NOMAD IO

telemetry and control systems

user manual

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Statement of Compliance

FCC Compliance Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
– Reorient or relocate the receiving antenna.
– Increase the separation between the equipment and receiver.
– Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
– Consult the dealer or an experienced technician for help.

• This device complies with Part 15 of the FCC Rules and with RSS-210 of Industry Canada.
Operation is subject to the following two conditions:
1) this device my not cause harmful interference, and
2) this device must accept any interference received, including interference that may cause undesired operation.
• The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Warning: Changes or modifications made to this equipment not expressly approved by Nomadio may void the FCC authorization to operate this equipment.

RF Exposure Statement

This transmitter has been tested and meets the FCC RF exposure guidelines when used with the Nomadio accessories supplied or designated for this product, and provided at least 20 cm separation between the antenna and the user's body is maintained. Do NOT use this device closer than 20cm to the body (for example, resting on one's lap). Use of other accessories may not ensure compliance with FCC RF exposure guidelines.

Modular Approval Statement

If you install the GC-205 transceiver inside of a vehicle, and you are not the final end user, FCC regulations require you to make the transceiver's FCC ID easily visible to the end user. In order to do this, please, print the image below onto a permanent sticker, and place it in a visible location such as on the bottom of the vehicle:

RCU
Car Transceiver
By Nomadio, Inc.

DEADBEEF010203
CONTAINS FCC ID
TSDNMD-AM06

Nomadio GC-205 OCU

The GC-205 operator control system (OCU) is a 5-channel digital radio system. It is intended for use in driving small unmanned vehicles with on-board video cameras. The controller allows an operator to drive the UGV to the desired location, and then train the on-board camera on the point of interest.
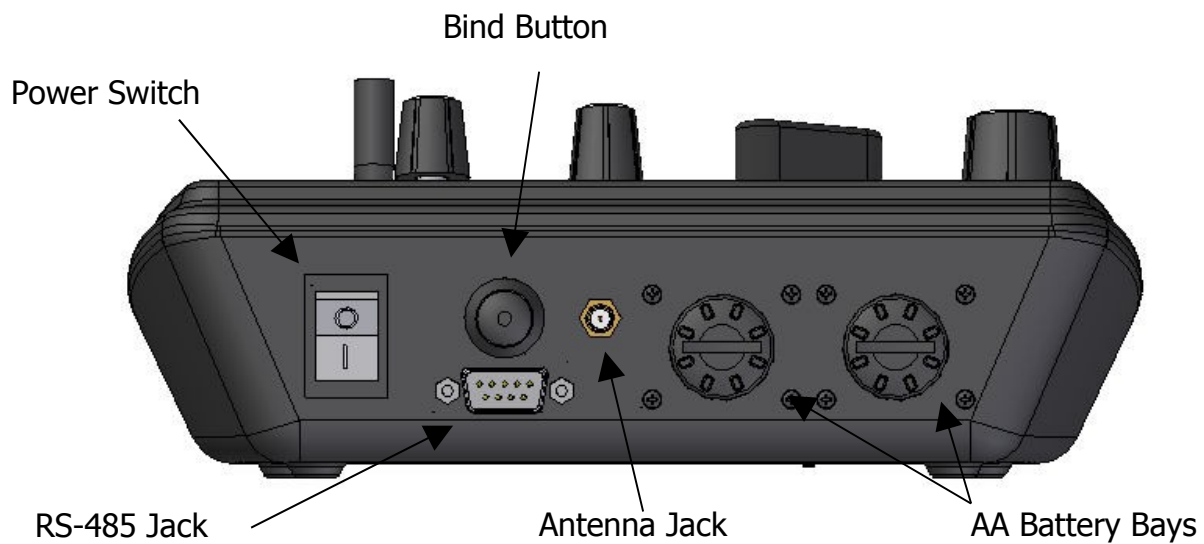
Front Panel Controls

The GC-205's control panel is arranged as follows:
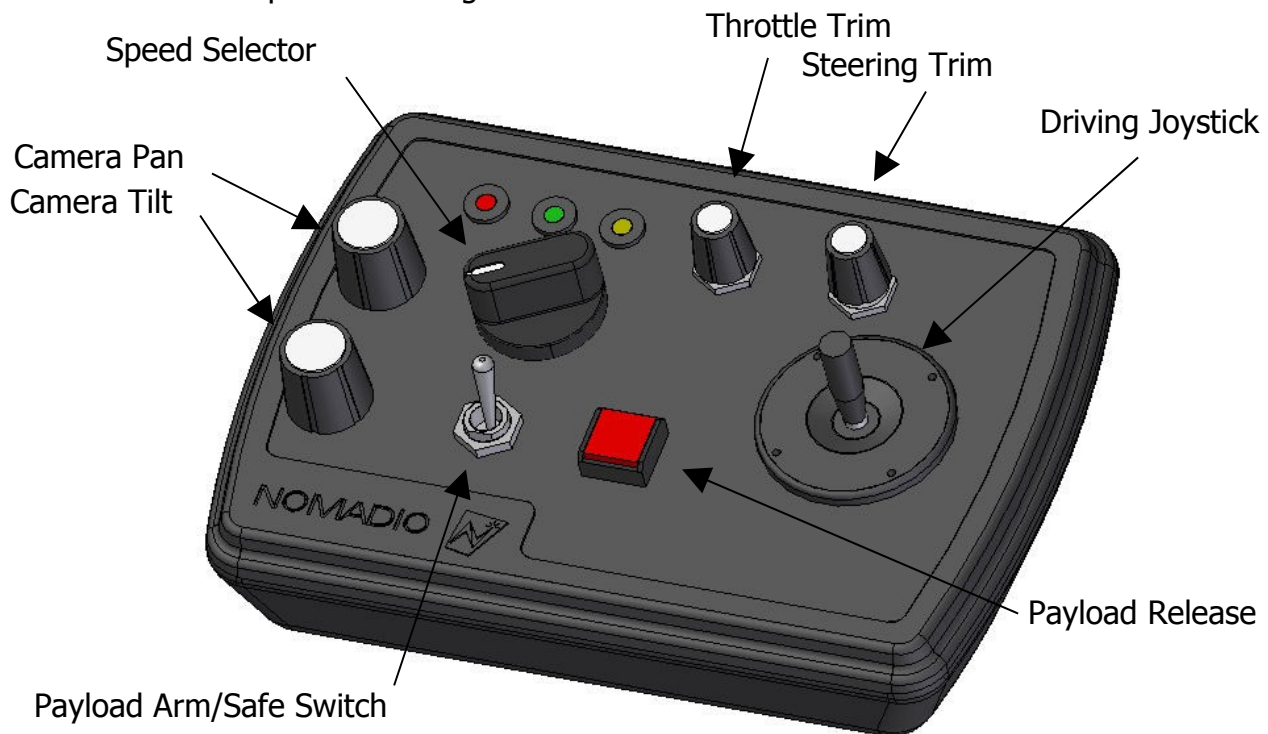
Back Panel

The GC-205's Rear panel is arranged as follows:

Power Switch

Bind Button

RS-485 Jack

Antenna Jack

AA Battery Bays

Setting Up a Robot

When the GC-205 transceiver is initially installed on a Bombot, the first task is to set the transceiver's failsafe positions. **Ensure that the wheels are not touching the ground.**

On power up, the robot will immediately go to failsafe positions:
- If it powers up, and centers the steering wheels, and does not accelerate, then failsafes are correctly configured.
- If the servos do not show movement (steering servo does not center itself, and shows no resistance to being moved by hand), then the transceiver does not have power. Check the connection to the electronic speed control, and the battery charge on the vehicle.
- If the servos assume another position (such as the throttle accelerating by itself on power on), then set the failsafes as explained below.

Setting Failsafes: Once connected to the robot, adjust the trims and controls until the robot has come to a complete stop, with the camera and steering centered. Hold the bind button on the receiver for 4 seconds and the receiver will save these settings to memory and will revert to this position on power on, or whenever the signal to the transmitter is lost.

The configured camera position will be used as the center point. This position will be taken when both transmitter camera controls are centered; other control positions are an offset from the saved position. This may cause the camera to move when the bind button is released.

Binding: Once the failsafes are correctly set, the user can "bind" (connect) to the Bombot:

1. Power on the Bombot
2. Briefly press the bind button on the Bombot transceiver (frees it to accept connections from any GC-205 transmitter operating in the area)
3. Ensure that GC-205 transmitter speed switch is set to 'L' (Low speed)
4. Power on GC-205 transmitter
5. Briefly press the bind button on transmitter (located on back, near the antenna)
6. Wait until Link LED goes on steadily. Test control with joystick
7. Put Bombot on ground to drive.

At this point the GC-205 transmitter is bound to the GC-205 transceiver on the Bombot. Each will seek to connect to the other whenever powered on.

Configuring the Video Transmitter: The GC-205 transceiver contains a built in radio frequency filter to allows the radio to be used in close proximity to other radio transmitters mounted on the same robot. This filter blocks interference from other radios operating at frequencies below 2430 MHz. If the GC-205 is used on a robot that uses another 2.4 GHz transmitter, ensure that the other transmitter is set to a channel below 2430 MHz. For a typical 2.4 GHz analog camera, this means using channel 1,2 or 3.

Transmitter Reference

Batteries: The GC-205 Transmitter runs on 4 standard "AA" size cells. Alkaline, NiCd, or NiMH 1.5v cells may be used.

LEDS: The transmitter has 3 LEDs that give basic feedback information.

All three LEDs blink one after another when the transmitter is not connected to the receiver. Once connected the LEDs have the following meanings:
- •Link LED: Turns on when a link is established and flashes slightly to show activity. Turns off briefly to indicate a lost message.
- •TX Battery LED: Flashes to indicate that the transmitter batteries are getting low.
- •RX Battery LED: Flashes to indicate that the robot's batteries are getting low. (Note the voltage sensor that triggers this alert is not installed in the standard Bombot configuration)

Trims: The steering and throttle trims can adjust the center positions on these servos by up to 25% of their range.

Bind Button: The Bind Button, mounted on the back of the unit provides several functions.
- •**Reset to Factory**: To reset the transmitter to factory settings, hold the bind button while powering on the unit. The Link LED will flash rapidly for 3-4 seconds then remain on for ½ second while all settings are returned to factory defaults.
- •**Reversing:** After booting, if the bind button is held for 1 second the transmitter enters reversing mode. The Link LED will flash rapidly to indicate Reversing is active. Move a control to its upper limit to reverse the channel, or to its lower limit to set the channel to normal. Otherwise the channel maintains its previously set mode. Press the release button to toggle reversing for the release channel. Release the bind button to return to normal operation. During reversing setup, the Link LED will flash rapidly. The Speed Switch controls the operation of the TX Bat and RX Bat LEDs:

	TX Bat LED	RX Bat LED
Speed Low	Steering* Reversed	Throttle* Reversed
Speed Med	Pan Reversed	Tilt Reversed
Speed High	Release Reversed	Off

* In Tank Mode Steering becomes the Right track and Throttle becomes the Left track.

- •**Unbind:** In other situations, pressing the bind button will erase the connection with the current receiver and sets the transmitter to seek other receivers that are either unbound or already bound to this transmitter. Hold the bind button until all three LEDs turn on and then release it immediately.

Speed Switch: The Speed Switch limits the maximum operating speed of the vehicle by restricting the range of the Throttle Servo. The Speed Switch has three positions:
- **High**: Throttle Servo moves through its full range of travel
- **Medium**: Throttle Servo moves through 50% of its range of travel
- **Low**: Throttle Servo moves through 25% of its range of travel

The High position should be used when programming a connected Electronic Speed Controller.

Release Button: The release button has a ½ second delay to prevent accidental activation. It is also used at power-up to enter Test Mode and to select Tank Mode or Normal Mode Steering and Throttle output. See Transmitter Modes for details.

Arm Switch: The arm switch must be in the "Armed" position for the release button to function. **The armed state is indicated by the illuminated release button**. When in the "Safe" position the release button will not function (including setup functions).

RS485: The transmitter has a DB9 connector that is used for tethered operations. When the transmitter starts, it automatically detects the presence of an RS485 cable, and if present automatically uses that cable instead of the radio. (See Appendix B for details on the RS485 cable as used by the GC-205).

Transmitter Setup

The Transmitter has a test mode and two operating modes: Normal and Tank. The active mode is set during the boot process:

1. **LED Test:** At power up, all 3 LEDs light for ½ second and then turn off from left to right with a ¼ second delay after each.
2. **Settings Reset:** If BIND is held down, the LINK LED will flash rapidly (5 times per second). If BIND is held for 3 seconds, the link LED is illuminated steadily for ½ second while all settings are reset to factory defaults.
3. **Mode Select:** If RELEASE is held down and ARM is on, the RX LED will flash rapidly (5 times per second) if in Normal Mode. If in Tank Mode, the TX LED will flash instead. If RELEASE is held for 3 seconds the test procedure runs (see below). If Bind is pressed before the 3 second countdown expires the Transmitter will switch modes (Tank or Normal) and the 3 second countdown restarts.
4. **Normal Operation:** The transmitter enters operating mode.

Receiver Reference

CAUTION: See "Setting Failsafes" before powering on the receiver for the first time on a robot. The factory defaults may not match the settings on your Electronic Speed Control: in this case the robot could run away when powered on. Whenever putting a new receiver on a robot, or resetting a receiver to factory default settings, the robot should be started with its wheels safely off the ground.

Servos: The receiver has clearly labeled servo extension cables for the throttle (THL), steering (STR), release (RLS), pan (PAN), and tilt (TILT) servos.

RS485: The receiver has a DB9 connector that is used for tethered operations. When the receiver starts, it automatically detects the presence of an RS485 cable, and if present automatically uses that cable instead of the radio.

Bind Button: The Bind Button on the receiver has three different possible uses:

- **Reset to Factory**: To reset the receiver to factory settings, hold the bind button for 10 seconds while powering on the unit. This will erase failsafe positions and binding settings and leave the receiver unbound.
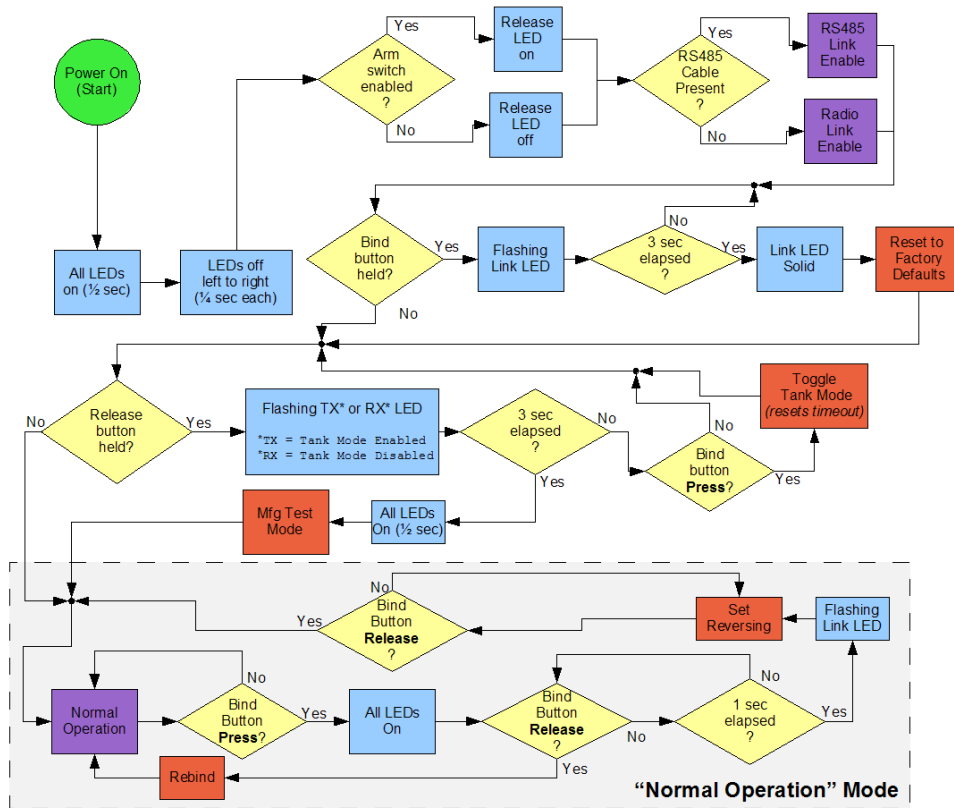- **Setting Failsafes:** Once connected to the robot, adjust the trims and controls until the robot has come to a complete stop, with the camera and steering centered. Hold the bind button on the receiver for 4 seconds and the receiver will save these settings to memory and will revert to this position on power on, or whenever the signal to the transmitter is lost.
The configured camera position will be used as the center point. This position will be taken when both transmitter camera controls are centered; other control positions are an offset from the saved position. This may cause the camera to move when the bind button is released.
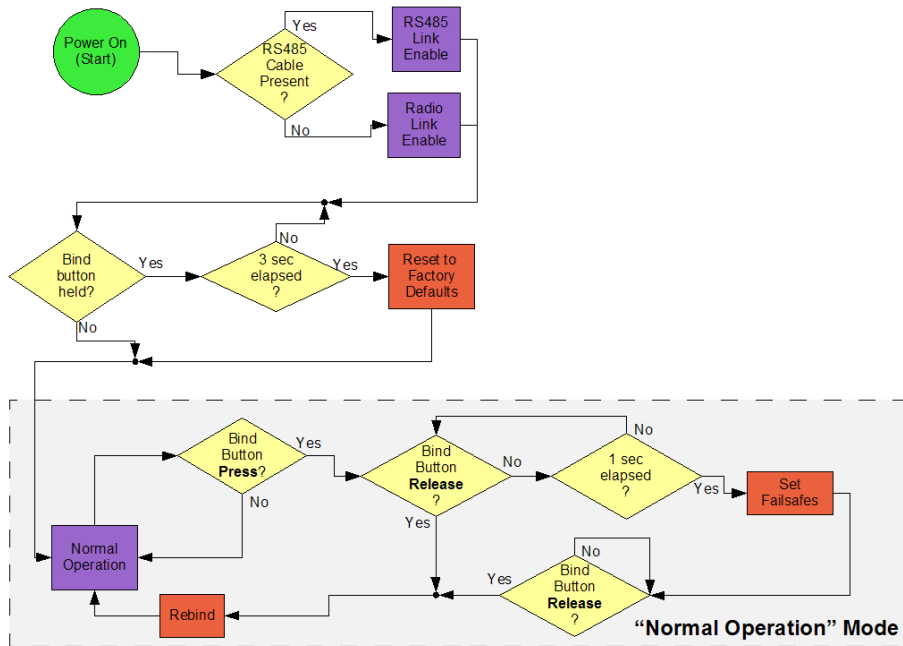- **Unbind:** In other situations pressing the bind button will erase the connection with the current transmitter and open the receiver to accept connections from other transmitters. This allows the user to switch transmitters if necessary.

Mode of Operation Flowcharts

GC-205 OCU Boot Process & Modes of Operation

GC-205 RCU Boot Process & Modes of Operation

Power On (Start) → RS485 Cable Present?
- Yes → RS485 Link Enable
- No → Radio Link Enable

Bind button held?
- Yes → 3 sec elapsed?
  - No → (back)
  - Yes → Reset to Factory Defaults
- No → (continue)

"Normal Operation" Mode

Bind Button **Press**?
- Yes → Bind Button **Release**?
  - No → 1 sec elapsed?
    - No → (back)
    - Yes → Set Failsafes
  - Yes → Bind Button **Release**?
    - No → (back)
    - Yes → Rebind
- No → Normal Operation

Appendix A: Transmitter Test Mode

The transmitter has basic test code built into the application, mainly for checking the front panel connections. See Transmitter Setup for instructions on entering Test Mode.

During the test procedure, any LED that is not specifically stated as being illuminated will flash briefly once per second. This is to make it clear that you are not in a normal operating mode. The RELEASE button is used to step through the test, implicitly testing it in the process. The sequence is:

1. BIND Test
   - Illuminate all front panel LEDs until RELEASE is not pressed.
   - LINK LED on whenever BIND is pressed
   - Test ends when RELEASE is pressed
2. Speed Switch Test
   - Illuminate all front panel LEDs until RELEASE is not pressed.
   - RX LED on when Speed is HIGH
   - TX LED on when Speed is MEDIUM
   - LINK LED on when Speed is LOW
   - Test ends when RELEASE is pressed
3. Steering Test
   - Illuminate all front panel LEDs until RELEASE is not pressed.
   - RX LED on when stick is full right
   - TX LED on when stick is centered
   - LINK LED on when stick is full left
   - Test ends when RELEASE is pressed
4. Throttle Test
   - Illuminate all front panel LEDs until RELEASE is not pressed.
   - RX LED on when stick is full forward
   - TX LED on when stick is centered
   - LINK LED on when stick is full back
   - Test ends when RELEASE is pressed
5. Pan Test
   - Illuminate all front panel LEDs until RELEASE is not pressed.
   - RX LED on when knob is full right
   - TX LED on when knob is centered
   - LINK LED on when knob is full left
   - Test ends when RELEASE is pressed
6. Tilt Test
   - As for Pan Test
7. Steering Trim Test
   - As for Pan Test
8. Throttle Trim Test

oAs for Pan Test
9.Arm switch test
    oRelease LED turns on and off when toggling arm switch
10.End of Test
    oIlluminate all front panel LEDs until RELEASE is not pressed.
    oTurn off LEDs left-to-right one at a time, ½ second per LED
    oFlash all LEDs on for $^1/_{10}$ second
    oTurn all LEDs off and return