# BRIO

## EN50155 Basic Remote I/O module

## Application note
## CAN2.0B communication

**P DOC BRIO 102E V01**

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## Introduction

BRIO is a decentralized-remote input/output module designed to be embedded onboard rolling stock vehicles.

BRIO is fully compliant with the EN50155 standard for railway systems.

This application note describes all the necessary information to getting started with 1 BRIO with CAN 2.0B functionalities: hardware & software settings.

Following User Manual for BRIO are available:

- ✓ User Manual "Hardware specifications & installation" P_DOC_BRIO_002E
- ✓ User Manual "Getting Started Software Guide" reference P_DOC_BRIO_003E

## Prerequisites

It is necessary that the user has got technical knowledge in mechanical & electrical railway systems.

## Safety instructions

Following symbols are used in this documentation in order to avoid user for potential risks:


Risk of personal injury or damage to the equipment.


Risk of an electrical hazard.

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Chapter

1

# Introduction

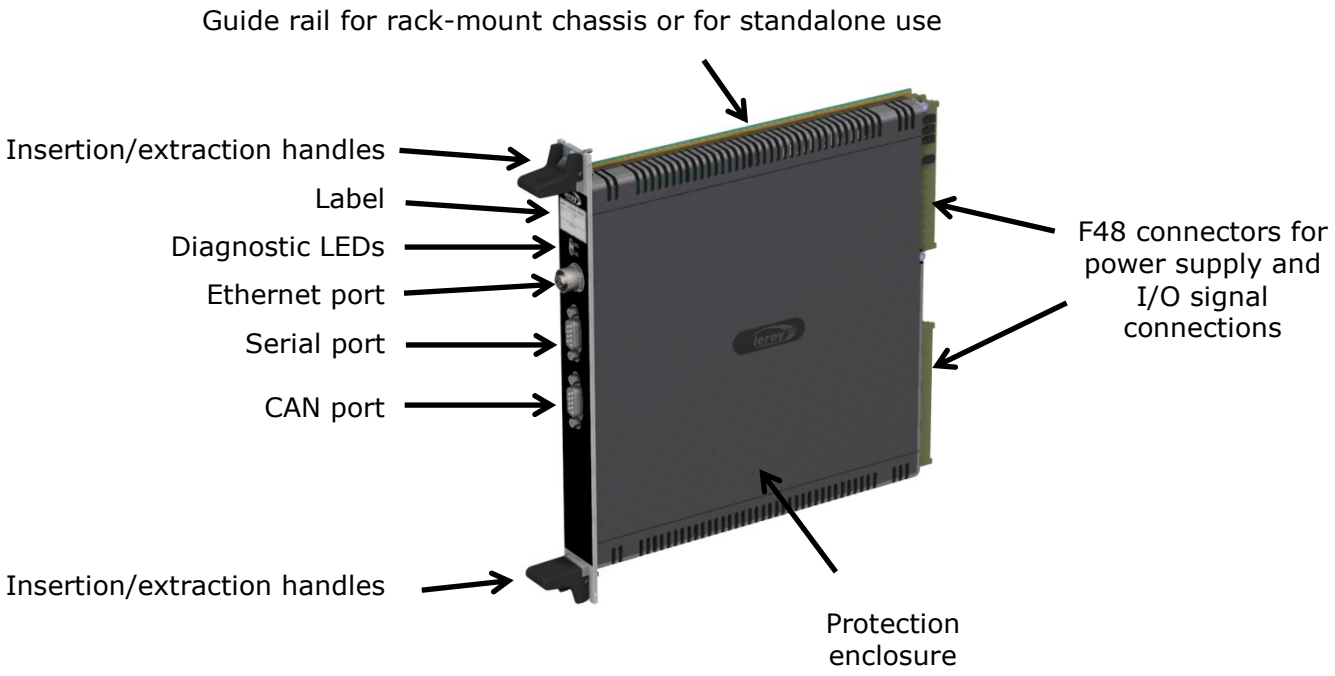
## Contents

In this section, we will discuss the following topics:

- Description,
- Product part numbers,
- System architecture examples,
- Features

## Description

BRIO is a hardware unit fully compliant with the EN50155 standard, and it is designed to be integrated in embedded railway systems and subsystems.

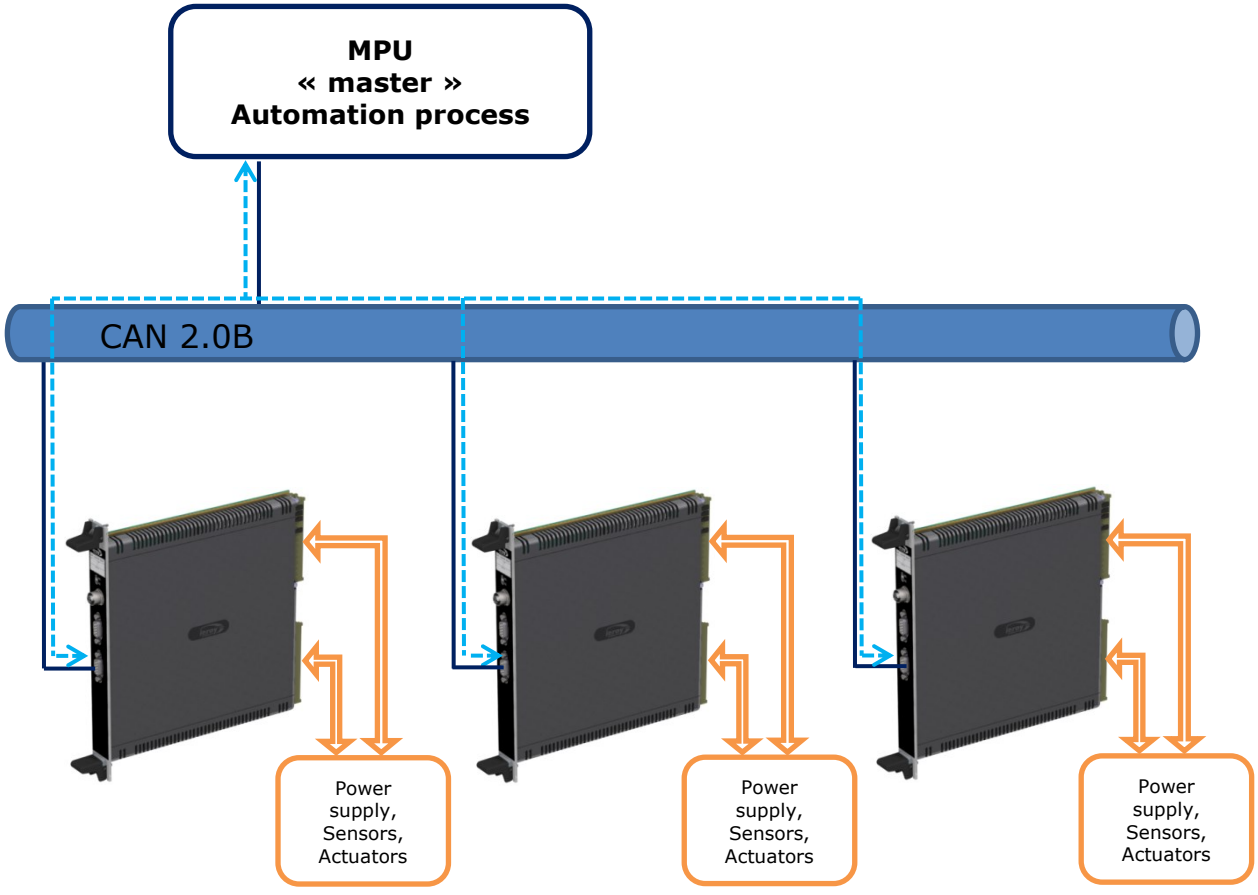


## Product part numbers

| | |
|---|---|
| **Power supply** | **Full range from 24V to 110VDC** |
| **Digital inputs** | **40** |
| **Digital outputs** | **8 Relays & 2 Solid State Relays (SSR)** |
| **Analog inputs** | **2 currents & 2 voltages** |
| **Analog outputs** | **1 current or voltage** |
| **Ethernet port** | **IEEE 802.3 10/100Mbits/s base Tx** |
| **CAN port** | **CAN2.0B** |

## System architecture example

BRIO may be used as a CAN2.0B IO device; it will then be controlled by another CAN2.0B device « scanner » through the CAN network; the « scanner » device will be able to read the state and values of the input signals, and to drive its output signals.



# Features

Variable power supply range from 24V to 110VDC

40 Digital inputs

- ✓ Variable power supply (full range from 24V to 110VDC)
- ✓ logical levels defined by software settings
- ✓ Individual filter parameters configurable
- ✓ 10mA fritting current
- ✓ Permanent auto-test on each input

10 Digital outputs

- ✓ SPDT (Single Pole Double Throw) type: relay outputs
- ✓ SSR (Solid state relay): isolated solid state ouputs, up-stream or down-stream loads, current monitoring on one output (optional)
- ✓ Command read-back feature on each output (optional)

Input/Output management implemented in an FPGA device

STM32 ARM Cortex-M3 microcontroller with FreeRTOS real time operating system

Maximum delay between Ethernet and I/O:

- ✓ Between digital or analog inputs and Ethernet <10ms
- ✓ Between Ethernet and digital or analog outputs <15ms

Protocols available:

- ✓ CAN port: CAN2.0B protocol
- ✓ Ethernet port:
  - EtherNet/IP adapter
  - UDP protocol

BRIO too includes internal safety features as:

- ✓ a watchdog for monitoring the data communication between FPGA and microcontroller.
- ✓ a watchdog on the microcontroller.
- ✓ a safe communication (HDLC) between FPGA and microcontroller.

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Chapter

2

# CAN2.0B communication protocol

## Contents

In this section, we will discuss the following topics:

- CAN2.0B header description
- Messages description

Refer to documentation "BRIO CAN Data dictionary" for the complete description of all CAN messages.

## CAN2.0B header description

| 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Function Code** | | | | | | | | | | | | | **src** | | | | **dest** | | | | **Message ID** | | | | | | | |
| | | | | | | | | | | | | | **Module addr** | | | | | | | | | | | | | | | |

| **Name** | **Description** |
|---|---|
| Function code | Used to identify function requested |
| Module Address - src | Is the source of emitter<br>0: TCU (Only TCU is allowed by BRIO) |
| Module Address - dest | For request is the destination<br>0: Broadcast (all device send a response)<br>[1-255]: unicast (only device requested send a response<br>For response equal to originator of request. |
| Message ID | Free running counter, incremented by one at each new message (only managed by BRIO) |

## Messages description

### Set Digital Output

Request message :

| | | **RQST_SET_DO_VALUE** | | |
|---|---|---|---|---|
| **Function code** | **DLC** | **DATA** | | |
| 0x101 | 2 | Name | Offset | Description |
| | | DIGITAL_OUTPUT_1_8 | 0x00 | Output value from 1 to 8 |

| | | | | |
|---|---|---|---|---|
| | | DIGITAL_OUTPUT_9_10 | 0X01 | Output value from 9 to 10 |

BRIO response message

| | | RESP_SET_DO_VALUE | | |
|---|---|---|---|---|
| **Function code** | **DLC** | **DATA** | | |
| 0x201 | 2 | Name | Offset | Description |
| | | DIGITAL_OUTPUT_1_8 | 0x00 | Output value from 1 to 8 |
| | | DIGITAL_OUTPUT_9_10 | 0X01 | Output value from 9 to 10 |

## Get Digital Input

Request message :

| | | RQST_SET_AO_VALUE |
|---|---|---|
| **Function code** | **DLC** | **DATA** |
| 0x103 | 0 | None |

BRIO response message

| | | RESP_SET_AO_VALUE | | |
|---|---|---|---|---|
| **Function code** | **DLC** | **DATA** | | |
| 0x203 | 2 | Name | Offset | Description |
| | | DIGITAL_INPUT_1_8 | 0x00 | Digital input from 1 to 8 (0:not activated,1:activated) |
| | | DIGITAL_INPUT_9_16 | 0X01 | Digital input from 9 to 16 (0:not activated,1:activated) |
| | | DIGITAL_INPUT_17_24 | 0X02 | Digital input from 17 to 24 (0:not activated,1:activated) |
| | | DIGITAL_INPUT_25_32 | 0X03 | Digital input from 25 to 32 (0:not activated,1:activated) |
| | | DIGITAL_INPUT_33_40 | 0X04 | Digital input from 33 to 40 (0:not activated,1:activated) |

Chapter

3

# Installation-wiring-settings

## Contents

In this section, we will discuss the following topics:

- Installation
- Wiring
- Settings

## Installation

BRIO shall be mounted on the standalone support designed for it.

It receives F48 connectors for power supply and IO on the rear panel.

For mounting or dismounting, refer to User Manual "Hardware specifications & installation" P_DOC_BRIO_002E Chapter 4.

## Wiring

### F48 IO connector pinout

Pinout is described in P_DOC_BRIO_002E documentation Chapter3.

### CAN2.0 B subD9 connector pinout (SubD9 Male)

Pinout is as following according to ISO 11898-2.

| SubD9 | Signal |
|---|---|
| 2 | CAN low |
| 3 | CAN ground |
| 7 | CAN high |

## BRIO Settings

Settings are saved in BRIO NVM (Non Volatile Memory).

They can be set or modified through BRIO subD9 RS232 link: refer to User Manuel Getting Started Software Guide P_DOC_BRIO_003E Chapter 5.

Use command "j" then command "a" in order to read all NVM settings.

```
LEROY Automation
www.leroy-automation.com
BRIO EIP Adapter Device

NVM configuration menu
-------------------------------------------
IP address                                  : 192.168.1.15
Netmask address                             : 255.255.255.0
Gateway address                             : 192.168.1.1
Ether config: Auto-negotiation(1=true,0=false)  : 1
Ether config: Speed(0=10Mb/s,1=100Mb/s)     : 0
Ether config: Type(0=half,1=full)           : 0
Dhcp(0=no,1=yes)                            : 0
Option 61(0=no,1=yes)                       : 1
Hostname                                    : BRIO EIP
Time-out scanner(0..255)                    : 50
Analog input threshold(0=24V,1=72v,2=110V)  : 0
Extension number(0..3)                      : 0
Extension number with analog(0..2)          : 1
Module type(0=master,1=slave)               : 0
device id (CAN addr)                : 4
```

Setting for CAN management:

- "device id" or CAN address: set to 4 in this example.

Chapter

4

# Monitoring examples

## Contents

In this section, we will discuss the following topics:

- Principle
- CAN2.0B communication with Busmaster
- CAN2.0B communication with Straton Runtime for PC

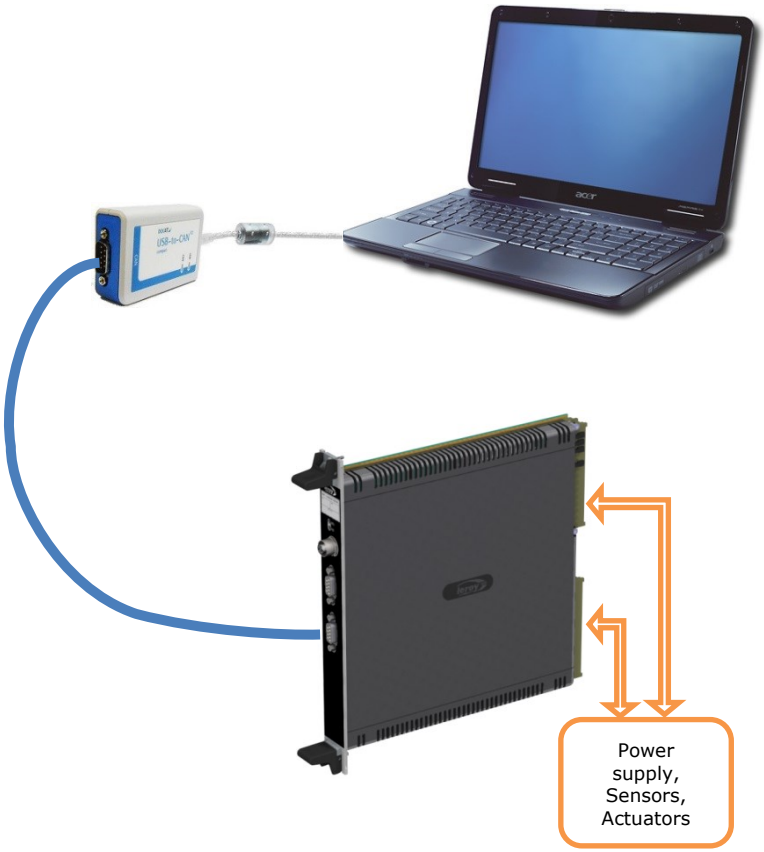
## Principle

BRIO will communicate with one PC through the CAN network.

For this, the PC will be fitted with a specific hardware: 1 USB/CAN device from IXXAT (USB-to-CAN V2) and specific software able to manage this hardware and CAN frames.

We will explain 2 examples with 2 different softwares in order to drive this hardware on the laptop and then to monitor BRIO through the CAN network:

- First example: use of Busmaster software from RBEI Company.
- Second example: use of Straton T5 Runtime software from Copalp Company.



# CAN2.0B communication with Busmaster

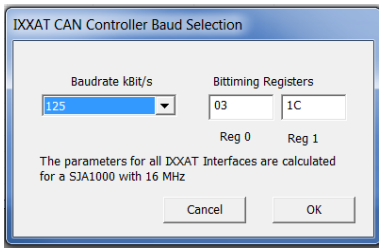
## Software Installation

We need to install Busmaster software on the PC:

- Download it : http://rbei-etas.github.io/busmaster/
- Install it : BUSMASTER_Installer_Ver_2.x.y.exe

After Busmaster installation, start it.

## Busmaster settings

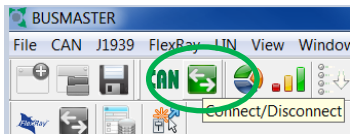



Do the following settings in the "CAN" menu:

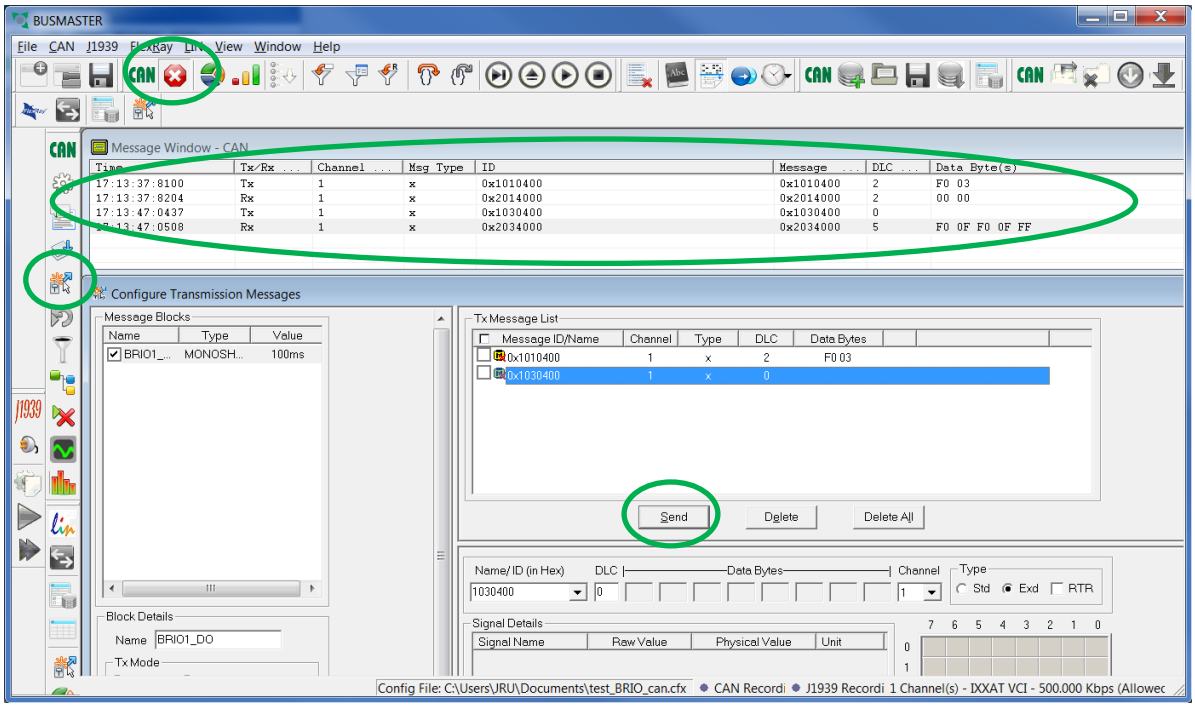
- Driver selection: select "IXXAT VCI"
- Channel configuration : for Baudrate kBit/s, select « 125 »
- Configure Transmission Messages : add 2 messages :
  - Message 1 : ID « 0x1010400 » for writing BRIO digital outputs
  - Message 2 : ID « 0x1030400 » for reading BRIO digital inputs

## Busmaster tests

Connect Busmaster to IXXAT device: menu "CAN" and "Connect" or Connect button.




Then select one Message and click on the "Send" button.
The send message and BRIO response appear in Message Window.



# CAN2.0B communication with Straton Runtime for PC

## Software Installation

We need to install several softwares on the PC:

- T5 runtime
- STRATON IDE

After STRATON installation, we will restore in STRATON the BRIO2E list of projects developed for this example.

## Copalp T5 runtime setup

Execute the following setup file "STRATON.T5.setup.8.7.build.2.exe". This software is protected, but you can run it for demonstrations during 15 minutes. If you need more, you have to stop & start it.

## STRATON IDE setup

Execute the following setup file "STRATON.IDE.setup.8.7.build.2.exe". This software is protected, but for demonstrations you can run it and build projects containing less 40 IO variables.

## STRATON Project List

The complete project list is contained in a zip file: "BRIO2E.zip"

- "BRIO_CAN": project with CAN2.0 communication.

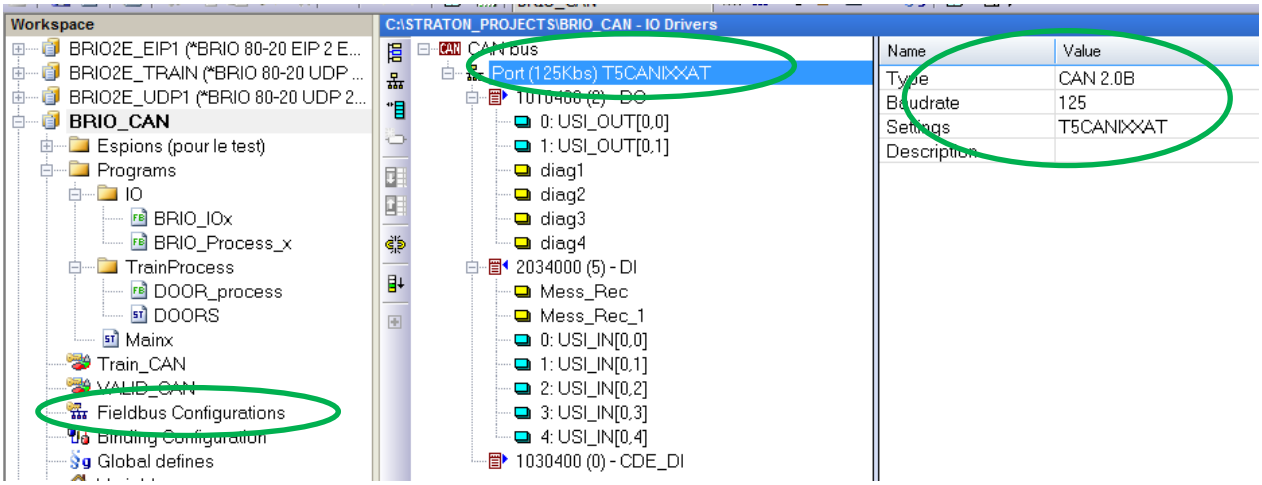
In STRATON Editor 8.7 (IDE), select menu "File"/"Open Project List"/"From Zip": select the zip file: "BRIO2E.zip", and validate.

## Principle

The project "BRIO_CAN" enables 1 CAN2.0B connection with one BRIO.

## Configuration

The fieldbus Configurations tool allows to define the complete CAN2.0B communication with each project variables linked to:



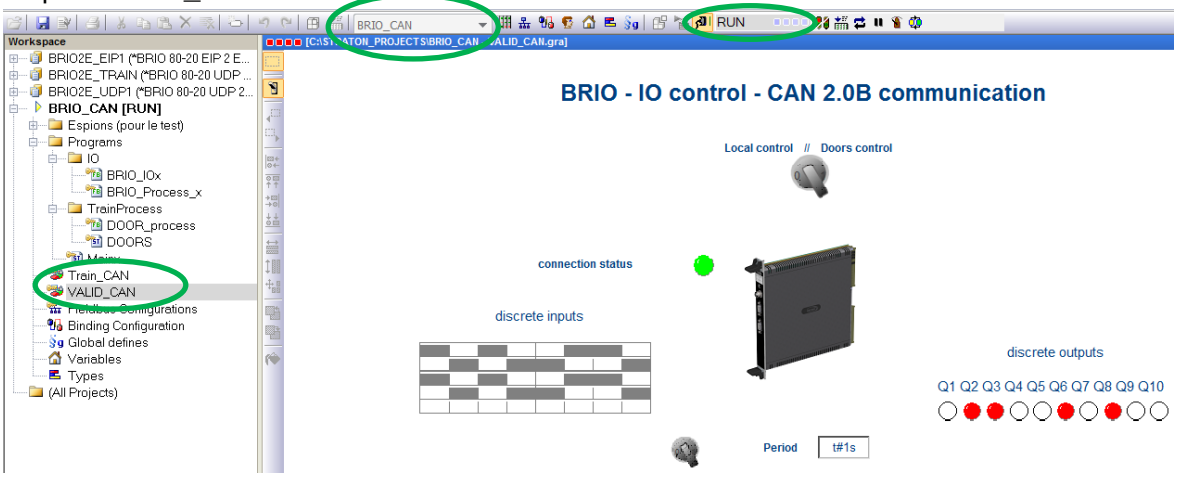
## Test

The project BRIO_CAN shall have been selected, then:

- connect you to the T5 Runtime with the "On line" button
- download the project code into the T5 runtime

The Graphic windows "Valid_CAN" or "Train_CAN" allows to monitor the BRIO.

Graphic "Valid_CAN":




Graphic "Train_CAN":