APPLICATION NOTE

Understanding IEEE 1641—Essentials of Measurement

A discussion on how to use the measurement capability in IEEE 1641

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Application Note 1001/ Issue 1, January 2010

Introduction

This application note is written from a perspective of how to interpret a measurement described in XML. Usually, measurements are created using an IEEE 1641 compliant software tool, which will automatically include all the relevant information. This should ensure that anyone creating a measurement in IEEE 1641 will include enough detail so that there will be no ambiguity. By explaining how a measurement should be interpreted, the exact meaning of any measurement statement (using XML) can be determined.

The main part of this application note explains the two basic types of measurement and what each part means. The explanation of each type includes examples together with brief explanations of the main points. Annexes are provided, which re-state all the examples, each with a detailed breakdown to show all the related attributes and their derivation.

Essential aspects and parts of a measurement

The two basic types of measurement are Intrinsic and Generic, which may be described as follows:

Intrinsic

This type of measurement performs the specific measurement specified by the BSC class, no matter what the signal being measured.

Generic

This type of measurement facilitates the measurement of control attributes of any signal.

Information required to complete a measurement

There are five sets of information required in order to complete a measurement definition:

1. **Method**—what is the measurement being performed
2. **Type**—what is the type (and refType) of the signal
3. **When**—when is the measurement to be performed
4. **Value**—what results are required from the measurement
5. **Capability**—expected measurement value and associated information

These are always present even if they are not initially apparent in the measurement information. If they are not specifically stated, they will be obtained by inference or from defaults.

Default attributes for sensors

If an attribute is not specified in a measurement, it may be assumed to have a value from the following list:

type = Voltage
refType = Time
measuredVariable = Dependent
samples = 1
gateTime = 0
condition = NONE
nominal = <no value> (0 is assumed if a value is required)
UL = <no value> (0 is assumed if a value is required)
LL = <no value> (0 is assumed if a value is required)
As = <none>

Intrinsic Measurement

intrinsic—*adjective*, belonging naturally; essential.

All the Sensor BSC subclasses except Measure specifically define the measurement method. These are intrinsic measurements.

Interpreting measurement information

Most measurements are made using the dependent variable with the independent variable (refType) being time. Therefore, this discussion will focus on measurements of this type when describing the meaning of measurement information. However, the information provided is equally true for different dependent and independent types.

The contents of the XML measurement string is interpreted as follows:

1 *Method (measurement method)*

The measurement method is determined by the BSC class, e.g. RMS, Average, Instantaneous, etc.

2 *Type (signal type)*

a) Specified type

If it is provided, the type is as specified, e.g. <… type = "Current" …>

b) Inferred type

If no specific type is provided, the type may determined from the nominal value, e.g. if the XML string contains <… nominal = "3 mA" …>, the type is Current.

c) Default type

If the type is not specified or cannot be determined from the nominal value, then the default Type is assumed, i.e. the type is Voltage.

d) Translated type

Only for translations between allowed types

If the type of the nominal value is different to the specified or default type, it may be a translated type, e.g. W to V. The type of the signal remains as determined but the values are translated.

3 *When*

3.1 *Condition*

The condition attribute determines when signal is evaluated.

When a condition attribute is used, the measurement(s) will only be taken and the abstract signal will only be output while the condition is satisfied. The event output is active while the condition is satisfied, otherwise it is inactive.

For intrinsic measurements, the reference value for the condition is obtained from the nominal value.

The nominal value provides the reference for the condition.

3.2 *Gate Time*

The period over which the measurement is evaluated or the signal monitored.

a) gateTime = 0

The measurement is taken over a period that is implementation dependent. The implementation provides the best result that it is able

b) gateTime = n s

The measurement is taken over the period defined by the gateTime.

c) gateTime = -n s

The measurement is taken over the period of the gate event

4 *Value*

4.1 *Samples*

Samples determines how many measurements are recorded

a) Samples = 1 (default)

A measurement is taken and the result stored in the read-only attribute "measurement".

b) Samples = n (n >1)

A series of measurements are taken and stored in the read-only array "measurements". The last value measured is also stored in the read-only attribute "measurement".

c) Samples = 0

The BSC is used as a monitor only. No measurements are recorded and the attributes "measurement" and "measurements" do not contain any valid values. The attribute "count" will contain the value 0 (zero).

4.2. *Measured variable*

The value or values returned by the measurement will be either the values related to the signal's physical or the point at which the measurement was achieved.

a) measuredVariable = Dependent (default)

The measurement values are of the type of the signal being evaluated.

b) measuredVariable = Independent

The measurement values are of the refType, i.e. the independent variable associated with the measurement.

The descriptions below assume the refType is time for the same of simplicity and understanding. The principles hold true for any other refType.

5 *Capability (nominal values)*

a) Compatible nominal values

Nominal values that are directly compatible with the measurement method and the signal type provide additional information for the measurement.

i) magnitude

he magnitude gives an indication of the expected value. This is for indication only and has no effect on the measured value.

ii) unit

The unit of a compatible nominal value must be compatible with the type of the measured signal.

iii) qualifier

The qualifier of a compatible nominal value must be compatible with the measurement method

v) errlmt

The errlmt value defines the acceptable uncertainty for the measurement method.

vi) range

The range attribute provides the range of values over which the measurement system is expected to operate. The measurement is not constrained but may not provide the correct value if it outside of the specified range.

vii) res

The res attribute provides the minimum resolution required of the measurement system.

b) Incompatible nominal values

Nominal values that are not directly compatible with the measurement and the signal type are assumed to be Capability attributes, i.e. they provide additional information about the signal being measured but do not contribute any information about the measurement itself. A nominal value is incompatible if one or both of ii) and iii) below are true.

A capability attribute describes an aspect of the measured signal that may help with suitable resource allocation.

i) magnitude

The magnitude gives an indication of the magnitude of the capability attribute of the expected signal. This is for indication only and has no effect on the measured value.

ii) unit

The unit of the capability attribute may be incompatible with the type of the measured signal.

iii) qualifier

The qualifier of the capability attribute may be incompatible with the measurement method

iv) errlmt

The errlmt value defines an uncertainty in the specified magnitude of the capability attribute.

vi) range

The range attribute provides a range of values over which the capability attribute may be found. The capability attribute is not constrained to the range specified but is expected to remain within the specified range.

vii) res

The res attribute does not provide any useful information about a capability attribute.

Returned values

The measurement returns values as a result of measurements in read-only attributes as follows:

Measurement—the last (or only) measurement value taken

Measurements—an array containing the values of the measurements taken

Count—the number of measurements taken

GO—set by comparing measured values against the LL and UL attributes

NOGO—set by comparing measured values against the LL and UL attributes

HI—set by comparing measured values against the UL attribute

LO—set by comparing measured values against the LL attribute

Examples

```
<RMS />
```

Take an rms voltage measurement and create an event when taken.

```
<RMS samples="0" />
```

Output an abstract signal of rms voltage values that would have been taken

```
<RMS nominal="0.03 +- 3% range MAX 10"/>
```

Take an rms Voltage measurement with an uncertainty better than 3%.

The expected measurement value is 30 mV but could be as high at 10 V

```
<RMS nominal="3 mW +- 3% range MAX 1 W" type= "Voltage" />
```

Take an rms Voltage measurement and convert the result to Power (mW) with an uncertainty better than 3%. The expected measurement value is 3mW but could be as high at 1W

```
<RMS nominal="3mA +- 3% range MAX 1A" type= "Current" />
```

Take an rms current measurement with an uncertainty better than 3%.

The expected measurement value is 3mA but could be as high at 1A

```
<RMS nominal="av 30 mV +- 3% range MAX 1" type= "Voltage" />
```

Take an rms voltage measurement. The expected **average** voltage characteristic of the input signal is 30 mV, within 3%, but could be as high as 1 V.

This nominal value is used as Capability of the signal. The required accuracy for the measurement is not specified and may be any value. No expected value, range or resolution for the measured value is provided.

```
<RMS nominal="av 3 mW +- 3% range MAX 1W" type= "Voltage" />
```

Take an rms voltage measurement. The expected **average** voltage characteristic of the input signal is equivalent to 3mW, within 3%, into 50 Ω but could be as high as an equivalent of 1 W (into 50 Ω).

This nominal value is used as Capability of the signal. The required accuracy for the measurement is not specified and may be any value. No expected value, range or resolution for the measured value is provided.

```
<RMS nominal="av 30 mA +- 3% range MAX 1A" />
```

Take an rms current measurement, the expected **average** current characteristic of the input signal is 30mA, within 3%, but could be as high as 1A;

This nominal value is used as Capability of the signal. The required accuracy for the measurement is not specified and may be any value. No expected value, range or resolution for the measured value is provided.

```
<RMS nominal="3 mA +- 3% range MAX 1A" type= "Voltage" />
```

Take an rms voltage measurement. The expected trms current characteristic of the input signal is 3mA, within 3%, but could be as high as 1A.

This nominal value is used as Capability of the signal. The required accuracy for the measurement is not specified and may be any value. No expected value, range or resolution for the measured value is provided.

```
<RMS nominal="av 30 mA +- 3% range MAX 1A" type= "Voltage" />
```

Take an rms voltage measurement, the expected **average** current characteristic of the input signal is 30mA but could be as high as 1A.

This nominal value is used as Capability of the signal. The required accuracy for the measurement is not specified and may be any value. No expected value, range or resolution for the measured value is provided.

```
<RMS nominal="3 +- 3% range MAX 10" samples="0" />
```

Output an abstract signal of rms voltage values with an uncertainty better than 3%. The expected value is 3 V but could be as high at 10V.

```
<RMS nominal="3mW +- 3% range MAX 1W" type="Voltage" samples="0" />
```

Output an abstract signal of rms voltage values and convert the result to Power (mW) with an uncertainty better than 3%. The expected value is 3 mW but could be as high at 1W.

```
<RMS nominal="3mA +- 3% range MAX 1A" samples="0" />
```

Output an abstract signal of rms current values with an uncertainty better than 3%. The expected value is 3 mA but could be as high at 1A.

```
<Average type="Current" name="AverageCurrentMeas" samples="1"
nominal="50 mA +-6 mA range 20 mA to 75 mA res 0.1 mA" UL="61 mA" LL="45 mA"
In="TwoWireInp" />
```

Take an average current measurement with an uncertainty of ±6 mA using a gateTime of 25 ms. Verify that the average value measured is between the limits of 45 mA and 61 mA. The resolution of the measurement is required to be 0.1 mA.

The expected average current of the input signal 50 mA, but could be between 20 mA and 75 mA.

```
<Average name="AverageVoltageMeas" samples="2" gateTime="25 ms"
nominal="trms 8 V +-0.5 V range MAX 10 V" condition="GT" UL="+1 V" LL="-1 V"
In="TwoWireInp" />
```

Take two average voltage measurements, each to be measured with a gateTime of 25 ms. Verify that the average values measured are between the limits of -1 V and +1 V. The signal is to be evaluated when the trms value of the signal is greater than 8 V.

The expected **trms** voltage characteristic of the input signal is 8 V ±0.5 V, but could be as high as 10 V.

This nominal value is used as Capability of the signal. The required accuracy for the measurement is not specified and may be any value. No expected value, range or resolution for the measured value is provided.

```
<Instantaneous name="InstantaneousVoltage" measuredVariable="INDEPENDENT"
samples="1" gateTime="1 ms" nominal="inst 3 V errlmt +-0.1 V" UL="1.3 s" LL="1.1 s"
In="TwoWireInp" />
```

Perform an instantaneous voltage measurement with an uncertainty of ±0.1 V using a gateTime of 1 ms. Record the time at which this measurement occurs and verify that the time value is between the limits of 1.1 s and 1.3 s.

The expected instantaneous value of the input signal is 3 V.

Generic Measurement

generic—*adjective*, referring to a class or group; not specific.

The Sensor BSC subclass Measure uses the context of the measurement information to determine which measurement method (or methods) is to be used.

<u>Interpreting measurement information</u>

Fundamentally, the same five sets of information that were defined previously are required to completely define a measurement. This information is obtained in a different way in generic measurement than it was for intrinsic measurement.

There are two ways of defining generic measurements:

by using “lazy” specifications

by the use of *As*, with or without attributes

<u>Lazy specifications</u>

A lazy specification may be identified by the use of the Measure BSC and no reference signal identified by the As attribute.

1 *Method (measurement method)*

The measurement method is determined from the qualifier of the nominal value if present, or uses the default—Instantaneous.

2 *Type (signal type)*

The type is determined from the unit of the quantity associated with the nominal value if present, or uses the default—Voltage.

3 *When*

3.1 *Condition*

The condition attribute determines when signal is evaluated.

When a condition attribute is used, the measurement(s) will only be taken and the abstract signal will only be output while the condition is satisfied. The event output is active while the condition is satisfied, otherwise it is inactive.

For generic measurements, the reference value for the condition is obtained from the nominal value.

The nominal value provides the reference for the condition.

3.2 *Gate Time*

The period over which the measurement is evaluated or the signal monitored.

a) gateTime = 0

The measurement is taken over a period that is implementation dependent. The implementation provides the best result that it is able

b) gateTime = n s

The measurement is taken over the period defined by the gateTime.

c) gateTime = -n s

The measurement is taken over the period of the gate event

4 *Value*

4.1 *Samples*

Samples determines how many measurements are recorded

a) Samples = 1 (default)

A measurement is taken and the result stored in the read-only attribute "measurement".

b) Samples = n (n >1)

A series of measurements are taken and stored in the read-only array "measurements". The last value measured is also stored in the read-only attribute "measurement".

c) Samples = 0

The BSC is used as a monitor only. No measurements are recorded and the attributes "measurement" and "measurements" do not contain any valid values. The attribute "count" will contain the value 0 (zero).

4.2. *Measured variable*

The value or values returned by the measurement will be either the values related to the signal's physical or the point at which the measurement was achieved.

a) measuredVariable = Dependent (default)

The measurement values are of the type of the signal being evaluated.

b) measuredVariable = Independent

The measurement values are of the refType, i.e. the independent variable associated with the measurement.

The descriptions below assume the refType is time for the same of simplicity and understanding. The principles hold true for any other refType.

5 *Capability (nominal values)*

a) Nominal values

Nominal values provide direct information for the measurement.

i) magnitude

The magnitude gives an indication of the expected value. This is for indication only and has no effect on the measured value.

ii) unit

The unit of the nominal value determines the type of the measured signal as described in 2 above).

iii) qualifier

The qualifier of the nominal value determines the measurement method as described in 1 above.

iv) errlmt

The errlmt value defines the acceptable uncertainty for the measurement method.

vi) range

The range attribute provides the range of values over which the measurement system is expected to operate. The measurement is not constrained but may not provide the correct value if it outside of the specified range.

vii) res

The res attribute provides the minimum resolution required of the measurement system.

Use of *As*

As is used to identify a signal that is used as a model against which the signal being measured is referenced or compared.

This reference signal may be used with or without attributes:

If attributes are defined, they define the values being measured. The expected values of these attributes are written within the reference model along with their uncertainties and ranges.

If no attributes are defined, the error between the input signal and the reference signal is measured.

1 *Method (measurement method)*

The measurement method is determined from the qualifier of the nominal value if present, or uses the default—Instantaneous.

2 *Type (signal type)*

The type is determined from the type of the attribute of the As signal

If no attribute is specified the unit type is determined from of the nominal value.

If no nominal value is provided, the default is used—Voltage

3 *When*

3.1 *Condition*

The condition attribute determines when signal is evaluated.

When a condition attribute is used, the measurement(s) will only be taken and the abstract signal will only be output while the condition is satisfied. The event output is active while the condition is satisfied, otherwise it is inactive.

For generic measurements, the reference value for the condition is obtained from the nominal value.

The nominal value provides the reference for the condition.

3.2 *Gate Time*

The period over which the measurement is evaluated or the signal monitored.

a) gateTime = 0

The measurement is taken over a period that is implementation dependent. The implementation provides the best result that it is able

b) gateTime = n s

The measurement is taken over the period defined by the gateTime.

c) gateTime = -n s

The measurement is taken over the period of the gate event

4 *Value*

4.1 *Samples*

Samples determines how many measurements are recorded

a) Samples = 1 (default)

A measurement is taken and the result stored in the read-only attribute "measurement".

b) Samples = n (n >1)

A series of measurements are taken and stored in the read-only array "measurements". The last value measured is also stored in the read-only attribute "measurement".

c) Samples = 0

The BSC is used as a monitor only. No measurements are recorded and the attributes "measurement" and "measurements" do not contain any valid values. The attribute "count" will contain the value 0 (zero).

4.2. *Measured variable*

The value or values returned by the measurement will be either the values related to the signal's physical or the point at which the measurement was achieved.

a) measuredVariable = Dependent (default)

The measurement values are of the type of the signal being evaluated.

b) measuredVariable = Independent

The measurement values are of the refType, i.e. the independent variable associated with the measurement.

The descriptions below assume the refType is time for the same of simplicity and understanding. The principles hold true for any other refType.

5 *Capability (nominal values)*

a) Nominal values

Nominal values provide direct information for the measurement.

i) magnitude

The magnitude gives an indication of the expected value. This is for indication only and has no effect on the measured value.

ii) unit

The unit of the nominal value determines the type of the measured signal as described in 2 above).

iii) qualifier

The qualifier of the nominal value determines the measurement method as described in 1 above.

iv) errlmt

The errlmt value defines the acceptable uncertainty for the measurement method.

vi) range

The range attribute provides the range of values over which the measurement system is expected to operate. The measurement is not constrained but may not provide the correct value if it outside of the specified range.

vii) res

The res attribute provides the minimum resolution required of the measurement system.

Examples

```
<Measure />
```

Take an instantaneous voltage measurement and create an event when taken.

```
<Measure nominal="1.5 V"  />
```

Take an instantaneous voltage measurement and create an event when taken.

```
<Measure samples="0"  />
```

Output an abstract signal of instantaneous voltages values.

```
<Measure nominal="trms 3.5 mA"  />
```

Take an rms current measurement and create an event when taken. The expected value is 3.5 mA.

```
<Measure nominal="av" type="Current"/>
```

Take an average current measurement and create an event when taken.

```
<Measure condition="GT" nominal="trms 3 V"  />
```

Take an rms voltage measurement and create an event when taken. The signal is to be evaluated when the trms value of the signal is greater than 3 V.

```
<Measure As="SpecifiedSignal"  />
```

Measure the error in the voltage of the input signal compared to the voltage of the specified signal and create an event when taken.

```
<Measure samples="0" As="SpecifiedSignal"  />
```

Output an abstract signal of instantaneous voltages values.

```
<Measure nominal="trms 3.5 mA" As="SpecifiedSignal"  />
```

Measure the error in the current of the input signal compared to the current of the specified signal. Use the trms intrinsic measurement method.

```
<Sinusoid name="ReferenceSignal" amplitude="0.43 V" frequency="1.2 kHz" />
<Measure As="ReferenceSignal" attribute="ReferenceSignal.amplitude"  />
```

The reference signal is a sinusoid with an amplitude of 0.43 V and a frequency of 1.2 kHz. Make a measurement on the input signal equivalent to measuring the amplitude attribute of the reference signal.

Annex A Intrinsic Measurements

Detailed breakdown of examples showing all relevant attributes and their derivation.

<RMS />

Take an rms voltage measurement and create an event when taken.

Signal attributes		
method	RMS	BSC class
type	Voltage	default
refType	Time	default
measuredVariable	Dependent	default
samples	1	default
gateTime	Implementation dependant	default = 0
condition	NONE	default
nominal	<no value>	default
UL	<no value>	default 0 assumed if required
LL	<no value>	default 0 assumed if required
As	<none>	default
Read-only attributes		
Measurement	rms voltage	default (method, type)
Measurements	n/a	default (samples = 1)
Events	1 when measurement complete	default (samples = 1)
Output abstract signal	Voltage @ rms level	default
GO	1 if within limits, else 0	
NOGO	0 if within limits, else 1	
HI	1 if > UL, else 0	
LO	1 if < LL, else 0	
Measurement info.		
Expected value	Any	default
Min value expected	Any	default
Max value expected	Any	default
Permitted uncertainty	Any	default
Required resolution	Any	default
Capability info.		
Characteristic (type)	none provided	
Observation method	none provided	
Value	none provided	
Max value	none provided	
Uncertainty in value	none provided	

```
<RMS samples="0" />
```

Output an abstract signal of rms voltage values that would have been taken

Signal attributes		
method	RMS	BSC class
type	Voltage	default
refType	Time	default
measuredVariable	Dependent	default
samples	0	default
gateTime	Implementation dependant	default = 0
condition	NONE	default
nominal	<no value>	default
UL	<no value>	default
LL	<no value>	default
As	<none>	default
Read-only attributes		
Measurement	none	samples = 0
Measurements	none	samples = 0
Events	none	samples = 0
Output abstract signal	Voltage @ rms level	default
GO	0	samples = 0
NOGO	0	samples = 0
HI	0	samples = 0
LO	0	samples = 0
Measurement info.		
Expected value	Any (used for abstract output only)	
Min value expected	Any (used for abstract output only)	
Max value expected	Any (used for abstract output only)	
Permitted uncertainty	Any (used for abstract output only)	
Required resolution	Any (used for abstract output only)	
Capability info.		
Characteristic (type)	none provided	
Observation method	none provided	
Value	none provided	
Max value	none provided	
Uncertainty in value	none provided	

```
<RMS nominal="0.03 +- 3% range MAX 10"/>
```

Take an rms Voltage measurement with an uncertainty better than 3%.
The expected measurement value is 30 mV but could be as high at 10 V

Signal attributes		
method	RMS	BSC class
type	Voltage	default
refType	Time	default
measuredVariable	Dependent	default
samples	1	default
gateTime	Implementation dependant	default = 0
condition	NONE	default
nominal	<no value>	default
UL	<no value>	default
LL	<no value>	default
As	<none>	default
Read-only attributes		
Measurement	none	samples = 0
Measurements	n/a	default (samples)
Events	none	samples = 0
Output abstract signal	Voltage @ rms level	default
GO	1 if within limits, else 0	
NOGO	0 if within limits, else 1	
HI	1 if > UL, else 0	
LO	1 if < LL, else 0	
Measurement info.		
Expected value	0.03 V	nominal
Min value expected	Any	default
Max value expected	10 V	nominal
Permitted uncertainty	±3%	nominal
Required resolution	Any	default
Capability info.		
Characteristic (type)	none provided	
Observation method	none provided	
Value	none provided	
Max value	none provided	
Uncertainty in value	none provided	

```
<RMS nominal="3 mW +- 3% range MAX 1 W" type= "Voltage" />
```

Take an rms Voltage measurement and convert the result to Power (mW) with an uncertainty better than 3%. The expected measurement value is 3mW but could be as high at 1W

Signal attributes		
method	RMS	BSC class
type	Voltage	default
refType	Time	default
measuredVariable	Dependent	default
samples	1	default
gateTime	Implementation dependant	default = 0
condition	NONE	default
nominal	<no value>	default
UL	<no value>	default
LL	<no value>	default
As	<none>	default
Read-only attributes		
Measurement	none	samples = 1 (default)
Measurements	n/a	default (samples)
Events	none	samples = 0
Output abstract signal	Voltage @ rms level	default
GO	1 if within limits, else 0	
NOGO	0 if within limits, else 1	
HI	1 if > UL, else 0	
LO	1 if < LL, else 0	
Measurement info.		
Expected value	3 mW, i.e. 0.387 V (using 50 Ω)	Nominal (50 Ω is default)
Min value expected	Any	default
Max value expected	1 W, i.e. 7.071 V (using 50 Ω)	Nominal (50 Ω is default)
Permitted uncertainty	±3%, i.e. 1.5% of voltage value (approx)	nominal
Required resolution	Any	default
Capability info.		
Characteristic (type)	none provided	
Observation method	none provided	
Value	none provided	
Max value	none provided	
Uncertainty in value	none provided	

```
<RMS nominal="3mA +- 3% range MAX 1A" type= "Current" />
```

Take an rms current measurement with an uncertainty better than 3%.
The expected measurement value is 3mA but could be as high at 1A

Signal attributes		
method	RMS	BSC class
type	Currrent	type= "Current"
refType	Time	default
measuredVariable	Dependent	default
samples	1	default
gateTime	Implementation dependant	default = 0
condition	NONE	default
nominal	<no value>	default
UL	<no value>	default
LL	<no value>	default
As	<none>	default
Read-only attributes		
Measurement	none	samples = 0
Measurements	n/a	default (samples)
Events	none	samples = 0
Output abstract signal	Current @ rms level	default
GO	1 if within limits, else 0	
NOGO	0 if within limits, else 1	
HI	1 if > UL, else 0	
LO	1 if < LL, else 0	
Measurement info.		
Expected value	3 mA,	nominal
Min value expected	Any	default
Max value expected	1 A	nominal
Permitted uncertainty	±3%	nominal
Required resolution	Any	default
Capability info.		
Characteristic (type)	none provided	
Observation method	none provided	
Value	none provided	
Max value	none provided	
Uncertainty in value	none provided	

```
<RMS nominal="av 30 mV +- 3% range MAX 1" type= "Voltage" />
```

Take an rms voltage measurement. The expected **average** voltage characteristic of the input signal is 30 mV, within 3%, but could be as high as 1 V.

This nominal value is used as Capability of the signal. The required accuracy for the measurement is not specified and may be any value. No expected value, range or resolution for the measured value is provided.

Signal attributes		
method	RMS	BSC class
type	Voltage	type= "Voltage"
refType	Time	default
measuredVariable	Dependent	default
samples	1	default
gateTime	Implementation dependant	default = 0
condition	NONE	default
nominal	<no value>	default
UL	<no value>	default
LL	<no value>	default
As	<none>	default
Read-only attributes		
Measurement	none	samples = 0
Measurements	n/a	default (samples)
Events	none	samples = 0
Output abstract signal	Voltage @ rms level	default
GO	1 if within limits, else 0	
NOGO	0 if within limits, else 1	
HI	1 if > UL, else 0	
LO	1 if < LL, else 0	
Measurement info.		
Expected value	Any	default
Min value expected	Any	default
Max value expected	Any	default
Permitted uncertainty	Any	default
Required resolution	Any	default
Capability info.		
Characteristic (type)	Voltage	nominal
Observation method	Average	nominal
Value	30 mV	nominal
Max value	1 V	nominal
Uncertainty in value	± 3%	nominal

```
<RMS nominal="av 3 mW +- 3% range MAX 1W" type= "Voltage" />
```

Take an rms voltage measurement. The expected **average** voltage characteristic of the input signal is equivalent to 3mW, within 3%, into 50 Ω but could be as high as an equivalent of 1 W (into 50 Ω).

This nominal value is used as Capability of the signal. The required accuracy for the measurement is not specified and may be any value. No expected value, range or resolution for the measured value is provided.

Signal attributes		
method	RMS	BSC class
type	Voltage	type= "Voltage"
refType	Time	default
measuredVariable	Dependent	default
samples	1	default
gateTime	Implementation dependant	default = 0
condition	NONE	default
nominal	<no value>	default
UL	<no value>	default
LL	<no value>	default
As	<none>	default
Read-only attributes		
Measurement	none	samples = 0
Measurements	n/a	default (samples)
Events	none	samples = 0
Output abstract signal	Voltage @ rms level	default
GO	1 if within limits, else 0	
NOGO	0 if within limits, else 1	
HI	1 if > UL, else 0	
LO	1 if < LL, else 0	
Measurement info.		
Expected value	Any	default
Min value expected	Any	default
Max value expected	Any	default
Permitted uncertainty	Any	default
Required resolution	Any	default
Capability info.		
Characteristic (type)	Voltage (expressed as a power, using 50 Ω)	nominal
Observation method	Average	nominal
Value	3 mW, i.e. 0.387 V (using 50 Ω)	nominal (50 Ω is default)
Max value	1 W, i.e. 0.387 V (using 50 Ω)	nominal (50 Ω is default)
Uncertainty in value	± 3%, i.e. 0.387 V (using 50 Ω)	nominal (50 Ω is default)

```
<RMS nominal="av 30 mA +- 3% range MAX 1A" />
```

Take an rms current measurement, the expected **average** current characteristic of the input signal is 30mA, within 3%, but could be as high as 1A;

This nominal value is used as Capability of the signal. The required accuracy for the measurement is not specified and may be any value. No expected value, range or resolution for the measured value is provided.

Signal attributes		
method	RMS	BSC class
type	Current	implied from nominal
refType	Time	default
measuredVariable	Dependent	default
samples	1	default
gateTime	Implementation dependant	default = 0
condition	NONE	default
nominal	<no value>	default
UL	<no value>	default
LL	<no value>	default
As	<none>	default
Read-only attributes		
Measurement	none	samples = 0
Measurements	n/a	default (samples)
Events	none	samples = 0
Output abstract signal	Voltage @ rms level	default
GO	1 if within limits, else 0	
NOGO	0 if within limits, else 1	
HI	1 if > UL, else 0	
LO	1 if < LL, else 0	
Measurement info.		
Expected value	Any	default
Min value expected	Any	default
Max value expected	Any	default
Permitted uncertainty	Any	default
Required resolution	Any	default
Capability info.		
Characteristic (type)	Current	nominal
Observation method	Average	nominal
Value	30 mA	nominal
Max value	1 A	nominal
Uncertainty in value	± 3%	nominal

```
<RMS nominal="3 mA +- 3% range MAX 1A" type= "Voltage" />
```

Take an rms voltage measurement. The expected trms current characteristic of the input signal is 3mA, within 3%, but could be as high as 1A.

This nominal value is used as Capability of the signal. The required accuracy for the measurement is not specified and may be any value. No expected value, range or resolution for the measured value is provided.

Signal attributes		
method	RMS	BSC class
type	Voltage	type= "Voltage"
refType	Time	default
measuredVariable	Dependent	default
samples	1	default
gateTime	Implementation dependant	default = 0
condition	NONE	default
nominal	<no value>	default
UL	<no value>	default
LL	<no value>	default
As	<none>	default
Read-only attributes		
Measurement	none	samples = 0
Measurements	n/a	default (samples)
Events	none	samples = 0
Output abstract signal	Voltage @ rms level	default
GO	1 if within limits, else 0	
NOGO	0 if within limits, else 1	
HI	1 if > UL, else 0	
LO	1 if < LL, else 0	
Measurement info.		
Expected value	Any	default
Min value expected	Any	default
Max value expected	Any	default
Permitted uncertainty	Any	default
Required resolution	Any	default
Capability info.		
Characteristic (type)	Current	nominal
Observation method	trms	nominal default
Value	3 mA	nominal
Max value	1 A	nominal
Uncertainty in value	± 3%	nominal

```
<RMS nominal="av 30 mA +- 3% range MAX 1A" type= "Voltage" />
```

Take an rms voltage measurement, the expected **average** current characteristic of the input signal is 30mA but could be as high as 1A.

This nominal value is used as Capability of the signal. The required accuracy for the measurement is not specified and may be any value. No expected value, range or resolution for the measured value is provided.

Signal attributes		
method	RMS	BSC class
type	Voltage	type= "Voltage"
refType	Time	default
measuredVariable	Dependent	default
samples	1	default
gateTime	Implementation dependant	default = 0
condition	NONE	default
nominal	<no value>	default
UL	<no value>	default
LL	<no value>	default
As	<none>	default
Read-only attributes		
Measurement	none	samples = 0
Measurements	n/a	default (samples)
Events	none	samples = 0
Output abstract signal	Voltage @ rms level	default
GO	1 if within limits, else 0	
NOGO	0 if within limits, else 1	
HI	1 if > UL, else 0	
LO	1 if < LL, else 0	
Measurement info.		
Expected value	Any	default
Min value expected	Any	default
Max value expected	Any	default
Permitted uncertainty	Any	default
Required resolution	Any	default
Capability info.		
Characteristic (type)	Current	nominal
Observation method	Average	nominal
Value	30 mA	nominal
Max value	1 A	nominal
Uncertainty in value	± 3%	nominal

```
<RMS nominal="3 +- 3% range MAX 10" samples="0" />
```

Output an abstract signal of rms voltage values with an uncertainty better than 3%. The expected value is 3 V but could be as high at 10V.

Signal attributes		
method	RMS	BSC class
type	Voltage	default
refType	Time	default
measuredVariable	Dependent	default
samples	0	samples="0"
gateTime	Implementation dependant	default = 0
condition	NONE	default
nominal	<no value>	default
UL	<no value>	default
LL	<no value>	default
As	<none>	default
Read-only attributes		
Measurement	none	samples = 0
Measurements	n/a	default (samples)
Events	none	samples = 0
Output abstract signal	Voltage @ rms level	default
GO	0	samples = 0
NOGO	0	samples = 0
HI	0	samples = 0
LO	0	samples = 0
Measurement info.		
Expected value	3 V (used for abstract output only)	nominal
Min value expected	Any	default
Max value expected	10 V (used for abstract output only)	nominal
Permitted uncertainty	±3% (used for abstract output only)	nominal
Required resolution	Any (used for abstract output only)	default
Capability info.		
Characteristic (type)	none provided	
Observation method	none provided	
Value	none provided	
Max value	none provided	
Uncertainty in value	none provided	

```
<RMS nominal="3mW +- 3% range MAX 1W" type="Voltage" samples="0" />
```

Output an abstract signal of rms voltage values and convert the result to Power (mW) with an uncertainty better than 3%. The expected value is 3 mW but could be as high at 1W.

Signal attributes		
method	RMS	BSC class
type	Voltage	type="Voltage"
refType	Time	default
measuredVariable	Dependent	default
samples	0	samples = 0
gateTime	Implementation dependant	default = 0
condition	NONE	default
nominal	<no value>	default
UL	<no value>	default
LL	<no value>	default
As	<none>	default
Read-only attributes		
Measurement	none	samples = 0
Measurements	none	samples = 0
Events	none	samples = 0
Output abstract signal	Voltage @ rms level	default
GO	0	samples = 0
NOGO	0	samples = 0
HI	0	samples = 0
LO	0	samples = 0
Measurement info.	(used for abstract output only)	
Expected value	3 mW, i.e. 0.387 V (using 50 Ω)	nominal (50 Ω is default)
Min value expected	Any	default
Max value expected	1 W, i.e. 7.071 V (using 50 Ω)	nominal (50 Ω is default)
Permitted uncertainty	±3%, i.e. 1.5% of voltage value (approx)	nominal
Required resolution	Any	default
Capability info.		
Characteristic (type)	none provided	
Observation method	none provided	
Value	none provided	
Max value	none provided	
Uncertainty in value	none provided	

```
<RMS nominal="3mA +- 3% range MAX 1A" samples="0" />
```

Output an abstract signal of rms current values with an uncertainty better than 3%. The expected value is 3 mA but could be as high at 1A.

Signal attributes		
method	RMS	BSC class
type	Current	Inferred type (nominal="3mA ")
refType	Time	default
measuredVariable	Dependent	default
samples	0	samples = 0
gateTime	Implementation dependant	default = 0
condition	NONE	default
nominal	<no value>	default
UL	<no value>	default
LL	<no value>	default
As	<none>	default
Read-only attributes		
Measurement	none	samples = 0
Measurements	none	samples = 0
Events	none	samples = 0
Output abstract signal	Current @ rms level	default
GO	0	samples = 0
NOGO	0	samples = 0
HI	0	samples = 0
LO	0	samples = 0
Measurement info.	(used for abstract output only)	
Expected value	3 mA	nominal
Min value expected	Any	default
Max value expected	1 A	nominal
Permitted uncertainty	±3%	nominal
Required resolution	Any	default
Capability info.		
Characteristic (type)	none provided	
Observation method	none provided	
Value	none provided	
Max value	none provided	
Uncertainty in value	none provided	

```
<Average type="Current" name="AverageCurrentMeas" samples="1"
nominal="50 mA +-6 mA range 20 mA to 75 mA res 0.1 mA" UL="61 mA" LL="45 mA"
In="TwoWireInp" />
```

Take an average current measurement with an uncertainty of ±6 mA using a gateTime of 25 ms. Verify that the average value measured is between the limits of 45 mA and 61 mA. The resolution of the measurement is required to be 0.1 mA.

The expected average current of the input signal 50 mA, but could be between 20 mA and 75 mA.

Signal attributes		
method	Average	BSC class
type	Current	type="Current"
refType	Time	default
measuredVariable	Dependent	default
samples	1	samples="1"
gateTime	25 ms	gateTime="25 ms"
condition	NONE	default
nominal	50 mA	nominal="50 mA"
UL	61 mA	UL="61 mA"
LL	45 mA	LL="45 mA"
As	<none>	default
Read-only attributes		
Measurement	Average current	samples = 1
Measurements	Only value measured	samples = 1
Events	1 (with measurement)	samples = 1
Output abstract signal	Current @ average level	default
GO	1 if meas. within limits, else 0	UL & LL specified
NOGO	0 if meas. within limits, else 1	UL & LL specified
HI	0 if meas. < UL, else 1	UL specified
LO	0 if meas. > LL, else 1	LL specified
Measurement info.		
Expected value	50 mA	nominal
Min value expected	20 mA	nominal
Max value expected	75 mA	nominal
Permitted uncertainty	±6 mA	nominal
Required resolution	0.1 mA	nominal
Capability info.		
Characteristic (type)	none provided	
Observation method	none provided	
Value	none provided	
Max value	none provided	
Uncertainty in value	none provided	

```
<Average name="AverageVoltageMeas" samples="2" gateTime="25 ms"
nominal="trms 8 V +-0.5 V range MAX 10 V" condition="GT" UL="+1 V" LL="- 1 V"
In="TwoWireInp" />
```

Take two average voltage measurements, each to be measured with a gateTime of 25 ms. Verify that the average values measured are between the limits of -1 V and +1 V. The signal is to be evaluated when the trms value of the signal is greater than 8 V.

The expected **trms** voltage characteristic of the input signal is 8 V ±0.5 V, but could be as high as 10 V.

This nominal value is used as Capability of the signal. The required accuracy for the measurement is not specified and may be any value. No expected value, range or resolution for the measured value is provided.

Signal attributes		
method	Average	BSC class
type	Voltage	default
refType	Time	default
measuredVariable	Dependent	default
samples	2	samples="2"
gateTime	25 ms	gateTime="25 ms"
condition	GT	condition="GT"
nominal	8 V trms	nominal="trms 8 V"
UL	+1 V	UL="+1 V"
LL	–1 V	LL="-1 V"
As	<none>	default
Read-only attributes		
Measurement	Average voltage	samples = 2
Measurements	Array of two values	samples = 2
Events	2 (one with each measurement)	samples = 2
Output abstract signal	Voltage @ average level	default
GO	2 if both meas. within limits, else 1 or 0	UL & LL specified
NOGO	0 if both meas. within limits, else 1 or 2	UL & LL specified
HI	0 if both meas. < UL, else 1 or 2	UL specified
LO	0 if both meas. > LL, else 1 or 2	LL specified
Measurement info.		
Expected value	Any	default
Min value expected	Any	default
Max value expected	Any	default
Permitted uncertainty	Any	default
Required resolution	Any	default
Capability info.		
Characteristic (type)	Voltage	nominal
Observation method	trms	nominal
Value	8 V	nominal
Max value	10 V	nominal
Uncertainty in value	± 0.5 V	nominal

```
<Instantaneous name="InstantaneousVoltage_4074"
measuredVariable="INDEPENDENT" samples="1" gateTime="1 ms" nominal="inst 3 V
errlmt +-0.1 V" UL="1.3 s" LL="1.1 s" In="TwoWireInp" />
```

Perform an instantaneous voltage measurement with an uncertainty of ±0.1 V using a gateTime of 1 ms. Record the time at which this measurement occurs and verify that the time value is between the limits of 1.1 s and 1.3 s.

The expected instantaneous value of the input signal is 3 V.

Signal attributes		
method	Instantaneous	BSC class
type	Voltage	implied from nominal
refType	Time	default
measuredVariable	independent	measuredVariable="INDEPENDENT"
samples	1	samples="1"
gateTime	1 ms	gateTime="1 ms"
condition	NONE	default
nominal	3 V	nominal="inst 3 V"
UL	1.3 s	UL="1.3 s"
LL	1.1 s	LL="1.1 s"
As	<none>	default
Read-only attributes		
Measurement	Time of measurement	samples = 1
Measurements	Only value measured	samples = 1
Events	1 (with measurement)	samples = 1
Output abstract signal	Voltage @ instantaneous level	default
GO	1 if meas. within limits, else 0	UL & LL specified
NOGO	0 if meas. within limits, else 1	UL & LL specified
HI	0 if meas. < UL, else 1	UL specified
LO	0 if meas. > LL, else 1	LL specified
Measurement info.		
Expected value	3 V	nominal
Min value expected	Any	default
Max value expected	Any	nominal
Permitted uncertainty	±0.1 V	nominal
Required resolution	Any	default
Capability info.		
Characteristic (type)	none provided	
Observation method	none provided	
Value	none provided	
Max value	none provided	
Uncertainty in value	none provided	

Annex B Generic Measurements

Detailed breakdown of examples showing all relevant attributes and their derivation.

<Measure />

Take an instantaneous voltage measurement and create an event when taken.

Signal attributes		
method	Instantaneous	default (no qualifier provided)
type	Voltage	default
refType	Time	default
measuredVariable	Dependent	default
samples	1	default
gateTime	Implementation dependant	default = 0
condition	NONE	default
nominal	<none>	default
UL	<no value>	default 0 assumed if required
LL	<no value>	default 0 assumed if required
As	<none>	default
Read-only attributes		
Measurement	instantaneous voltage	method, type
Measurements	n/a	default (samples = 1)
Events	1 when measurement occurs	default (samples = 1)
Output abstract signal	Voltage @ instantaneous level	default
GO	1 if within limits, else 0	
NOGO	0 if within limits, else 1	
HI	1 if > UL, else 0	
LO	1 if < LL, else 0	
Measurement info.		
Expected value	Any	default
Min value expected	Any	default
Max value expected	Any	default
Permitted uncertainty	Any	default
Required resolution	Any	default
Capability info.		
Characteristic (type)	none provided	
Observation method	none provided	
Value	none provided	
Max value	none provided	
Uncertainty in value	none provided	

```
<Measure nominal="1.5 V" />
```

Take an instantaneous voltage measurement and create an event when taken.

Signal attributes		
method	Instantaneous	default (no qualifier provided)
type	Voltage	implied from nominal
refType	Time	default
measuredVariable	Dependent	default
samples	1	default
gateTime	Implementation dependant	default = 0
condition	NONE	default
nominal	1.5 V	nominal
UL	<no value>	default 0 assumed if required
LL	<no value>	default 0 assumed if required
As	<none>	default
Read-only attributes		
Measurement	instantaneous voltage	method, type
Measurements	n/a	default (samples = 1)
Events	1 when measurement occurs	default (samples = 1)
Output abstract signal	Voltage @ instantaneous level	default
GO	1 if within limits, else 0	
NOGO	0 if within limits, else 1	
HI	1 if > UL, else 0	
LO	1 if < LL, else 0	
Measurement info.		
Expected value	1.5 V	nominal
Min value expected	Any	default
Max value expected	Any	default
Permitted uncertainty	Any	default
Required resolution	Any	default
Capability info.		
Characteristic (type)	none provided	
Observation method	none provided	
Value	none provided	
Max value	none provided	
Uncertainty in value	none provided	

```
<Measure samples="0" />
```

Output an abstract signal of instantaneous voltages values.

Signal attributes		
method	Instantaneous	default (no qualifier provided)
type	Voltage	implied from nominal
refType	Time	default
measuredVariable	Dependent	default
samples	0	samples="0"
gateTime	Implementation dependant	default = 0
condition	NONE	default
nominal	<none>	default
UL	<no value>	default 0 assumed if required
LL	<no value>	default 0 assumed if required
As	<none>	default
Read-only attributes		
Measurement	none	samples = 0
Measurements	none	samples = 0
Events	none	samples="0"
Output abstract signal	Voltage @ instantaneous level	default
GO	0	samples = 0
NOGO	0	samples = 0
HI	0	samples = 0
LO	0	samples = 0
Measurement info.		
Expected value	Any	default
Min value expected	Any	default
Max value expected	Any	default
Permitted uncertainty	Any	default
Required resolution	Any	default
Capability info.		
Characteristic (type)	none provided	
Observation method	none provided	
Value	none provided	
Max value	none provided	
Uncertainty in value	none provided	

```
<Measure nominal="trms 3.5 mA" />
```

Take an rms current measurement and create an event when taken. The expected value is 3.5 mA.

Signal attributes		
method	RMS	qualifier
type	Current	implied from nominal
refType	Time	default
measuredVariable	Dependent	default
samples	1	default
gateTime	Implementation dependant	default = 0
condition	NONE	default
nominal	3.5 mA	nominal
UL	<no value>	default 0 assumed if required
LL	<no value>	default 0 assumed if required
As	<none>	default
Read-only attributes		
Measurement	trms current	method, type
Measurements	n/a	default (samples = 1)
Events	1 when measurement occurs	default (samples = 1)
Output abstract signal	Current @ trms level	default
GO	1 if within limits, else 0	
NOGO	0 if within limits, else 1	
HI	1 if > UL, else 0	
LO	1 if < LL, else 0	
Measurement info.		
Expected value	3.5 mA	nominal
Min value expected	Any	default
Max value expected	Any	default
Permitted uncertainty	Any	default
Required resolution	Any	default
Capability info.		
Characteristic (type)	none provided	
Observation method	none provided	
Value	none provided	
Max value	none provided	
Uncertainty in value	none provided	

```
<Measure nominal="av" type="Current"/>
```

Take an average current measurement and create an event when taken.

Signal attributes		
method	Average	qualifier
type	Current	type="Current"
refType	Time	default
measuredVariable	Dependent	default
samples	1	default
gateTime	Implementation dependant	default = 0
condition	NONE	default
nominal	<none>	default
UL	<no value>	default 0 assumed if required
LL	<no value>	default 0 assumed if required
As	<none>	default
Read-only attributes		
Measurement	average current	method, type
Measurements	n/a	default (samples = 1)
Events	1 when measurement occurs	default (samples = 1)
Output abstract signal	Current @ average level	default
GO	1 if within limits, else 0	
NOGO	0 if within limits, else 1	
HI	1 if > UL, else 0	
LO	1 if < LL, else 0	
Measurement info.		
Expected value	Any	default
Min value expected	Any	default
Max value expected	Any	default
Permitted uncertainty	Any	default
Required resolution	Any	default
Capability info.		
Characteristic (type)	none provided	
Observation method	none provided	
Value	none provided	
Max value	none provided	
Uncertainty in value	none provided	

```
<Measure condition="GT" nominal="trms 3 V" />
```

Take an rms voltage measurement and create an event when taken. The signal is to be evaluated when the trms value of the signal is greater than 3 V.

Signal attributes		
method	RMS	qualifier
type	Voltage	implied from nominal
refType	Time	default
measuredVariable	Dependent	default
samples	1	default
gateTime	Implementation dependant	default = 0
condition	GT	condition="GT"
nominal	3 V trms	nominal="trms 3 V"
UL	<no value>	default 0 assumed if required
LL	<no value>	default 0 assumed if required
As	<none>	default
Read-only attributes		
Measurement	rms voltage	method, type
Measurements	n/a	default (samples = 1)
Events	1 when measurement occurs	default (samples = 1)
Output abstract signal	Voltage @rms level	default
GO	1 if within limits, else 0	
NOGO	0 if within limits, else 1	
HI	1 if > UL, else 0	
LO	1 if < LL, else 0	
Measurement info.		
Expected value	3 V	nominal
Min value expected	Any	default
Max value expected	Any	default
Permitted uncertainty	Any	default
Required resolution	Any	default
Capability info.		
Characteristic (type)	none provided	
Observation method	none provided	
Value	none provided	
Max value	none provided	
Uncertainty in value	none provided	

```
<Measure As="SpecifiedSignal" />
```

Measure the error in the voltage of the input signal compared to the voltage of the specified signal and create an event when taken.

Signal attributes		
method	Instantaneous	default (no qualifier provided)
type	Voltage	default
refType	Time	default
measuredVariable	Dependent	default
samples	1	default
gateTime	Implementation dependant	default = 0
condition	NONE	default
nominal	<none>	default
UL	<no value>	default 0 assumed if required
LL	<no value>	default 0 assumed if required
As	<none>	default
Read-only attributes		
Measurement	instantaneous voltage (error in)	method, type
Measurements	n/a	default (samples = 1)
Events	1 when measurement occurs	default (samples = 1)
Output abstract signal	Error Voltage @ instantaneous level	default
GO	1 if within limits, else 0	
NOGO	0 if within limits, else 1	
HI	1 if > UL, else 0	
LO	1 if < LL, else 0	
Measurement info.		
Expected value	Any	default
Min value expected	Any	default
Max value expected	Any	default
Permitted uncertainty	Any	default
Required resolution	Any	default
Capability info.		
Characteristic (type)	none provided	
Observation method	none provided	
Value	none provided	
Max value	none provided	
Uncertainty in value	none provided	

```
<Measure samples="0" As="SpecifiedSignal"  />
```

Output an abstract signal of instantaneous voltages values.

Signal attributes		
method	Instantaneous	default (no qualifier provided)
type	Voltage	default
refType	Time	default
measuredVariable	Dependent	default
samples	0	samples="0"
gateTime	Implementation dependant	default = 0
condition	NONE	default
nominal	<none>	default
UL	<no value>	default 0 assumed if required
LL	<no value>	default 0 assumed if required
As	<none>	default
Read-only attributes		
Measurement	none	samples = 0
Measurements	none	samples = 0
Events	none	Samples = 0
Output abstract signal	Error Voltage @ instantaneous level	default
GO	0	samples = 0
NOGO	0	samples = 0
HI	0	samples = 0
LO	0	samples = 0
Measurement info.		
Expected value	Any	default
Min value expected	Any	default
Max value expected	Any	default
Permitted uncertainty	Any	default
Required resolution	Any	default
Capability info.		
Characteristic (type)	none provided	
Observation method	none provided	
Value	none provided	
Max value	none provided	
Uncertainty in value	none provided	

```
<Measure nominal="trms 3.5 mA" As="SpecifiedSignal"  />
```

Measure the error in the current of the input signal compared to the current of the specified signal. Use the trms intrinsic measurement method.

Signal attributes		
method	RMS	qualifier
type	Current	implied from nominal
refType	Time	default
measuredVariable	Dependent	default
samples	1	default
gateTime	Implementation dependant	default = 0
condition	NONE	default
nominal	<none>	default
UL	<no value>	default 0 assumed if required
LL	<no value>	default 0 assumed if required
As	<none>	default
Read-only attributes		
Measurement	rms current (error in)	method, type
Measurements	n/a	default (samples = 1)
Events	1 when measurement occurs	default (samples = 1)
Output abstract signal	Error Current @ rms level	default
GO	1 if within limits, else 0	
NOGO	0 if within limits, else 1	
HI	1 if > UL, else 0	
LO	1 if < LL, else 0	
Measurement info.		
Expected value	3.5 mA	nominal
Min value expected	Any	default
Max value expected	Any	default
Permitted uncertainty	Any	default
Required resolution	Any	default
Capability info.		
Characteristic (type)	none provided	
Observation method	none provided	
Value	none provided	
Max value	none provided	
Uncertainty in value	none provided	

```
<Sinusoid name="ReferenceSignal" amplitude="0.43 V" frequency="1.2 kHz" />
<Measure As="ReferenceSignal" attribute="ReferenceSignal.amplitude"  />
```

The reference signal is a sinusoid with an amplitude of 0.43 V and a frequency of 1.2 kHz. Make a measurement on the input signal equivalent to measuring the amplitude attribute of the reference signal.

Signal attributes		
method	Instantaneous	referenced attribute
type	Voltage	referenced attribute
refType	Time	default
measuredVariable	Dependent	default
samples	1	default
gateTime	Implementation dependant	default = 0
condition	NONE	default
nominal	<none>	default
UL	<no value>	default 0 assumed if required
LL	<no value>	default 0 assumed if required
As	<none>	default
Read-only attributes		
Measurement	instantaneous voltage	method, type
Measurements	n/a	default (samples = 1)
Events	1 when measurement occurs	default (samples = 1)
Output abstract signal	Voltage@ instantaneous level	default
GO	1 if within limits, else 0	
NOGO	0 if within limits, else 1	
HI	1 if > UL, else 0	
LO	1 if < LL, else 0	
Measurement info.		
Expected value	0.43 V	referenced attribute
Min value expected	Any	default
Max value expected	Any	default
Permitted uncertainty	Any	default
Required resolution	Any	default
Capability info.		
Characteristic (type)	Frequency	referenced attribute
Observation method		
Value	1.2 kHz	referenced attribute
Max value	none provided	
Uncertainty in value	none provided	