GMTROM

User manual

14th June 2023

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Technical data

Weight(g): 469g

Size (mm): 150x110x100 mm

Speed (bps): max. 96.000 bps

Voltage (V): max. 5V

Components

- Arduino Due
- Ring Oscillator
- circuit board
- Raspberry PI
- 4x acrylic glass black
- 4x acrylic glass colorless transparent
- 1x acrylic glass black transparent
- Spacer bolt version¨supply external thread
    - m2.5x6+6 16pcs
    - m2.5x10+6 6pcs
    - m2.5x12+6 7pcs
    - m2.5x15+6 11pcs
- Spacer version internal thread
    - m2.5x6 3pcs
    - m2.5x10 2pcs
    - m2.5x12 3pcs
- Screws 14pcs
- single core conductive cables 7pcs

Details

Raspberry Pi 3b

Specifications

Processor: Broadcom BCM2387 chipset. 1.2GHz Quad-Core ARM Cortex-A53 802.11 b/g/n Wireless LAN and Bluetooth 4.1 (Bluetooth Classic and LE)

GPU: Dual Core VideoCore IV® Multimedia Co-Processor. Provides Open GL ES 2.0, hardware-accelerated OpenVG, and 1080p30 H.264 high-profile decode. Capable of 1Gpixel/s, 1.5Gtexel/s or 24GFLOPs with texture filtering and DMA infrastructure

Memory: 1GB LPDDR2

Operating System: Boots from Micro SD card, running a version of the Linux operating system or Windows 10 IoT

Dimensions: 85 x 56 x 17mm

Power: Micro USB socket 5V1, 2.5A

Connectors

Ethernet: 10/100 BaseT Ethernet socket

Video Output: HDMI (rev 1.3 & 1.4 Composite RCA (PAL and NTSC)

Audio Output: Audio Output 3.5mm jack, HDMI USB 4 x USB 2.0 Connector

GPIO Connector: 40-pin 2.54 mm (100 mil) expansion header: 2x20 strip Providing 27 GPIO pins as well as +3.3 V, +5 V and GND supply lines

Camera Connector: 15-pin MIPI Camera Serial Interface (CSI-2)

Display Connector: Display Serial Interface (DSI) 15 way flat flex cable connector with two data lanes and a clock lane

Memory Card Slot: Push/pull Micro SDIO

Arduino® Due

Specifications

Microcontroller: AT91SAM3X8E

USB Connector: Micro USB

Pins:

- Built-in LED Pin → 13
- Digital I/O Pins → 54
- Analog input Pins → 12
- Analog output Pins → 2

Communication:

- CAN
- UART
- I2C
- SPI

Power:

- I/O Voltage → 3.3V
- Input Voltage (nominal) → 7-12V
- DC Current per I/O pin (G1) → 9 mA
- DC Current per I/O pin (G2) → 3 mA
- Power Supply Connector → Barrel Plug
- Total DC Output Current on all I/O lines → 130 mA

Dimensions:

- Weight → 36g
- Width → 53.3 mm
- Length → 101.05 mm

Safety Information

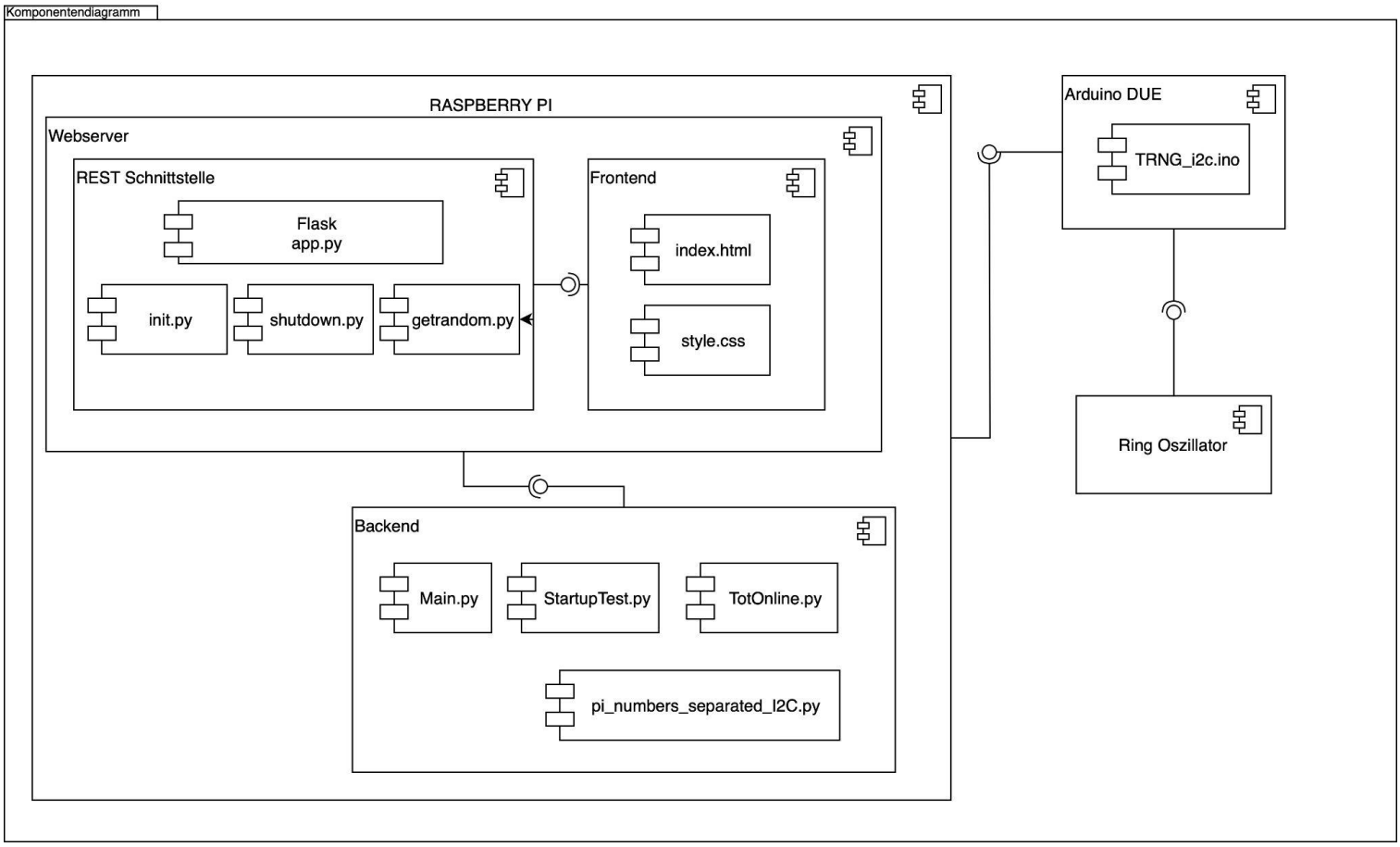
1. **General Safety Guidelines:**
    a. Read and understand this user manual thoroughly before operating the system.
    b. Keep the system away from water, moisture, and extreme temperatures.
    c. Do not expose the system to direct sunlight or heat sources.
    d. Avoid dropping or subjecting the system to impact or rough handling.
    e. Use the system only for its intended purpose as described in the manual.
    f. Keep the system out of reach of children and pets.

2. **Electrical Safety:**
    a. Ensure that the power supply to the system is compatible with the specified voltage and current requirements.
    b. Do not attempt to modify or tamper with the system's electrical components.
    c. Disconnect the power supply before connecting or disconnecting any peripheral devices.
    d. Use caution when working with electrical connections to prevent electric shock or short circuits.
    e. If you notice any unusual behavior, burning smells, or smoke, immediately disconnect the power supply and seek professional assistance.

3. **Handling and Storage:**
    a. Handle the system with clean, dry hands to avoid contamination or damage.
    b. Avoid exposing the system to excessive dust, dirt, or debris.
    c. Store the microcontroller in a clean and dry environment, away from direct sunlight and extreme temperatures.
    d. Do not stack heavy objects on top of the microcontroller, as it may cause damage.
    e. When transporting the microcontroller, use appropriate protective packaging to prevent physical damage.

Remember, this microcontroller generates random numbers and requires proper handling to ensure safe and reliable operation. Following these safety guidelines will help maintain the integrity of the microcontroller and reduce the risk of accidents or damage.

System architecture



Identify following components:

1. **Raspberry PI**
    a. This component handles the interaction between users and the system. It includes functionality for capturing user inputs, and providing random numbers to users.
    b. All troubleshooting processes are managed on the PI
2. **Arduino DUE**
    a. This component manages the input of the ring oscillator and answers the request of the PI

3. **Ring Oscillator**
    a. This component is responsible for the truly random number generation.
    b. The ring oscillator exploits the delay introduced by inverters in a loop to create a continuous oscillating signal.

Rest-Interface specification

1. **Overview:**
    a. The REST (Representational State Transfer) interface allows for communication and interaction with the system using the principles of RESTful architecture.
    b. This specification outlines the endpoints, methods, request/response formats, and authentication mechanisms for the REST interface.

2. **Base URL:**
    a. The base URL for accessing the REST interface is: `https://172.16.78.57`

3. **Methods:**

Methods	LINK	Description
GET init	`https://172.16.78.57`**/randomNum/init**	starts system
GET shutdown	`https://172.16.78.57`**/randomNum/shutdown**	shutdown system
GET random	https://172.16.78.57**/randomNum/getRandom?quantity=${quantity}&numBits=${numBits}**	generate random number (quantity = how many numbers; numBits = how many Bits per number)

4. **Error Handling:**
    a. For troubleshooting follow the suggestions in the Maintenance and Troubleshooting chapter.

Product Overview

The GMTROMy is a compact and powerful device designed to generate truly random numbers for various applications. With its advanced technology and user-friendly interface, this system provides a reliable and efficient solution for projects that require randomization.

Key Features:

1. Random Number Generation: The GMTROMy utilizes the sophisticated algorithms and hardware-base techniques to generate truly random numbers with high entropy. This ensures the unpredictability and fairness of the generated random values.
2. Versatile Applications: The GMTROMy is suitable for a wide range of applications, including cryptography, statistical analysis, gaming, simulations, and scientific research. It can be integrated into existing systems or used as a standalone device.
3. User-Friendly Interface: The GMTROMy features a user-friendly interface that allows easy configurations of the random number generator parameters. Users can set the desired output range to meet their specific requirements.
4. Compact and Portable Design: The microcontroller is compact and lightweight, making it easy to integrate into various projects and portable applications. Its low power consumption ensures efficient operation.

The Random Number Generator Microcontroller provides a reliable and secure solution for generating random numbers in a wide range of applications. Its advanced features, user-friendly interface, and compact design make it an ideal choice for projects that require high-quality randomization.

Setup

1. **Connection and Power Requirements:**
    a. Identify the appropriate power source for the GMTROMy.
    b. Connect the power source to the GMTROMy, following the recommended voltage and polarity specifications.
    c. If applicable, connect any required peripheral devices or interfaces (e.g., USB, Micro-USB, UART, SPI, LAN) according to the provided guidelines.

2. **Initial Configuration:**
    a. Power on the GMTROMy.
    b. Open the preinstalled Browser (FireFox) and type “https://172.16.78.57/”
    c. Follow the on-screen prompts and click the button “Initialize”
    d. Automatically the server performs the required “Start-Up-Test” and “ Total-Failure-Test” (this may take a few seconds)

    Note: The "Initial Configuration" must always be performed after the device is restarted.

3. **System Testing:**
    a. Verify that all connections are secure and peripherals are recognized by the GMTROMy.
    b. If every connection is correct, a **green** LED will shine.
    c. Test the basic operations and functions to confirm that the device is working as expected.
4. **User Manual Reference:**
    a. Refer to the accompanying user manual for additional information and detailed instructions regarding specific features, configurations, or troubleshooting procedures.
    b. Familiarize yourself with the user manual to maximize the capabilities of the GMTROMy and address any potential issues that may arise during use.

Operation

1. **Powering On/Off:**
    a. To power on the GMTROMy, connect it to a power source.
    b. Wait for the device to boot up and initialize. This may take a few seconds.
    c. To power off the GMTROMy completely pull the power cable.
2. **Navigation and User Interface:**
    a. Familiarize yourself with the user interface of the microcontroller, which includes buttons.
    b. Navigate through the menus and options using the provided controls, following the on-screen prompts.

3. **Basic Operations and Functions:**
    a. Inputting data or parameters using the available input methods
    b. Selecting options or menu items from the displayed interface.
    c. Initiating specific actions or processes by pressing the corresponding buttons or triggering commands.

4. **Troubleshooting:**
    a. If you encounter any issues or errors during operation, consult the troubleshooting section of the user manual.
    b. Follow the suggested troubleshooting steps to identify and resolve common problems.

Maintenance and troubleshooting

Maintenance Tasks	Frequency	Troubleshooting Tips
Regular cleaning	Weekly	Disconnect power before cleaning.
		Use a soft, lint-free cloth to clean the device.
		Avoid using harsh chemicals or abrasive materials.
		Ensure the device is completely dry before use.
Component inspection	Monthly	Check for loose connections or damaged parts.
		Ensure all cables and connectors are secure.
		Look for any signs of overheating or abnormal behavior.

Issue	Possible Causes	Troubleshooting Steps
Device not powering on/off	Power source issue	Check the power source and ensure it is connected properly.
	Faulty power switch	Verify if the power switch is functioning correctly.
Malfunctioning controls/buttons	Loose connections	Check the connections of the controls/buttons
	Dust or debris buildup	Clean the controls/buttons (Maintenance Tasks)
Unexpected errors or crashes	‘error 432’	Initial configuration not performed
	‘error 555’	Check all connections and restart the device
	‘error 400’	Quantity and bits must be numeric. Quantity and bits must be positive figures.
	‘error 500’	Click reset button on Arduino
		Restart the device
Connection or communication issues	Faulty cables or ports	Try using different cables or ports for connectivity.
	Incompatible protocols	Ensure that the GMTROMy and external devices are using compatible communication protocols.
Abnormal or excessive heating	Poor ventilation	Ensure proper airflow around the system
	Overloaded usage	Reduce the workload or processing demands on the GMTROMy

Test procedure

The following test procedure outlines the steps to be followed for conducting tests based on the BSI (Bundesamt für Sicherheit in der Informationstechnik) tests and NIST (National Institute of Standards and Technology) test, as described in the BSI Paper PTG 2.0.

1. **Test Environment Setup:**
    a. Prepare a suitable test environment that meets the requirements specified in the BSI Paper PTG 2.0.
    b. Ensure the availability of necessary hardware, software, and network components as described in the BSI guidelines.
    c. Install and configure the system and any additional devices or systems required for the tests.

2. **BSI Test Execution:**
    a. Follow the specific test procedures outlined in the BSI Paper PTG 2.0, which may include the following tests:
        i. Randomness Test: Validate the randomness and quality of the generated random numbers.
        ii. Entropy Source Test: Assess the entropy sources used by the system.
        iii. Statistical Test Suite: Apply statistical tests to evaluate the randomness properties.
    b. Perform each test according to the instructions provided in the BSI Paper PTG 2.0.
    c. Document the test results, including any observed deviations or failures, as well as any relevant details or observations.

3. **NIST Test Execution:**
    a. Refer to the NIST test suite specified in the BSI Paper PTG 2.0 for additional comprehensive testing.
    b. Execute the NIST Statistical Test Suite, which includes various statistical tests designed to evaluate the randomness properties.
    c. Follow the specific test procedures provided in the BSI guidelines for conducting the NIST tests.
    d. Record the test results, noting any deviations, failures, or observations that arise during the tests.

4. **Test Analysis and Evaluation:**
    a. Analyze the test results obtained from both the BSI tests and NIST tests.
    b. Compare the results against the defined criteria and requirements mentioned in the BSI Paper PTG 2.0.
    c. Evaluate the performance and compliance of the microcontroller based on the test outcomes.
    d. Identify any issues, vulnerabilities, or areas for improvement that are highlighted by the tests.

5. **Test Report Generation:**
    a. Prepare a comprehensive test report summarizing the test procedures, methodologies, and results.
    b. Include details of the test environment, test configurations, and any deviations or anomalies observed.
    c. Provide a clear analysis of the test outcomes, including pass/fail criteria and compliance assessments.
    d. Document any recommendations, findings, or suggestions for further improvement or refinement.

Note: The test procedure outlined above is based on the BSI Paper PTG 2.0 and incorporates both BSI and NIST tests. It is important to refer to the specific guidelines and instructions provided in the BSI Paper PTG 2.0 for detailed test procedures and any specific requirements applicable to the microcontroller being tested.