

## **NAVREMOTE CONTROL**

### **Purpose**

The purpose of the NavRemote Control is to wirelessly operate motorised push golf buggies over a range up to 50m.

### **Engineering Description**

The MGI remote control NA7101 includes the following items.

- Power supply
- USB powered battery charger
- Microprocessor
- Data flash memory
- Indicator LEDs
- RF Transmitter

### **Power Supply and Battery Charger**

The battery power is connected to the PCB at SK1 and is normally electronically disconnected from the remaining circuitry unless a keypad button is pressed or the USB connector is connected to a charger or a PC USB port. If a keypad button is operated. The power supply, microprocessor and data flash circuits become active. The power supply, components around U3 and reference D9 provide a regulated 3.3V and 2.6V to the remote control electronics. If the remote's USB port is connected to a USB charger or a PC's USB hub, the battery charger integrated circuit (U1) becomes active and charges the battery. The other power supplies are also activated if the USB port is powered.

### **Microprocessor**

The microprocessor U5 (Atmel AT90USB1286) becomes active when power is applied. The processor reads the status of the keypad and the USB port. If a key is pressed, the processor determines which key and:

- Activates one of the activity LEDs
- Programs and activates the RF Transmitter. While a remote control key is pressed, the remote's ID and the key code are transmitted. The transmitted data packet is repeated every approximately every 35mS. The RF on time is approximately 2.5mS giving a duty cycle of approximately 7%.
- After a buggy command button, with the exception of the 'STOP' button on the remote has been released, the remote will remain active for a period of 2 minutes. During that time the remote will periodically generate a safety status message of 1.4ms transmission duration every 2.45seconds, to be sent via the RF transmitter. At the end of the 2-minute period or the release of the 'STOP' button, the safety status message will cease.

The remote control and buggy electronics are paired.

If the USB port is the cause of the awakening of the processor, the processor will attempt to enumerate with a connected USB host.

The microprocessor is clocked an internal crystal oscillator running on an external 8MHz crystal (X1). The microprocessor also uses this oscillator to generate the USB clocks as required.

### **FCC Transmission requirements**

The product is intended to operate on a nominal 5minutes activation cycle.

To comply with FCC CFR47 Part15.231 MGI has been provided a ruling from FCC under tracking number 544595 that this product must comply with sub parts (a)(1) and (a)(3) of the clause.

This product provides a safety status information packet, of 1.4ms duration, to detect loss of control between the remote vehicle every 2.45 seconds.

This periodic transmission occurs for up to 2 minutes or until the stop button is pressed and acknowledged.

Calculating for the worst case condition where the transmitter is actuated every 2 minutes, to effectively provide continuous operation over the full hour.

1)  $3600\text{seconds per hour} / 2.45\text{seconds between status transmissions} = 1469 \text{ status transmission per hour.}$

2)  $1469 \text{ status transmission per hour} - 60 \text{ operation transmissions to restart the sequence} = 1409 \text{ status transmission per hour}$

3)  $1.4\text{ms} \times 1409 \text{ status transmissions} = 1.97\text{s of status transmissions per operational hour.}$

This maximum transmission cycle then complies with the maximum allowed transmission duration of 2seconds per hour.

If the user presses the button more often, then the total number of status transmission per hour is reduced thereby reducing the associated transmission time further.

### **Data flash memory**

The data flash memory, IC U4, AT45DB32ID, is used for the storage of encrypted firmware binary files and is used during firmware upgrades.

### **Indicator LEDs**

The indicator LEDs are used to alert the operator to the operational status of the remote control unit and the buggy. If the left-hand green led is flashing, a 'Nav ON' command is being sent from the remote control to the golf buggy. If the right hand red led is flashing a 'Nav OFF' command is being sent from the remote control to the golf buggy.

## RF Transmitter

The RF Transmitter is comprised of IC U6 (NRF905), crystal X2 (12MHz) and their associated passive components. The transmitter is programmed and activated by the microprocessor. The NRF905, manufactured by Nordic, has the following features:

- Crystal locked PLL circuit to accurately set the transmit frequency.
- Proprietary 'Shock Burst' transmission to minimise 'on-air' time.
- Gaussian Frequency Shift Keying
- Internally limited RF output power level (+10dBm maximum)

The NRF employs Manchester encoding / decoding on the data to achieve a data rate of 100kbps. Gaussian Frequency Shift Keying modulation techniques are used to reduce the overall RF bandwidth. The deviation is  $\pm 50\text{KHz}$ . The operational frequency is set to 433.92MHz.

The remote control PCB antenna provides matching to the differential outputs of the NRF905.