



Autonomous Power Technologies

Safety Instruction Manual

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Date: July 2021

Version control			
Version Number	Date issued	Author	Update information
V1.0	2020.09.25	Lim Ziyou/ Arie Nawawi	First published version
V1.1	2020.11.04	Arie Nawawi	Add declaration of conformity to European Directives
V1.2	2021.07.01	Vincent Chuang	Modify vertical TPU mounting figures

Quality Certification and Assurance

We certify that series wireless charger meets all the published specifications at time of shipment from the factory.

Warranty

XENERGY warrants that the product will be free from defects in material and workmanship under normal use for a period of one (1) year from the date of delivery (except those described in the Limitation of Warranty below).

For warranty service or repair, the product must be returned to a service centre designated by XENERGY.

- The product returned to XENERGY for warranty service must be shipped PREPAID. And XENERGY will pay for return of the product to customer.
- If the product is returned to XENERGY for warranty service from overseas, all the freights, duties and other taxes shall be on the account of customer.

Limitation of Warranty

This Warranty will be rendered invalid in case of the following:

- Damage caused by circuit installed by customer or using customer own products or accessories;
- Torn or missing warranty seal;
- Modified or repaired by customer without authorization;
- Damage caused by circuit installed by customer or not operating our products under designated environment;
- The product model or serial number is altered, deleted, removed, or made illegible by customer;
- Damaged as a result of accidents, including but not limited to lightning, moisture, fire, improper use or negligence

Safety Symbols

	Dangerous voltage
	Caution! Refer to accompanying documents.
	Caution! Hot surface during operation. Wait for one hour after switching off before handling parts.

Safety Precautions

The following safety precautions must be observed during all phases of operation of this wireless charger. Failure to comply with these precautions or specific warnings elsewhere in this manual will constitute a default under safety standards of design, manufacture and intended use of the wireless charger. XENERGY assumes no liability for the customer's failure to comply with these precautions.



Warning

- The wireless charger is not intended for use by persons (including children) with physical or mental disability, or by the persons lacking of professional electrician knowledge or certification or licensed to perform installation, operation, maintenance, repair or servicing works.
- The equipment is not suitable for use in locations where children is likely to be present.
- Before operation, check for the warranty seal and the casing to see whether it cracks. Do not use the wireless charger if it is damaged.
- Do not operate the wireless charger in the presence of inflammable gasses, vapours, or dusts.
- The wireless charger is provided with a power entry plug during delivery and the power cord must be assembled and manufactured by qualified personnel. The power cord should be connected to a socket with a protective earth terminal, a junction box or a single phase distribution box.
- Please always use the provided power entry plug IEC 320-C19 to connect the wireless charger.
- To prevent the possibility of accidental injuries, be sure to use the power entry plug IEC 320-C19 supplied by the manufacturer only .
- Check all marks on the wireless charger before connecting the wireless charger to power supply.
- Ensure the voltage fluctuation of mains supply is less than 10% of the working voltage range to reduce risks of fire and electric shock.
- Do not install alternative parts on the wireless charger or perform any unauthorized modification.
- We do not accept responsibility for any direct or indirect financial damage or loss of profit or injury/ harms that might occur for improper usage of the wireless charger.
- This wireless charger is used for industrial purposes, strictly do not apply this product to IT power supply system, life-support system, mobile devices or other equipment subject to safety requirements. Please consult Xnergy for any new applications intended.
- Ensure persons with implantable medical devices such as implantable cardioverter defibrillator, hearing aid devices, pacemakers, etc. to stay away at least 5 metres during the wireless charging operation.
- Ensure that the Receiver Charging Unit (RCU) is connected correctly corresponding the battery terminals polarity via a DC fuse. Ensure that fuse current rating is at least 20% above the RCU maximum rated current.



Warning

- Do not power off RCU or disconnect the battery during the wireless charging operation. Otherwise, this action will cause irreversible damage to RCU.
- Do not block or obstruct any ventilation ducts.
- **SHOCK HAZARD-** Ground the Wireless transmitter powering unit (TPU). This product is provided with a protective earth terminal. To minimize shock hazard, the TPU must be connected to the AC mains through a grounded power cable, with the ground wire firmly connected to an electrical ground (safety ground) at the power outlet or distribution box. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal might cause a potential shock hazard that could result in injury or death.
- Before applying power, verify that all safety precautions are taken. All connections must be made while the wireless charger is turned off. It must be performed by qualified personnel who are aware of the hazards involved. Improper actions can cause fatal injury as well as equipment damage.
- **SHOCK HAZARD, LETHAL VOLTAGES-** This product can output the dangerous voltage that can cause electric shock and personal injury. Ensure that the output electrodes and cables are either insulated or covered using the safety covers provided, so that no accidental contact with lethal voltages can occur.
- Never touch cables or connections immediately after turning off the wireless charger. Verify that all LED lights are off and there is no dangerous voltage on the electrodes or sense terminals before touching.



CAUTION

- Failure to use the wireless charger as directed by the manufacturer may render its protective features void.
- Always clean the casing with a dry cloth. Do not clean the internals.
- Ensure no metallic materials or metallic objects to be found between the Transmitter Pad and the Receiver Charging Unit before operating the wireless charger and at all times.
- Make sure the vent holes are always unblocked.

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates,

uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

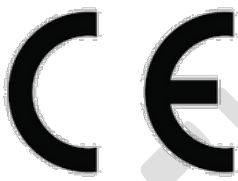
Environmental Conditions

The wireless charger is designed for indoor use and an area with low condensation. The table below shows the general environmental requirements for the wireless charger.

Environmental Conditions Requirements

Operating temperature	-10°C to 40°C
Storage temperature	-20°C to 60°C (short term temperature for transportation)
Operating humidity	≤ 90% (non-condensation)
Operating altitude	≤ 2000 meters
Pollution degree	2

Regulation Tag

	The CE tag shows that the product complies with the provisions of all relevant European laws (if the year is shown, it indicates that the year when the design is approved).
	This wireless charger complies with the WEEE directive (2002/96/EC) tag requirements. This attached product tag shows that the electrical/electronic product cannot be discarded in household waste.
	This wireless charger contains recyclable materials. Do not dispose unnecessary charger to general bin. Please contact Xnergy sales office.
	The wireless charger complies with Directive 2002/95/EC which restricts the use of specific hazardous materials found in electrical and electronic products.

Waste Electrical and Electronic Equipment (WEEE) Directive

Waste electrical and electronic equipment (WEEE) directive, 2002/96/EC

The product complies with tag requirements of the WEEE directive (2002/96/EC). This tag indicates that the electronic equipment cannot be disposed of as ordinary household waste. Product Category According to the equipment classification in Annex I of the WEEE directive, this wireless charger belongs to the “Monitoring” product.

If you want to return the unnecessary wireless charger, please contact the nearest sales office of XENERGY.

Compliance Information

European Union

This product complies with the essential requirements of the following applicable European Directives, and carries the CE marking accordingly:

RED Directive (2014/53/EU)

RoHS Directive (2018/65/EU)

and conforms with the following product standards:

EMC	EN 301 489-1 V2.2.3:2019 EN 301 489-3 V2.1.1 :2019 EN 301 489-17 V3.2.4:2020 EN 61000-3-2 : 2019 EN 61000-3-3 : 2013 EN 55011 : 2016+A1 :2017
RF	EN 300 328 V2.2.2 : 2019 EN 303 417 V1.1.1 : 2017
RF Health	EN 62311:2020
Safety	EN IEC 62368-1:2020+ A11:2020
RoHS	EN IEC 63000:2018

United States

This product complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC RF Radiation Exposure Statement:

1. This Transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
2. This equipment complies with RF radiation exposure limits set forth for an uncontrolled environment.
3. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

Canada

This product contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

- (1) This device may not cause interference.
- (2) This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'ISED applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

- (1) l'appareil n' doit pas produire de brouillage, et
- (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Radio apparatus containing digital circuitry which can function separately from the operation of a transmitter or an associated transmitter, shall comply with ICES-003. In such cases, the labelling requirements of the applicable RSS apply, rather than the labelling requirements in ICES-003. This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

IC SAR Warning:

This equipment should be installed and operated with minimum distance 20 cm between the radiator and your body.

Lors de l' installation et de l' exploitation de ce dispositif, la distance entre le radiateur et le corps est d' au moins 20 cm.

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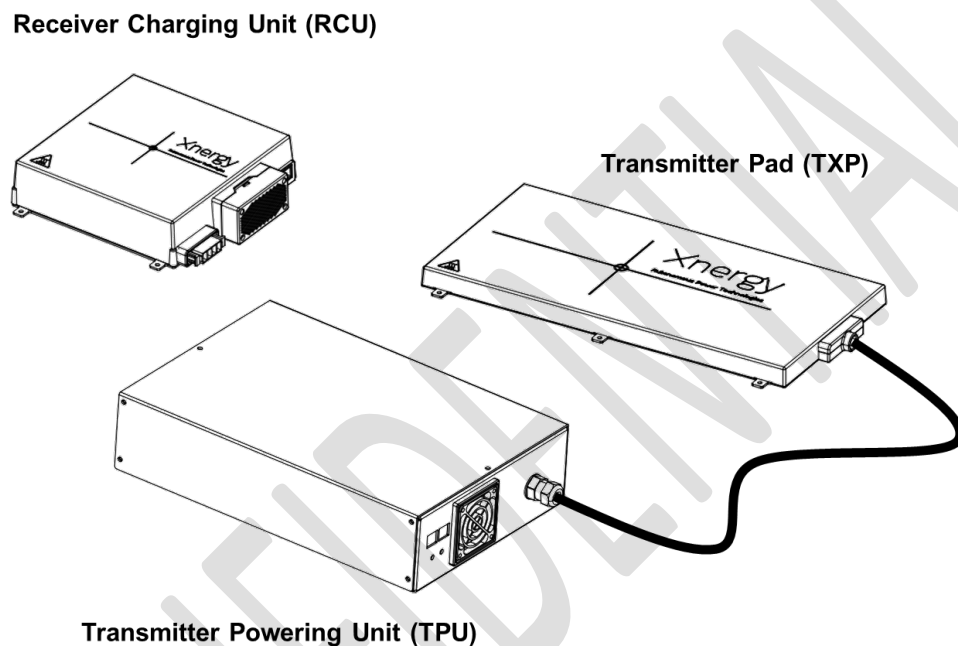
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1. Quick Reference

This chapter introduces all the component parts that form a single set of wireless charger system as well as its features.

- 1.1 Brief Introduction
- 1.2 Transmitter Powering Unit (TPU) and Transmitter Pad (TXP)
- 1.3 Receiver Charging Unit (RCU)

1.1 Brief Introduction

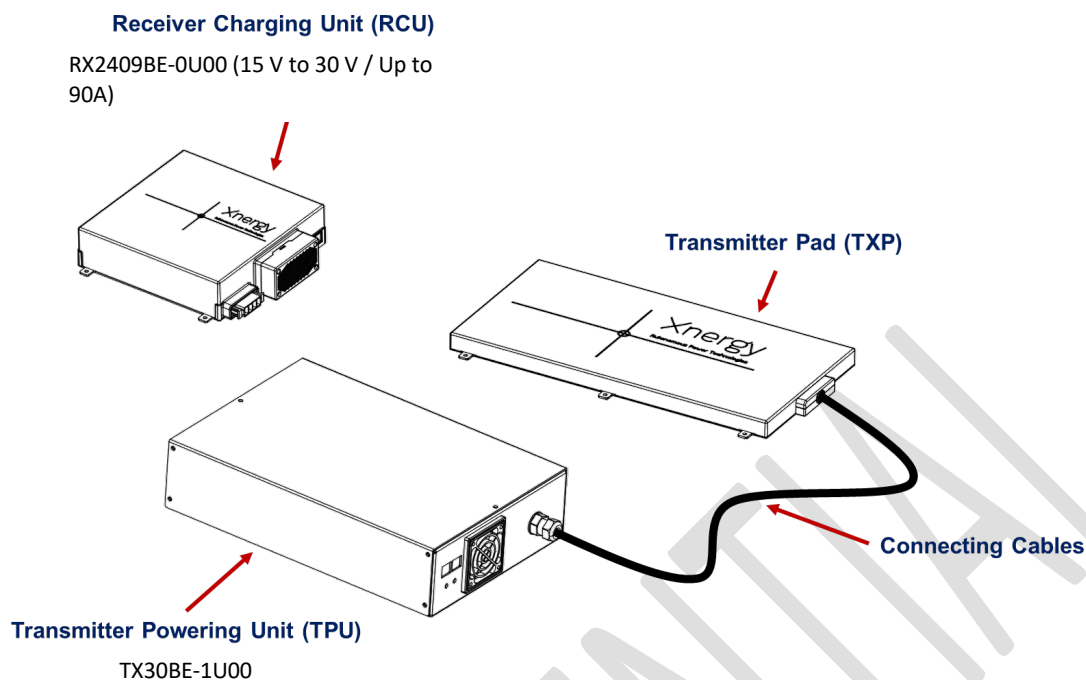


Xnergy BE series wireless charging is a new way of charging electrical driven applications through the medium of air unlike the conventional method of using physical contact. The wireless charging process is achieved using magnetic field that allows energy to be transferred wirelessly through magnetic induction. As such, electrical isolation capability can be achieved, thus allowing charging power to take place safely even in wet and dirty environments.

Xnergy BE series wireless charging system consists of mainly 3 parts which are (1) transmitter powering unit (TPU) with (2) transmitter pad (TXP) and (3) compact receiver charging unit (RCU). The electrical power energy from the grid is being transferred wirelessly from the TPU and TXP to the RCU. Thus, allowing the RCU to charge the desired energy storage such as battery.

With the modular design, integrating chargers into any existing environment can be adopted easily and facilitated the installation with minimal changes required. The sophisticated design of inductive coil also allows our high power, efficient and compact chargers to have larger and wider displacement tolerance requiring less accuracy parking or docking of any mobile robotics. These attractive attributes of Xnergy wireless chargers help evolving the current robotic systems into the next generation by becoming more autonomous and intelligent.

1.2 Transmitter Powering Unit (TPU) and Transmitter Pad (TXP)



The transmitter power unit (TPU) is always connected with a transmitter pad (TXP) together to be considered as a single set. The connecting cable between TPU and TXP can come in different lengths such as standard length of 1.1 m, longer length of 3 m or customizable length from Xnergy.

The TPU model number TX30BE-1U00 can be explained as follow.

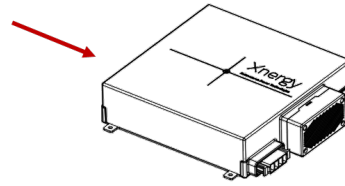
TX	TPU module
30	Input power maximum 3000 W
BE	BE series
-	
1 / 3 / C	1 meter length of connecting cables 3 meter length of connecting cables C for customised length of connecting cables
U	IPX0 (This alphabet is fixed until further ingress protection test)
00	The length of customized cable (15 for 1.5m cable)

It is an electrical hazard to replace, to cut, or to disconnect the connecting cable between TPU and TXP at all times. Careful attention is required while handling the connecting cable. If wires are damaged or exposed, please stop all operation immediately and consult your Xnergy dealer immediately.

1.3 Receiver Charging Unit (RCU)

Receiver Charging Unit (RCU)

RX2409BE-0U00 (15 V to 30 V / Up to 90A)



The receiver charging unit (RCU) is designed modular and small which will be installed on the mobile robots. It receives electrical power wirelessly from TPU to charge or to supply the electrical system of the mobile robots. There are two distinct models, i.e. RX2409BE-0U00 and RX4805BE-0U00 that have the same dimension size. Both RX2409BE-0U00 and RX4805BE-0U00 are designed for electrical system that requires less than 30 V and 60 V respectively and produced maximum charging current of 90 A and 50 A correspondingly.

The RCU model number can be explained as follow.

RX	RCU module
24 / 48	24 V battery system 48 V battery system
05 / 09	Maximum output current of 50 A Maximum output current of 90 A
BE	BE series
-	
0	Reserved
J	IPX0 (This alphabet is fixed until further ingress protection test)
00	Reserved

2. Inspection and Installation

This chapter provides the standard package, the details of product dimensions, and the proper way of connecting TPU and RCU before operation.

- 2.1 Product Package in Shipment
- 2.2 Wireless Charger Size and Dimensions
- 2.3 Connecting Power Cord for Transmitter Powering Unit (TPU)
- 2.4 Connecting Receiver Charging Unit (RCU)
- 2.5 Communication Interface Connection

2.1 Product Package in Shipment

It is important to check the contents upon receiving the product package and unpacking the box. Please contact the Xnergy dealer from which you purchase the wireless charger from immediately if wrong items are delivered if there are missing items or if there is defect in the products.

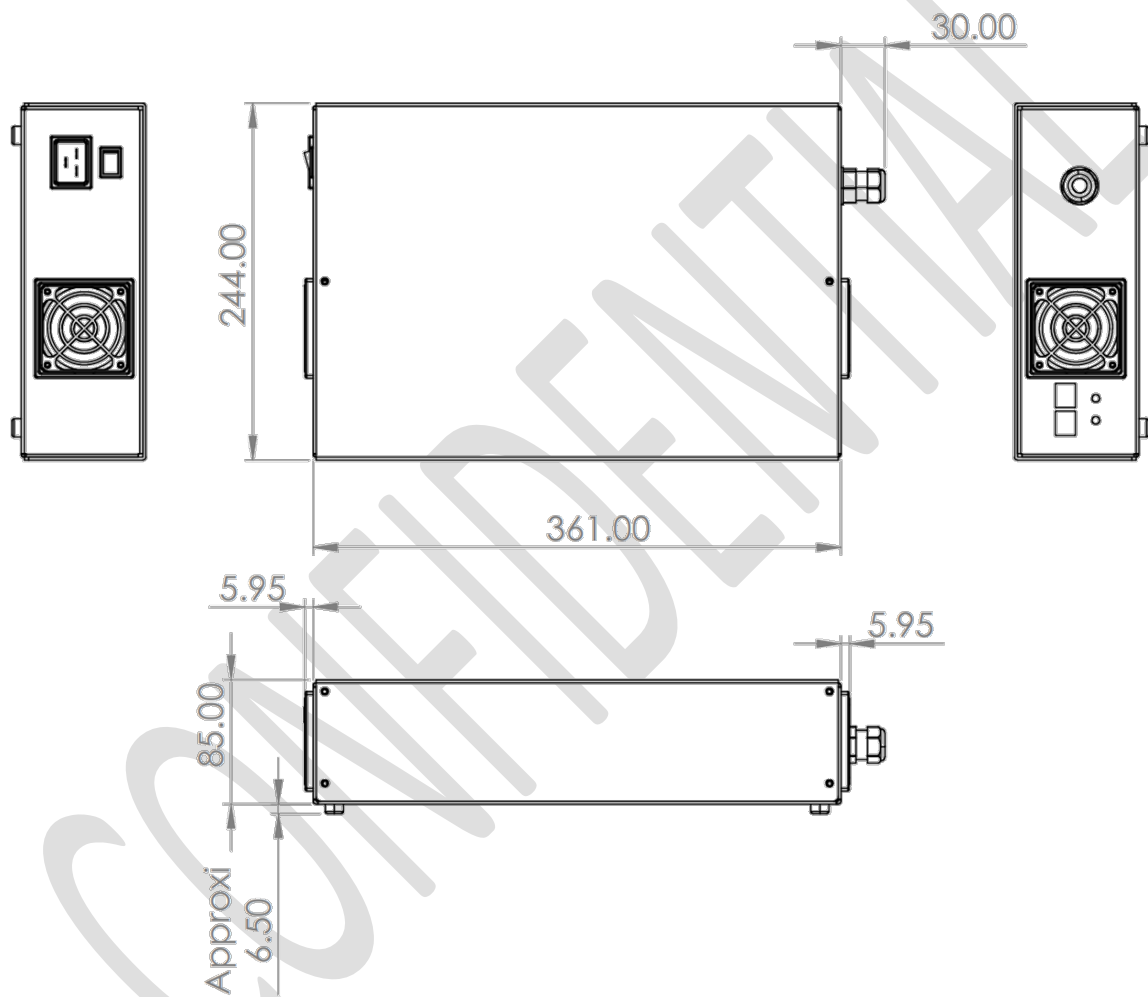
Item	Quantity	Model	Remarks
Transmitter Powering Unit (TPU)	1	TX30BE-1U00	For the specific length of the connecting cables, please refer to 1.2 Transmitter Powering Unit (TPU) and Transmitter Pad (TXP) .
Transmitter Pad (TXP)	1		
Power Entry Plug for TPU	1	IEC 320-C19	This accessory is provided in the package to specially cater for 16 A (IEC) and 20 A (UL).
Receiver Charging Unit (RCU)	1	RX2409BE-0U00 or RX4805BE-0U00	For specific models, please refer to 1.3 Receiver Charging Unit (RCU) and specification details in 5. Technical Specification
Power Output Receptacle Connector for RCU	1	Molex 1725090224	This accessory is provided in the package.
Safety Manual	1	-	It contains safety instructions to install and to operate wireless charger.
Factory Test Report	1	-	It contains the test report and calibration report of wireless charger before delivery.

2.2 Wireless Charger Size and Dimensions

The wireless charger set that consists of TPU, TXP and RCU must be installed at well-ventilated and rational-sized space. Please select the appropriate space for installation based on the given detailed dimension drawings of Xnergy BE series wireless charger in the following:

2.2.1 Transmitter Powering Unit (TPU) Dimensions

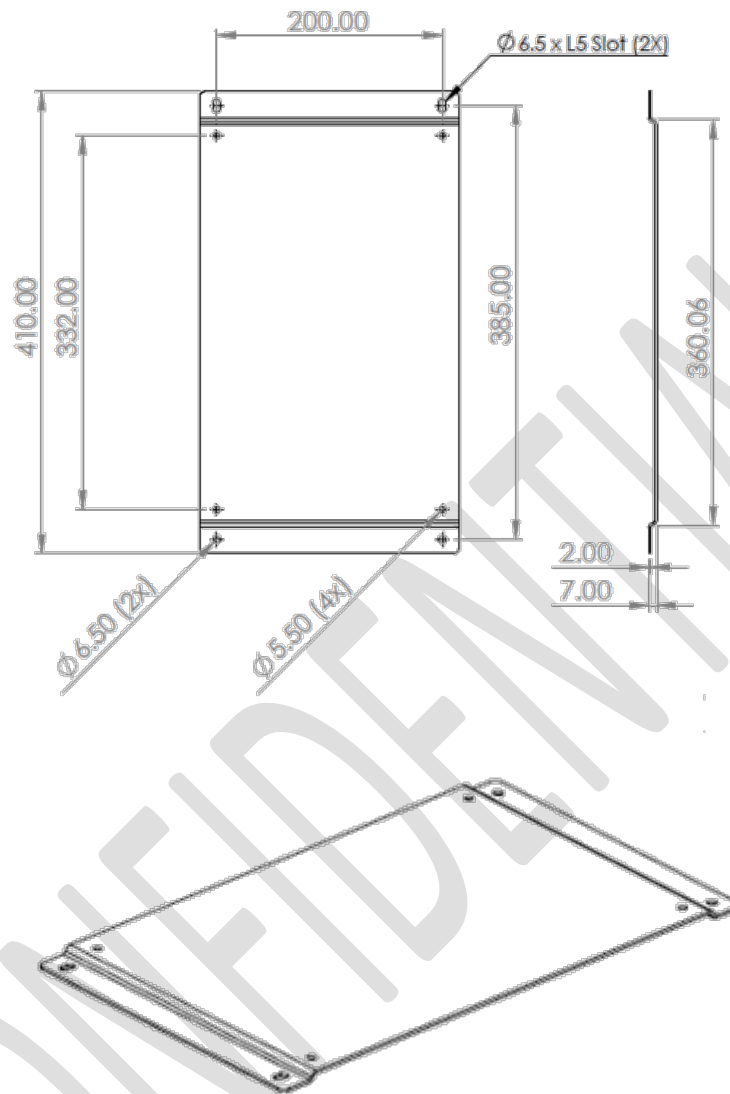
All dimension units are in millimetres (mm).



The TPU can be placed in horizontal/ flat position on its rubber footer.

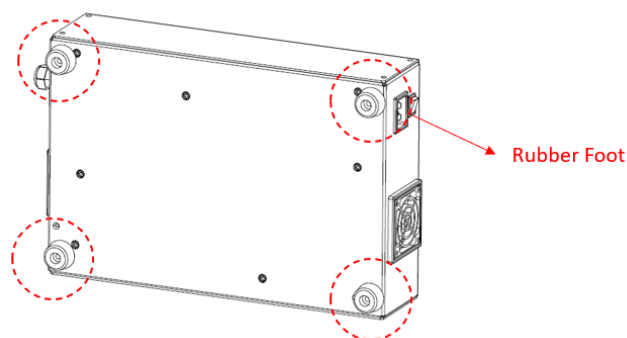
The option for TPU to be wall mounted is available as well using Wall Mount Bracket accessories.

All dimension units are in millimetres (mm).

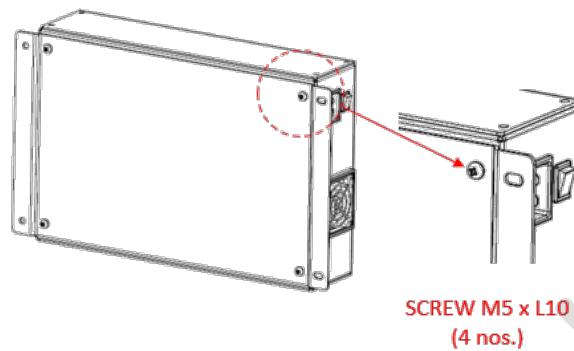


Please use the following instruction for mounting TPU to the wall:

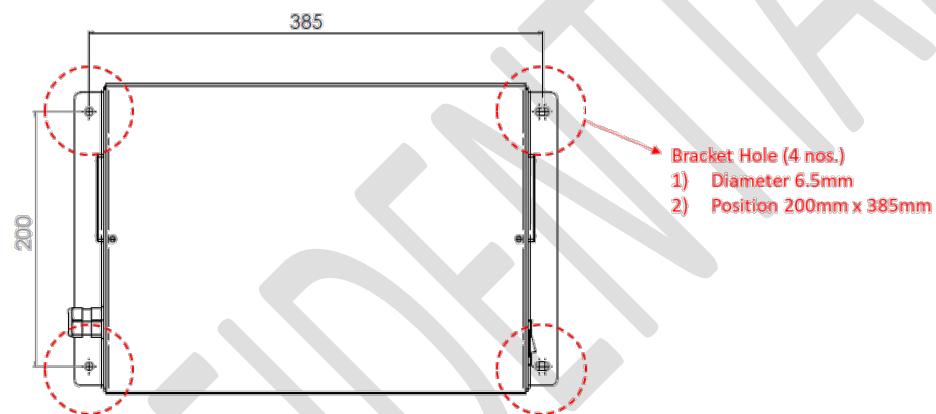
- 1) Remove 4 rubber foot from bottom side (use M5 Philip driver)



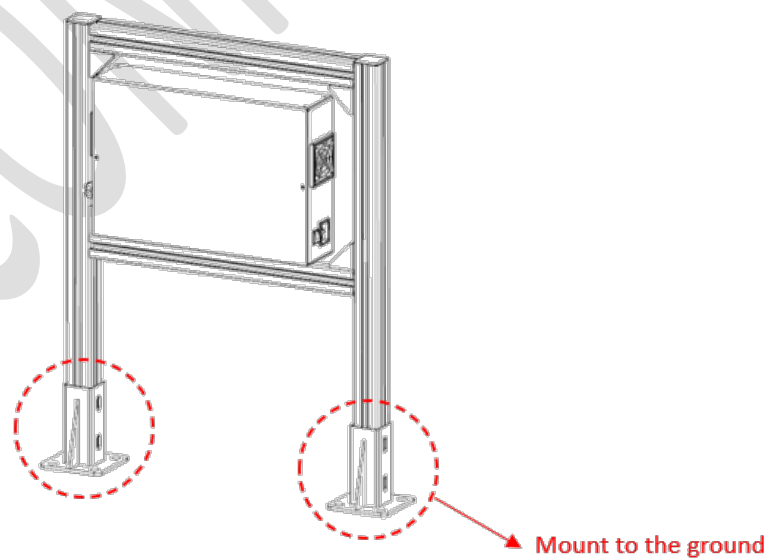
- 2) Assemble the Wall Mount Bracket using the same M5 screws (8mm length) from the dismantled rubber foot



- 3) Tighten the TPU to wall (bracket hole size is diameter 6.5mm). Use M6 screw with length 12 mm.

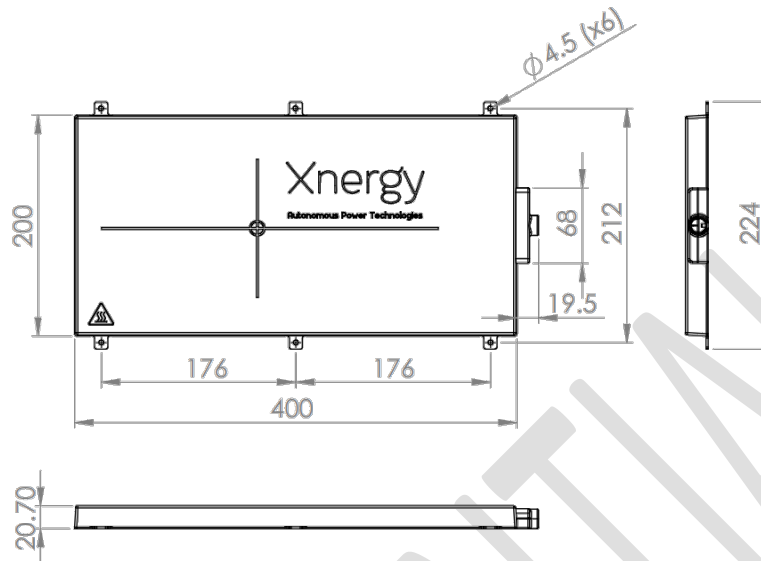


Alternatively, user can also mount the TPU to a stand fixed to the ground. User needs to ensure the strength and stability of the structure.



2.2.2 Transmitter Pad (TXP) Dimensions

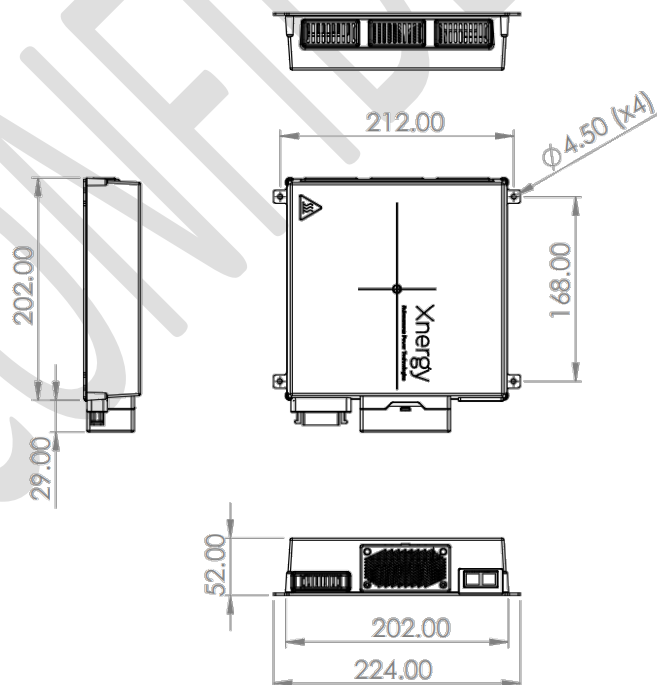
All dimension units are in millimetres (mm).



There are 6 bracket holes with diameter 4.5 mm for the purpose of mounting the TXP. Use M4 screws with length of 10 mm.

2.2.3 Receiver Charging Unit (RCU) Dimensions

All dimension units are in millimetres (mm).



There are 4 bracket holes with diameter 4.5 mm for the purpose of mounting the RCU. Use M4 screws with length of 10 mm.

2.3 Connecting Power Cord for Transmitter Powering Unit (TPU)

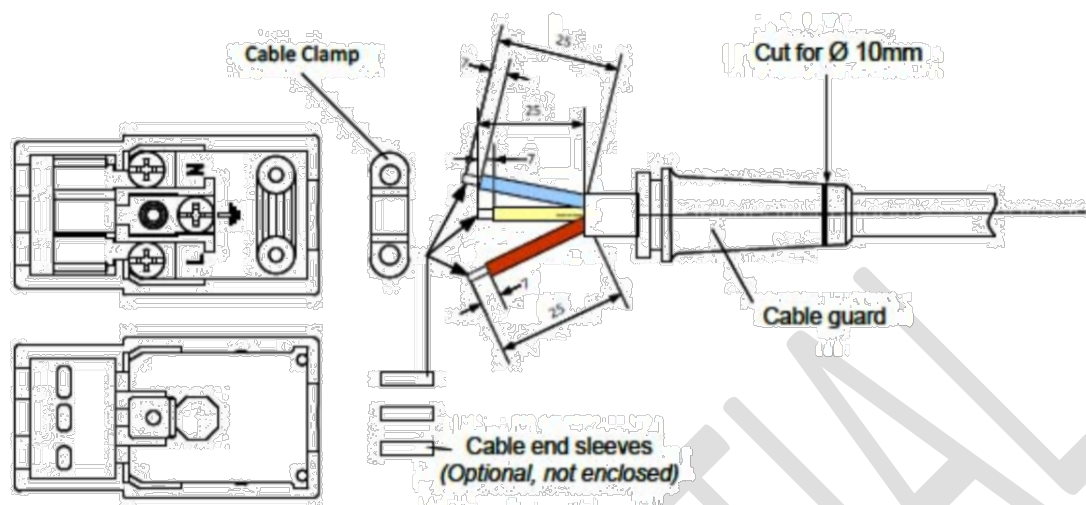
Precautions must be strictly observed to prevent electric shock and damage to the wireless charger.



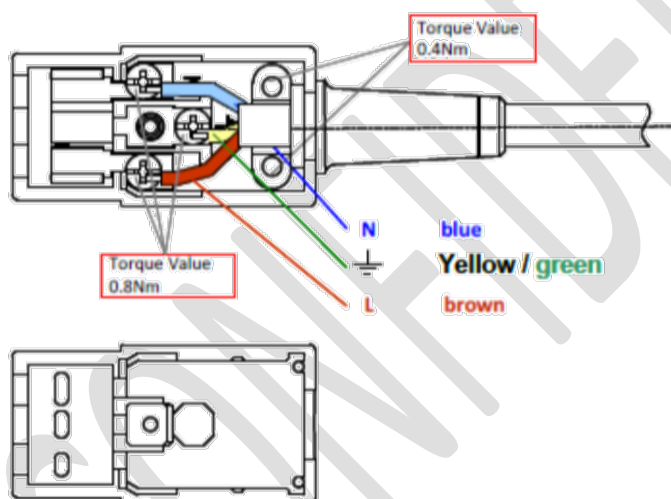
Warning

- Be sure and confirm that the rated voltage and current of the power cord matches with the rated input voltage and current of the TPU. Use appropriate voltage rating IEC/UL/CSA approved cable with at least 4 mm² cross-section area.
- The power supply assembly must be installed in accordance with local regulation and best practice.
- Be sure that the switch on the TPU is switched off and verify that all LED lights are off and there is no dangerous voltage on the connecting terminals before connecting the power cord to the TPU.
- Be sure that the AC wall socket or AC distribution box has protective grounding before connecting the power cord.
- Do not use terminal board without protective grounding or use an extended power cord without protective grounding, otherwise protection function will fail.
- Please use the power entry plug supplied by Xnergy in the product package to avoid fire or electric shock.
- Be sure that the power cord connection terminals are well insulated and covered by the supplied protective cover so that no accidental contact with lethal voltage can occur.
- Please strictly follow the assembly instructions for making the power supply cables with the provided Power Entry Plug for TPU.
- Failure to wire as instructed may cause personal injury or damage to TPU.

Power Entry Plug Assembly Illustration



Power Entry Plug Connector and Single Phase Three Wires



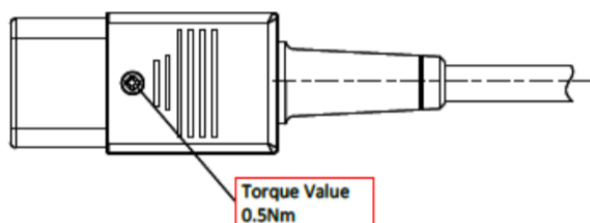
Cable Type:
H05VV-F, H05RR-F, H05RN-F
SVT, SJT

Cable Diameter:
Min. Ø 6.3mm
Max. Ø 10mm

Max. Wire Size:
3x1.5mm² for 16A
3x14AWG for 20A

Min. Wire Size:
3x1.0mm² for 16A
3x16AWG for 20A

Assembly of Power Cables to Power Entry Plug Connector



IN NO ———— C N' OUT
PE ———— C PE'
LO ———— C L'

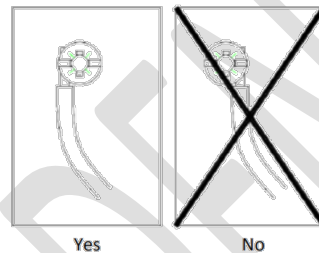
Final Assembled Power Entry Plug Connector

Power Entry Plug Assembly Instructions

Keep removed piece parts at a safe place to have them ready for reassembling process.

- 1) Loosen cover screw and remove cover.
- 2) Loosen cable clamp screws and remove cable guard.
- 3) Insert cord into PVC-cable guard.
- 4) Remove outer jacket on cord 25 mm. Make sure not to hurt the insulation of the single conductors.
- 5) Strip bare each copper conductor 7 mm and crimp on multicore cable ends. Do not strip more than 7 mm.
- 6) Loosen terminal screws but do not remove screws.

For connecting wires to terminals insert bare ends of conductors from left side of terminal screw according to the figure below. Make sure that no copper strands splice off when connecting conductors to clamps.



- 7) Connect green or green / yellow (ground) wire to centre clamp marked with ground symbol.
- 8) Connect blue (white or light grey) wire to clamp marked "N" (neutral).
- 9) Connect brown (black / "hot") wire to clamp marked "L" (line).
- 10) Tighten all wire clamp screws with a torque of 0.8 Nm.
- 11) Insert shoulder of PVC-cable guard into cut out of base unit.
- 12) Assemble cable clamp over cut-off end of outer jacket of the cord and tighten cable screws with a torque of 0.4 Nm.
- 13) Assemble cover unit and tighten cover screw with a torque of 0.5 Nm.

Connecting the Power Cord with Provided Power Entry Plug to TPU

See the steps below to connect the power cord to TX30BE-1U00.

- 1) Confirm that the switch of AC wall socket or AC distribution box is off.
- 2) Confirm that the power switch on the TPU TX30BE-1U00 is in the OFF position with (0) symbol indication and verify that there is no dangerous voltage on the connecting terminals.
- 3) Connect one end of the power cord (IEC Connector C19) to the TPU TX30BE-1U00.
- 4) Connect the other end of the power cord to the required AC wall socket or AC distribution box.

2.4 Connecting Receiver Charging Unit (RCU)

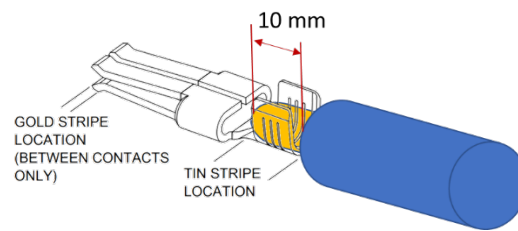
Precautions must be strictly observed to prevent electric shock and damage to the wireless charger.



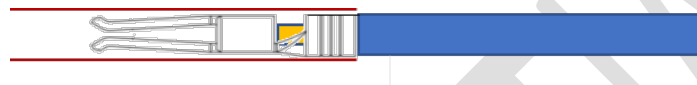
Warning

- Please use the provided Power Output Receptacle Connector for power supply cable assembly.
- Be sure and confirm the maximum current that the supply cables can withstand before wiring to avoid fire and electric shock. Use only the IEC/UL/CSA approved cable.
- The assembly must be installed in accordance with local regulation and best practice.
- Be sure that the supply cables are well insulated and covered so that no accidental contact with lethal voltage can occur.
- Do not short the battery when connecting or disconnecting the supply cables at all time. Short circuit may cause severe accident, fire and damage the battery unit.
- Check that the positive and negative poles of the supply cables are assembled properly according to the RCU output and tightly connected to the battery terminals. Do not connect the positive pole and leave the negative pole disconnected.
- Be sure that there is a properly rated DC fuse installed between the RCU and the battery. Ensure that fuse current rating is at least 20% above the RCU maximum rated current.
- Always be sure that the supply cables are connected to the DC fuse first then to the battery before connecting the other end with receptacle housing to the RCU (RX2409BE-0U00 or RX4805BE-0U00).
- Please strictly follow the assembly instructions for making the power supply cables with the provided Power Output Receptacle Connector for RCU.

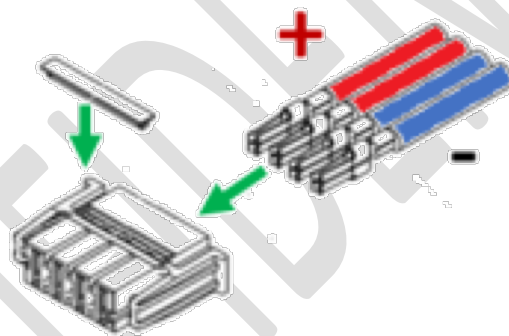
Power Output Receptacle Connector Assembly Illustration



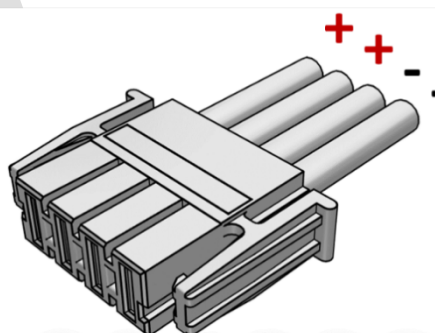
Power Output Receptacle Connector and Copper Wires



Crimped Copper Wires



Assembly of Power Output Receptacle Connector with Crimped Copper Wires



Final Assembled Power Output Receptacle Connector

Power Output Receptacle Connector Assembly Instructions

- 1) Strip bare each copper conductor of two wires 10 mm. Do not strip more than 10 mm. Each of copper conductor should be rated half of RCU maximum rated current (RCU maximum rated current for RX4805BE-0U00 is 50A and for RX2409BE-0U00 is 90A).
- 2) Place the two copper conductors onto each crimp.
- 3) Be sure that the tip of two copper conductors are not placed too close to the crimp header and no copper strands splice off when connecting conductors to clamps.
- 4) Always maintain the crimp and the two copper conductors straight and flat as possible.
- 5) Crimp the two copper conductors and solder them on the crimp for better bonding.
- 6) Repeat steps 1 to 5 to make the other three sets of crimp headers similarly with two copper conductors on each crimp header.
- 7) Place the wires into the receptacle connector housing with the receptacle guard slot facing up.
- 8) Make sure that the most left two crimped copper conductors are for connection to battery (-) terminals and the most right two crimped copper conductors are for connection to battery (+) terminals.
- 9) Push the copper conductors to the end of the receptacle connector housing.
- 10) Assemble and make sure the receptacle guard is secured tightly and covered flatly.
- 11) Check again by pulling the copper conductors lightly to ensure none can be pulled out from the power output receptacle connector.

Connecting the Supply Cables

See the steps below to connect the supply cables to RX2409BE-0U00 or RX4805BE-0U00.

- 1) Confirm that the supply cables are well insulated and covered.
- 2) Connect one end of the supply cables to the DC fuse that is connected to the battery.
- 3) Ensure that the DC fuse with proper rating is installed. Ensure that fuse current rating is at least 20% above the RCU maximum rated current.
- 4) Confirm that the positive and negative poles of supply cables are connected to the corresponding battery terminals.
- 5) Connect the other end of the supply cables that has receptacle housing to either one of the RCU models.

2.5 Communication Interface Connection

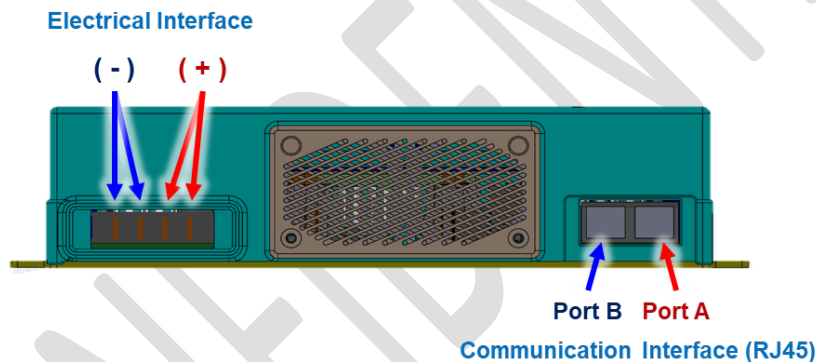
Precautions must be strictly observed to prevent damage to the wireless charger.



Warning

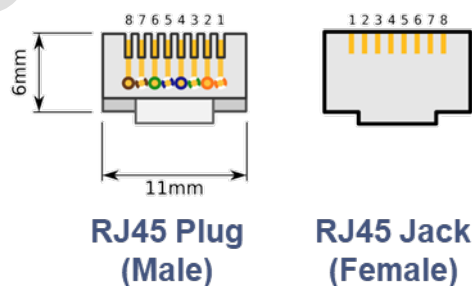
- Be sure and confirm that the communication cables RJ45 are made following the given pins configuration to match the communication interface ports of RCU, otherwise may cause severe accident, and damage the system.
- Be sure to assemble the communication cables with RJ45 plugs strictly following the Pins Configuration correspondingly. Leave unintended pins open contacted at the RJ45 plugs.
- Make sure the GND pin of the RJ45 is connected to the destined device.

Communication Interface Ports in RCU



There are two RJ45 ports (Port A and Port B) on the receiver charging unit side as shown that are designed for electric mobility vehicle units to communication with Xnergy wireless charger. There are three different communication methods which are (i) Modbus RTU based on RS485, (ii) GPIO or (iii) CANopen. For details please refer to application note: “BEAB6BA-Control-and-Monitor-your-charger”

Pins Configuration for RJ45 Communication Interface Ports



The pin numbers for two RJ45 ports (Port A and Port B) are given with Pin 8 to Pin 1 from left to right for male mating which should be considered for making the RJ45 cables.

Port A and Port B definition

Pin NO.	PORT A*		PORT B*	
	Name	Description	Name	Description
1	RS485A	Modbus RTU RS485A	CHARGER_EN	Charger enable pin
2	RS485B	Modbus RTU RS485B	CHARGER_ST	Charger status pin
3	CANH	CAN Bus High	CANH	CAN Bus High
4	CANL	CAN Bus Low	CANL	CAN Bus Low
5	Reserved	Xnergy use only	Reserved	Xnergy use only
6	Aux Power Input	Optional, if main power is not always on, please use this pin to power RCU	Aux Power Input	Optional, if main power is not always on, please use this pin to power RCU
7	Reserved	Xnergy use only	Reserved	Xnergy use only
8	GND	RCU Ground	GND	RCU Ground

2.5.1 Modbus RTU 485

Communication Parameters

Protocol	Modbus RTU (RS485)
Baud rate	9600
Data bits	8
Parity bit	None
Stop bit	1
Unit ID	0x10

Data Type Conversion

Float follow the standard IEEE 754 single precision binary floating-point format using two Modbus registers.

Modbus RTU Parameter Address

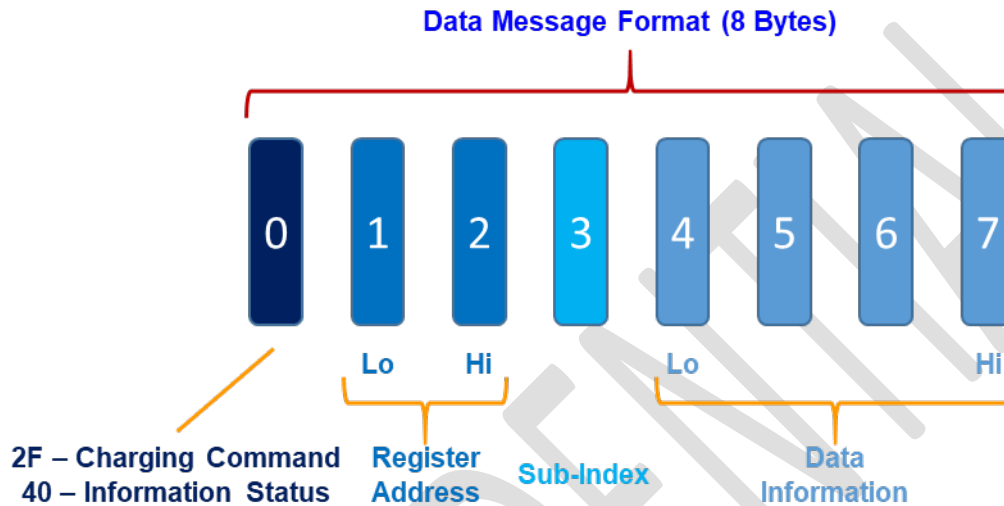
Function	Data type	Access	Modbus Type	Modbus Address	More Detail
Start/Stop Charging	Bool	Read/Write	Coil	0	1: start charging 0: stop charging
Firmware Version Number Low	Uint16	Read Only	Input register	98	
Firmware Version Number High	Uint16	Read Only	Input register	99	
Display Code Low	Uint16	Read Only	Input register	0	
Display Code High	Uint16	Read Only	Input register	1	
Runtime Code Low	Uint16	Read Only	Input register	52	
Runtime Code High	Uint16	Read Only	Input register	53	

2.5.2 GPIO

The port definition for PORT B is given in the following table for GPIO communication method. The GPIO signal generated must be within the permissible voltage range of 0 V to 5 V.

2.5.3 CANopen & CAN Bus 2.0

For CANopen communication using CAN Bus 2.0, please connect Pins 3 and 4 for CAN High (CANH) and CAN Low (CANL) respectively while assembly the communication cables with RJ45 plugs. The communication cables can be connected to either Port A or Port B.



CANopen Data Message Format

Byte Number	Data Message Information
Byte 0	2F – Charging Command 40 – Information Status
Byte 1	Register Address Lo (Low)
Byte 2	Register Address Hi (High)
Byte 3	Sub-Index
Byte 4	Data Information (Lowest – Most Significant)
Byte 5	Data Information
Byte 6	Data Information
Byte 7	Data Information (Highest – Least Significant)

The charging command to enable or disable the wireless charger and to request for charging status are provided in the following table.

CANopen Parameters Address – ID and Data Message (Request)

Parameters	ID	Length	Data Message
Enable Charging	0x60A	8	2F 00 20 01 01 00 00 00
Disable Charging	0x60A	8	2F 00 20 01 00 00 00 00
Charging Status	0x60A	8	40 00 20 01 00 00 00 00
Display Code Low	0x60A	8	40 02 20 01 00 00 00 00
Display Code High	0x60A	8	40 02 20 02 00 00 00 00
Runtime Code Low	0x60A	8	40 02 20 03 00 00 00 00
Runtime Code High	0x60A	8	40 02 20 04 00 00 00 00
Battery Voltage	0x60A	8	40 02 20 06 00 00 00 00
Charging Current	0x60A	8	40 02 20 07 00 00 00 00

Xnergy wireless charger will respond the following Data Message based on 0x58A ID.

CANopen Parameters Address – ID and Data Message (Respond)

Parameters	ID	Length	Data Message	Data Conversion
Enable Charging	0x58A	8	60 00 20 01 xx xx xx xx	-
Disable Charging	0x58A	8	60 00 20 01 xx xx xx xx	-
Charging Status	0x58A	8	4F 00 20 01 xx xx xx xx	Byte 4 – 01 (ON) 00 (OFF)
Display Code Low	0x60A	8	4B 02 20 01 xx xx xx xx	(Byte 5 Byte 4) Hex
Display Code High	0x58A	8	4B 02 20 02 xx xx xx xx	(Byte 5 Byte 4) Hex
Runtime Code Low	0x58A	8	4B 02 20 03 xx xx xx xx	(Byte 5 Byte 4) Hex
Runtime Code High	0x58A	8	4B 02 20 04 xx xx xx xx	(Byte 5 Byte 4) Hex
Battery Voltage	0x58A	8	4B 02 20 06 xx xx xx xx	(Byte Hi to Byte Lo) Hex to Dec × Voltage Converter Value
Charging Current	0x58A	8	4B 02 20 07 xx xx xx xx	(Byte Hi to Byte Lo) Hex to Dec × Current Convert Value

Note:

Voltage Converter Value = 0.01155 (RX2409BE-0U00) or 0.02229 (RX4805BE-0U00)

Current Converter Value = 0.04028 (RX2409BE-0U00) or 0.020142 (RX4805BE-0U00)

For data information, please refer to Byte 4 – 7 specified in the Data Conversion column based on respective parameters.

3. Getting Started

This chapter gives the proper procedures and sequences to power on and off the wireless charger system as well as how the operating system of electric mobility vehicle can enable or disable the RCU when battery energy level is low or full.

- [3.1 Power On Wireless Charger System](#)
- [3.2 Enable / Disable of Wireless Charging via Receiver Charging Unit \(RCU\)](#)
- [3.3 Power Off Wireless Charger System](#)

3.1 Power On Wireless Charger System

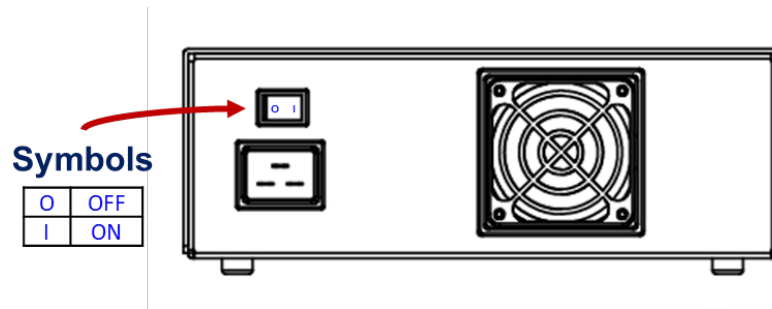
Please make sure that you have fully understood the safety instructions before operation.



Warning

- Be sure and confirm that the power voltage and current of the power cord matches with the rated input voltage and current of the TPU.
- Be sure that the switch at the TPU is switched off and verify that there is no dangerous voltage on the connecting terminals before connecting the power cord to the TPU.
- Please use the power entry plug supplied by Xnergy in the product package to avoid fire or electric shock.
- Be sure that the AC wall socket or AC distribution box has protective grounding before connecting the power cord.
- Do not use terminal board without protective grounding or use an extended power cord without protective grounding, otherwise protection function will fail.
- Be sure that the power cord connection terminals are well insulated and covered by the supplied protective cover so that no accidental contact with lethal voltage can occur.
- If strange sounds, unusual odours, fire, or smoke are detected from inside or outside the TPU, immediately flip the POWER switch off to (0) symbol and turn off the breaker in AC wall socket or AC distribution box. Wait until all the LEDs light are off, then unplug the power cord.
- Ensure no metallic or unintended magnetic materials/ objects to be found between the Transmitter Pad and the Receiver Charging Unit before operating the wireless charger and at all times.

User may access the power switch at TPU directly to turn on and off. The status of POWER switch is as follows:



See the steps below to **power on** TPU (TX30BE-1U00) and RCU (RX2409BE-0U00 or RX4805BE-0U00).

- 1) Check that the power cord is connected properly to the AC wall socket and the TPU.
- 2) Check that the DC fuse is connected and the RCU is powered on.
- 3) Switch on the AC wall socket or AC distribution box.
- 4) Flip the POWER switch on the TPU to (|) side to turn on the TPU.
- 5) The LEDs on the TPU will light up after a few seconds. Follow the LEDs status in TPU LED Status Message.
- 6) Once the GREEN LED is OFF and RED LED is SLOW BLINK on the TPU means that it is ready and waiting for RCU to initiate the wireless charging operation.

3.2 Enable / Disable of Wireless Charging via Receiver Charging Unit (RCU)

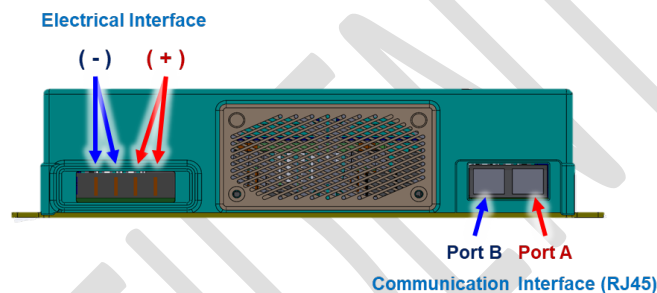
Please make sure that you have fully understood the safety instructions before operation.



Warning

- Please use the provided Power Output Receptacle Connector (Molex 1725090224) for power supply cable assembly.
- Be sure and confirm the maximum current that the supply cables can withstand before wiring to avoid fire and electric shock. Use only the IEC/UL/CSA approved cable.
- The power supply assembly must be installed in accordance with local regulation and best practice.
- Be sure that the supply cables are well insulated and covered so that no accidental contact with lethal voltage can occur.
- Do not short the battery when connecting or disconnecting the supply cables at all time. Short circuit may cause severe accident, injury, fire and damage the battery unit and the wireless charger.
- Check that the positive and negative poles of the supply cables are assembled properly according to the RCU output and tightly connected to the battery terminals. Do not connect the positive pole and leave the negative pole disconnected.

- Be sure that there is a properly rated DC fuse installed between the RCU and the battery. Ensure that fuse current rating is at least 20% above the RCU maximum rated current.
- Always be sure that the supply cables are connected to the DC fuse first then to the battery before connecting the other end with receptacle housing to the RCU (RX2409BE-0U00 or RX4805BE-0U00).
- Be sure that there is continuity in the DC fuse and the RCU is always powered up based on the LED status.
- Do not power off the RCU at all time during wireless charging operation else may cause fire and damage to both the wireless charger and the battery.
- Be sure that the communication ports (port A or port B) is connected with communication cable RJ45 to (i) the operating system of electric mobility vehicle for MODBUS RTU 485 or (ii) external circuitry to provide GPIO signals within the permissible voltage level of 0 V to 5 V. (iii) GND pin is connected.



See the steps below to **enable** the wireless charging operation via RCU.

- 1) Check that the supply cable is connected properly to the RCU and the battery terminals.
- 2) Check that the DC fuse has continuity and the RCU is always powered on. Check that the RCU is in standby mode (GREEN LED is SLOW BLINK, YELLOW LED is OFF).
- 3) For Modbus RTU 485, the operating system of the electric mobility vehicle must send a command "1" to enable the wireless charging operation following the instructions given in **Port A and Port B definition** in [2.5.1 Modbus RTU 485](#).
- 4) For GPIO, the external circuitry designed must produce a 5V signal continuously corresponding to the pin configurations given in
- 5) [2.5.2 GPIO](#).
- 6) For CANopen, the operating system of the electric mobility vehicle must send 0x60A (ID) with 2F 00 20 01 01 00 00 00 (Data Message) "01" for Byte 4 to enable the wireless charging operation following the instructions given in [2.5.3 CANopen & CAN Bus 2.0](#).
- 7) Wireless charging operation will initiate when the RCU is within the effective charging tolerance capability in 4.1 Effective Charging Tolerance Capability, otherwise the wireless charging operation might fail.
- 8) Please refer to TPU LED Status Message and RCU LED Status Message for more details.
- 9) Do not power off the RCU during wireless charging operation, else may cause fire or damage both the wireless charger and the battery.

See the steps below to **disable** the wireless charging operation via RCU.

- 1) For Modbus RTU 485, the operating system of the electric mobility vehicle must send a command “0” to disable the wireless charging operation following the instructions given in **Port A and Port B definition** in [2.5.1 Modbus RTU 485](#).
- 2) For GPIO, the external circuitry designed must produce a 0 V signal the corresponding to the pin configurations given in
- 3) [2.5.2 GPIO](#).
- 4) For CANopen, the operating system of the electric mobility vehicle must send 0x60A (ID) with 2F 00 20 01 00 00 00 00 (Data Message) “00” for Byte 4 to disable the wireless charging operation following the instructions given in [2.5.3 CANopen & CAN Bus 2.0](#).
- 5) Wireless charging operation will stop upon receiving the right command.
- 6) After wireless charging operation stops, both the TPU and RCU will enter standby mode state.
- 7) Please refer to [TPU LED Status Message](#) and [RCU LED Status Message](#) for more details.

3.3 Power Off Wireless Charger System

Please make sure that you have fully understood the safety instructions before operation.



Warning

- **Do not disconnect the RCU from the battery and ensure that the DC fuse has continuity during wireless charging operation. It may cause fire and damage to both the wireless charger and the battery.**
- **Be sure and confirm that RCU is remained powered on at all time after disabling wireless charging operation.**
- **Strictly follow the proper procedures and sequences to power off the wireless charger system.**

See the steps below to power off TPU (TX30BE-1U00) and RCU (RX2409BE-0U00 or RX4805BE-0U00).

- 1) Ensure there is no wireless charging operation.
- 2) Flip the POWER switch at the TPU to (0) side to turn off the TPU.
- 3) Switch off the AC wall socket or AC distribution box.
- 4) Check that the LEDs are all OFF for TPU.
- 5) Disconnect the power cord from the AC wall socket and the TPU.
- 6) Remove the output power receptacle connector and RCU will be powered off.
- 7) Check that the LEDs are all OFF for RCU.

These steps are important and must be strictly followed in sequences especially when the Xnergy BE series wireless charger is required for maintenance, repair, and servicing. Complying to these steps will avoid electric shock hazards to the operators and the technicians.

4. Wireless Charger Function

This chapter provides detailed explanations on the key functionalities, protection features as well as the error messages of Xnergy BE series wireless charger product.

- 4.1 Effective Charging Tolerance Capability
- 4.2 Constant Current (CC) / Constant Voltage (CV) Mode Operations
- 4.3 Wireless Charging Cut Off Protection Feature
- 4.4 Thermal Protection Feature
- 4.5 Abnormal Operation Protection
- 4.6 LED Status Message

4.1 Effective Charging Tolerance Capability

Precautions must be strictly observed to prevent damage to the wireless charger and the electric mobility vehicle system.



Warning

- **Do not place any metallic items within 10 cm from the surrounding of TXP and RCU in terms of x-axis, y-axis, and z-axis at all time. Any metallic items found may results fire and electric shock.**

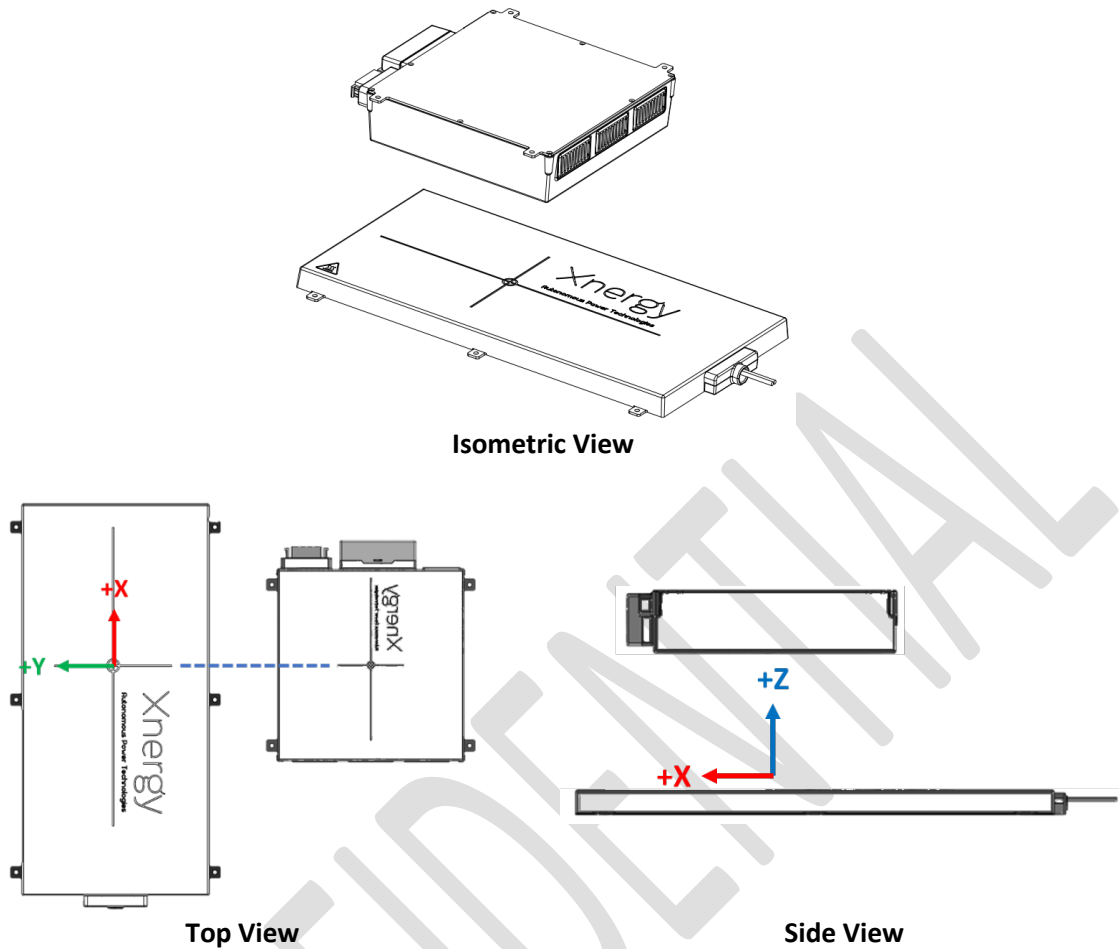


CAUTION

- **Do not touch the surface of TXP and RCU during wireless charging operation or directly after the wireless charging operation stops. Physical contact must be avoided to prevent injury.**
- **Anyone with implantable devices such as pacemakers must not go close to the wireless charger especially during wireless charging operation. Observe minimum 5 m distance from the wireless charger.**

It is important for operators and technicians to understand the effective charging tolerance capability of Xnergy BE series wireless charger before installation of TPU, TXP, and RCU can be carried out. This allows the wireless charger to operate as intended.

The effective charging tolerance capability is presented and clearly illustrated as follows with the indications of x-axis, y-axis and z-axis (x, y, z) based on the reference of the TXP and RCU facings.

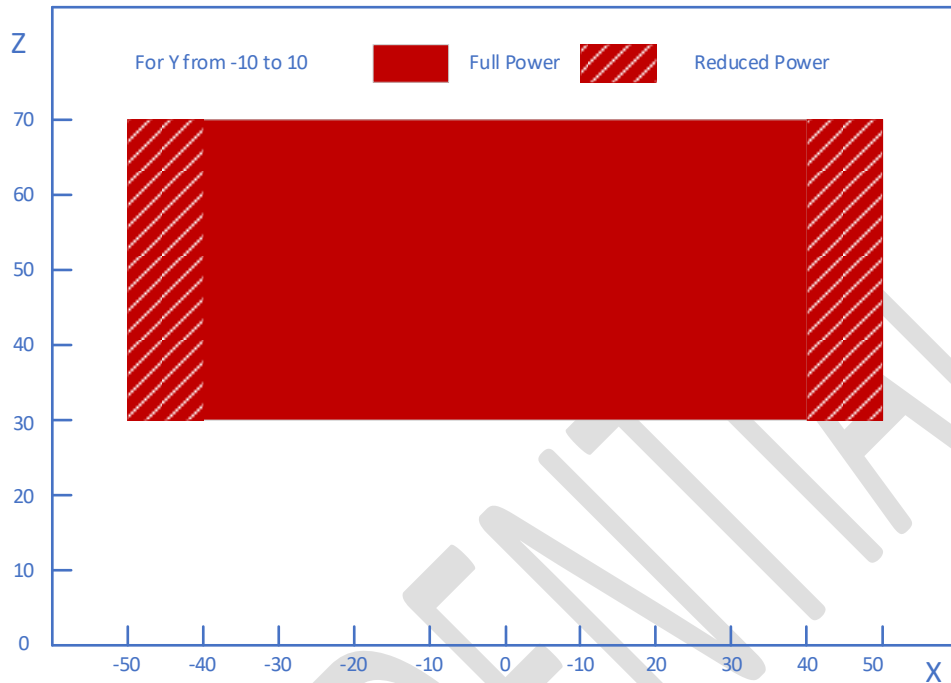


The directional of x-axis and y-axis is indicated on the top view of TXP where Xnergy logo is facing up while the z-axis can be understood from the side view of TXP. The z-axis is referred to the air gap distance. The exact location of (0, 0, 0) for x-axis (red arrow), y-axis (green arrow) and z-axis (blue arrow) is referenced to the centre point of the TXP based on the top view and side view.

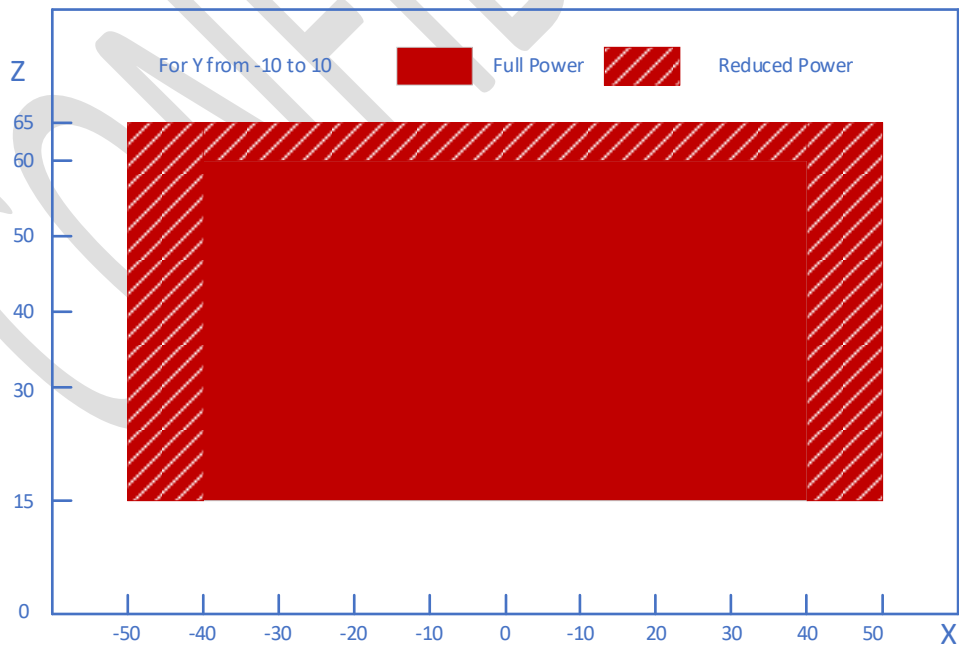
The Xnergy logo on the TXP and the RCU must always be facing each other and be on the same side for the installation.

The effective charging tolerance capability for guaranteed wireless charging operations is shown as below:

24V system : TX30BE to RX2409BE

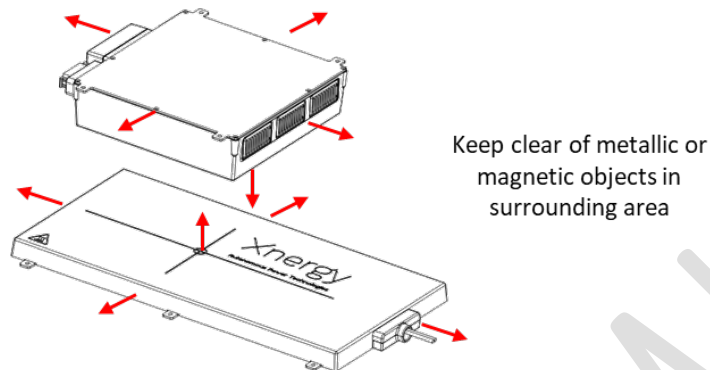


48V system : TX30BE to RX4805BE



Beyond these permissible tolerance capability, the wireless charging operations is not guaranteed. It might operates at very low efficiency, lower power output, or the wireless charging might fail to operate. Therefore it is important to work within this tolerance capability.

It is also important that there is no metallic or unintended magnetic items to be found near within 100 mm away from the surrounding of TXP and RCU as these metallic or magnetic items may cause fire and electric shock.



No physical contact is allowed on the TXP and RCU at all time to avoid undesirable accident from happening. The surface of both TXP and RCU may be hot during or even after the wireless charging operation. Hence, do not touch the hot surfaces of TXP and RCU as it may cause burnt. Persons with any implantable medical devices such as pacemakers must stay away from the wireless charger.

4.2 Constant Current (CC) / Constant Voltage (CV) Mode Operations

Precautions must be strictly observed to prevent damage to the wireless charger and the electric mobility vehicle system.



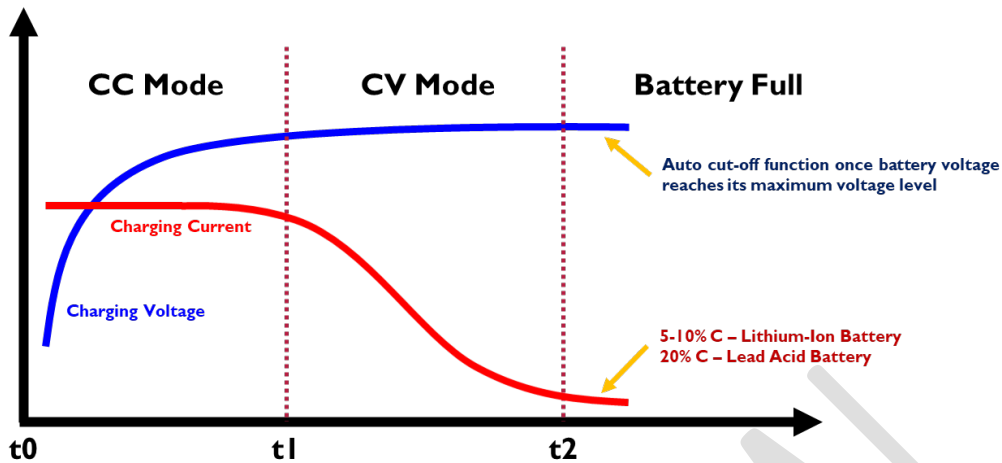
Warning

- Be sure and confirm that the constant current and the constant voltage values are given to Xnergy before delivery and must follow strictly to given data in the battery datasheet.
- Be sure and confirm that the constant current and the constant voltage values determined are within the rated values of RCU models (RX2409BE-0U00 or RX4805BE-0U00).



CAUTION

- It is recommended that the operating system of electric mobility vehicle monitors the battery capacity during the wireless charging operation.
- Be sure the RCU is either disabled automatically or disabled by the operating system of electric mobility vehicle when battery capacity is full.
- If unsure about the charging operation, please contact the Xnergy for technical support.



The constant current (CC) / constant voltage (CV) mode operation is the fundamental charging profile for most battery powered applications.

The constant current (CC) value must be set strictly complying to the following whichever has the lowest value:

- (i) The rated charging current value given in the battery datasheet or by the battery manufacturer.
- (ii) Less than or up to the rated current value given in the [5.3 Receive Charging Unit \(RCU\)](#) based on the respective models RX2409BE-0U00 or RX4805BE-0U00 in [5. Technical Specification](#).

The constant voltage (CV) value must be set strictly complying to the following whichever has the lowest value:

- (i) the full charge voltage value given in the battery datasheet or by the battery manufacturer;
- (ii) less than or up to the rated voltage value given in the [5.3 Receive Charging Unit \(RCU\)](#) based on the respective models RX2409BE-0U00 or RX4805BE-0U00 in [5. Technical Specification](#).

When the wireless charging operation is initiated, if the battery voltage level is less than the CV value, the RCU will be in CC mode and produce the constant current value to charge the battery.

Once the battery voltage level increase to the CV value, the RCU enters the CV mode, and the charging current will decrease accordingly.

It is highly recommended to monitor the battery capacity throughout the charging operation. Once the battery reaches the full charge voltage or the electric mobility vehicle has to move away, the operating system of electric mobility vehicle must disable the wireless charging operation.

If other charging profile is needed please refer to application note: "BEAAFA9_Set_and_customize_charging_profile"

4.3 Wireless Charging Cut Off Protection Feature

Precautions must be strictly observed to prevent damage to the wireless charger and the electric mobility vehicle system.



Warning

- Be sure and confirm that the cut-off voltage value is given to Xnergy before delivery and must follow strictly to given data in the battery datasheet.
- Be sure and confirm that the cut-off voltage value determined is within the rated values of RCU models (RX2409BE-0U00 or RX4805BE-0U00).

In the event that the battery capacity is full (the third stage of charging profile graph in [4.2 Constant Current \(CC\) / Constant Voltage \(CV\) Mode Operations](#)) and the RCU is still continuing to produce charging current despite less than 0.05 C, the battery voltage in the electric mobility vehicle may continue to increase beyond the fully charged voltage value.

With wireless charging cut off protection feature in RCU, the cut off voltage value is set between its full charge voltage value and its maximum rated voltage given in the battery datasheet before delivery. The RCU will cut off all electrical power when the battery reaches the cut off voltage value. This protection feature is designed to protect the battery from being over-charged to avoid heating and fire hazards.

4.4 Thermal Protection Feature

Precautions must be strictly observed to prevent damage to the wireless charger and the electric mobility vehicle system.



Warning

- Do not change or modify the thermal threshold levels set by Xnergy for TPU and RCU, otherwise may cause fire and electric shock.
- Do not change or modify the current derating value set by Xnergy for thermal protection feature.

The TPU (TX30BE-1U00) and the RCU models (RX2409BE-0U00 or RX4805BE-0U00) are all equipped with thermal protection feature. This is designed to ensure that the wireless charger will not overheat to cause fire, electric shock, and undesired accidents.

There is a total of three temperature threshold levels. The first two levels will trigger current derating setting. The last temperature threshold level will stop the wireless charging operations immediately.

The current derating is included in the thermal protection feature to prolong the wireless charging operation instead of having the wireless charging operation to be ceased immediately. When current derating is triggered, the wireless charging operation will continue at lower output power. If the temperature continues to be lower than the second threshold, the output current will remain at this reduced level.

Else, if the temperatures goes up and reach the second temperature threshold level, there will be another current derating event. As long as the temperatures continues to be lower than the third temperature threshold level, the output current will remain at this reduced level.

However, if the measured temperature continues to heat up and reach the third temperature threshold level, the wireless charging operation will immediately stop. This is to protect the system and avoid fire and electric shock hazards.

4.5 Abnormal Operation Protection

Precautions must be strictly observed to prevent damage to the wireless charger and the electric mobility vehicle system.



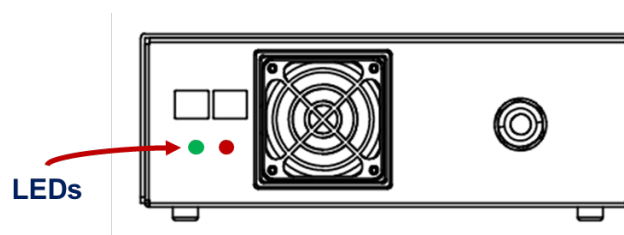
Warning

- **Do not perform abnormal operation as described in the following during the wireless charging operation.**
- **Be sure and comply to the proper procedures and sequences to disable the wireless charging operation.**

There are occasions that the electric mobility vehicles accidentally move away from the transmitter station during wireless charging operation. In this instance, the wireless charger will stop the wireless charging operation immediately. This is to protect both the wireless charger and the electric mobility vehicle system.

4.6 LED Status Message

This section describes the LED status for both TPU and RCU in normal operation.

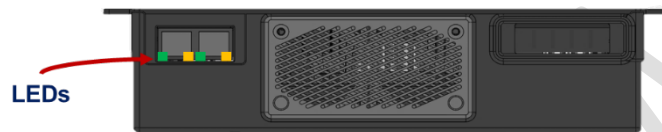


TPU LED Status Message

Green LED	Red LED	Device State
OFF	SLOW BLINK	Standby mode waiting for RCU to initiate charging process
OFF	ON	Wireless charging in operation
SLOW BLINK	SLOW BLINK	TPU turn off or error

FAST BLINK is 200 ms blinking time.

SLOW BLINK is 500 ms blinking time.



RCU LED Status Message

Green LED	Yellow LED	Device State
SLOW BLINK	OFF	Standby mode waiting for command
ON	ON	Wireless charging in operation
FAST BLINK	FAST BLINK	Error

FAST BLINK is 100 ms blinking time.

SLOW BLINK is 500 ms blinking time.

For the details of the error code please refer to application note: “**BEAB6BA – Control and Monitor Your Charger**” or “**BEAB5F2 - Troubleshoot Guide**”.

5. Technical Specification

5.1 Transmitter Powering Unit (TPU)

Model	TX30BE-1U00
Nominal AC voltage	220 – 230 Vac
Nominal AC frequency	50/60 Hz
Maximum AC input current	16A
Rated input power factor	> 0.99
Dimensions	361 mm (L) x 244 mm (W) x 91.5 mm (H)
Weight	7 kg
AC input power entry connector	IEC60320-C20
Cooling	Forced air cooling
Enclosure	IPX0 Indoor use

5.2 Transmitter Pad (TXP)

Cable length to TPU	1.1m / 3m / customisable
Dimensions	400 mm (L) x 200 mm (W) x 20.7 mm (H)
Weight	3.6 kg
Mounting holes	M4
Cooling	Natural convection
Enclosure	IPX0 Indoor use

5.3 Receive Charging Unit (RCU)

Model	RX2409BE-0U00	RX4805BE-0U00
Normal charging voltage	24V	48V
Maximum charging voltage	30V	60V
Maximum charging current	90A	50A
Maximum charging power	2,400W	2,500W
Minimum charging voltage	15V	15V
Battery type	Lithium Ion, Lead acid, Lithium Titanate, Lithium Iron Phosphate, Nickel Cadmium (other batteries can be supported)	
DC Output Protection & Reliability		
Over voltage protection	Yes	
Over current protection	Yes	
Short circuit protection	Yes	
Over temperature protection	Yes	
Mechanical		
Dimensions	202mm (L) x 231 mm (W) x 52 mm (H)	
Weight	3 kg	
Output power receptacle connector	Molex 1725090224, mating connector will be provided.	
Communication	GPIO, CAN bus, Modbus	
Mounting holes	M4	
Cooling	Forced air cooling	
Enclosure	IPX0 Indoor use	

5.4 Standards Compliance

Safety	IEC 62368-1
EMC emissions	EN 55011
EMC immunity	EN 61000-4-2/3/4/5/6/11
Harmonic currents emission	EN 61000-3-2
Voltage fluctuations and flickers emission	EN 61000-3-3
EU wireless standard	ETSI EN 303 417
Stray field (human exposure)	EN 62311 ICNIRP

5.5 Environmental Conditions

Environmental	
Corrosion & humidity	≤ 90% (non-condensation)
Altitude	≤ 2000 meters
Operating temperature	-10 to +40 °C with thermal derating.
Storage temperature	-20 to +60 °C (short-term temperature during transportation)