

In most installations, the power produced by the T701 is fed directly into the home's central distribution panel, and is used directly by the electrical loads of the home, decreasing the current draw from the utility. If the power output of the turbine exceeds the total demand of the home, excess power flows back into the utility grid, 'turning the meter backwards' and reducing the customer's electric bill.

	**NOTE:** Many common types of 'smart meters' do not deduct exported power from the recorded total. If you have a smart meter, be sure to contact your utility for a bi-directional smart meter or dual-meter installation, to ensure credit for excess energy production.

High Winds

In high winds the turbine will continue to operate, but the controller will limit the power output and speed. It is normal for the turbine to briefly exceed the rated power during high or gusty winds. In winds exceeding 30 m/s (66 mph), the turbine will curtail its speed and output power to prevent damage. If the wind turbine controller shuts down the turbine for self-protection, it will enter "high wind" mode. High wind shutdown will last for at least 10 minutes and will be longer if the wind continues at an extreme speed. When the wind returns to more moderate speed, the turbine will resume normal operation.

4.5 Power Outages

In the event of a power outage, the inverter is required to shut off to prevent a hazard to utility repair personnel. The turbine will enter the 'disabled' state until power is restored. ***Ask your dealer about battery-backed system options that will allow your turbine system to operate and provide power to your home during power outages.***

4.6 Manually disabling the turbine

The turbine may be temporarily disabled from the inverter. The turbine should be disabled for raising and lowering. Owners may choose to disable it in extreme weather (such as an approaching hurricane or tornado).

To disable the turbine:

1. From the front panel display of the inverter, scroll horizontally to the turbine page.
2. Press the center button to show the menu
3. Select ‘Disable’ from the menu options and press the center button
4. Press the center button once more to confirm
5. The wind turbine page on the inverter front panel display will report ‘disabled’.

To re-enable:

1. From the front panel display of the inverter, scroll horizontally to the turbine page.
2. Press the center button to show the menu
3. Select ‘Enable’ from the menu options and press the center button
4. Press the center button once more to confirm
5. The wind turbine page on the inverter front panel will report the turbine’s current state

5 Inspection and Maintenance

The T701 turbine has been designed to give years of trouble-free service. Pika Energy recommends the following inspection and maintenance schedule:

5.1 After first month of operation:

Perform the annual inspection described below.

5.2 Monthly:

Check that turbine operation appears normal.

5.3 Annually:

Inspect the turbine carefully from the ground while it is operating in moderate winds. Put your ear against the tower and listen for any unusual clicks, rattles, scrapes, thumps, or grinding noises. It is normal to hear a low hum that changes pitch with the speed of the rotor.

Check condition of tower, including turnbuckles, turnbuckle safety cables, anchor rods, tower base bolts, and tension of guy wires, with reference to tower manufacturer's instructions. With turbine disabled, tighten or adjust as necessary.

5.4 Every 10 years of operation (5 years in high wind site):

A qualified installer should lower the tower and carefully inspect the turbine, paying special attention to the blades, hub, shaft, bearings, and shrouds. The backup safety brake cartridge should be inspected to ensure free movement of the brake mechanism and correct release torque.

Pending real-world lifetime data from the field, Pika Energy provisionally recommends replacing the mainshaft/bearing assembly, bladeset, and blade attachment fasteners every 10 years. Contact Pika Energy tech support for updated recommendations.

While the tower is lowered, the installer should carefully check the tower for chafing, wear, or loose fasteners, and tighten or replace parts as appropriate.

5.5 End-of-life:

Pending real-world lifetime data from the field, Pika Energy provisionally recommends a factory re-build of your T701 turbine after 30 years in the field (20 years in high wind sites).

Major components of the T701 turbine including blades, hub, and nacelle castings are recyclable. Pika Energy strongly recommends recycling your turbine when its useful life is over.

6 States, Faults and Errors

6.1 States

State Name	Description	Comment
Offline	The turbine is not able to communicate with the inverter; this state is reported when REbus is not powered up	Sometimes caused by a bad earth connection between turbine and inverter
Powering Up	The turbine's internal systems are settling	Prolonged time in the Powering Up state can be the result of an unstable bus voltage
Low Bus Voltage	REbus voltage is too low to operate	
Disabled	Turbine is manually disabled	Turbine will not start up without user input
Low Wind	Not enough wind to operate	
Making Power	Normal operation mode	
Waiting	Temporary timeout as result of startup sequence or a fault	Turbine will automatically restart after timeout period has elapsed; see Faults section below.
High Wind	High wind shutdown mode	Turbine will restart 10 minutes after extreme wind event passes
Error	Error mode	Turbine will not automatically restart; see Errors section below.

6.2 Faults

The T701 turbine features sophisticated microprocessor control, and is capable of sensing and responding to events including high winds, extreme temperature variations, and vibration due to imbalance (e.g. caused by ice). If the turbine seems to behave in an unusual way, check the inverter front panel display for status messages. A turbine that is frequently in the Waiting state might be experiencing multiple faults. Contact Pika Energy to investigate what can be done to improve your system's performance.

6.3 Errors

An Error state results from a serious condition detected by the wind turbine that has caused it to shutdown permanently. It will not restart automatically. Contact Pika Energy to understand the nature of the error and how to rectify it.

7 Troubleshooting

Use the table below to help diagnose issues with theT701 turbine.

Symptom	Possible cause	What to do about it
Turbine spins very slowly in wind that would normally cause operation	Turbine disabled	Check status of turbine at inverter front panel display. Enable turbine.
	REbus shorted	Check REbus voltage at inverter front panel display. If the inverter is not able to enable and bring up the bus voltage, it may be the result of a bus short. Disconnect all sources of power and troubleshoot REbus wiring.
	Fault in alternator or control circuit	Check turbine status at inverter front panel display. Contact your installer or Pika Energy for more information.
	REbus nanogrid not active	Check REbus status at inverter front panel display; enable the inverter and check REbus voltage.
	Turbine disconnected from REbus	Check turbine status at inverter front panel display. "Offline" indicates turbine is not communicating with inverter. Make sure DC disconnects are closed. Check wiring for open circuits.
Turbine does not spin at all in moderate to high winds	Safety brake engaged due to control circuit failure	Call your installer
	Failure of alternator or bearings	Call your installer
Turbine vibrates, or makes grinding or chunking noise	Buildup of ice on blades or hub	Wait for ice to melt.
	Failure of alternator or bearings	Disable turbine immediately at inverter front panel display; call your installer
Blades whistle or howl in moderate to high wind	Damage to blade from flying debris	Disable turbine immediately at inverter front panel display; call your installer
Turbine does not orient to wind	Seized yaw bearings	Disable turbine immediately at inverter front panel display; call your installer

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