Demo Day

STU FIIT

KISTLER

measure. analyze. innovate.

Introduction

- Team members
- Team Web Page: http://labss2.fiit.stuba.sk/TeamProject/2018/team15iss-it/
- Team GIT: https://git.kistler.com/FIIT/iotester/tree/master
- Contact: fiit.tp.tim15@gmail.com

Vision and Mission - Project Goals

- Team Goals:
  - SCRUM
  - Collaboration
  - Teamwork
- Product Owner Goals:
  - Design and implementation of device for automatic tesing
  - Integration to existing framework (Robot Framework)

Vision and Mission - Start vs. End

Start of Winter Semester (17.09.2018)

End of Winter Semester (13.12.2018)

Start of Summer Semester (11.02.2019)

End of Summer Semester (10.05.2019)

S 1 (2W) | S 2 (2W) | S 3 (2W) | S 4 (2W) | S 5 (1W) | S 6 (2W) | S 7 (2W) | S 8 (3W) | S 9 (2W) | S 10 (2W) | S 11 (1W)

CPU and PRU Communication

First Digital Signal Output and Automated Test

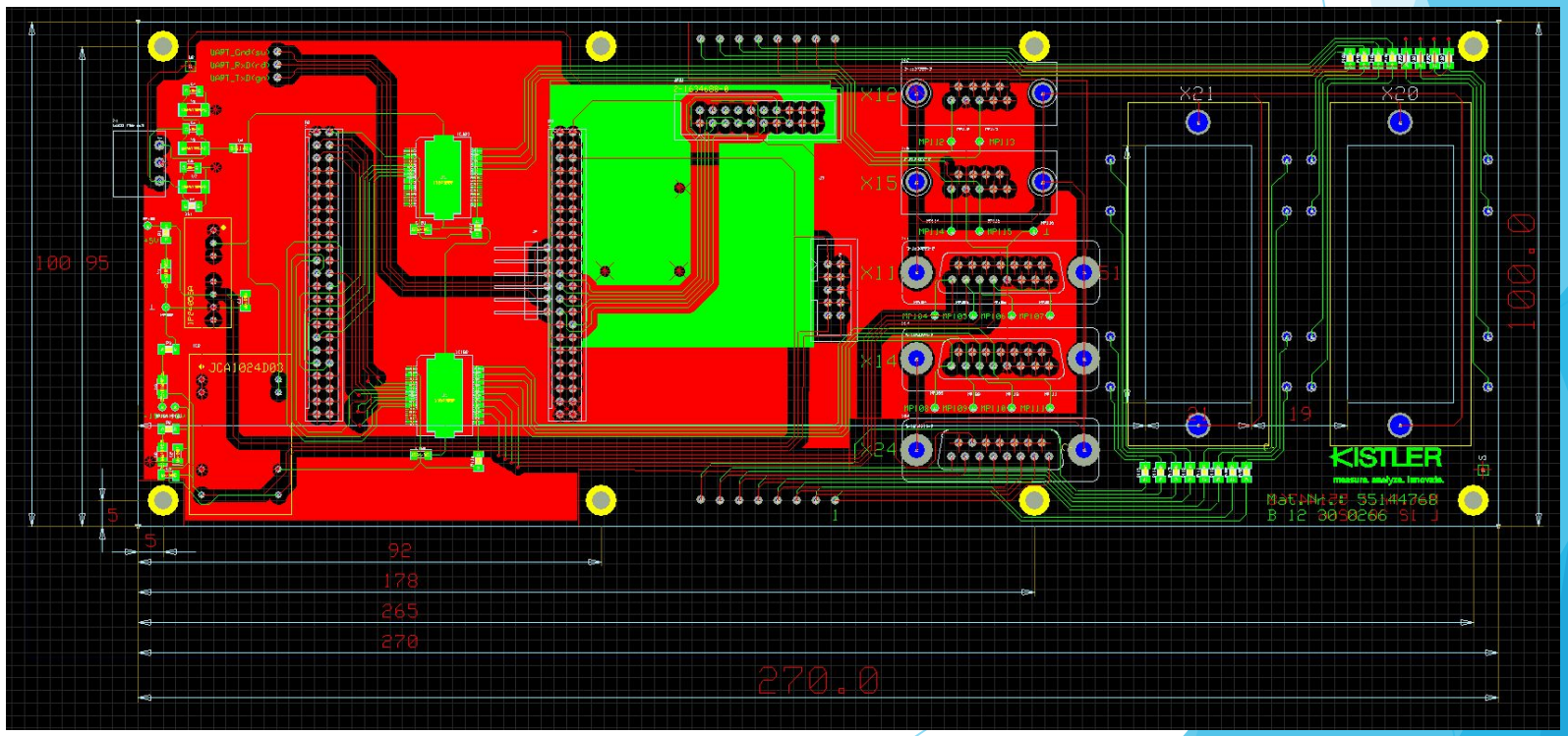
Analog and Digital Signal Output from PRU

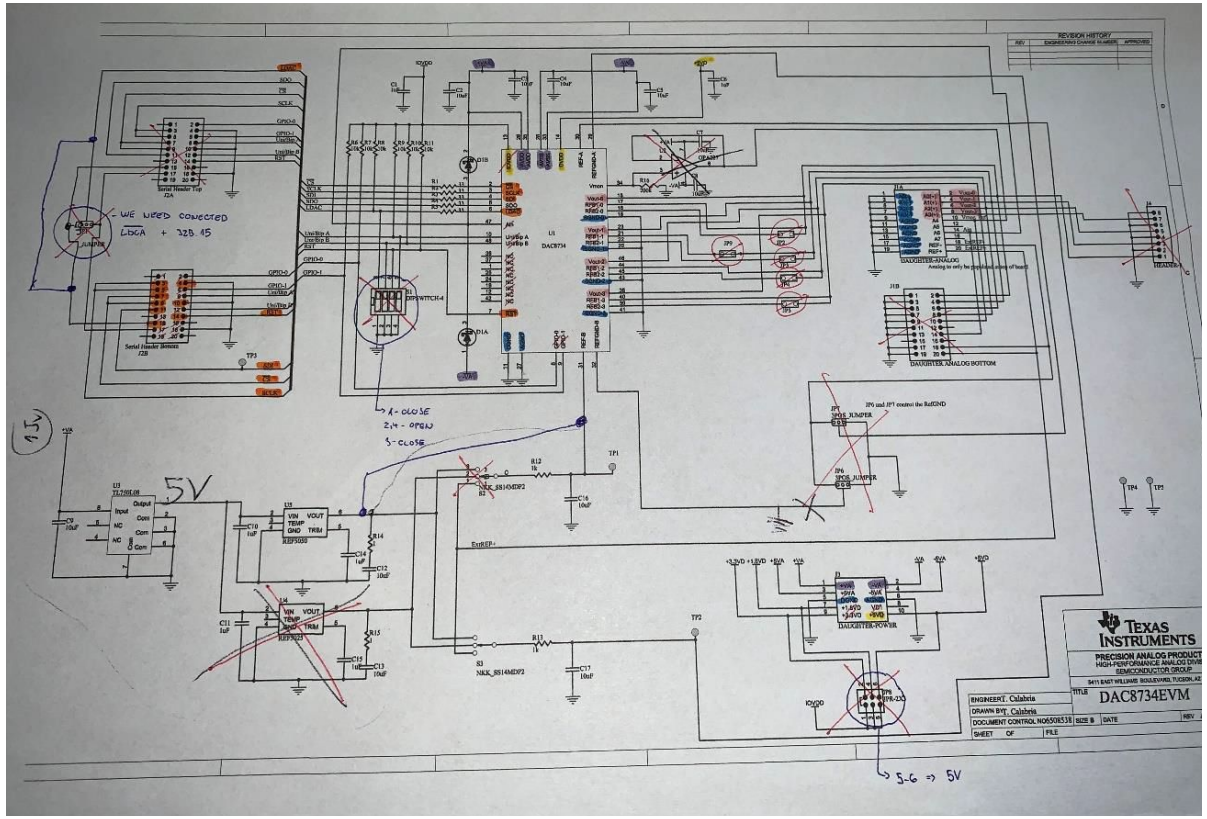
Technical Specification - Software

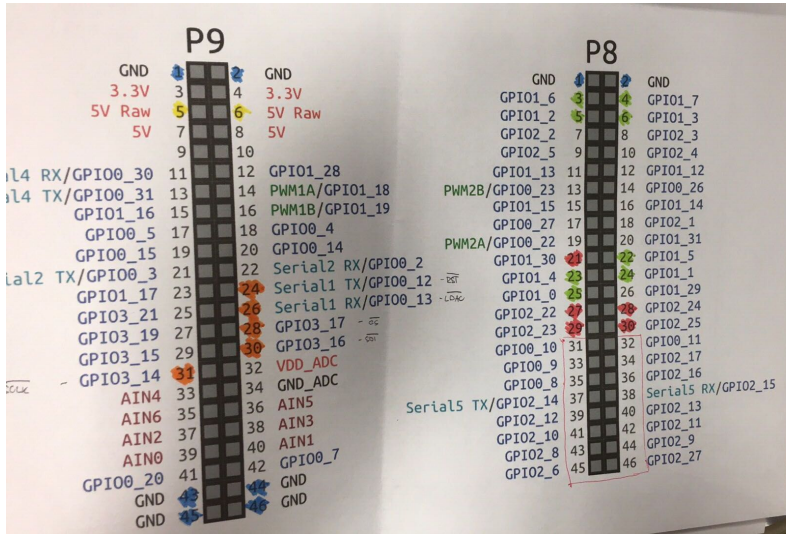
- IDE - Code Composer
- Source codes in C language - compilation is needed
- Web Server - Flask
- Robot Framework
  - Digital Input
  - Python library for sending json

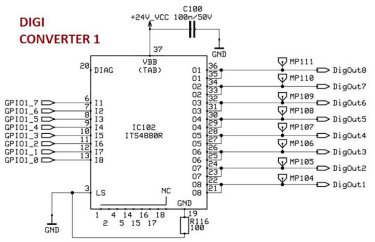
Technical Specification - Hardware

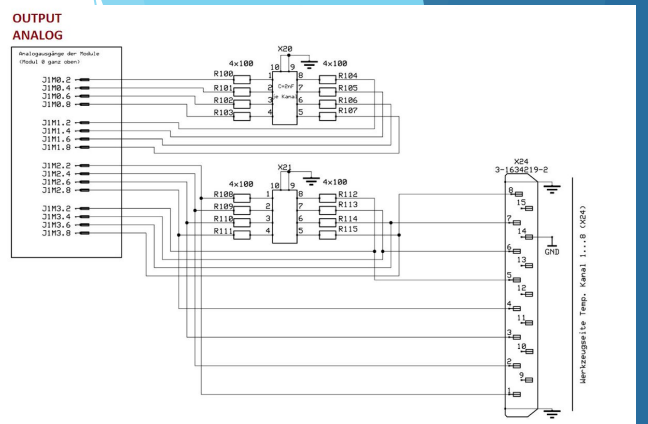
- To do:
  - analyze the hardware
  - create new prototype design
  - create documentation

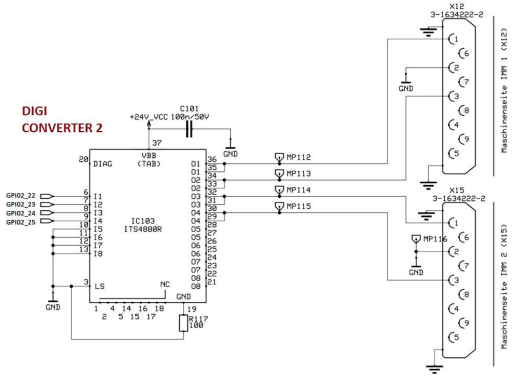


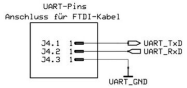

DAC8734EVM
TEXAS INSTRUMENTS
5V
15V

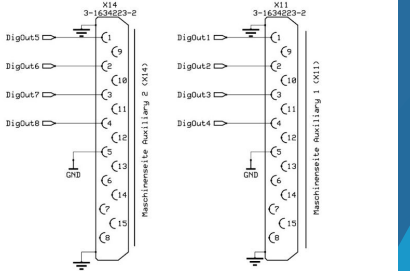

P9
GND
3.3V
5V Raw
5V
GPIO1_28
PWM1A/GPIO1_18
PWM1B/GPIO1_19
GPIO0_4
GPIO0_14
Serial2 RX/GPIO0_2
Serial1 TX/GPIO0_12
Serial1 RX/GPIO0_13
GPIO3_17
GPIO3_16
VDD_ADC
GND_ADC
AIN4
AIN5
AIN6
AIN3
AIN2
AIN1
AIN0
GPIO0_7
GPIO0_20
P8
GPIO1_6
GPIO1_7
GPIO1_2
GPIO1_3
GPIO2_2
GPIO2_3
GPIO2_5
GPIO2_4
GPIO1_13
GPIO1_12
PWM2B/GPIO0_23
GPIO0_26
GPIO1_15
GPIO1_14
GPIO0_27
GPIO2_1
PWM2A/GPIO0_22
GPIO1_31
GPIO1_30
GPIO1_5
GPIO1_4
GPIO1_1
GPIO1_0
GPIO1_29
GPIO2_22
GPIO2_24
GPIO2_23
GPIO2_25
GPIO0_10
GPIO0_11
GPIO0_9
GPIO2_17
GPIO0_8
GPIO2_16
Serial5 TX/GPIO2_14
Serial5 RX/GPIO2_15
GPIO2_12
GPIO2_13
GPIO2_10
GPIO2_11
GPIO2_8
GPIO2_9
GPIO2_6
GPIO2_27

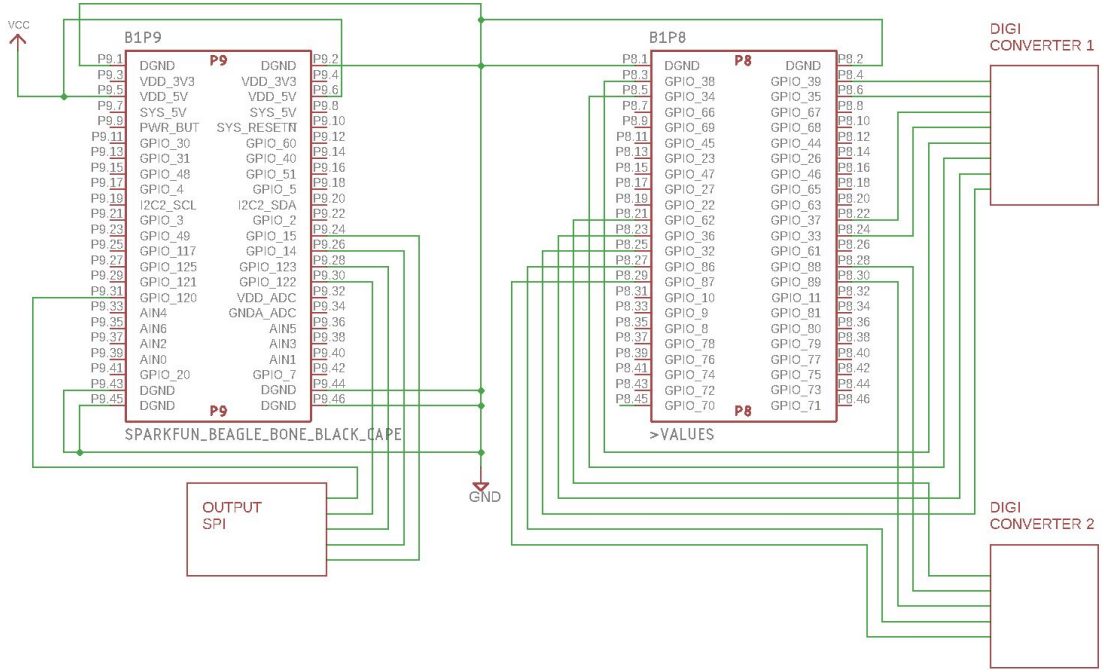

DIGI
CONVERTER 1
+24V_VCC 100n/50V
IC102
ITS4880R
DigOut8
DigOut7
DigOut6
DigOut5
DigOut4
DigOut3
DigOut2
DigOut1

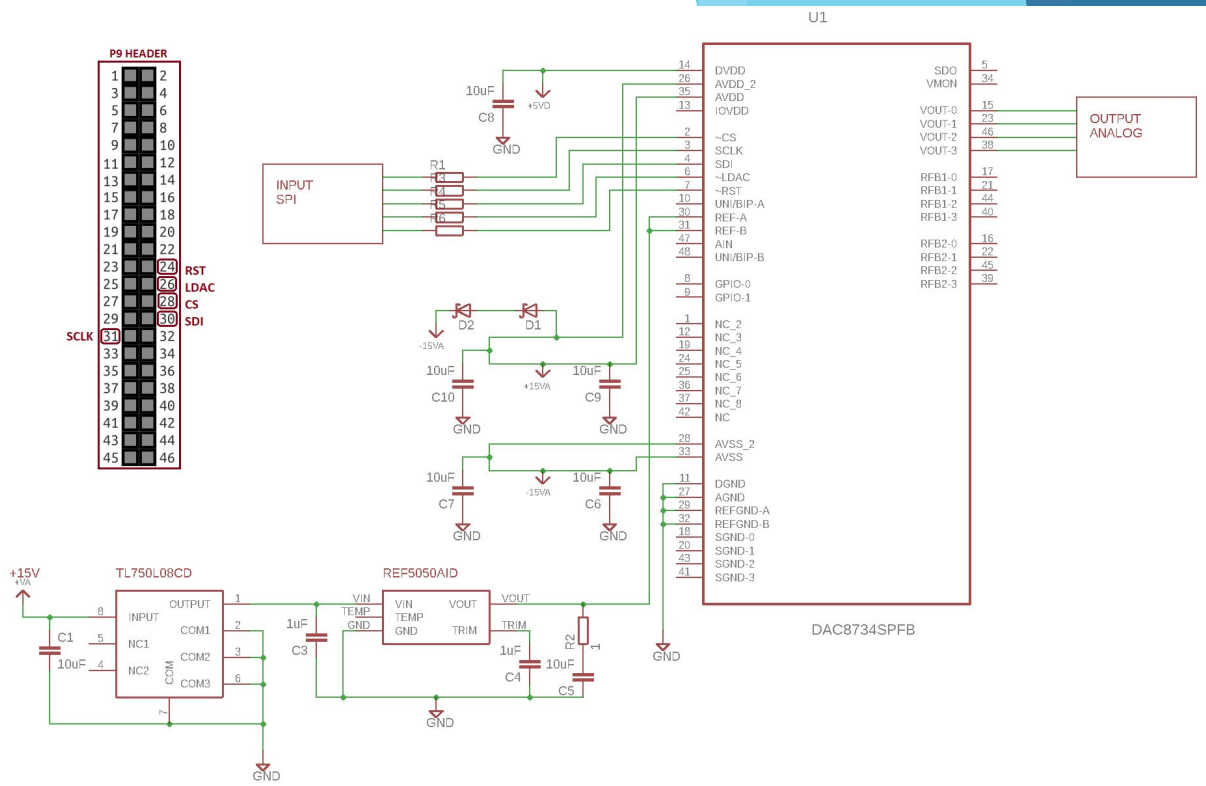

OUTPUT
ANALOG
Werkzeugseite Temp. Kanal 1...8 (X24)


DIGI
CONVERTER 2
+24V_VCC 100n/50V
IC103
ITS4880R
Maschinenseite IMM 1 (X12)
Maschinenseite IMM 2 (X15)

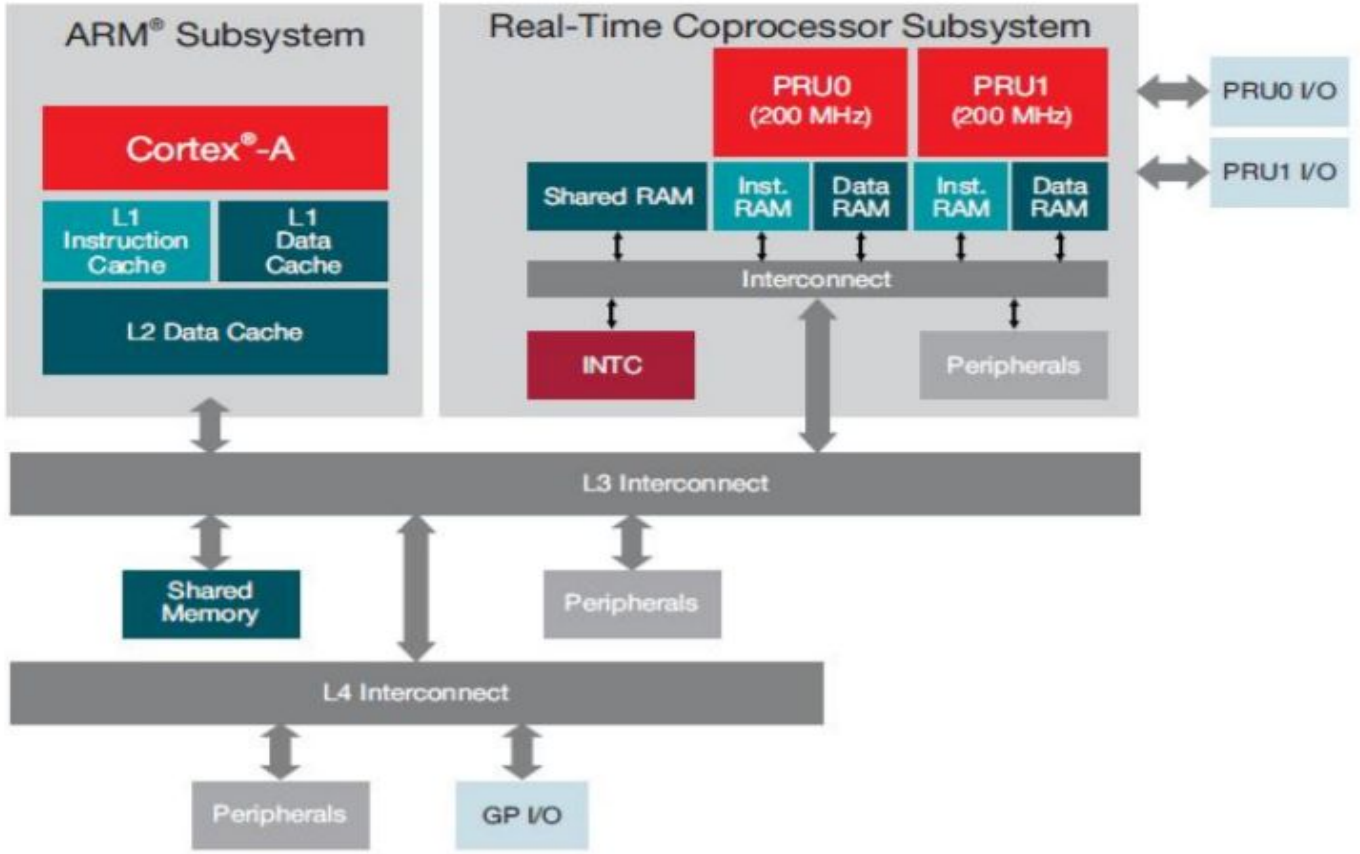

UART-Pins
Anschluss für FTDI-Kabel
UART_TxD
UART_RxD
UART_GND

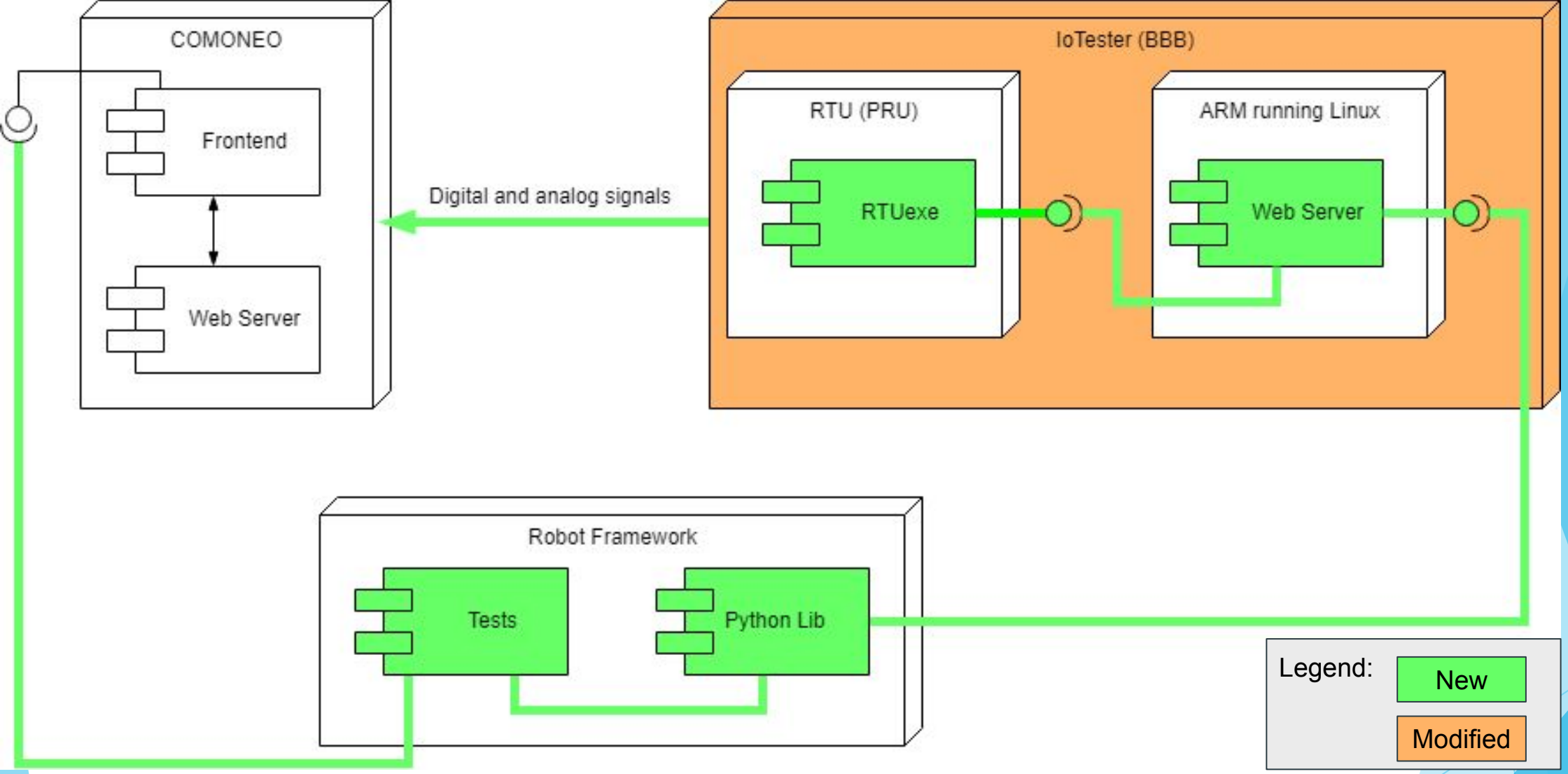

Maschinenseite Auxiliarg 2 (X14)
Maschinenseite Auxiliarg 1 (X11)

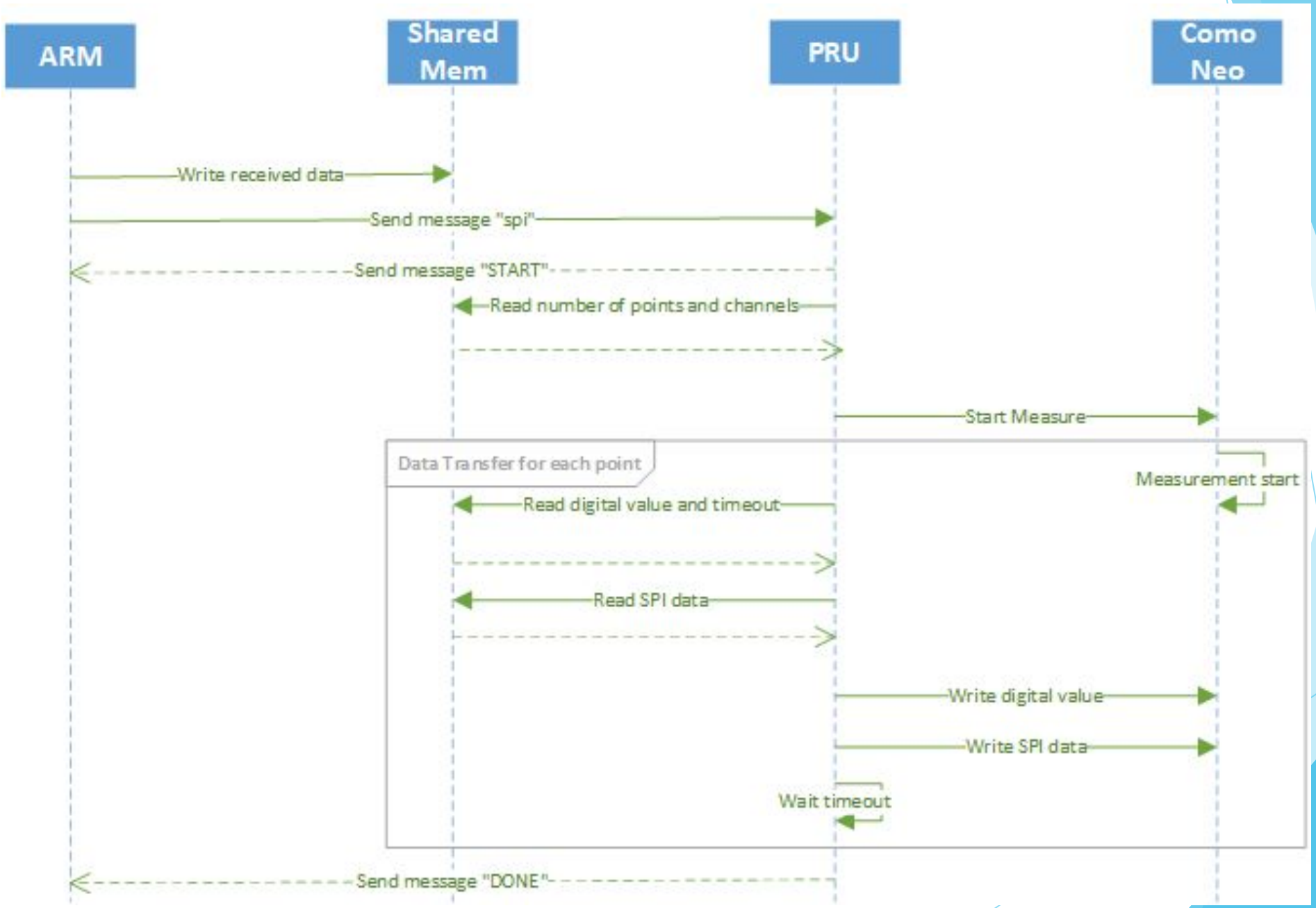

VCC
B1P9
P9
SPARKFUN_BEAGLE_BONE_BLACK_CAPE
B1P8
P8
>VALUES
GND
OUTPUT
SPI
DIGI
CONVERTER 1
DIGI
CONVERTER 2


P9 HEADER
RST
LDAC
CS
SDI
SCLK
U1
INPUT
SPI
R1
D2
D1
C8
C10
C9
C7
C6
C1
C3
C4
C5
C2
+15V
TL750L08CD
REF5050AID
DAC8734SPFB
OUTPUT
ANALOG
GND

Technical Specification - Hardware (Architecture of ARM/PRU)




COMONEO
Frontend
Web Server
Digital and analog signals
IoTester (BBB)
RTU (PRU)
RTUexe
ARM running Linux
Web Server
Robot Framework
Tests
Python Lib
Legend:
New
Modified


ARM
Shared Mem
PRU
Como Neo
Write received data
Send message "spi"
Send message "START"
Read number of points and channels
Start Measure
Data Transfer for each point
Measurement start
Read digital value and timeout
Read SPI data
Write digital value
Write SPI data
Wait timeout
Send message "DONE"

Solution - Data for BBB

- Data structure, which represents data that is sent to BBB:

std::uint32_t sampleIndex; ///< Index of sample in the cycle.

std::uint32_t digitalIn; ///< Status of digital inputs.

std::int32_t channel[cChannelsInSample]; //< max 16 channels

- JSON structure:

"sampleIndex": "0",

"digitalIn": "256",

"channel": ["0", "-2751", "-1566", "-1190", "-2775", "-24", "- 88", "-588", "477", "0", "0", "0", "0", "0", "0", "0"]

Solution - CPU and PRU Communication

Adresa	Posun adresy	Údaj
0x4a312000	(+4)	Počet bodov na krivke
0x4a312004	(+4)	Počet kanálov
0x4a312008	(+4)	Časova dĺžka zápisu (Delay)
0x4a31200c	(+4)	Digital Input
0x4a31200e	(+2)	Hodnota kanálu 1
0x4a312010	(+2)	Hodnota kanálu 2
...	...	...
0x4a312014	(+4)	Časova dĺžka zápisu (Delay)
0x4a312018	(+4)	Digital Input
0x4a31201a	(+2)	Hodnota kanálu 1
0x4a31201c	(+2)	Hodnota kanálu 2
...	...	...
	Hlavička (iba na začiatku)	
	hodnoty vstupu v čase x	
	hodnoty vstupu v čase x+1	

Solution - Hardware

- Build dependencies packages with Yocto
- Boot from SD card
- Setup PINs to desired modes

Head_pin	$PINS	ADDR/OFFSET	Name	GPIO NO.	Mode3
P9_28	103	0x99c/19c	SPI1_CS0	113	spi1_cs0
P9_29	101	0x994/194	SPI1_D0	111	spi1_d0
P9_30	102	0x998/198	SPI1_D1	112	spi1_d1
P9_31	100	0x990/190	SPI1_SCLK	110	spi1_sclk

Head_pin	$PINS	ADDR/OFFSET	GPIO NO.	Name	Mode7
P8_01				DGND	
P8_02				DGND	
P8_03	6	0x818/018	38	GPIO1_6	gpio1[6]
P8_04	7	0x81c/01c	39	GPIO1_7	gpio1[7]
P8_05	2	0x808/008	34	GPIO1_2	gpio1[2]
P8_06	3	0x80c/00c	35	GPIO1_3	gpio1[3]
P8_07	36	0x890/090	66	TIMER4	gpio2[2]
P8_34	51	0x8cc/0cc	81	UART3_RTSN	gpio2[17]
P8_36	50	0x8c8/0c8	80	UART3_CTSN	gpio2[16]
P8_37	48	0x8c0/0c0	78	UART5_TXD	gpio2[14]
P8_38	49	0x8c4/0c4	79	UART5_RXD	gpio2[15]

Solution - PRU

- PRU-ICSS Remoteproc and RPMsg - messages
- Loading PRU program
  - echo 'am335x-pru0-fw' > /sys/class/remoteproc/remoteproc1/firmware
- Run PRU programu
  - echo 'start' > /sys/class/remoteproc/remoteproc1/state
- Stop PRU program
  - echo 'stop' > /sys/class/remoteproc/remoteproc1/state
- Send message
  - ARM => PRU
    - echo "test30" > /dev/rpmsg_pru30
  - PRU => ARM
    - pru_rpmsg_send(&transport, dst, src, "START", 5);
- "pru_iep.h" library for timing

Solution - PRU

- Execution steps:
  - Data are stored in memory
  - Fetch message “spi”
  - Read data from memory
  - Start measurement
  - Write data to SPI in cycle
  - Write digital data
  - Timing with register IEP (1 time period = 62,5 us)
  - Writing all points

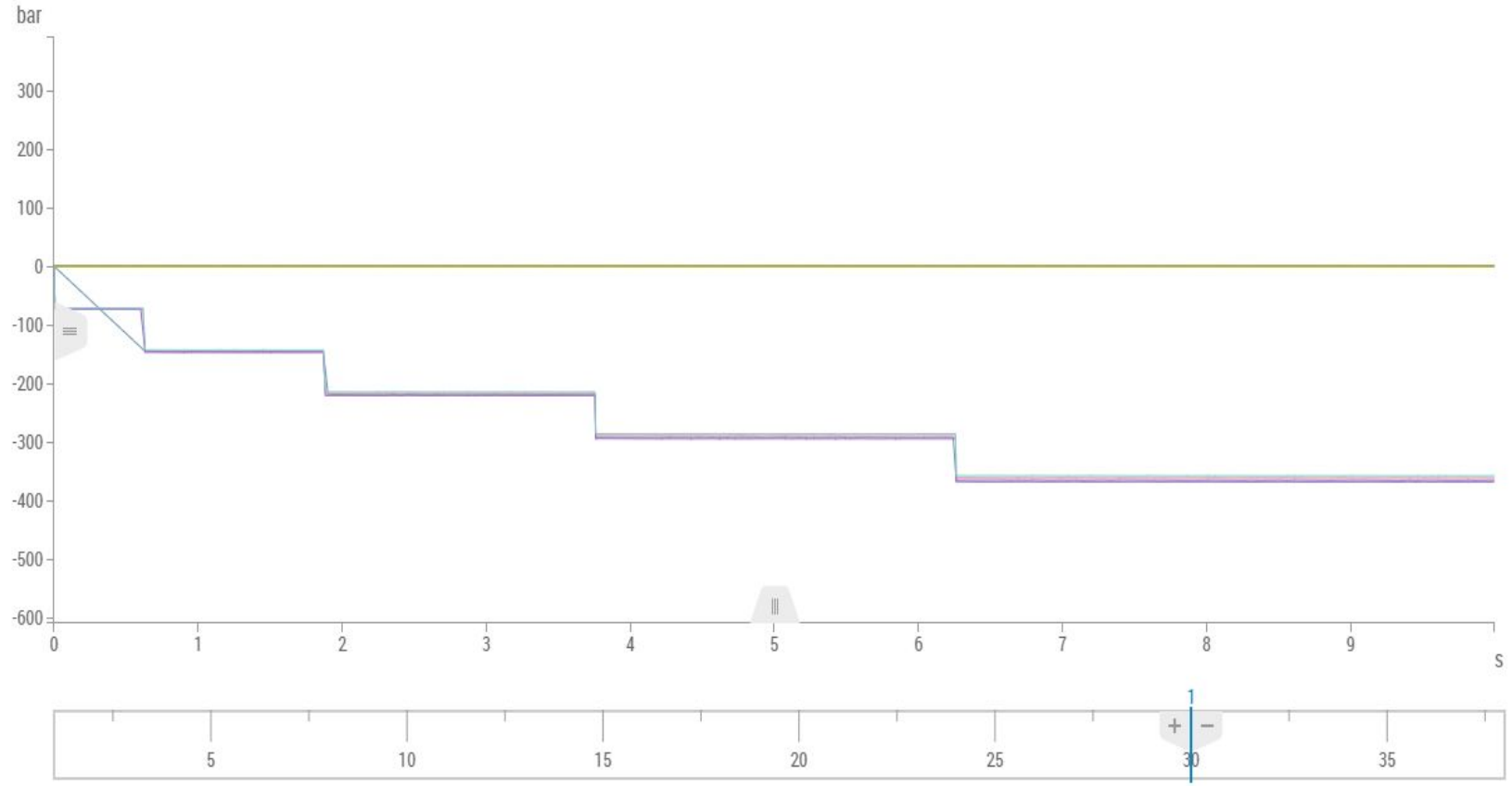
Solution - Obstacles

- Usage of PRU-ICSS Remoteproc and RPMsg
  - Loss of BBB Linux OS.
  - Missing packages
  - Hard to debug
  - Can’t do standard boot from SD card
  - Less advantages with lot of problems

Home
Analysis
Trend
Cycle
Delta Time
Monitoring
Control
Mould
Device
Maintenance

Analysis > Cycle > Cycle View

Cycle 30 May 2, 2019 9:22:51 AM



Graph settings | Cursor | Comments

Cavity Display — Highlight

01 02 03 04
05 06 07 08
09 10 11 12
13 14 15 16

Sensors — Pressure — Temperature

PostGate

Machine Signal

1 eSwitchOverPoint1

Visualisation Options

Evaluation Objects: show current

Reference: None

Create Reference

Colouring: colour per cavity

Discussion Time