

UGOWORK HMI V2 User Manual

Eric Duplain, P.Eng., M.Sc.

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1. System Scope

The system is mostly autonomous and intended to work only with other modules inside a UGOWORK battery, with connections with its other subsystems:

- Power supply
- CAN communication

FCC Part 15 Subpart C 15.247 rules apply for this product, in particular:

- FCC Part 15 Subpart C 15.247(a)(2)
- FCC Part 15 Subpart C 15.247(b)(3)
- FCC Part 15 Subpart C 15.247(d)
- FCC Part 15 Subpart C 15.247(e)

ISED RSS-247 Issue 3 Part 5 rules apply for this product, in particular:

- ISED RSS-247 Issue 3 Part 5.2(a)
- ISED RSS-247 Issue 3 Part 5.2(b)
- ISED RSS-247 Issue 3 Part 5.4(d)
- ISED RSS-247 Issue 3 Part 5.4(e)
- ISED RSS-247 Issue 3 Part 5.5

2. System Operation

The UGOWORK HMI V2 module is powered through a 12V DC supply by the BMS (Battery Management System) module of the battery, which is itself battery powered. The UGOWORK HMI V2 module receives data over CANbus from the BMS module of the battery, and captures this data once per second to send over Wi-Fi to a Cloud data collector every 10 seconds. If there is no network connection, the data is saved to the SD Card. On the next network connection, 10-second blocks of data will be read back from the SD Card and sent to the Cloud data collector over Wi-Fi as fast as possible, giving a few packets each second. The module also displays the SOC (State Of Charge) sent by the BMS module, keeping track of time with a connection to a NTP server and a battery power RTC (Real Time Clock) IC when the main battery is shut down.

The module uses the CC3200 processor, an ARM Cortex M4 microcontroller with an on-chip 802.11bgn Wi-Fi Network Processor made by Texas Instruments. The ARM microcontroller executes the main application, as described in the previous paragraph, and can issue high level commands and associated data to the Wi-Fi Network processor. The Wi-Fi Network processor will then communicate with the following parameters:

- 802.11 b/g/n Wi-Fi protocol, using the 2.4 GHz frequency band (2.412 to 2.462 GHz)
- Use of the on-board antenna, a chip antenna with a nominal gain of 1.9 dBi
- Use of the maximal transmit power available for the device, which is rated as:
 - 18 dBm for DSSS @ 1 or 2 Mbps
 - 18.3 dBm for CCK @ 11 Mbps
 - 17.3 dBm for OFDM @ 6 or 9 Mbps
 - 17 dBm for OFDM @ 18 Mbps
 - 16 dBm for OFDM @ 36 Mbps
 - 14.5 dBm for OFDM @ 54 Mbps

During operation, the system is intended to be mobile and at a distance greater than 20 cm from a user's body. The UGOWORK battery (host product) manuals shall indicate RF exposure information.

3. System Specifications

The system uses standard 802.11 Wi-Fi b/g/n modulation in the 2400-2483.5 MHz frequency band, with center frequencies from 2412 to 2462 MHz, and bandwidth varying between 20 to 22MHz:

Wi-Fi spec	Modulation	Bandwidth
802.11b	DSSS, CCK	22 MHz
802.11g	BPSK, QPSK, 16-QAM, 64-QAM	22 MHz
802.11n	BPSK, QPSK, 16-QAM, 64-QAM	20 MHz

The only allowed antenna is the on-board chip antenna, which has a 1.9 dBi gain.

As the system is intended for use in UGOWORK batteries, it is only intended to be battery powered through the 12 VDC power input.

4. System Configuration and Maintenance

Wi-Fi configuration is limited to access point SSID and password. Configuration is possible through custom UGOWORK service tools. Modifications to RF signal parameters with UGOWORK service tools are not possible.

For service purposes, in case a failure related to the module has been identified, the UGOWORK HMI V2 module can only be replaced by another identical UGOWORK HMI V2 module.

5. Module Test Plan

Testing the radio module on all specified modulations listed in the System Specifications section may be done with the use of a specific test firmware. This firmware must be installed through the CAN interface with the custom UGOWORK service tools. To enable radio configuration the UART interface needs to be connected via the tag connect wire. With the test firmware the module can be controlled via PC with the help of the Texas Instruments Radio Tool, which can set all necessary parameters for testing all Wi-Fi module functions to the limits of what the module is able to transmit. This module test plan should be used by the certification company to assess the radio module.

6. Host Test Plan

The module is only certified for intentional emissions with a limited modular approval. Every UGOWORK battery model that will include the UGOWORK HMI V2 shall be validated for both unintentional (e.g. FCC Part 15 Subpart B, ICES-003) and intentional emissions (fundamental and spurious emissions levels) after the integration of the UGOWORK HMI V2. Since this is a Limited Modular Approval each host configuration would have to be added through a Class II Permissive Change.

To validate the intentional emissions of the UGOWORK HMI V2 module in a UGOWORK battery, a specific firmware, sending data in continuous mode, is used to validate the field strength of fundamental and spurious in an anechoic chamber of an accredited test lab.

The standard UGOWORK HMI V2 firmware should be reinstalled through the CAN interface for the UGOWORK battery to work correctly. With the default firmware, it is possible to disable the Wi-Fi to validate non intentional emissions.

Once intentional emission is validate for a UGOWORK battery model, every UGOWORK battery shall have a label indicating that it contains the module including both the FCC ID and the ISSED certification number with the following mentions:

Contains FCC ID: 2AUBT-UGOWORKHMI2

Contains IC: 25380-UGOWORKHMI2

Detailed test plan for the accredited test lab

1. **Test Objective:** Verify the electromagnetic emissions of the Product.
2. **Specifications:**
 - Transmit output power according to FCC Part 15 Subpart C, paragraph 15.247(b)(3) – with limits: 30 dBm at antenna port, 36 dBm EIRP.
 - Spurious unwanted emissions according to FCC Part 15 Subpart C, paragraph 15.247(d) – with limits according to FCC 15.209 within bands listed in FCC 15.205.
 - Test methods are according to (ANSI C6310 (2020):
 - i. Section 6.5, 11.1, and 11.2 for emissions below 1 GHz
 - ii. Section 6.6, 11.1, and 11.2 for emissions above 1 GHz.
 - iii. Section 6.10, and 11.2 for band-edges
 - iv. Section 11.9 for fundamental power
3. **Setup:**
 - Place the Product on the turn platform within the anechoic chamber.
 - Position the measurement antenna on the antenna mast at a distance of 3 meters from the Product.
 - For fundamental power set transmitter to operate in continuous mode on the highest aggregate power, and highest power spectral density to confirm continued compliance.
 - For band edge compliance, set the transmitter to operate in continuous mode on the widest and the narrowest bandwidths per modulation type.
 - For radiated spurious emissions up to 10th harmonic the following three parameters should be tested: 1) widest bandwidth, 2) highest aggregate power, and 3) highest power spectral density. If according to the radio module's initial test report these conditions do not all combine in the same mode, then multiple modes should be tested: set transmitter to operate in continuous mode at low, mid and top channels with all the supported modulations, data rates and channel bandwidths until the modes with these three parameters have been tested and confirmed.
4. **Rotation and Elevation:**
 - Rotate the turn platform 360 degrees.
 - Gradually raise the antenna from 1 to 4 meters.

- Purpose: Maximize emissions and verify compliance with Quasi-peak limits below 1 GHz and Peak/Average limits above 1 GHz; and compare with the appropriate limits as outlined in ANSI C63.10 and appropriate FCC Part 15 Subpart C rule parts.
- 5. **Frequency Scans:**
 - Initial scan: Cover frequency ranges from 30 MHz to 1 GHz.
 - Subsequent scan: Change measurement setup for above 1 GHz measurements.
- 6. **Verification:**
 - Verify fundamental emission levels, according to FCC 15.247(b)(3) within the pass band 2400–2483.5 MHz.
 - Check band edges within restricted bands at 2390 MHz and 2483.5 MHz, and check for Harmonics above 4.8 GHz - according to 15.247(d).
- 7. **Extended Scans:**
 - Continue scanning for frequency ranges:
 - 1–18 GHz
 - 18–25 GHz (10th harmonic of fundamental)
- 8. **Spurious Emissions:**
 - Verify against quasi-peak, peak and average limits.

This comprehensive test plan ensures thorough assessment of the product's electromagnetic behavior across various frequency ranges connected to spectrum analyzer via appropriate attenuators, notch filters and LNA where applicable.

7. Manufacturing Process

The UGOWORK HMI V2 PCBs are assembled by our PCB manufacturer. When assembly is finished, the PCBA are tested and programmed using our testbench hardware and application(see picture below). Functional testing and test results logging are done during this stage. The functions tested are:

- MCU operation
- Flash read and write
- CAN communication
- Wi-Fi communication
- SD card read and write
- RTC operational with the battery
- State of charge LEDs



Prior to being installed into a UGOWORK battery, the PCB is assembled into an HMI assembly, as seen in picture below.



During battery assembly, the HMI assembly is mounted and the UGOWORK HMI V2 is connected with the BMS through the power and communication cables, see picture below.



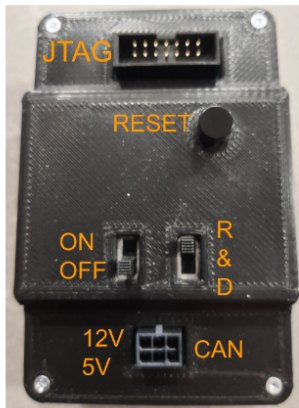
When the battery is fully assembled, a functional test and a cycling phase are executed. During that cycling phase the UGOWORK HMI V2 is connected to our Wi-Fi network and sends data to the cloud. The data is analyzed to make sure the discharge and charge profile are as expected. With the cycling phase, the HMI Wi-Fi communication is sending data for a few hours.

8. Installation Instructions

This section will show installation instructions extracted from the battery assembly line instructions. Only instructions relevant to the UGOWORK HMI V2 will be shown.

TEST AND PROGRAM THE HMI

ILLUSTRATION:



PARTS:

Item	P/N	QTY
1	1230-0021-01-A01	1

TOOLS:

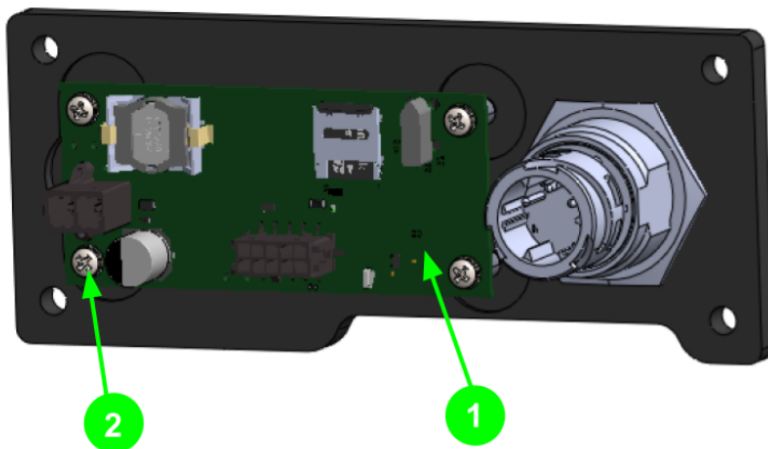
Item	P/N	⚙️
A	1230-0020-A01 Testbench	
B	> 5610-01-01-00-R Testbench software	
C	anti-static bracelet	

DESCRIPTION

- Test the PCB on the testbench.
- Open **Testbench** application.
- Scan the serial number
- Select "HMI V2" card type.
- Click on program bootloader.
- Follow instructions given by software
- **The program cards need to be put in the 1230-0021-01-A01 BIN.**

INSTALL THE PCB ON THE PLATE

ILLUSTRATION:



PARTS/PIÈCES:

Item	P/N	QTY
1	1230-0021-01-A01 (HMI program and tested)	1
2	0103-0022-P01 screw	4

TOOLS/OUTILS:

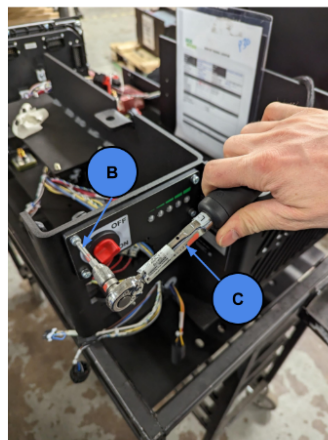
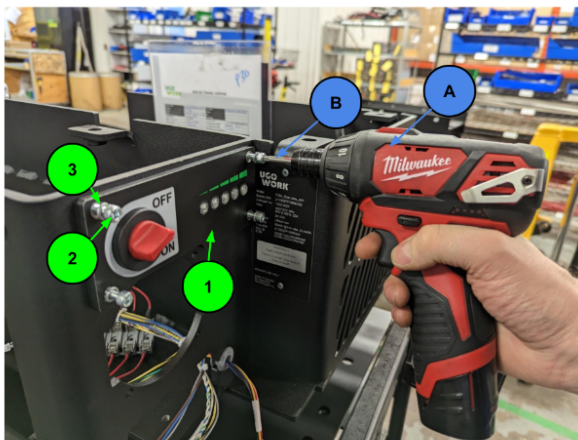
Item	P/N	⚙️
A	anti-static bracelet	-
B	Wera 7440	0.7Nm
C	PH/S1x70 ou PH/S2x70	-

DESCRIPTION:

- Screw the PCB in place with the recommended torque

HMI INSTALLATION

ILLUSTRATION:



PARTS/PIÈCES:

Item	P/N	QTY
1	1200-0031-C01 HMI Assembly	1
2	0101-0045-P01 Bolt	4
3	0109-0021-P01 Lock washer	4

TOOLS/OUTILS:

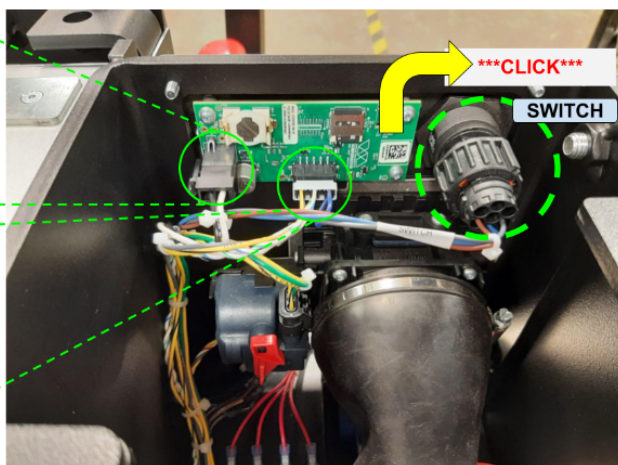
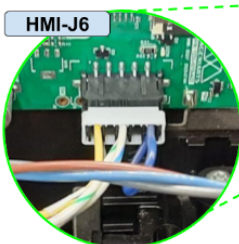
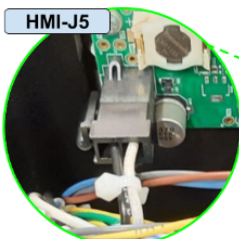
Item	P/N	⚙️
A	Electric Screwdriver M12	#13
B	HOP 4x50mm	-
C	QL10N	3Nm

DESCRIPTION (2 min)

- ☐ Fix HMI assembly HMI on the enclosure with the help of the **4 lock washers and bolts**.
- ☐ Apply the tightening torque on the 4 lock washers with a crosswise pattern.
- ☐ Write down the serial number on the work order.

CONNECTING THE HMI CONNECTORS

ILLUSTRATION:



PARTS/PIÈCES:

Item	P/N	QTY
-	-	-

TOOLS/OUTILS:

Item	P/N	⚙️
-	-	-

DESCRIPTION (30 sec)

- ☐ Connect the **HMI-J5** connector to the HMI assembly.
- ☐ Connect the **HMI-J6** connector to the HMI assembly.
- ☐ Connect the **switch** to the HMI assembly. Turn it until the "Click".

9. Statements / Notes

English version:

The UGOWORK HMI V2 module is not intended for third-party use. It is only intended for integration in various UGOWORK battery models.

FCC ID: 2AUBT-UGOWORKHMI2

IC: 25380-UGOWORKHMI2

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.

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

- this device may not cause harmful interference, and
- this device must accept any interference received, including interference that may cause undesired operation. Please note that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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This device 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:

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

This device complies with the Canadian ICES-003 Class A specifications. CAN ICES-003(A) / NMB-003 (A).

This equipment complies with FCC and ISSED RSS-102 radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. In order to avoid the possibility of exceeding the FCC and ISSED RSS-10 radio frequency exposure limits, this equipment should be installed and operated with minimum distance

20 cm (7.9 inches) between the antenna and your body during normal operation. Users must follow the specific operating instructions for satisfying RF exposure compliance.

Version française :

Le module UGOWORK HMI V2 n'est pas prévu pour être utilisé par un tiers. Il est seulement prévu pour être intégré aux différents modèles de batteries UGOWORK.

FCC ID: 2AUBT-UGOWORKHMI2

IC: 25380-UGOWORKHMI2

Cet équipement a été testé et déclaré conforme aux limites d'un appareil numérique de classe A, conformément à la partie 15 des règles FCC. Ces limites sont conçues pour fournir une protection raisonnable contre les interférences nuisibles lorsque l'équipement est utilisé dans un environnement commercial. Cet équipement génère, utilise et peut émettre de l'énergie radiofréquence et, s'il n'est pas installé et utilisé conformément au manuel d'instructions, peut provoquer des interférences nuisibles aux communications radio. Le fonctionnement de cet équipement dans une zone résidentielle est susceptible de provoquer des interférences nuisibles, auquel cas l'utilisateur devra corriger ces interférences à ses frais.

Cet appareil est conforme à la partie 15 des règles FCC. L'exploitation est soumise aux deux conditions suivantes :

- cet appareil ne doit pas provoquer d'interférences nuisibles, et
- cet appareil doit accepter toute interférence reçue, y compris les interférences susceptibles de provoquer un fonctionnement indésirable. Veuillez noter que les changements ou modifications non expressément approuvés par la partie responsable de la conformité pourraient annuler le droit de l'utilisateur à utiliser l'équipement.

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L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempt de licence. L'exploitation est autorisée aux deux conditions suivantes :

- L'appareil ne doit pas produire de brouillage
- L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

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

Cet équipement est conforme aux limites d'exposition aux rayonnements FCC et ISSED CNR-102 établies pour un environnement non contrôlé. Cet émetteur ne doit pas être installé ou utilisé en conjonction avec une autre antenne ou un autre émetteur. Afin d'éviter la possibilité de dépasser les limites d'exposition aux radiofréquences FCC et ISSED, cet équipement doit être installé et utilisé avec une distance minimale



de 720 cm (7.9 pouces) entre l'antenne et votre corps pendant le fonctionnement normal. Les utilisateurs doivent suivre les instructions spécifiques d'utilisation pour respecter la conformité à l'exposition aux RF.