# 03_Working_with_Signal

March 27, 2020

## 1 Working with asammdf.Signal

[1]:
```
from asammdf import Signal
print(Signal.__doc__)
```

```
    The *Signal* represents a channel described by it's samples and timestamps.
    It can perform arithmetic operations against other *Signal* or numeric
types.
    The operations are computed in respect to the timestamps (time correct).
    The non-float signals are not interpolated, instead the last value relative
    to the current timestamp is used.
    *samples*, *timestamps* and *name* are mandatory arguments.

    Parameters
    ----------
    samples : numpy.array | list | tuple
        signal samples
    timestamps : numpy.array | list | tuple
        signal timestamps
    unit : str
        signal unit
    name : str
        signal name
    conversion : dict | channel conversion block
        dict that contains extra conversion information about the signal ,
        default *None*
    comment : str
        signal comment, default ''
    raw : bool
        signal samples are raw values, with no physical conversion applied
    master_metadata : list
        master name and sync type
    display_name : str
        display name used by mdf version 3
    attachment : bytes, name
        channel attachment and name from MDF version 4
    source : SignalSource
```

```
        source information named tuple
    bit_count : int
        bit count; useful for integer channels
    stream_sync : bool
        the channel is a synchronisation for the attachment stream (mdf v4 only)
    invalidation_bits : numpy.array | None
        channel invalidation bits, default *None*
    encoding : str | None
        encoding for string signals; default *None*
```

[2]:
```
# Imports to pretty up plots.
%matplotlib inline
import seaborn as sns
import numpy as np
```

[3]:
```
# Full Sheet of Paper Plots
sns.set(
    rc={
        "figure.figsize": (11.69, 8.27), # A4 paper size.
        "figure.facecolor": "w",
        "figure.edgecolor": "k",
        "axes.labelsize": 18,
        "axes.titlesize": 18,
    }
)
```

### 1.1 0.1: Create 3 Signal objects with different time stamps

[4]:
```
# unit8 with 100ms time raster
timestamps = np.array([0.1 * t for t in range(5)], dtype=np.float32)
s_uint8 = Signal(
    samples=np.array([t for t in range(5)], dtype=np.uint8),
    timestamps=timestamps,
    name="Uint8_Signal",
    unit="u1",
)

# int32 with 50ms time raster
timestamps = np.array([0.05 * t for t in range(10)], dtype=np.float32)
s_int32 = Signal(
    samples=np.array(list(range(-500, 500, 100)), dtype=np.int32),
    timestamps=timestamps,
    name="Int32_Signal",
    unit="i4",
)
```

```
# float64 with 300ms time raster
timestamps = np.array([0.3 * t for t in range(3)], dtype=np.float32)
s_float64 = Signal(
    samples=np.array(list(range(2000, -1000, -1000)), dtype=np.int32),
    timestamps=timestamps,
    name="Float64_Signal",
    unit="f8",
)
```

## 2 Map signals

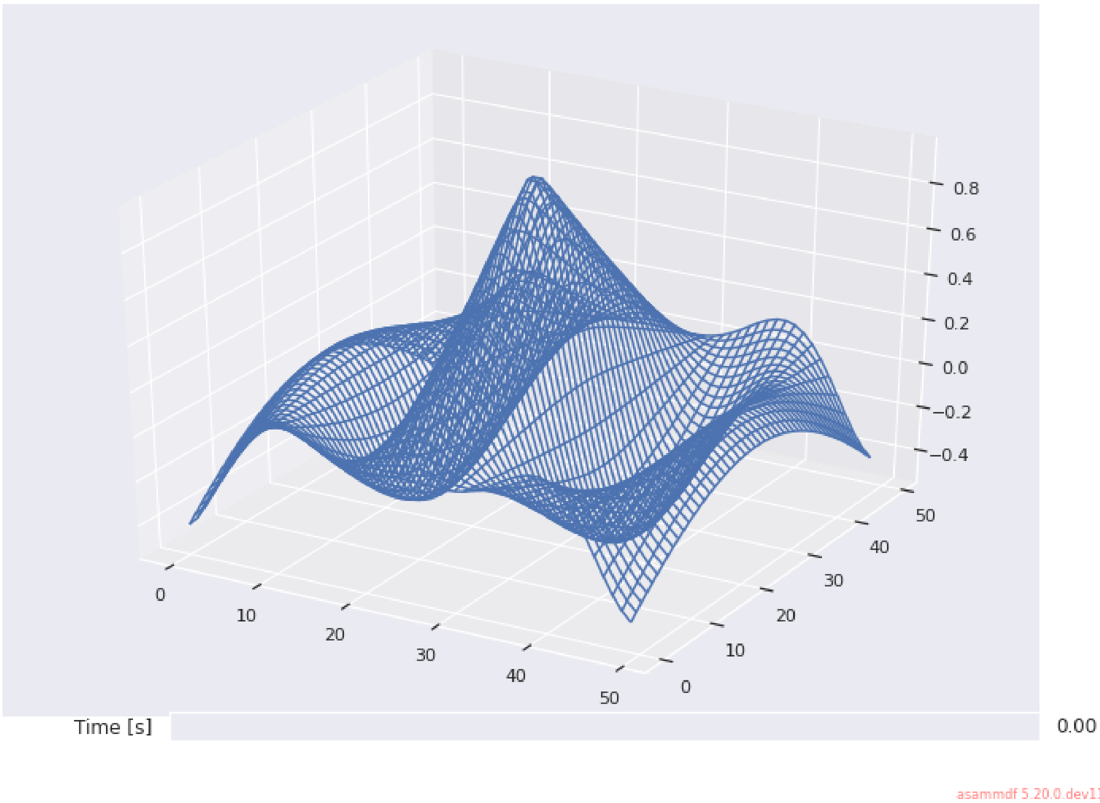
[5]:
```
xs = np.linspace(-1, 1, 50)
ys = np.linspace(-1, 1, 50)
X, Y = np.meshgrid(xs, ys)
```

[6]:
```
vals = np.linspace(0, 180.0 / np.pi, 100)
phi = np.ones((len(vals), 50, 50), dtype=np.float64)
```

[7]:
```
for i, val in enumerate(vals):
    phi[i] *= val
R = 1 - np.sqrt(X ** 2 + Y ** 2)
samples = np.cos(2 * np.pi * X + phi) * R

timestamps = np.arange(0, 2, 0.02)

s_map = Signal(
    samples=samples, timestamps=timestamps, name="Variable Map Signal",␣
 ↪unit="dB"
)
```

[8]:
```
s_map.plot()
```

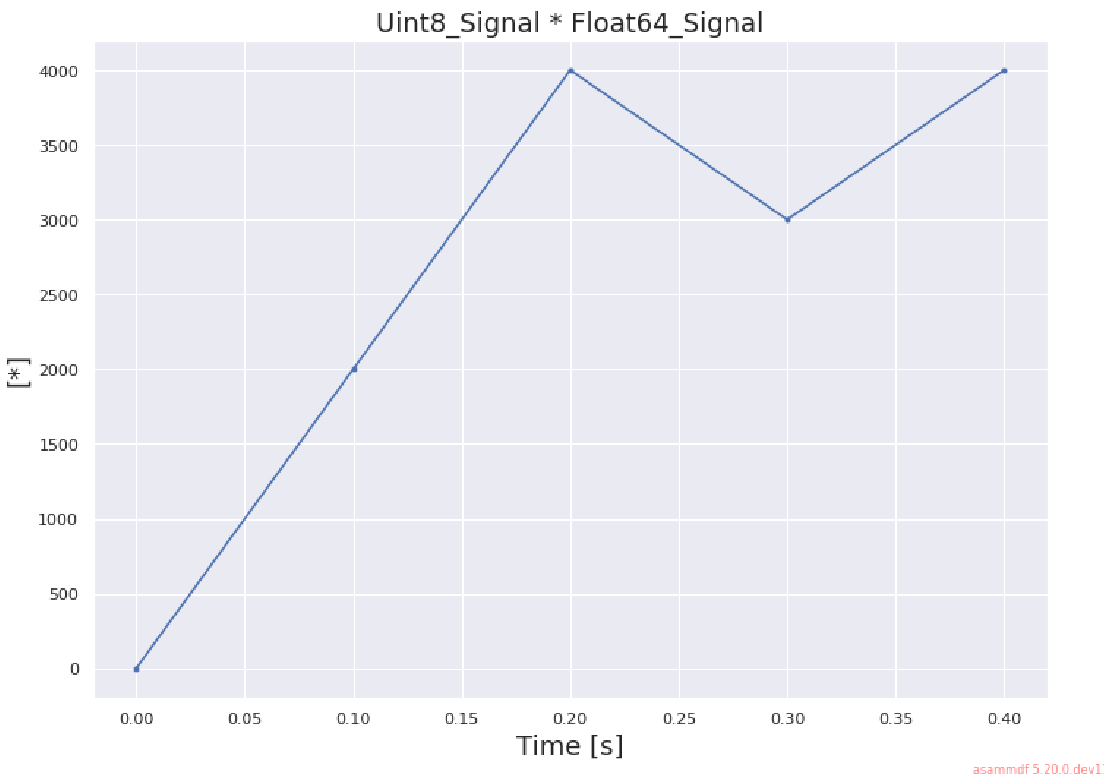
```
WARNING:root:Signal plotting requires pyqtgraph or matplotlib
/projects/Jupyter_MDF_Analysis/venv3.8/lib/python3.8/site-
packages/asammdf/signal.py:262: MatplotlibDeprecationWarning: Adding an axes
using the same arguments as a previous axes currently reuses the earlier
instance.  In a future version, a new instance will always be created and
returned.  Meanwhile, this warning can be suppressed, and the future behavior
ensured, by passing a unique label to each axes instance.
  ax = fig.add_subplot(111, projection="3d")
```



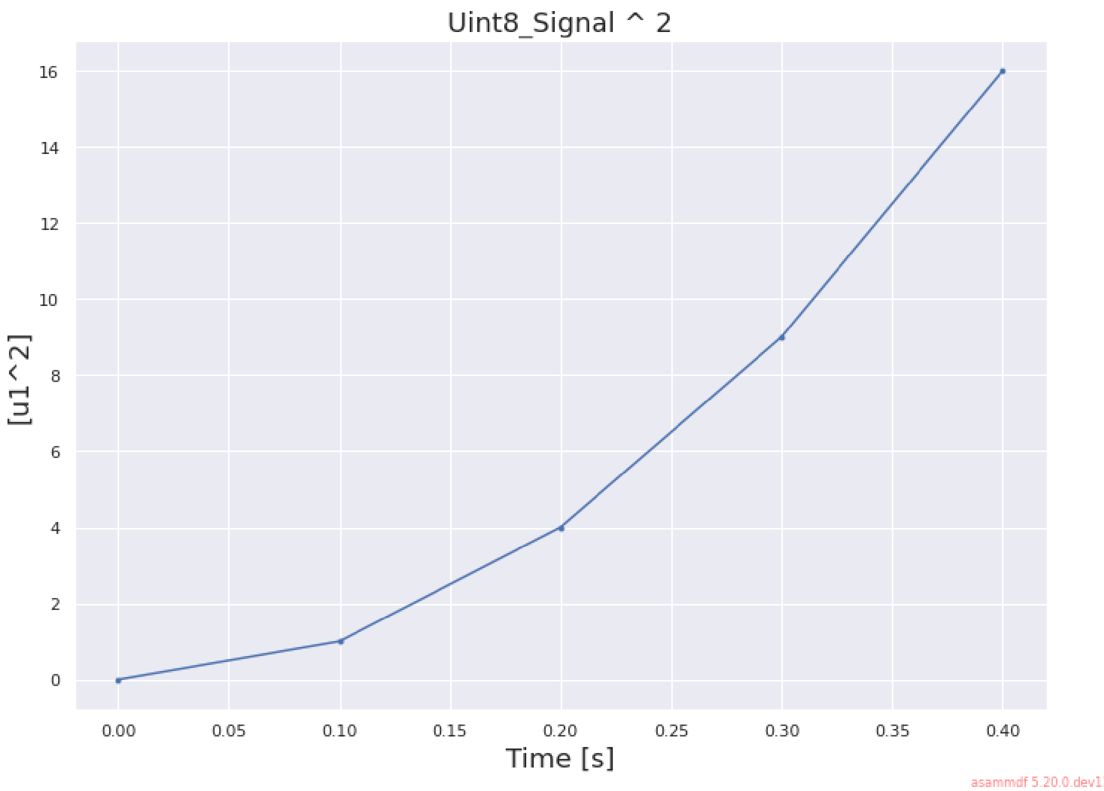

[9]:
```
prod = s_float64 * s_uint8
prod.name = "Uint8_Signal * Float64_Signal"
prod.unit = "*"
prod.plot()

pow2 = s_uint8 ** 2
pow2.name = "Uint8_Signal ^ 2"
pow2.unit = "u1^2"
pow2.plot()

allsum = s_uint8 + s_int32 + s_float64
allsum.name = "Uint8_Signal + Int32_Signal + Float64_Signal"
allsum.unit = "+"
allsum.plot()

# inplace operations
pow2 *= -1
pow2.name = "- Uint8_Signal ^ 2"
pow2.plot()

# cut signal
```

```
s_int32.plot()
cut_signal = s_int32.cut(start=0.2, stop=0.35)
cut_signal.plot()
```

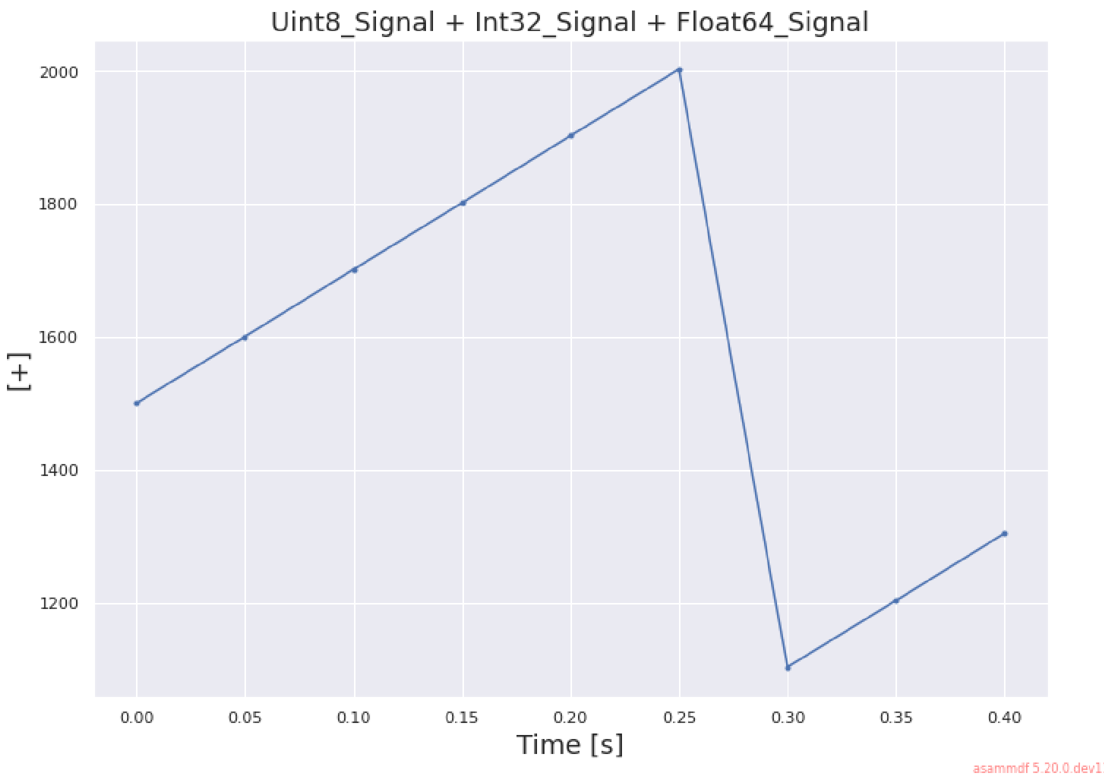
```
WARNING:root:Signal plotting requires pyqtgraph or matplotlib
```



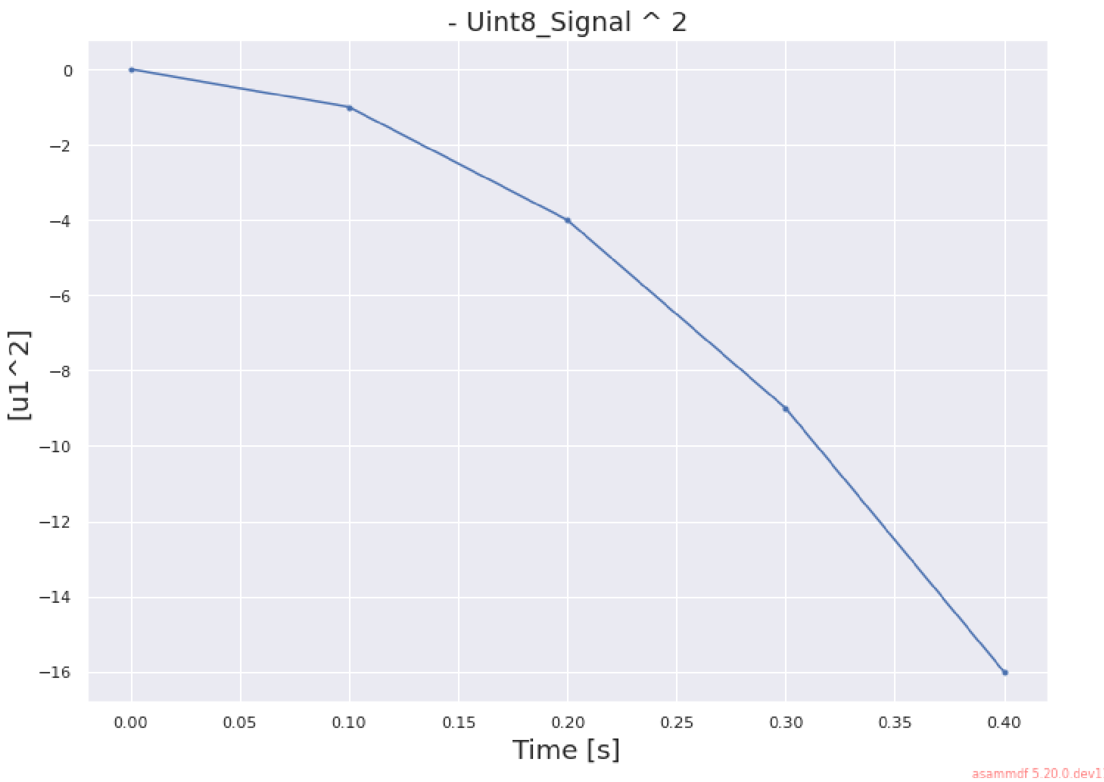

```
WARNING:root:Signal plotting requires pyqtgraph or matplotlib
```



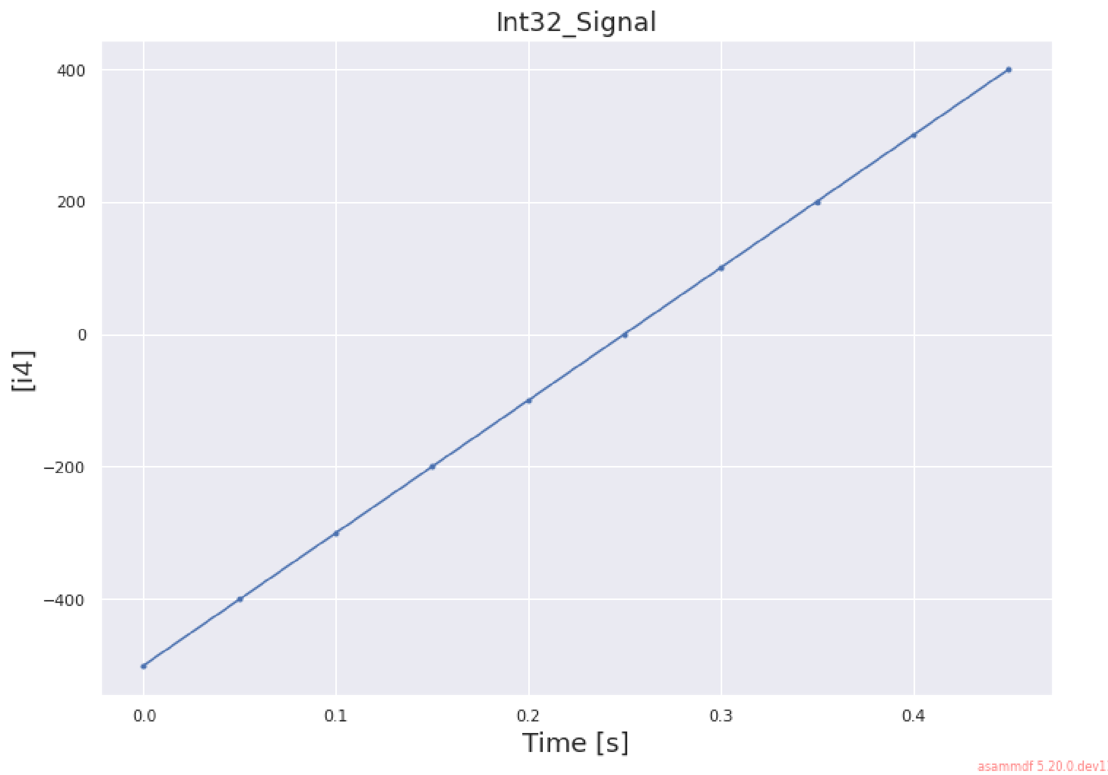

```
WARNING:root:Signal plotting requires pyqtgraph or matplotlib
```



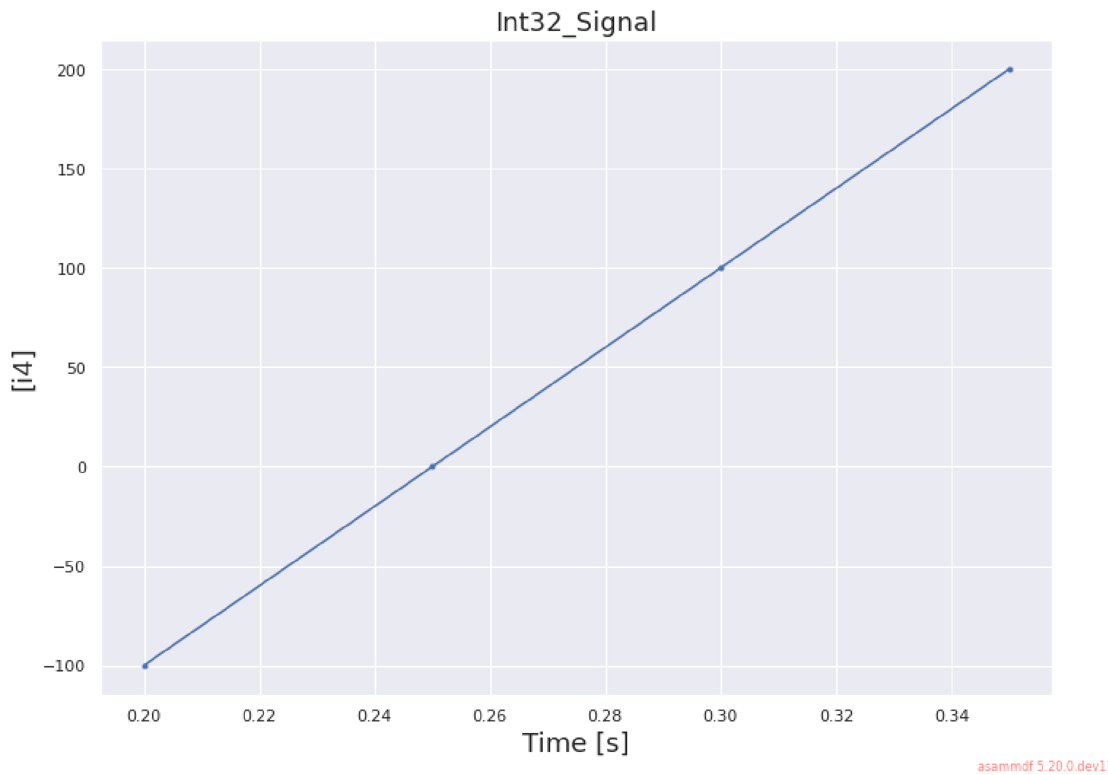

```
WARNING:root:Signal plotting requires pyqtgraph or matplotlib
```




```
WARNING:root:Signal plotting requires pyqtgraph or matplotlib
```

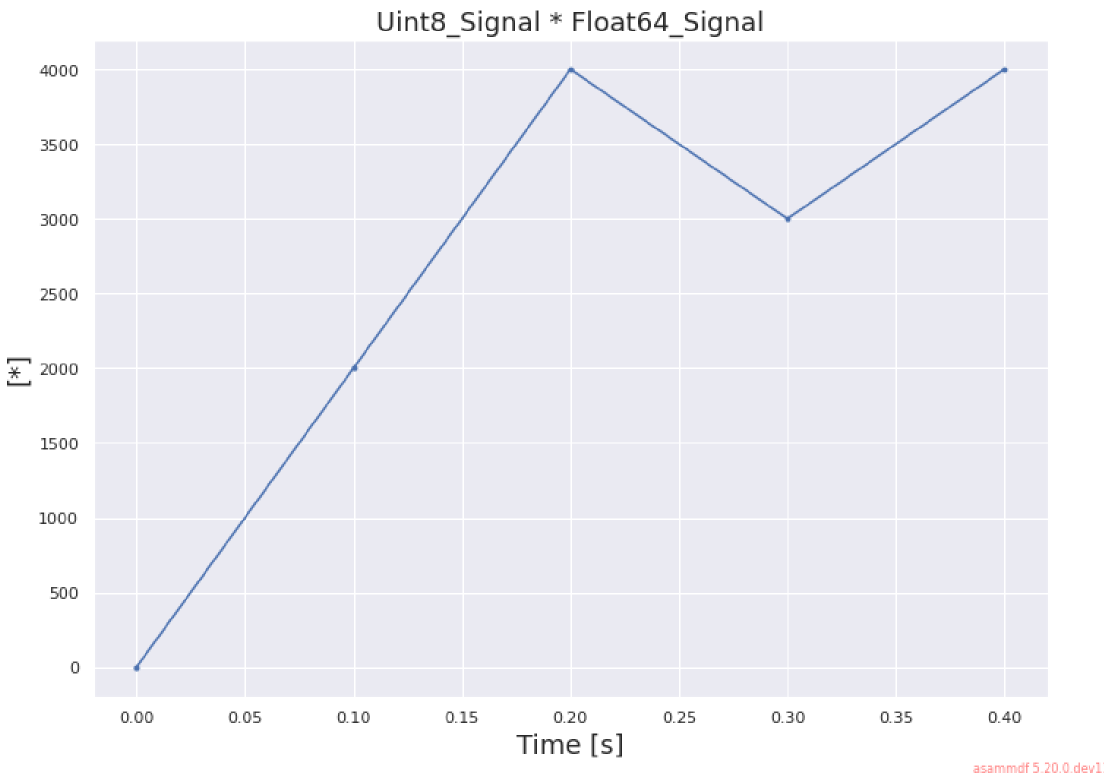



```
WARNING:root:Signal plotting requires pyqtgraph or matplotlib
```



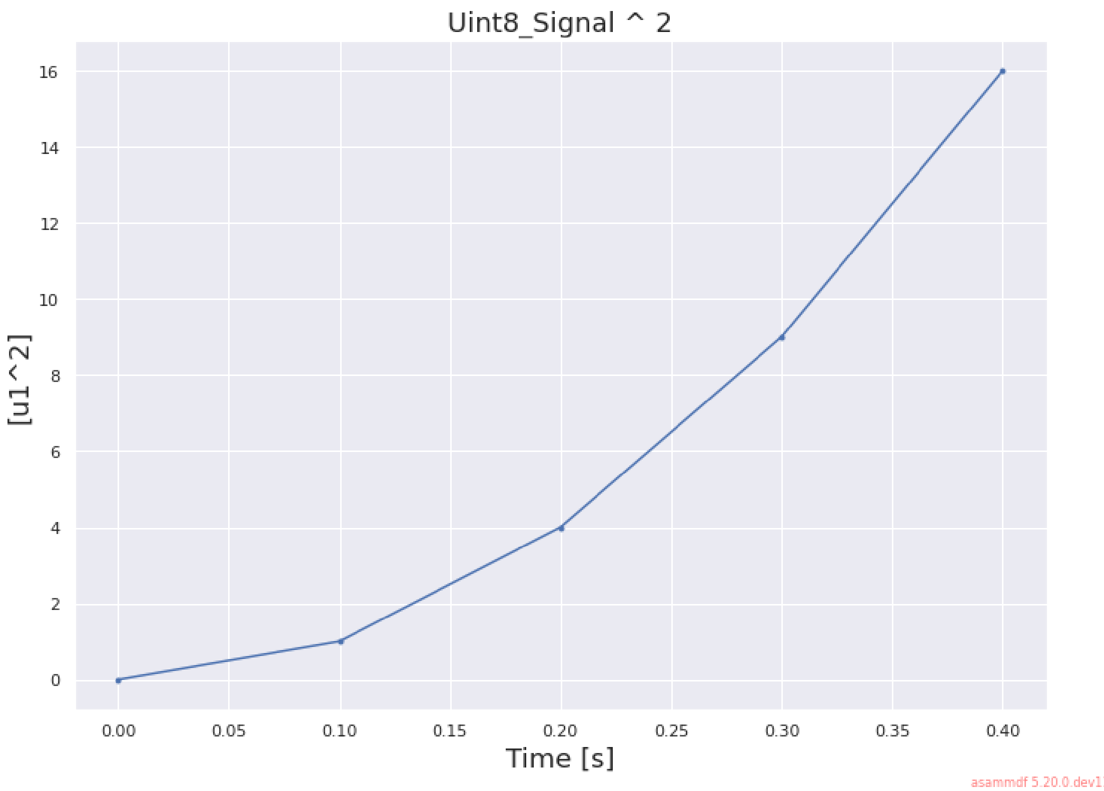

[10]:
```
prod = s_float64 * s_uint8
prod.name = "Uint8_Signal * Float64_Signal"
prod.unit = "*"
prod.plot()
```

```
WARNING:root:Signal plotting requires pyqtgraph or matplotlib
```



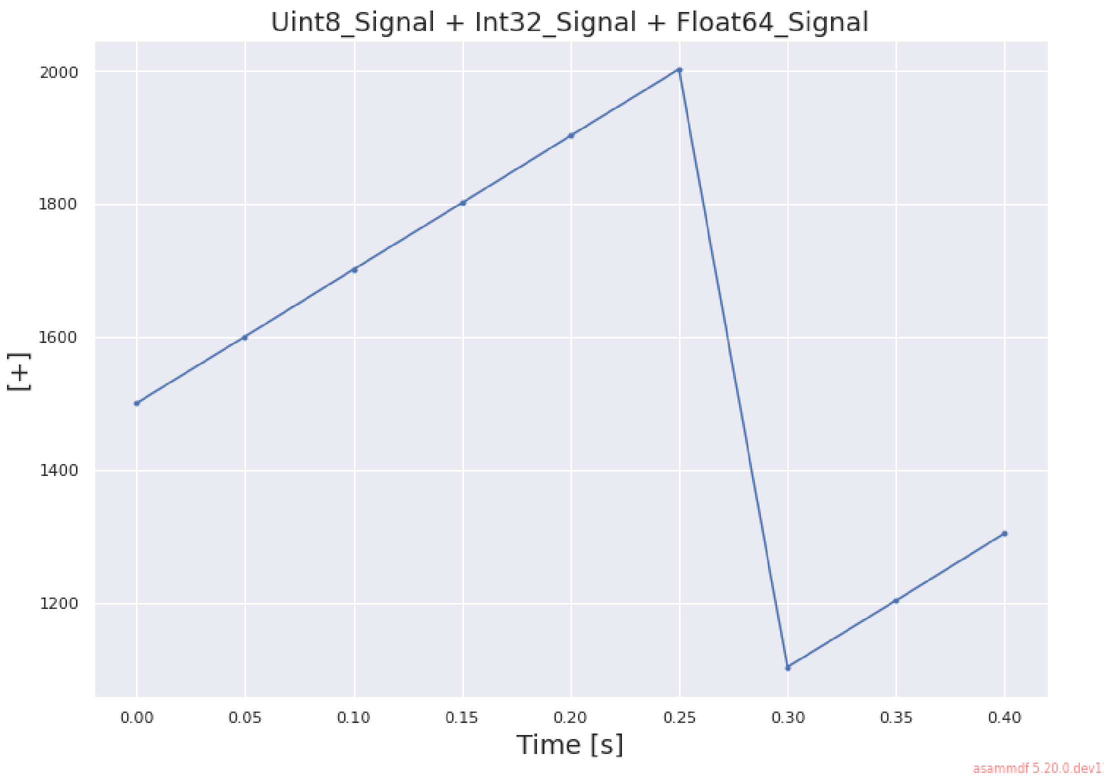

[11]:
```
pow2 = s_uint8 ** 2
pow2.name = "Uint8_Signal ^ 2"
pow2.unit = "u1^2"
pow2.plot()
```

```
WARNING:root:Signal plotting requires pyqtgraph or matplotlib
```




[12]:
```
allsum = s_uint8 + s_int32 + s_float64
allsum.name = "Uint8_Signal + Int32_Signal + Float64_Signal"
allsum.unit = "+"
allsum.plot()
```

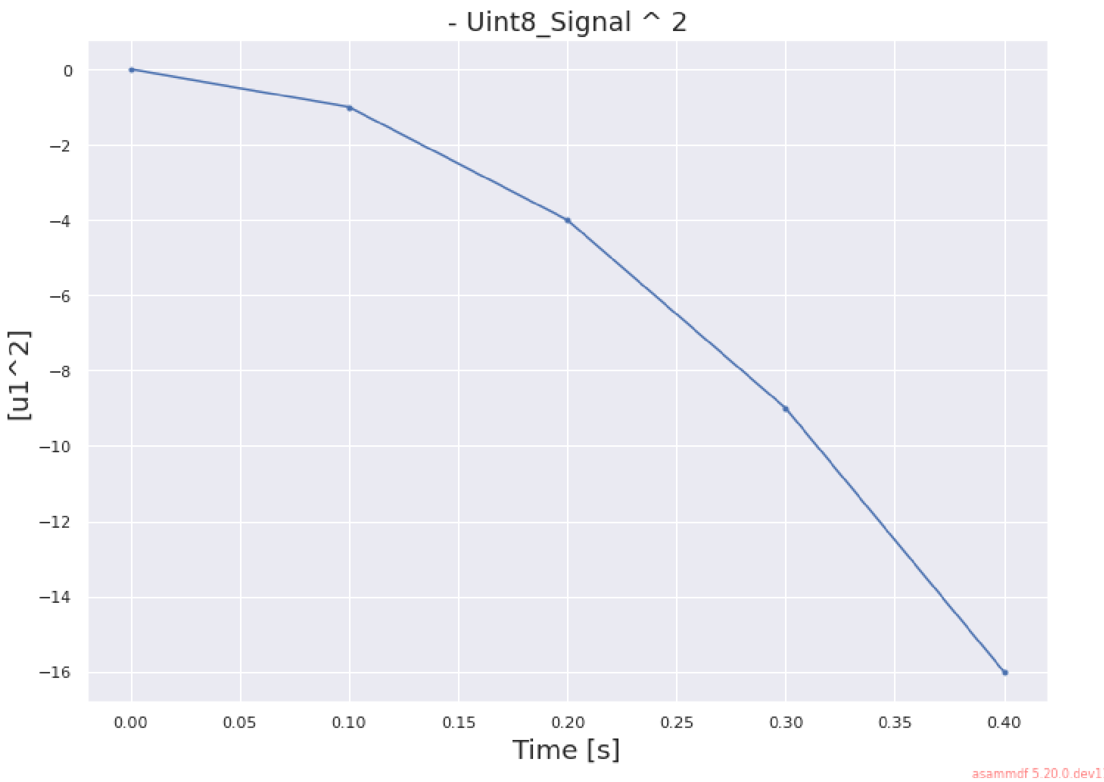
```
WARNING:root:Signal plotting requires pyqtgraph or matplotlib
```




# 3 Inplace operations

[13]:
```
pow2 *= -1
pow2.name = "- Uint8_Signal ^ 2"
pow2.plot()
```

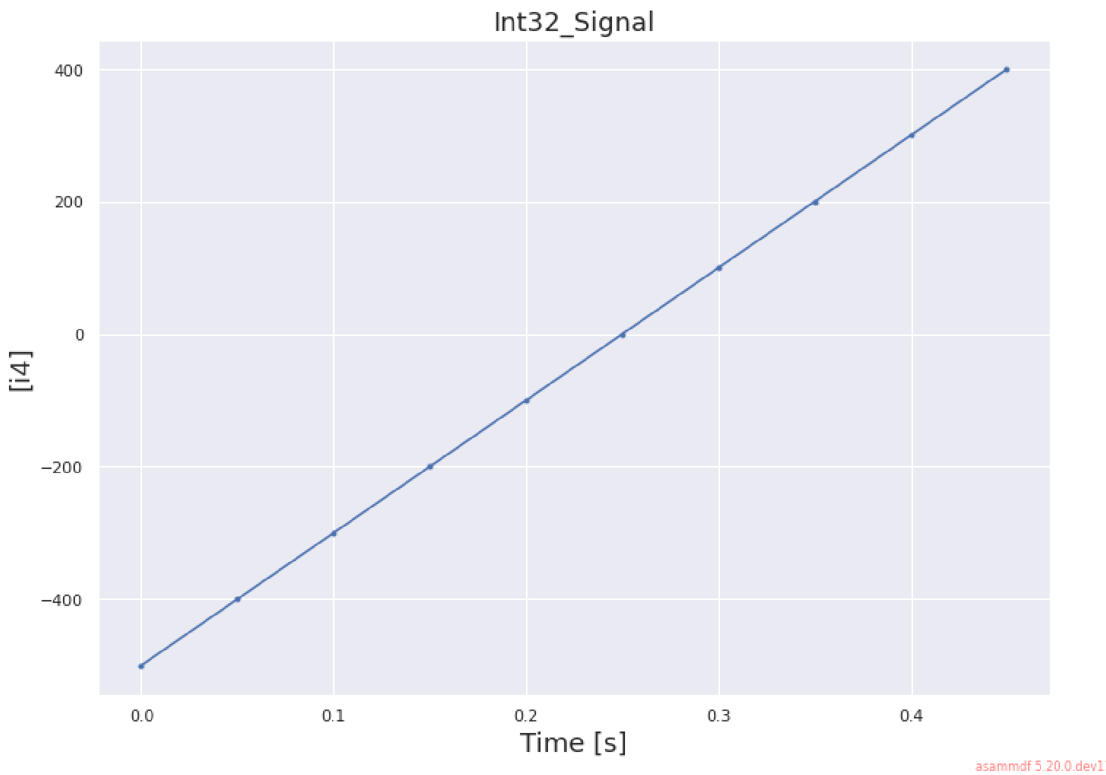
```
WARNING:root:Signal plotting requires pyqtgraph or matplotlib
```



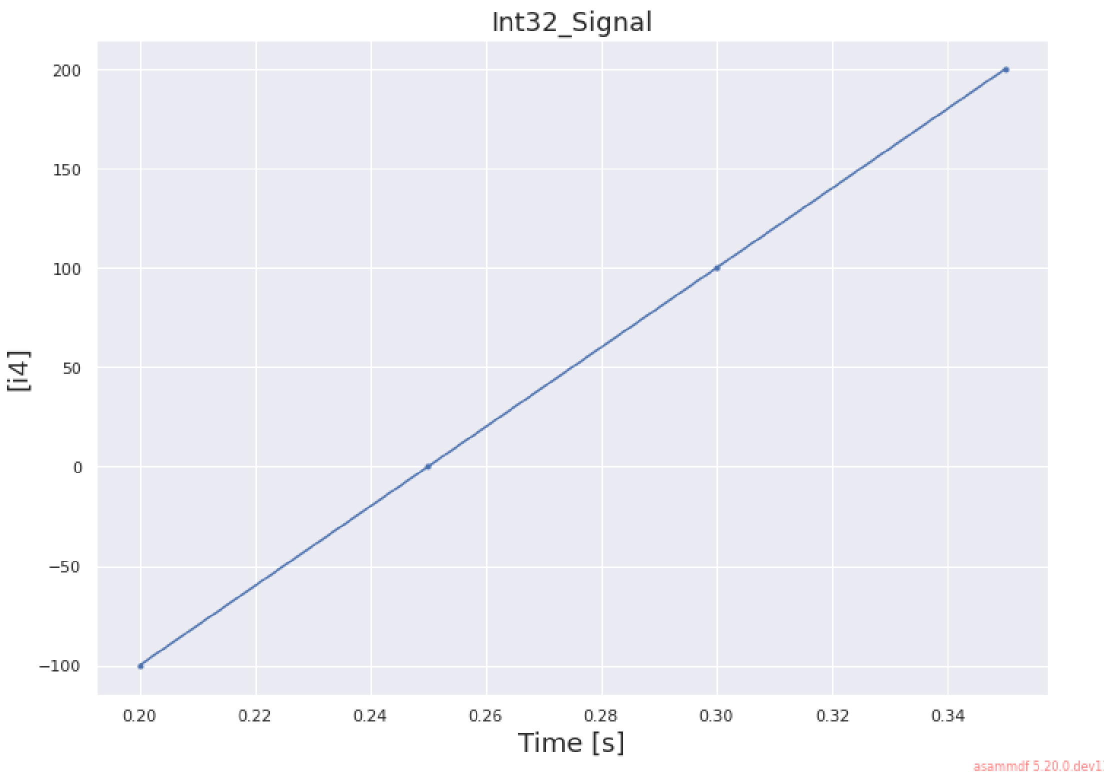

# 4 Cut Signal

[14]:
```
s_int32.plot()
cut_signal = s_int32.cut(start=0.2, stop=0.35)
cut_signal.plot()
```

```
WARNING:root:Signal plotting requires pyqtgraph or matplotlib
```




```
WARNING:root:Signal plotting requires pyqtgraph or matplotlib
```


Int32_Signal
200
150
100
50
0
−50
−100
[i4]
0.20
0.22
0.24
0.26
0.28
0.30
0.32
0.34
Time [s]
asammdf 5.20.0.dev11