Новосибирский государственный университет

|  |  |
| --- | --- |
| СОГЛАСОВАНО | УТВЕРЖДАЮ |
| Начальник 628 ВП МО РФ  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ О.Э. Тимаков  «\_\_\_» \_\_\_\_\_\_\_\_\_ 2020 г. | Проректор НГУ по научно- исследовательской деятельности  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Д. В. Чуркин  «\_\_\_» \_\_\_\_\_\_\_\_\_ 2020 г. |
|  | СОГЛАСОВАНО |
|  | Главный конструктор  электрического проектирования и испытаний КА АО «ИСС»  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ С.И. Опенько  «\_\_\_» \_\_\_\_\_\_\_\_\_ 2020 г. |

Цифровой модуль КПА ОАИ

Описание регистров

|  |  |
| --- | --- |
| От 628 ВП МО: | От НГУ: |
| Ведущий специалист  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Н.В. Сапожникова  «\_\_\_» \_\_\_\_\_\_\_\_\_ 2020 г. | Инженер  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ А.С. Козлов  «\_\_\_» \_\_\_\_\_\_\_\_\_ 2020 г. |
|  |  |

2020 г..

Содержание

[1 Общие указания 4](#_Toc60054932)

[2 Карта регистров 5](#_Toc60054933)

[3 Аналоговые входы 6](#_Toc60054934)

[3.1 Входы АЦП 6](#_Toc60054935)

[3.2 INA226 3V3 7](#_Toc60054936)

[3.3 INA226 5 7](#_Toc60054937)

[3.4 UART1 данные приемника 7](#_Toc60054938)

[3.5 UART2 данные приемника 9](#_Toc60054939)

[3.6 GPIO in 10](#_Toc60054940)

[3.7 SPI receive data 11](#_Toc60054941)

[3.8 INA226 5 12](#_Toc60054942)

[4 Аналоговые выходы 13](#_Toc60054943)

[4.1 DAC1 13](#_Toc60054944)

[4.2 DAC2 15](#_Toc60054945)

[4.3 ADC control 17](#_Toc60054946)

[4.4 GPIO\_config 18](#_Toc60054947)

[4.5 GPIO\_set 20](#_Toc60054948)

[4.6 UART1 transmitter 21](#_Toc60054949)

[4.7 UART1 settings 23](#_Toc60054950)

[4.8 UART2 transmitter 25](#_Toc60054951)

[4.9 UART2 settings 27](#_Toc60054952)

[4.10 GPIO alternative set 29](#_Toc60054953)

[4.11 SPI settings 32](#_Toc60054954)

[4.12 SPI transmitter 34](#_Toc60054955)

[4.13 SPI receive 36](#_Toc60054956)

[4.14 SPI cs settings 37](#_Toc60054957)

[4.15 Power Module 38](#_Toc60054958)

Настоящая инструкция по эксплуатации (ИЭ) является техническим руководством для обслуживающего персонала по подготовке к эксплуатации, при эксплуатации и хранении контрольно-проверочной аппаратуры (КПА) Аппаратуры КВВ.

Инструкция состоит из разделов:

* общие указания;
* меры безопасности;
* подготовка к работе (входной контроль);
* автономные испытания;
* техническое обслуживание;
* правила хранения;
* транспортирование.

# Общие указания

Цифровой модуль предназначен для использования как самостоятельное устройство, так и как составная часть ОАИ КПА.

Модуль подключается к ПК как USB устройство определяющееся как Virtual Com port. Каждый модуль имеет свой серийный номер, по которому модули отличаются друг от друга.

Опрос и управление модулем реализовано пакетами по протоколу ModBus.

В модуле реализована поддержка следующих команд:

* 0x04 – чтения аналоговых входов (analog inputs);
* 0x03 – чтение аналоговых выходов (analog outputs);
* 0x06 – запись одного аналогового выхода;
* 0x10 – запись нескольких аналоговых выходов.

# Карта регистров

В модуле реализованы следующие регистры.

|  |  |  |  |
| --- | --- | --- | --- |
| Analog\_inputs | Адресс | Название | Краткое описание |
| 0 | Входы АЦП | Сюда записываются результаты измерений аналоговых входов 1-8. Частота обновления 2Гц |
| 8 | INA226 3V3 (0x41) | Содержат данные о собственном напряжении и токе потребления модуля (по 3.3 и 5В) |
| 11 | INA226 5V (0x40) |
| 14 | UART1 данные приемника | Содержат данные которые принимает модуль UART |
| 1042 | UART2 данные приемника |
| 2070 | GPIO in | Содержат информацию о текущем состоянии GPIO |
| 2074 | SPI receive data | Данные приемника SPI |
| 2138 | INA226 mother board | Данные о напряжении и токе датчика ina226 с адресом 0x44 |
| Analog outputs | 0 | DAC1 | Регистры настройки ЦАП |
| 528 | DAC2 |
| 1056 | ADC control | Регистры настройки АЦП (вкл/выкл) |
| 1059 | GPIO\_config | Настройки GPIO. (Маска вход выход) |
| 1064 | GPIO\_out | Управление GPIO настроенными на выход |
| 1072 | UART1 transmitter | Управление UART1 на передачу |
| 1140 | UART1 settings | Настройки UART1 |
| 1150 | UART2 transmitter | Управление UART2 на передачу |
| 1218 | UART2 settings | Настройки UART2 |
| 1228 | GPIO\_alternative | Управление альтернативным состоянием GPIO настроенных на выход. Позволяет сформировать импульс необходимой длительности |
| 1246 | SPI setings | Настройки SPI |
| 1266 | SPI transmiter | Управление SPI на передачу |
| 1308 | SPI receive | Управление SPI на прием |
| 1318 | SPI CS settings | Настройка чип селекта SPI |
| 1338 | Power Module | Настройки для модуля питания |

# Аналоговые входы

## Входы АЦП

|  |  |
| --- | --- |
| Адрес | Название |
| 0 | Data[8] |

В регистрах данных Data[0] – Data[7] содержатся последние измеренные значения АЦП1 – АЦП8 соответсвенно. Данные в 12 битном формате. 0 – 0 В. 4096 – 2,048 В.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 0 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| N/U | | | | Data[0] | | | | | | | | | | | |
|  | | | | 0-4096 | | | | | | | | | | | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 7 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| N/U | | | | Data[7] | | | | | | | | | | | |
|  | | | | 0-4096 | | | | | | | | | | | |

## INA226 3V3

|  |  |
| --- | --- |
| Адрес | Название |
| 8 | Voltage |
| 9 | Current |

Значение напряжения по шине 3.3 вольта. 1 LSB 1,25 мВ.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 8 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Voltage | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |

Значение тока по шине 3.3 вольта 1 LSB – 30 мкА

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 9 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Current | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |

## INA226 5

|  |  |
| --- | --- |
| Адрес | Название |
| 11 | Voltage |
| 12 | Current |

Значение напряжения по шине 5 вольт. 1 LSB 1,25 мВ.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 11 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Voltage | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |

Значение тока по шине 5 вольт 1 LSB – 30 мкА

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 12 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Current | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |

## UART1 данные приемника

В этих регистрах хранятся принятые данные и указатель записи.

|  |  |
| --- | --- |
| Адрес | Название |
| 17 | Write\_ptr |
| 18 | Data[0] | Data[1] |
| 1041 | Data[2046] | Data[2047] |

Регистр Write Ptr. Хранит указатель записи. Показывает в какую ячейку будет записан следующий принятый байт.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 17 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Write\_ptr | | | | | | | | | | | | | | | |
| 0-1023 | | | | | | | | | | | | | | | |

Регистры данных. Хранят принятые по UART 1 байты. Как только указатель чтения достигает 1023 он сбрасывается в 0. Буфер при переполнении перезаписывается.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 18 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Data[0] | | | | | | | | Data[1] | | | | | | | |
| 0-256 | | | | | | | | 0-256 | | | | | | | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 18 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Data[2046] | | | | | | | | Data[2047] | | | | | | | |
| 0-256 | | | | | | | | 0-256 | | | | | | | |

## UART2 данные приемника

В этих регистрах хранятся принятые данные и указатель записи.

|  |  |
| --- | --- |
| Адрес | Название |
| 1045 | Write\_ptr |
| 1046 | Data[0] | Data[1] |
| 2069 | Data[2046] | Data[2047] |

Регистр Write Ptr. Хранит указатель записи. Показывает в какую ячейку будет записан следующий принятый байт.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1045 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Write\_ptr | | | | | | | | | | | | | | | |
| 0-1023 | | | | | | | | | | | | | | | |

Регистры данных. Хранят принятые по UART 1 байты. Как только указатель чтения достигает 1023 он сбрасывается в 0. Буфер при переполнении перезаписывается.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1046 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Data[0] | | | | | | | | Data[1] | | | | | | | |
| 0-256 | | | | | | | | 0-256 | | | | | | | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 2069 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Data[2046] | | | | | | | | Data[2047] | | | | | | | |
| 0-256 | | | | | | | | 0-256 | | | | | | | |

## GPIO in

Регистры хранящие текущее состояние GPIO. Обновляются с частотой 2 Гц.

|  |  |
| --- | --- |
| Адрес | Название |
| 2070 | GPIO 1 – 12 |
| 2071 | GPIO 13 – 28 |
| 2072 | GPIO 29 – 44 |
| 2073 | GPIO 45 – 60 |

2070-2073 являются битовыми регистрами. Значение бита отражает текущее состояние соответствующего GPIO. 1 соответствует высокому состоянию на входе. 0 соответствует низкому состоянию на входе.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 2070 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Не используются | | | | GPIO | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 0 | | | | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 2071 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| GPIO | | | | | | | | | | | | | | | |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 2072 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| GPIO | | | | | | | | | | | | | | | |
| 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 |
| 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 2073 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| GPIO | | | | | | | | | | | | | | | |
| 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 |
| 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 |

## SPI receive data

|  |  |
| --- | --- |
| Адрес | Название |
| 2074 | Data[0] – 16 bit mode. Data[0] | Data[1] – 8 Bit mode. |
| 2137 | Data[64] – 16 Bit mode. Data[126] | Data[127] – 8 Bit mode. |

Регистры данных. Хранят принятые по SPI данные. При каждой транзакции буфер записывается с 0.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 2074 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Data[0] | | | | | | | | Data[1] | | | | | | | |
| 0-256 | | | | | | | | 0-256 | | | | | | | |
| Data[0] | | | | | | | | | | | | | | | |
| 0-65535 | | | | | | | | | | | | | | | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 2137 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Data[2046] | | | | | | | | Data[2047] | | | | | | | |
| 0-256 | | | | | | | | 0-256 | | | | | | | |
| Data[64] | | | | | | | | | | | | | | | |
| 0-65535 | | | | | | | | | | | | | | | |

## Power\_module data

|  |  |
| --- | --- |
| Адрес | Название |
| 2141 | Voltage |
| 2142 | Current |
| 2143 | Allert |
| 2144 | Ina\_errot |

Значение напряжения нагрузки вольт. 1 LSB 1 - мВ.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 2141 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Voltage | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |

Значение тока по шине 5 вольт 1 LSB – 1 мА

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 2142 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Current | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |

Allert – показывает что сработала какая то из защит. Либо по превышению напряжения. Либо по занижению напряжения ниже 22 вольт. 1 – есть срабатывания. 0 – нет срабатываний.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 2143 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Allert | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |

Ina Error – показывает что микросхема ina 226 не отвечает. 1 – есть ошибка. 0 – ошибок нет.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 2144 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Ina\_error | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |

# Аналоговые выходы

## DAC1

Регистры управления ЦАП.

|  |  |
| --- | --- |
| Адрес | Название |
| 0 | Scaler |
| 1 | Start |
| 2 | Stop |
| 16 | Data[0] |
| 527 | Data[511] |

Scaler – регистр запуска обновления команды.

При записи 1 – обновляется и исполняется команда. После завершения команды регистр перезаписывается 0.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 0 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Scaler | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Start – регистр запуска ЦАП. При записи 1 начинает работу генератор сигнала. Обязательно сначала заполнить регистры данных, затем запускать генератор.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Start | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Stop – регистр остановки ЦАП. При записи 1 останавливает работу генератора.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 2 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Stopt | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Регистры данных сигнала ЦАП. ЦАП настроен на работу в 12 битном формате. 0 – 0В. 4096 – 2,048В.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 16 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Не используются | | | | Data[0] | | | | | | | | | | | |
| 0 | | | | 0-4096 | | | | | | | | | | | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 527 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Не используются | | | | Data[0] | | | | | | | | | | | |
| 0 | | | | 0-4096 | | | | | | | | | | | |

## DAC2

Регистры управления ЦАП.

|  |  |
| --- | --- |
| Адрес | Название |
| 528 | Scaler |
| 529 | Start |
| 530 | Stop |
| 544 | Data[0] |
| 1055 | Data[511] |

Scaler – регистр запуска обновления команды.

При записи 1 – обновляется и исполняется команда. После завершения команды регистр перезаписывается 0.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 528 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Scaler | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Start – регистр запуска ЦАП. При записи 1 начинает работу генератор сигнала. Обязательно сначала заполнить регистры данных, затем запускать генератор.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 529 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Start | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Stop – регистр остановки ЦАП. При записи 1 останавливает работу генератора.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 530 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Stopt | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Регистры данных сигнала ЦАП. ЦАП настроен на работу в 12 битном формате. 0 – 0В. 4096 – 2,048В.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 544 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Не используются | | | | Data[0] | | | | | | | | | | | |
| 0 | | | | 0-4096 | | | | | | | | | | | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1055 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Не используются | | | | Data[0] | | | | | | | | | | | |
| 0 | | | | 0-4096 | | | | | | | | | | | |

## ADC control

Регистры управления каналами АЦП 1-8.

|  |  |
| --- | --- |
| Адрес | Название |
| 1056 | Scaler |
| 1055 | Start |

Scaler – регистр запуска обновления команды.

При записи 1 – обновляется и исполняется команда. После завершения команды регистр перезаписывается 0.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1056 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Scaler | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Start – регистр запуска АЦП. При записи 1 запускается преобразователь. По умолчанию АЦП запущен.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1055 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Start | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

## GPIO\_config

Регистры настроек GPIO. Данные регистры позволяют выполнить конфигурацию GPIO на вход (с внутренней подтяжкой к 0) или на выход (без подтяжки).

|  |  |
| --- | --- |
| Адрес | Название |
| 1059 | Init flag |
| 1060 | Scaler | GPIO 1 – 12 |
| 1061 | GPIO 13 – 28 |
| 1062 | GPIO 29 – 44 |
| 1063 | GPIO 45 – 60 |

После инициализации в данный регистр будет записана 1. Перед процедурой инициализации регистр сбрасывается в 0.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1059 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Init flag | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Scaler – регистр запуска обновления команды. При записи 1 обновляются параметры команды, и команда запускается. После запуска сбрасывается в 0.

1060-1063 являются битовыми регистрами. Значение бита задает направление работы GPIO. 0 – вход, 1 – выход. По умолчанию все GPIO сконфигурированы на вход.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1060 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Scaler | | | | GPIO | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 0/1 | | | | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1061 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| GPIO | | | | | | | | | | | | | | | |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1062 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| GPIO | | | | | | | | | | | | | | | |
| 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 |
| 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1063 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| GPIO | | | | | | | | | | | | | | | |
| 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 |
| 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 |

## GPIO\_set

Регистры выставления GPIO. Данные регистры позволяют выполнить конфигурацию GPIO на вход (с внутренней подтяжкой к 0) или на выход (без подтяжки).

|  |  |
| --- | --- |
| Адрес | Название |
| 1064 | Scaler | GPIO 1 – 12 |
| 1065 | GPIO 13 – 28 |
| 1066 | GPIO 29 – 44 |
| 1067 | GPIO 45 – 60 |

Scaler – регистр запуска обновления команды. При записи 1 обновляются параметры команды, и команда запускается. После запуска сбрасывается в 0.

1060-1063 являются битовыми регистрами. Значение бита задает состояние GPIO. 0 – низкий уровень на выходе, 1 – высокий уровень на выходе. По умолчанию все GPIO предустановлены в 0.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1064 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Scaler | | | | GPIO | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 0/1 | | | | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1065 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| GPIO | | | | | | | | | | | | | | | |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1066 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| GPIO | | | | | | | | | | | | | | | |
| 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 |
| 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1067 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| GPIO | | | | | | | | | | | | | | | |
| 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 |
| 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 |

## UART1 transmitter

Регистры передатчика UART1

|  |  |
| --- | --- |
| Адрес | Название |
| 1072 | Scaler |
| 1073 | Start |
| 1074 | Transmit flag |
| 1075 | Len |
| 1076 | Data[0]|Data[1] 8 битный режим. |
| 1139 | Data[126]|Data[127] |

Scaler – регистр запуска обновления команды. При записи 1 обновляются параметры команды, и команда запускается. После запуска сбрасывается в 0.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1072 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Scaler | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Start – регистр запуска отправки данных по Uart1. При записи 1 будет отправлена посылка длиной len из массива Data[] начиная с нулевого элемента.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1073 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Start | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Transmit flag – регистр отображающий завершение транзакции. Перед отправкой сбрасывается в 0. После отправки всех байтов выставляется в 1.

Error flag – регистр ошибки в случае неудачной отправки будет выставлен флаг ошибки. 0xFF – длина превышает 128.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1074 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Error Flag | | | | | | | | Transmit flag | | | | | | | |
| 0x0 – 0xFF | | | | | | | | 0/1 | | | | | | | |

Len – регистр в который необходимо записать количество байтов для отправки. Не более 128. Если записать более 128 отправка не произойдет, будет выставлен флаг ошибки 0xFF.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1075 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Len | | | | | | | | | | | | | | | |
| 0-128 | | | | | | | | | | | | | | | |

Регистры данных на отправку.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1076 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Data[0] | | | | | | | | Data[1] | | | | | | | |
| 0-256 | | | | | | | | 0-256 | | | | | | | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1139 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Data[126] | | | | | | | | Data[127] | | | | | | | |
| 0-256 | | | | | | | | 0-256 | | | | | | | |

## UART1 settings

Регистры настроек UART1

|  |  |
| --- | --- |
| Адрес | Название |
| 1140 | Scaler |
| 1141 | Low\_baud |
| 1142 | High\_baud |
| 1143 | Stop\_bits |
| 1144 | Pairity |
| 1145 | Word\_lengh |
| 1146 | Default |
| 1149 | Init\_flag |

Scaler – регистр запуска обновления команды. При записи 1 обновляются параметры команды, и команда запускается. После запуска сбрасывается в 0.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1140 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Scaler | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Low и High baud задают 32 битное значение baudrate для UART1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1141 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Low baud | | | | | | | | | | | | | | | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1142 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| High baud | | | | | | | | | | | | | | | |

Stop bits – конфигурация количества стоп битов. 0 – 1 стоп бит. 1 – 2 стоп бита.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1143 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Stop\_bits | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Pairity – бит четности. 0 – не проверяется. 1 – проверка на четность. 2 – проверка на нечетность.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1144 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Pairity | | | | | | | | | | | | | | | |
| 0/1/2 | | | | | | | | | | | | | | | |

Word lengh – длина слова. 0 – 8 bit

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1145 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Word\_lengh | | | | | | | | | | | | | | | |
| 0 | | | | | | | | | | | | | | | |

Default – настройки по умолчанию. Если выставить 1 то будут установлены настройки по умолчанию. 115200, 8 бит, 1 стоп бит без проверки четности.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1146 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Default | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Init flag –флаг инициализации. Перед инициализацией сбрасывается в 0. После успешной инициализации выставляется в 1.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1149 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Init flag | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

## UART2 transmitter

Регистры передатчика UART2

|  |  |
| --- | --- |
| Адрес | Название |
| 1150 | Scaler |
| 1151 | Start |
| 1152 | Transmit flag |
| 1153 | Len |
| 1154 | Data[0]|Data[1] 8 битный режим. |
| 1217 | Data[126]|Data[127] |

Scaler – регистр запуска обновления команды. При записи 1 обновляются параметры команды, и команда запускается. После запуска сбрасывается в 0.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1150 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Scaler | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Start – регистр запуска отправки данных по Uart1. При записи 1 будет отправлена посылка длиной len из массива Data[] начиная с нулевого элемента.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1151 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Start | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Transmit flag – регистр отображающий завершение транзакции. Перед отправкой сбрасывается в 0. После отправки всех байтов выставляется в 1.

Error flag – регистр ошибки в случае неудачной отправки будет выставлен флаг ошибки. 0xFF – длина превышает 128.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1152 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Error Flag | | | | | | | | Transmit flag | | | | | | | |
| 0x0 – 0xFF | | | | | | | | 0/1 | | | | | | | |

Len – регистр в который необходимо записать количество байтов для отправки. Не более 128. Если записать более 128 отправка не произойдет, будет выставлен флаг ошибки 0xFF.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1153 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Len | | | | | | | | | | | | | | | |
| 0-128 | | | | | | | | | | | | | | | |

Регистры данных на отправку.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1154 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Data[0] | | | | | | | | Data[1] | | | | | | | |
| 0-256 | | | | | | | | 0-256 | | | | | | | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1217 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Data[126] | | | | | | | | Data[127] | | | | | | | |
| 0-256 | | | | | | | | 0-256 | | | | | | | |

## UART2 settings

Регистры настроек UART2

|  |  |
| --- | --- |
| Адрес | Название |
| 1218 | Scaler |
| 1219 | Low\_baud |
| 1220 | High\_baud |
| 1221 | Stop\_bits |
| 1222 | Pairity |
| 1223 | Word\_lengh |
| 1224 | Default |
| 1227 | Init\_flag |

Scaler – регистр запуска обновления команды. При записи 1 обновляются параметры команды, и команда запускается. После запуска сбрасывается в 0.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1218 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Scaler | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Low и High baud задают 32 битное значение baudrate для UART1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1219 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Low baud | | | | | | | | | | | | | | | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1220 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| High baud | | | | | | | | | | | | | | | |

Stop bits – конфигурация количества стоп битов. 0 – 1 стоп бит. 1 – 2 стоп бита.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1221 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Stop\_bits | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Pairity – бит четности. 0 – не проверяется. 1 – проверка на четность. 2 – проверка на нечетность.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1222 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Pairity | | | | | | | | | | | | | | | |
| 0/1/2 | | | | | | | | | | | | | | | |

Word lengh – длина слова. 0 – 8 bit

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1223 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Word\_lengh | | | | | | | | | | | | | | | |
| 0 | | | | | | | | | | | | | | | |

Default – настройки по умолчанию. Если выставить 1 то будут установлены настройки по умолчанию. 115200, 8 бит, 1 стоп бит без проверки четности.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1224 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Default | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Init flag –флаг инициализации. Перед инициализацией сбрасывается в 0. После успешной инициализации выставляется в 1.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1227 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Init flag | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

## GPIO alternative set

Регистры выставления временного состояния GPIO. Данные регистры позволяют выставить GPIO на заданный промежуток времени.

|  |  |
| --- | --- |
| Адрес | Название |
| 1228 | Scaler |
| 1229 | Start |
| 1230 | Stop |
| 1231 | End\_flag |
| 1232 | Process\_flag |
| 1233 | Low\_time |
| 1234 | High\_time |
| 1235 | Low\_time\_left |
| 1236 | High\_time\_lef |
| 1242 | GPIO 1 – 12 |
| 1243 | GPIO 13 – 28 |
| 1244 | GPIO 29 – 44 |
| 1245 | GPIO 45 – 60 |

Scaler – регистр запуска обновления команды. При записи 1 обновляются параметры команды, и команда запускается. После запуска сбрасывается в 0.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1228 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Scaler | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Start – если выставлен в 1 будет запущена процедура выставления альтернативного состояния на заданное время.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1229 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Start | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Stop – если выставлен в 1, будет остановлен процесс выставления альтернативного состояния GPIO. (В случае если был запущен).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1230 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Stop | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

End flag – выставляется в 1 по окончанию процесса.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1231 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| End flag | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Proces flag – находится в 1 если процесс запущен.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1232 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Process\_flag | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Low и High time регистры образуют 32 битную переменную определяющую время задержки. LSB – 1 мкс.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1233 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Low\_time | | | | | | | | | | | | | | | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1234 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| High\_time | | | | | | | | | | | | | | | |

Low и High time left регистры образуют 32 битную переменную показывающую сколько времени осталось до конца процесса.. LSB – 1 мкс.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1235 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Low\_time | | | | | | | | | | | | | | | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1236 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| High\_time | | | | | | | | | | | | | | | |

Регистры 1242-1245 определяют состояние GPIO определенных как выход на время заданное в регистрах 1233-1234.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1242 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Не используются | | | | GPIO | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 0 | | | | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1243 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| GPIO | | | | | | | | | | | | | | | |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1244 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| GPIO | | | | | | | | | | | | | | | |
| 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 |
| 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1245 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| GPIO | | | | | | | | | | | | | | | |
| 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 |
| 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 |

## SPI settings

Регистры настроек SPI

|  |  |
| --- | --- |
| Адрес | Название |
| 1246 | Scaler |
| 1247 | Mode |
| 1248 | Direction |
| 1249 | Data\_size |
| 1250 | Polarity1 |
| 1251 | Phase |
| 1252 | Slave |
| 1253 | Baud |
| 1254 | First\_bit |
| 1255 | Ti\_mode |
| 1256 | Init flag |
| 1257 | Set default |

Scaler – регистр запуска обновления команды. При записи 1 обновляются параметры команды, и команда запускается. После запуска сбрасывается в 0.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1246 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Scaler | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Mode. 0 – master.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1247 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Mode | | | | | | | | | | | | | | | |
| 0 | | | | | | | | | | | | | | | |

Direction. 0 – 2Line. 1 – 2Line Rx only. 2 – 1 Line/

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1248 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Mode | | | | | | | | | | | | | | | |
| 0/1/2 | | | | | | | | | | | | | | | |

Data size. 0 – 8 Bit. 1 – 16 Bit.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1249 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Data size | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Polarity. 0 – Low. 1 – High.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1250 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Polarity | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Phase. 0 – One edge. 1 – Two edge.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1251 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Phase | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Slave. Не используется

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1252 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Slave | | | | | | | | | | | | | | | |
| Не используется | | | | | | | | | | | | | | | |

Baud. 0 - 21MB/s, 1 - 10,5 MB/s, 2 - 5,25 MB/s, 3 - 2,625 MB/s, 4 - 1,3125 MB/s, 5 - 656,25 kB/s, 6 - 328,125 kB/s, 7 - 164,062 kB/s.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1253 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Baud | | | | | | | | | | | | | | | |
| 0-7 | | | | | | | | | | | | | | | |

First bit. 0 - MSB\_first, 1 - LSB\_first

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1254 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| First bit | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Ti mode. 0 - disable, 1 - enable

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1255 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| First bit | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

## SPI transmitter

Регистры передатчика SPI

|  |  |
| --- | --- |
| Адрес | Название |
| 1266 | Scaler |
| 1267 | reserved |
| 1268 | Len |
| 1269 | Start |
| 1270 | Transaction end |
| 1271 | Rx\_tx\_flag |
| 1372 | Chip select |
| 1276 | Data[0]|Data[1] 8 bit. Data[0] 16 bit. |
| 1307 | Data[62]|Data[63 8 bit. Data[31] 16 bit |

Перед использованием SPI, необходимо провести инициализацию SPI и инициализацию SPI chip\_select. Иначе запросы не будут исполнятся.

Scaler – регистр запуска обновления команды. При записи 1 обновляются параметры команды, и команда запускается. После запуска сбрасывается в 0.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1266 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Scaler | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Len – регистр в который необходимо записать количество байтов для отправки. Не более 32 (64). Если записать более отправка не произойдет.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1268 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Len | | | | | | | | | | | | | | | |
| 0-128 | | | | | | | | | | | | | | | |

Start – регистр запуска отправки данных по SPI. При записи 1 будет отправлена посылка длиной len из массива Data[] начиная с нулевого элемента.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1269 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Start | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Transaction end– регистр отображающий завершение транзакции. Перед отправкой сбрасывается в 0. После отправки всех байтов выставляется в 1.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1270 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Transaction end | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Rx\_tx\_flag. Если выставлен в 1, то транзакция происходит в режиме приема/передачи. Принятые данные будут сложены в регистры данных SPI receive.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1270 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Transaction end | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Регистры данных на отправку.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1276 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 8 Bit mode | | | | | | | | | | | | | | | |
| Data[0] | | | | | | | | Data[1] | | | | | | | |
| 0-256 | | | | | | | | 0-256 | | | | | | | |
| 16 Bit mode | | | | | | | | | | | | | | | |
| Data[0] | | | | | | | | | | | | | | | |
| 0-65535 | | | | | | | | | | | | | | | |

Регистры данных на отправку.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1307 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 8 Bit mode | | | | | | | | | | | | | | | |
| Data[62] | | | | | | | | Data[63] | | | | | | | |
| 0-256 | | | | | | | | 0-256 | | | | | | | |
| 16 Bit mode | | | | | | | | | | | | | | | |
| Data[32] | | | | | | | | | | | | | | | |
| 0-65535 | | | | | | | | | | | | | | | |

## SPI receive

Регистры приемника SPI

|  |  |
| --- | --- |
| Адрес | Название |
| 1308 | Scaler |
| 1309 | reserved |
| 1310 | Len |
| 1311 | Start |
| 1312 | Transaction end |

Scaler – регистр запуска обновления команды. При записи 1 обновляются параметры команды, и команда запускается. После запуска сбрасывается в 0.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1308 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Scaler | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Len – регистр в который необходимо записать количество байтов для отправки. Не более 32 (64). Если записать более отправка не произойдет.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1310 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Len | | | | | | | | | | | | | | | |
| 0-128 | | | | | | | | | | | | | | | |

Start – регистр запуска отправки данных по SPI. При записи 1 будут вычитаны байты количеством len в масстив SPI receive data.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1311 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Start | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Transaction end– регистр отображающий завершение транзакции. Перед приемом сбрасывается в 0. После приема всех байтов выставляется в 1.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1312 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Transaction end | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

## SPI cs settings

Регистры настроек выбора чипа SPI

|  |  |
| --- | --- |
| Адрес | Название |
| 1318 | Scaler |
| 1319 | reserved |
| 1320 | Init\_flag |
| 1321 | CS\_1 |
| 1322 | CS\_2 |
| 1323 | CS\_3 |
| 1324 | CS\_4 |
| 1325 | CS\_5 |
| 1326 | CS\_6 |
| 1327 | CS\_7 |
| 1328 | CS\_8 |
| 1329 | CS\_9 |
| 1330 | CS\_10 |
| 1331 | CS\_11 |
| 1332 | CS\_12 |

Scaler – регистр запуска обновления команды. При записи 1 обновляются параметры команды, и команда запускается. После запуска сбрасывается в 0.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1318 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Scaler | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Init\_flag – выставляется в 1 после инициализации.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1320 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| First bit | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

CS-1 – CS-12. Номер GPIO к которой подключена ножка чип селект.

Если нужно использовать GPIO1 как чип селект, нужно записать 1 в CS\_1. Если GPIO2 – нужно записать 2 в CS\_2. Если GPIO7 – нужно записать 7 в CS\_7. GPIO12 – 12 в CS\_12.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1255 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| First bit | | | | | | | | | | | | | | | |
| 0-12 | | | | | | | | | | | | | | | |

## Power Module

Регистры модуля управления питанием

|  |  |
| --- | --- |
| Адрес | Название |
| 1337 | Scaler |
| 1338 | Voltage |
| 1339 | On\_Off |
| 1340 | OverVoltage |
| 1341 | OverCurrent |
| 1342 | Calibration\_1 |
| 1343 | Calobration\_2 |
| 1344 | Flag New Constrain |
| 1345 | Flag New Calibration |
| 1346 | It\_is\_power\_module Flag |
| 1347 | INA\_Allert\_Reset |

Scaler – регистр запуска обновления команды. При записи 1 обновляются параметры команды, и команда запускается. После запуска сбрасывается в 0.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1337 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Scaler | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Voltage – регистр управления выходным напряжением. 1 LSB – 1 мВ. При записи регистр значения будет генерироваться заданное напряжение на DC-DC преобразователях.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1338 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Voltage | | | | | | | | | | | | | | | |
| 7000-34000 | | | | | | | | | | | | | | | |

On-Off – регистр включения выключения выходного напряжения. Если нет никаких ошибок по перенапряжению, току или по слишком низкому напряжению, будет включено выходное напряжение. В модуле предусмотрены защиты от перенапряжения и от превышения тока (задается пользователем). Защита от пониженного напряжения выполнена на аппаратном уровне, если нужно ее изменить, то необходимо обратиться к документации на модуль питания. По умолчанию меньше 20 Вольт на выходе получить нельзя.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1339 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| On\_Off | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

OverVoltage – регистр регистр настройки защиты от перенапряжения. 1 LSB -1 мВ

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1340 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Voltage | | | | | | | | | | | | | | | |
| 7000-34000 | | | | | | | | | | | | | | | |

OverCurrent – регистр регистр настройки защиты от превышения тока. 1 LSB -1 мА. Рекомендуется использовать ток не больше 2А. Иначе необходимо улучшать охлаждение

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1341 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Voltage | | | | | | | | | | | | | | | |
| 0-3000 | | | | | | | | | | | | | | | |

Calibration 1/2 – регистр регистр настройки DC/DC преобразователей. Из-за неодинаковости резисторов обратной связи, необходимо выполнять программную подстройку выходного напряжения каждого преобразователя. Так же этими регистрами можно компенсировать падение напряжения на токовом шунте. 1 LSB -1 мВ. Регистр знаковый.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1342/1343 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Calibration\_1/2 | | | | | | | | | | | | | | | |
| 0-1000 | | | | | | | | | | | | | | | |

Flag New Constrain / Flag New Calibration – флаг обновления ограничений по току и напряжению и флаг обновления калибровок соответсвенно. При записи 1 будут взяты ограничения и/или калибровки из соответсвующих регистров и перезаписаны.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1344/1345 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Flag New Constrain/Flag New Calibration | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

It\_is\_power\_module\_Flag – регистр показывающий что модуль инициализировался как модуль питания.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1346 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| It\_is\_power\_module\_Flag | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

INA\_Allert\_Reset – регистр для сброса ошибки INA\_226.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Номер регистра 1347 | | | | | | | | | | | | | | | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| INA\_Allert\_Reset | | | | | | | | | | | | | | | |
| 0/1 | | | | | | | | | | | | | | | |

Лист регистрации изменений

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Изм. | Номера листов (страниц) | | | | Всего листов (страниц) в докум. | № докум. | Входящий № сопроводит. документа | Подпись | Дата |
| изменённых | заменённых | новых | аннули­рованных |
|  |  |  |  |  |  |  |  |  |  |