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Railway applications — Functional Interface Specification — Pantograph System

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**Railway applications - Functional Interface Specification -
Pantograph System**

Applications ferroviaires - Spécification d'interface
fonctionnelle - Système de pantographe

To be completed

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Foreword

This document (CLC/TR 50624:2014) has been prepared by WG15 of CLC/TC 9X "Electrical and electronic applications for railways".

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This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association.

1 Scope

This Technical Report is covering the description of the pantograph system and the functional interface between the pantograph system itself and the TCMS, including the context of multiple units.

The pantograph system contains the pantograph and the pantograph control. The internal interface between pantograph and pantograph control is not in the scope of this document.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 50367, *Railway applications - Current collection systems - Technical criteria for the interaction between pantograph and overhead line (to achieve free access)*

EN 61131-3:2013, *Programmable controllers - Part 3: Programming languages (IEC 61131-3:2013)*

UIC 556, *Information transmission in the train (train-bus)*

3 Terms, definitions and abbreviations

For the purposes of this document, the following terms, definitions and abbreviations apply.

3.1 Terms

3.1.1

configuration

action that affects the system function

3.1.2

parameterisation

action that affects the system behaviour

3.2 Abbreviations

All the abbreviations used in this document are listed in Table 1, in alphabetic order referenced to their term.

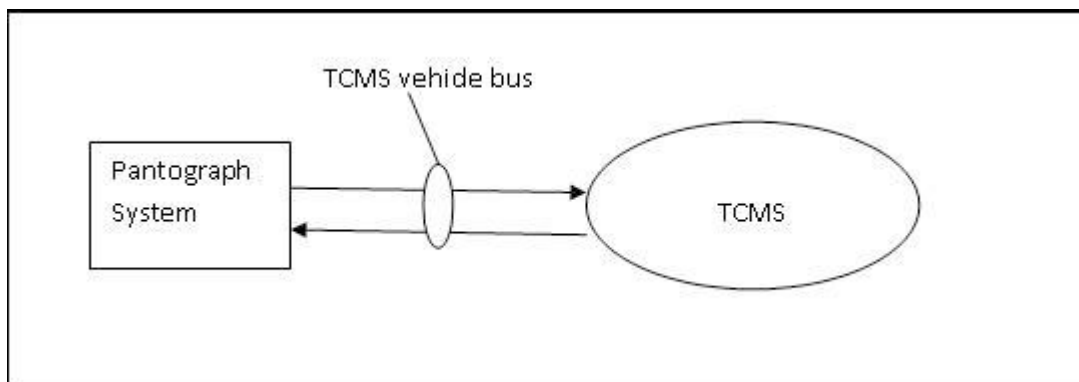
Table 1 - Abbreviation table

Abbreviation	Term
FBS	Functional Breakdown Structure
FIS	Functional Interface Specification
MAC	Media Access Control (related to data transmission in networks)
MPU	Main Processing Unit
PBS	Product Breakdown Structure
PTU	Pantograph Control Unit
QoS	Quality of Service (related to data transmission in networks)
RAMS	Reliability, Availability, Maintainability, Safety
TCMS	Train Control & Monitoring System
UML	Unified Modelling Language
UTC	Universal Time Coordinated (time scale)

4 Pantograph reference architecture

The pantograph reference architecture is shown in Figure 1.

The pantograph system has a network interface with the TCMS for the purpose of control and monitoring, as well as for service and diagnostics. This document describes the interface between TCMS and one single Pantograph system with regard to the context of multiple units.

**Figure 1 - pantograph system and TCMS interface**

In addition to the pantograph control reference overview, as it is described in the subsequent clauses, the scope of this FIS for controlling a pantograph is shown in Figure 2. It is to be noted that PBS 4.1.1 is the reference to the original MODTRAIN document from which this document is derived and PBS 9.2 is the reference to the original MODTRAIN document describing TCMS.

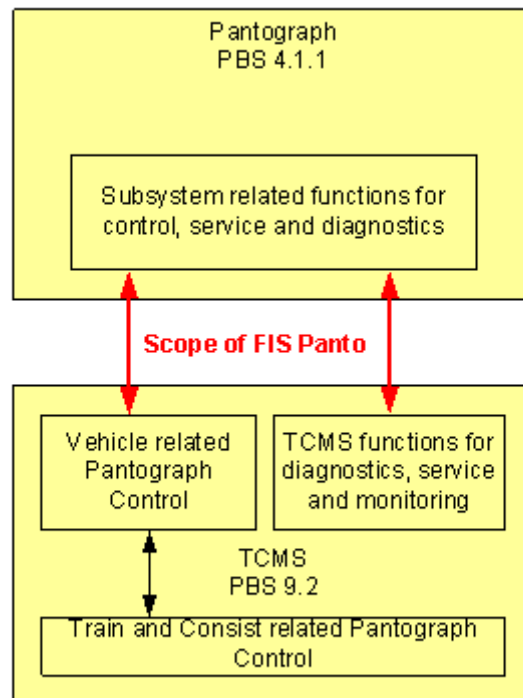


Figure 2 - interaction between Pantograph system and TCMS

5 Functional description

5.1 General

In this clause are described the pantograph functions external to the TCMS, which exchange information with the TCMS over the interface.

The here described interface is a basic standard interface with possibilities of extension (parameters and services can be added).

If not especially mentioned for each parameter a Set and a Get service is provided.

The function types which are considered are the following:

- Functions for parameterisation
- Functions for control
- Functions for monitoring
- Functions for diagnostics
- Functions for service

5.2 Specific requirements on functional interfaces

If deemed useful, the static description of data are completed by:

- Dynamic description, with sequence diagrams, possibly using several interfaces identified in the reference architecture, for normal and degraded modes. These diagrams may contains timing requirements (such as time between the command set to TCMS and notification to remote actuators)

- RAMS requirements to the communication and processing in the TCMS
- Any other relevant item
- The physical layer shall be defined later

5.3 Interface between pantograph and TCMS

5.3.1 General

Figure 3 shows the UML diagram of the TCMS control interface related to the pantograph system.

Figure 4 shows the UML diagram of the diagnostic common interface between the pantograph and TCMS.

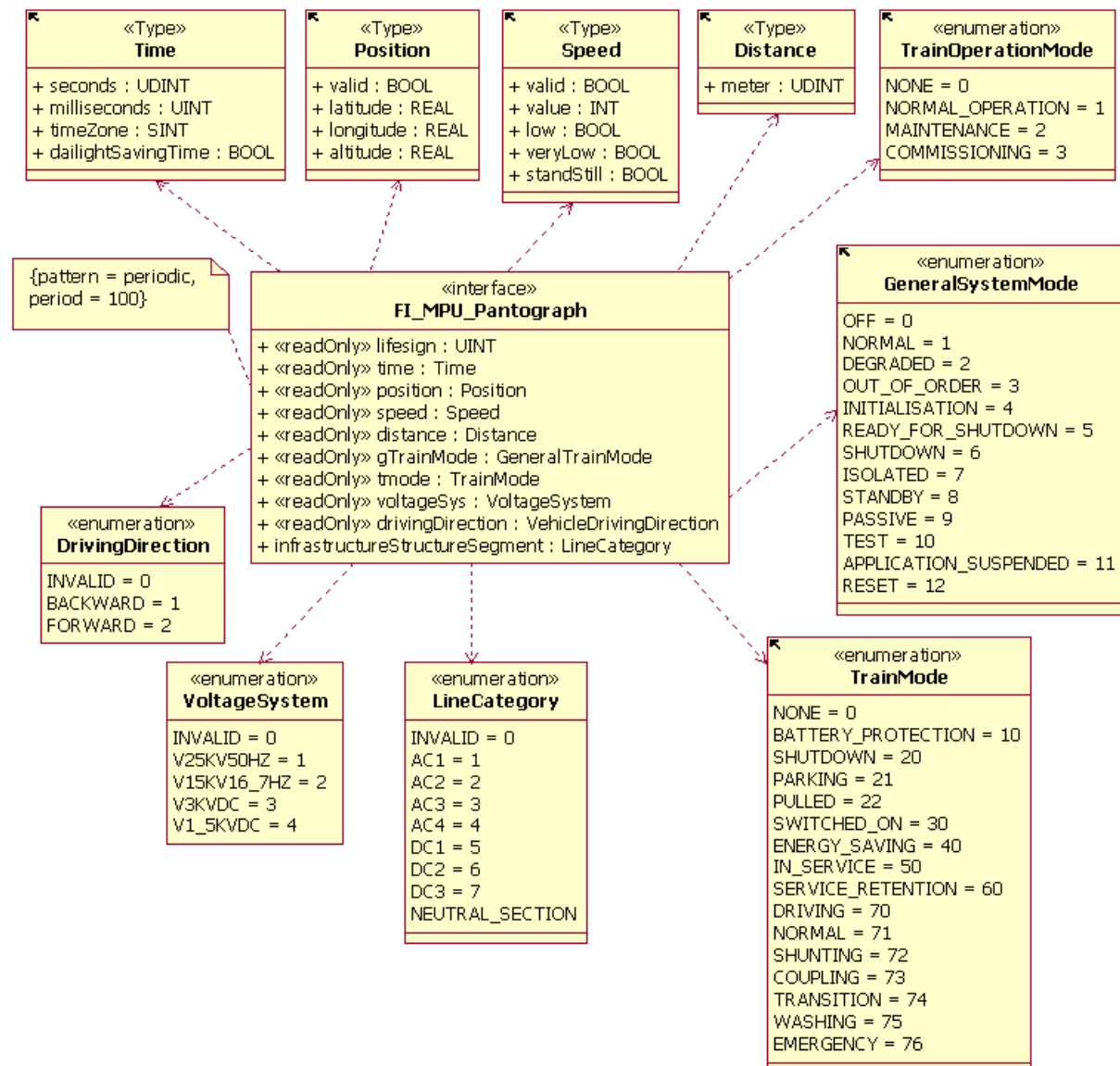


Figure 3 - TCMS control interface related to the pantograph system

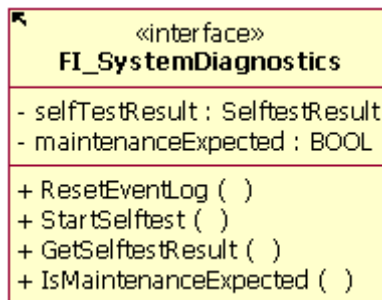
**Figure 4 - Common Diagnostics TCMS interface****5.3.2 <Interface> FI_MPU_Pantograph**

Table 2 lists the attribute of the central interface of the TCMS providing data for the Pantograph

Table 2 - MPU functional interface - attributes

Attribute	Visibility	Type	Description
lifesign	0 - PUBLIC	UINT	<<readOnly>> refer to CommonDefinitions - Types
time	0 - PUBLIC	Time	<<readOnly>> refer to CommonDefinitions - Types
position	0 - PUBLIC	Position	<<readOnly>> refer to CommonDefinitions - Types
speed	0 - PUBLIC	Speed	<<readOnly>> refer to CommonDefinitions - Types; for vehicle pantograph control
distance	0 - PUBLIC	Distance	<<readOnly>> refer to CommonDefinitions - Types
gTrainMode	0 - PUBLIC	GeneralTrainMode	<<readOnly>> refer to CommonDefinitions - Types
tmode	0 - PUBLIC	TrainMode	<<readOnly>> refer to CommonDefinitions - Types
voltageSys	0 - PUBLIC	VoltageSystem	<<readOnly>> voltage system detected for vehicle pantograph control; types according to MODPOWER FRS/SyFRS MP01
drivingDirection	0 - PUBLIC	VehicleDrivingDirection	<<readOnly>> driving direction in accordance with UIC 556 for vehicle pantograph control
infrastructureStructureSegment	0 - PUBLIC	LineCategory	optional: actual category of infrastructure (EN 50367) at the train's location for vehicle pantograph control

5.3.3 <Enumeration> VoltageSystem

Table 3 lists the voltage systems managed by the pantograph.

Table 3 - Voltage systems managed by the pantograph

Literal	Value	Description
INVALID	0	Invalid value
V25KV50HZ	1	25 kV, 50 Hz
V15KV16_7HZ	2	15 kV, 16,7 Hz
V3KVDC	3	3 kV, DC
V1_5KVDC	4	1,5 kV, DC

5.3.4 <Enumeration> DrivingDirection

Table 4 lists the train driving direction according to UIC 556

Table 4 - Driving directions

Literal	Value	Description
INVALID	0	Signal is invalid
BACKWARD	1	driving direction in accordance with UIC 556 is backward
FORWARD	2	driving direction in accordance with UIC 556 is forward

5.4 Pantograph Overview

Figure 5 shows the UML model of the pantograph control unit reference architecture.

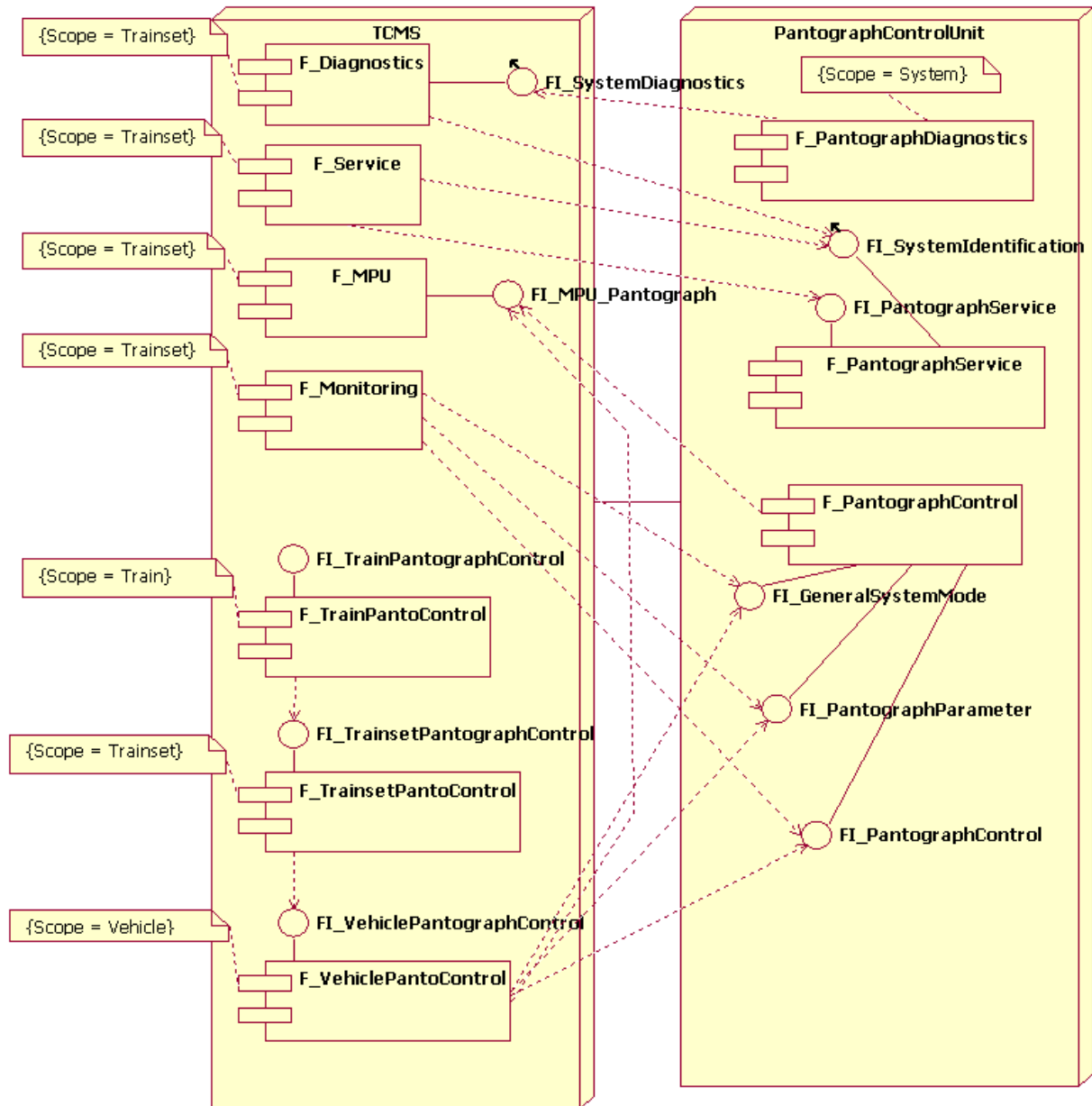


Figure 5 - Pantograph control reference architecture overview

5.5 Types

5.5.1 General

Figure 6 special Pantograph system data types.

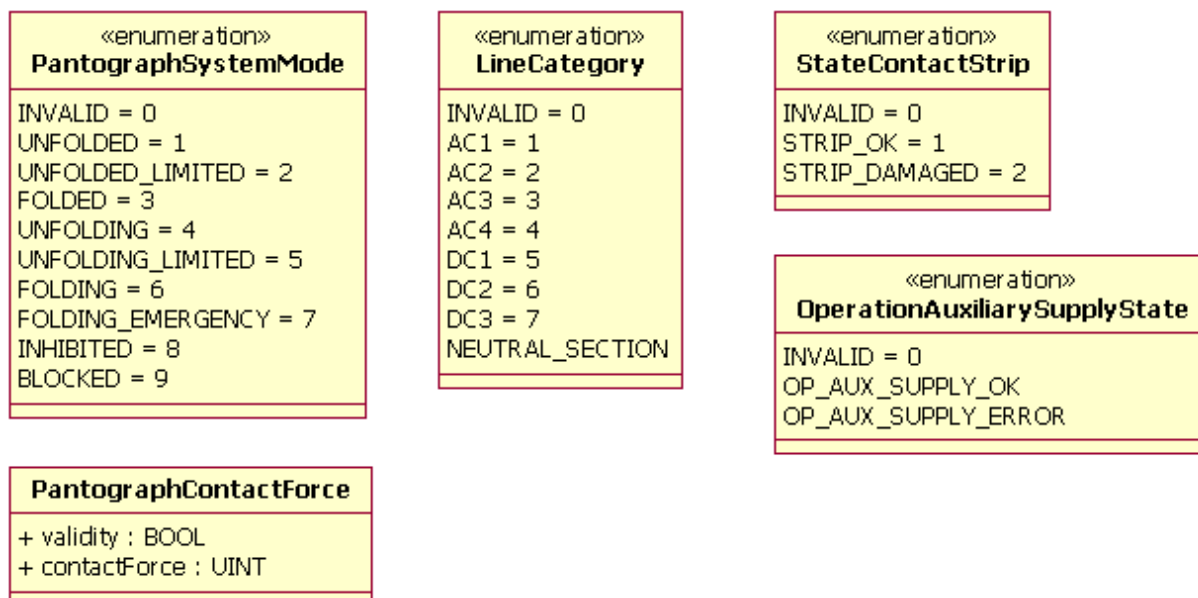


Figure 6 - Pantograph system data types

5.5.2 <Enumeration> PantographSystemMode

Table 5 lists system operation mode typically as an additional specific mode inside the general system modes. The parameters listed are read only by the other systems.

Table 5 - Pantograph system modes

Literal	Value	Description
INVALID	0	Signal is invalid
UNFOLDED	1	Pantograph is unfolded
UNFOLDED_LIMITED	2	Pantograph is unfolded with height limitation
FOLDED	3	Pantograph is folded
UNFOLDING	4	Pantograph is actually unfolding
UNFOLDING_LIMITED	5	Pantograph is actually unfolding to a height limit
FOLDING	6	Pantograph is actually folding
FOLDING_EMERGENCY	7	Pantograph is actually folding in an emergency way
INHIBITED	8	Unfolding of the pantograph is actually inhibited because

Literal	Value	Description
		of a detected damage of its contact strip
BLOCKED	9	Pantograph is actually manually blocked

5.5.3 <Enumeration> OperationAuxiliarySupplyState

Table 6 lists the status of Operation Auxiliary Supply and reports if it is sufficient or not for the pantograph's unfold/fold operation.

Table 6 - Status of the operation auxiliary supply

Literal	Value	Description
INVALID	0	Signal is invalid
OP_AUX_SUPPLY_OK		e.g pressure in the air supply of the pantograph system is sufficient for operation.
OP_AUX_SUPPLY_ERROR		e.g. pressure level of the air supply of the pantograph system is insufficient for operation

5.5.4 <Enumeration> StateContactStrip

Table 7 lists the status of contact strip and reports if it is damaged or not.

Table 7 - Status of the contact strip

Literal	Value	Description
INVALID	0	Signal is invalid
STRIP_OK	1	No strip damage detected
STRIP_DAMAGED	2	Strip damage detected

5.5.5 <Class> PantographContactForce

Table 8 lists the parameters relevant to definition of the contact force between the pantograph contact strip and the catenary.

Table 8 - Contact force of the pantograph

Attribute	Visibility	Type	Description
validity	0 - PUBLIC	BOOL	Indicates the validity of the value contactForce: TRUE: value of contactForce is valid FALSE: value of contactForce is not valid
contactForce	0 - PUBLIC	UINT	Contact force between the pantograph contact strip and the catenary in units of 0,1 N.

5.5.6 <Enumeration> LineCategory

Table 9 lists the contact line categories according to EN 50367, defining parameters for pantograph operation, like overhead voltage system, maximum speed, current at standstill, collector head parameters, catenary parameters and contact force parameters.

Table 9 - Contact line categories

Literal	Value	Description
INVALID	0	value invalid
AC1	1	EN 50367: category for conventional and connecting lines - a.c.; $v = 160 \text{ km/h}$
AC2	2	EN 50367: upgraded lines around 200 km/h - a.c.; $160 \text{ km/h} < v = 220 \text{ km/h}$
AC3	3	EN 50367: upgraded lines around 200 km/h - a.c.; $220 \text{ km/h} < v < 250 \text{ km/h}$
AC4	4	EN 50367: high-speed lines - a.c.; $v = 250 \text{ km/h}$
DC1	5	EN 50367: conventional and connecting lines - d.c.; $v = 160 \text{ km/h}$
DC2	6	EN 50367: upgraded lines around 200 km/h - d.c.; $160 \text{ km/h} < v = 220 \text{ km/h}$
DC3	7	EN 50367: high-speed lines - d.c.; $220 \text{ km/h} < v = 250 \text{ km/h}$
NEUTRAL_SECTION		neutral section

5.6 Control and Parameterisation

5.6.1 General

Figure 7 shows the pantograph control and parameterisation interfaces.

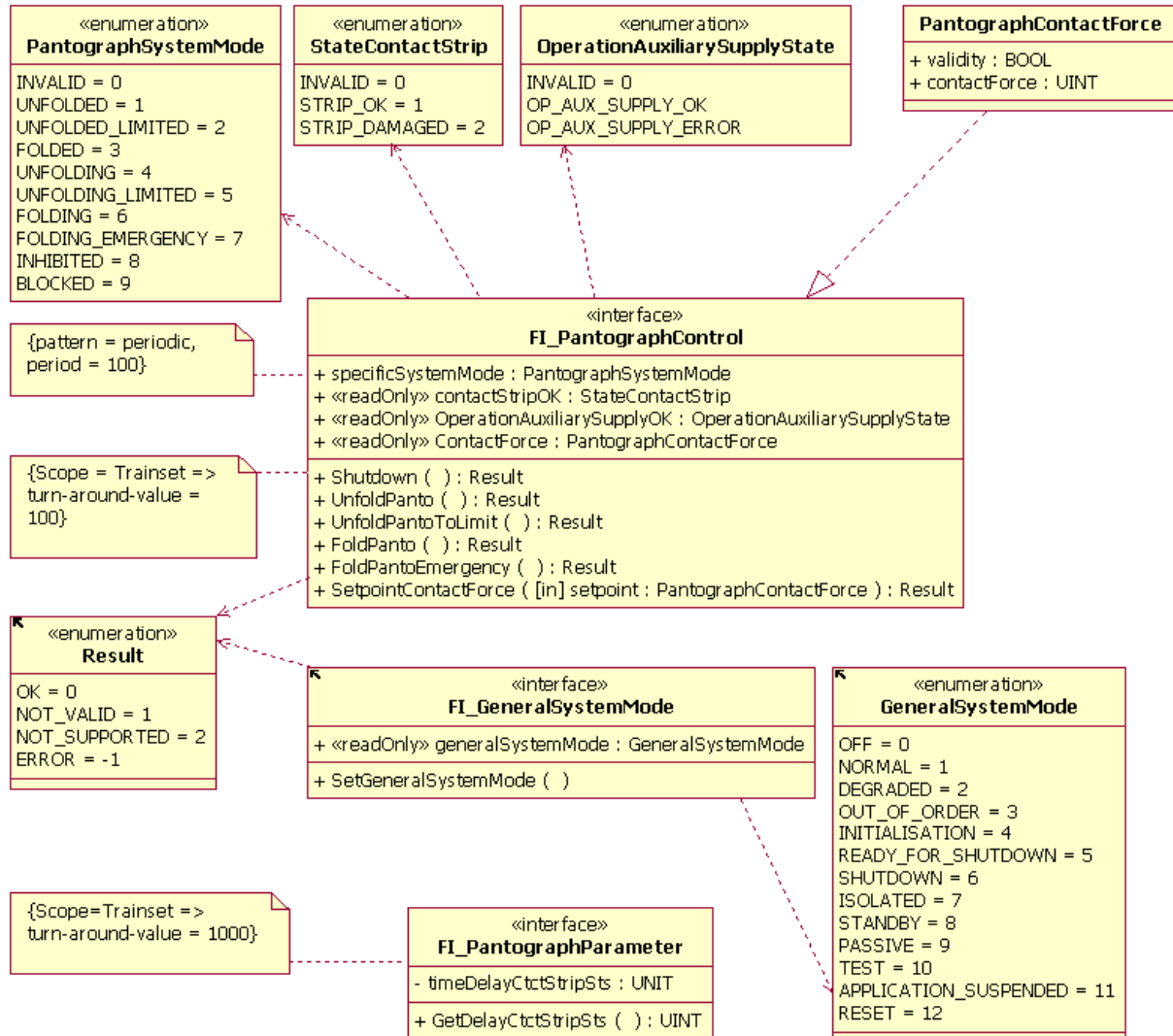


Figure 7 - Pantograph control and parameterisation interfaces

5.6.2 <Interface> FI_PantographControl

Table 10 lists the Pantograph control functional interface attributes.