# BUMP TEST

## CHAPTER 4

## 4.1. ADMINISTRATIVE INFORMATION

4.1.1. CLIENT

Martec Kannad

4.1.2. REPRESENTATIVES

For the Client : S. JINCHELEAU (MARTEC) & GPEYROU (ITS/ES)
For the Test Laboratory : A.BONAMICH ( ITS/ES)

4.1.3. DATES

Start of test : 18 September 2007
End of test : 20 September 2007

4.1.4. INTESPACE FILE REFERENCE : E7555-RTCM

## 4.2. UNIT UNDER TEST (UUT)

| | | | |
|---|---|---|---|
| Beacon Unit | : | 1/2 (with 50 ohm output) | 2/2 (normal fitted) |
| Name | : | MARTEC / KANNAD | MARTEC / KANNAD |
| Type | : | XS3_GPS | XS3_GPS |
| Number | : | UT1 | UT2 |

## 4 3. PURPOSE OF THE TEST

Functional checkout of hardware after bump testing.

## 4.4. TEST FACILITIES

4.4.1. TEST DEVICES

Electrodynamic Shaker 67kN
Vibration Control System (SD3) : Spectral Dynamics SD2550

4.4.2. METROLOGICAL EQUIPMENT

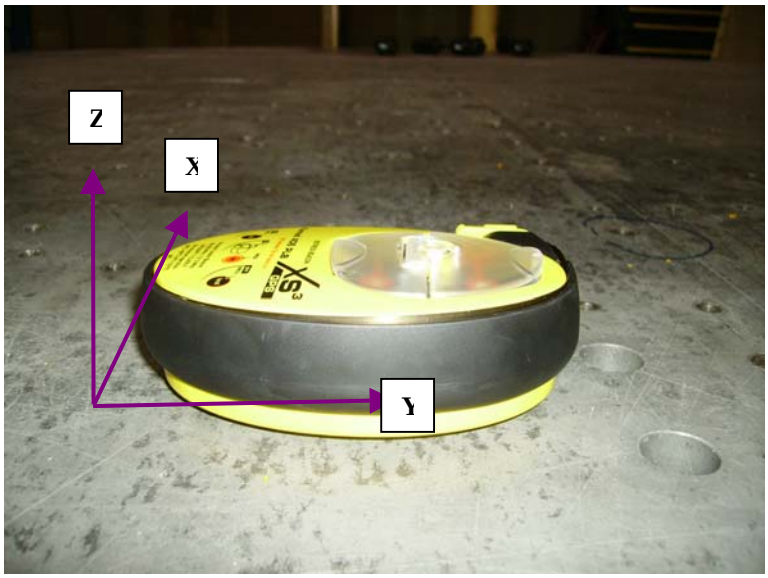
Vibration Control : piezo-electrical accelerometer (analysis and processing)
Vibration Measurements : Spectral Dynamics SD2550

Electrical Beacon Checking : Argos – Cospas / Sarsat Test Bench.

## 4.5. TEST PROCEDURE

### 4.5.1. REFERENCE AXES (See draw § 4.7)

X-axis : parallel to the Beacon fixing plane and Beacon « lengthways »
Y-axis : parallel to the Beacon fixing plane and Beacon « widthways »
Z-axis : perpendicular to the Beacon fixing plane




### 4.5.2. MOUNTING

The two beacons are secured to a light-alloy supporting square.
The complete assembly is firmly attached to the moving part of the vibration table according to the required axis.

### 4.5.3. TEST SPECIFICATIONS AND SEQUENCE

Bumps following Section A4.0 of RTCM Recommended Standards for 406 MHz Satellite PLBs (Version 1.1 Feb 4, 2003)

- Profile of bump test :

| | |
|---|---|
| Peak acceleration | 98 m/s$^2$ |
| Pulse duration | 16 ms |
| Waveshape | Half-cycle Sinewave |
| Test axes | On the three axes |
| Number of Bumps | 4000 |

- Beacons control : Visual inspection and Aliveness test after the Bump Tests

4.5.3. MEASUREMENT PRECISIONS

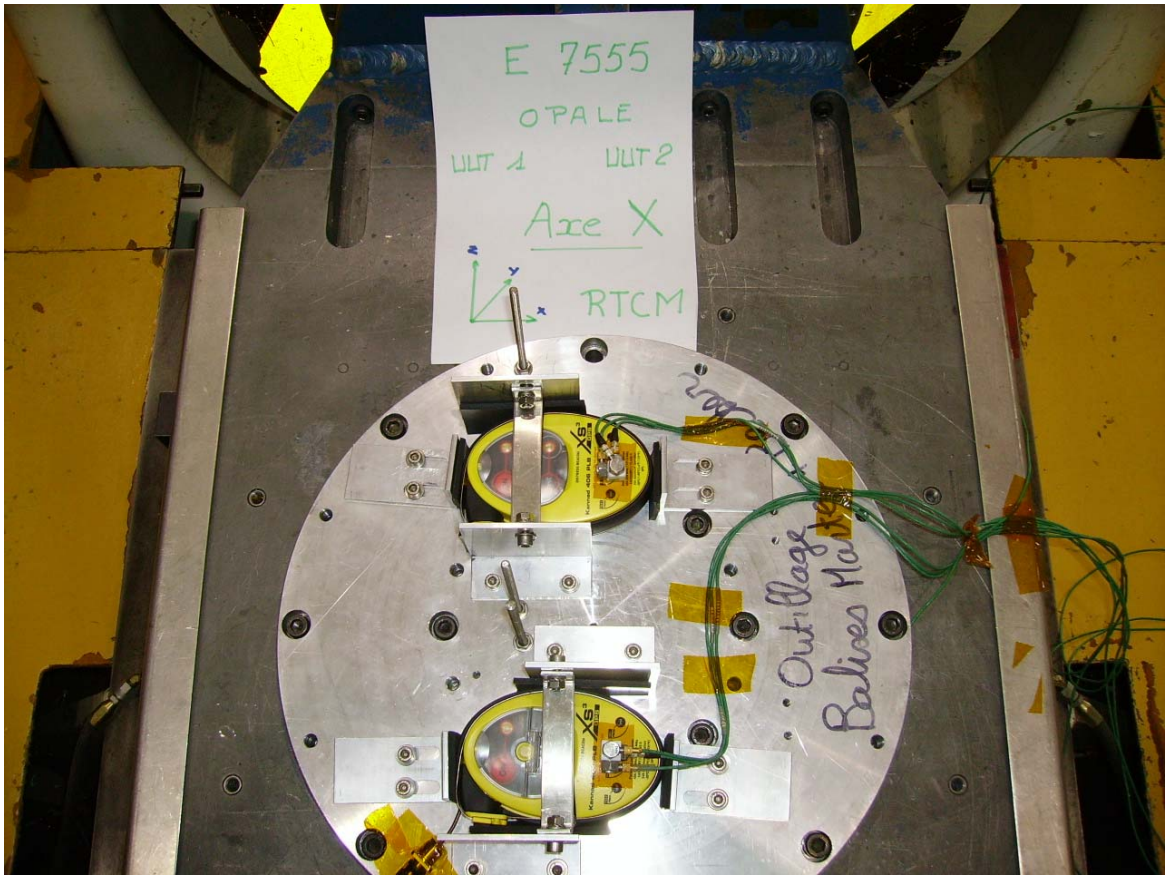
In the following table are given the measurement precisions for sine and random environments and for different types of accelerometers.
These precisions are given with respect to the measurement range.

| | Piezo-electric sensors + Conditioners | Strain-gages measurements | Integrated electronic sensors + PCB conditioners |
|---|---|---|---|
| Sine Tests (fundamental & harmonics) | 9.8 % | 14.6 % | 7.4 % |
| Sine Tests (frequency estimation) | 0.1 % | 0.1 % | 0.1 % |
| Random Tests (PSD) | 11.6 % | 15.8 % | 9.6 % |
| Random Test (FRF) | 12.8 % | 16.7 % | 11.1 % |

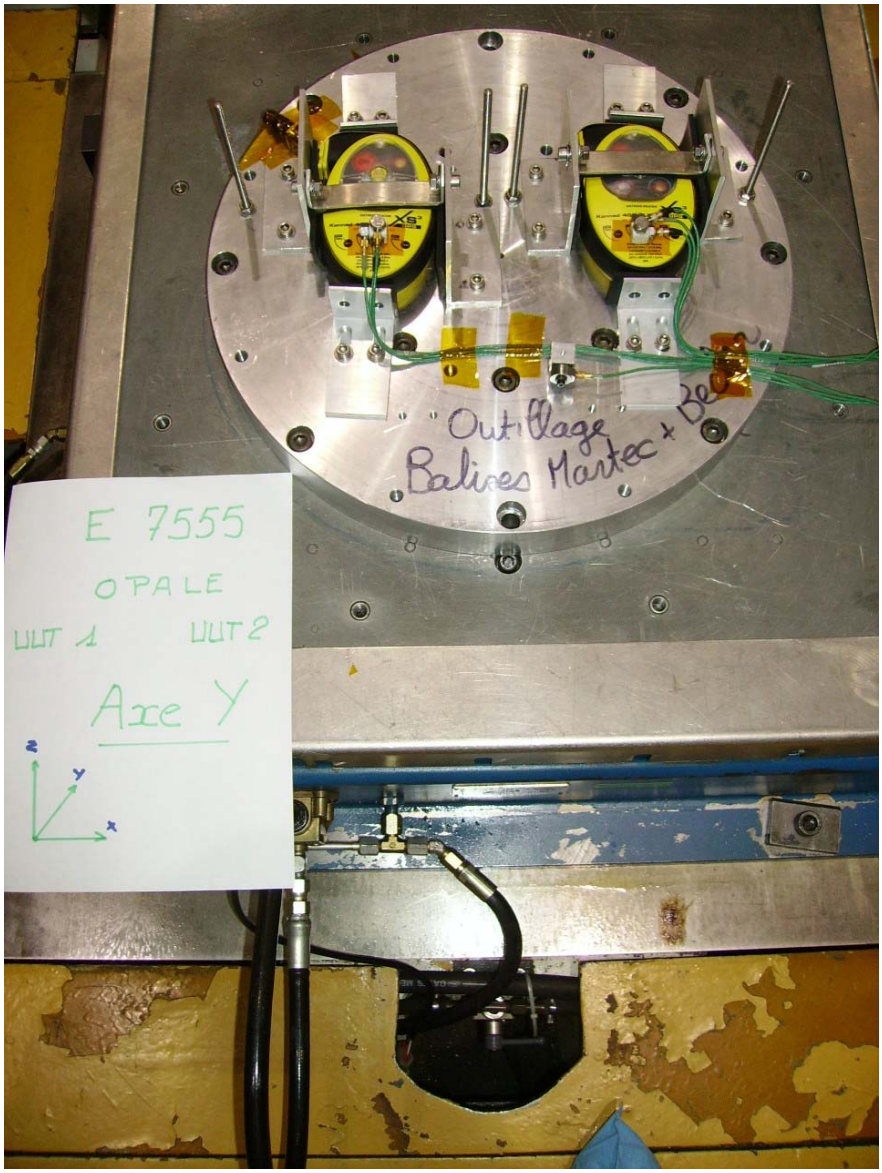
**4.6.**

| Sensor | Location | N° acc. | Cable | Sensivity pC/g |
|---|---|---|---|---|
| P (Control) | Screwed on test holder sheet | TD17 | 10M170 | 8.94 |
| X /UUT 01 (Measurement) | Glued on the Beacon | 5798 | 5122 | 6.67 |
| Y/UUT 01 (Measurement) | Glued on the Beacon | 12271 | 10M385 | 3.09 |
| Z/UUT 01 (Measurement) | Glued on the Beacon | 5845 | 10M206 | 6.67 |
| X/UUT 02 (Measurement) | Glued on the Beacon 007 | NC96 | 1228 | 2.69 |
| Y/UUT 02 (Measurement) | Glued on the Beacon 007 | 8568 | 12M076 | 7.94 |
| Z/UUT 02 (Measurement) | Glued on the Beacon 007 | 9335 | 12M048 | 7.38 |

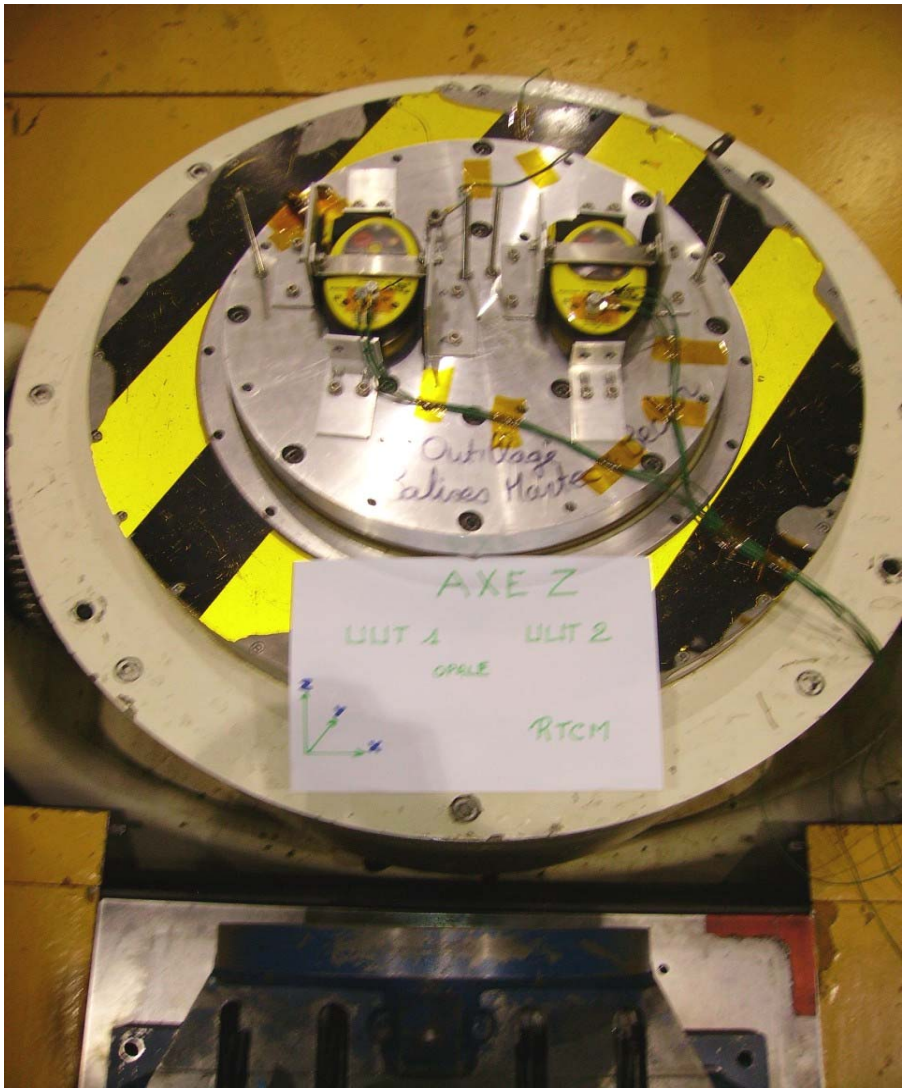
### 4.7. PHOTOGRAPHS




# AXE X




# AXE Y




# AXE Z

## 4.8. TEST SCHEDULE

| Date / Test n° | Specifications | Paragraph | Events - Observations | |
|---|---|---|---|---|
| | | | Test equipment | Unit under test |
| | **AXE X** | | | |
| September 18th, 2007<br><br>**Axe X+**<br>&<br>**Axe X-** | **Half-cycle sinewave Bump**<br>Peak acceleration 98 $m/s^2$<br>Pulse duration 16 ms<br>Test axis **X**<br>Number of Bumps : 4000 (2000 pos. + 2000 neg.)<br>Delay between 2 bumps: 1000ms. | 4.9.1 | Nominal | Set up the beacons on test table on **X** axis.<br><br>Functional testing : nominal. |
| | **AXE Y** | | | |
| September 18th, 2007<br><br>**Axe Y-**<br><br>September 19th, 2007<br><br>**Axe Y+** | **Half-cycle sinewave Bump**<br>Peak acceleration 98 $m/s^2$<br>Pulse duration 16 ms<br>Test axis **Y**<br>Number of Bumps : 4000 (2000 pos. + 2000 neg.)<br>Delay between 2 bumps: 1000ms. | 4.9.2 | Nominal | Set up the beacons on test table on **Y** axis.<br><br>Functional testing : nominal. |
| | **AXE Z** | | | |
| September 19th, 2007<br><br>**Axe Z+**<br><br>September 20th, 2007<br><br>**Axe Z-** | **Half-cycle sinewave Bump**<br>Peak acceleration 98 $m/s^2$<br>Pulse duration 16 ms<br>Test axis **Z**<br>Number of Bumps : 4000 (2000 pos. + 2000 neg.)<br>Delay between 2 bumps: 1000ms | 4.9.3 | Nominal | Set up the beacons on test table on **Z** axis.<br><br>Functional testing : nominal. |
| | | | End of the bump test. | Removal of the Beacons. |
| September 20th, 2007 | **BEACON CHECKOUT**<br>Test using a portable test bench and visual inspection | 4.9.4 | | Nothing abnormal to note |
| September 20th, 2007 | **FINAL CONTROL :**<br>4.9.5.1.External mechanical inspection.<br>4.9.5.2 PLB - Aliveness test. | 4.9.5 | Cospas Sarsat Test Bench | Nominal |

## 4.9. TEST RESULTS

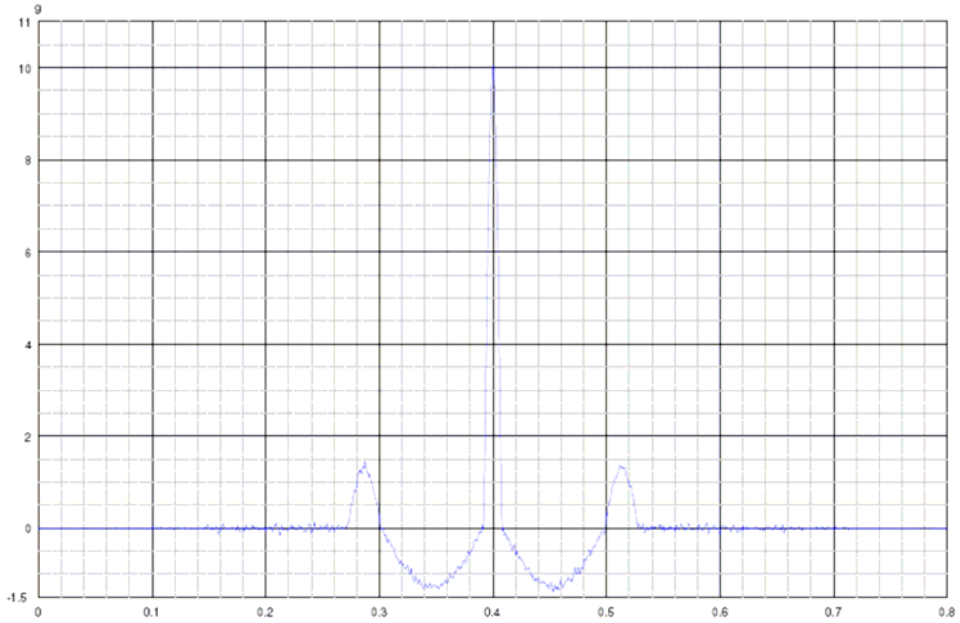
### 4.9.1. BUMP TEST RESULTS ON X DIRECTION (4000 bumps)

```
Setup
-----
Classical Shock  Test File Listing

File Name:                          10gposX_MARTEC
Current Date:                       Tue Sep 18 2007  13:26:35

CONTROL PARAMETERS:
    DURATION -
        Number of Full Level Pulses:  2000
        Delay between Pulses:        1500.0 ms
    CONTROL STRATEGY -
        Drive Update:                    On
        Pulse Output Polarity:            +
        Weighting for Averaging:       0.125
        Feedback Gain:                 0.750
        Waveform Trend Removal:        Enable
    OPERATION MODE -
        Mode:                          Semi-Automatic
    EQUALIZATION & SYSTEM IDENTIFICATION-
        Start Level:                  -15.0 dB
        Initial Excitation:            Pulse
        Prestored Drive:                 Off
    STARTUP -
        Initial Test Level:           -12.0 dB
        Level Increment:                1.0 dB
        Delay between Pulses:        1500.0 ms

REFERENCE PARAMETERS:
    REFERENCE PULSE -
    Pulse Type:                        Half Sine
        Pulse Amplitude:               10.00 g
        Pulse Duration:                16.00 ms
    Specify Buffer Duration:           No
    Buffer Duration:                  400.00 ms
    Center Pulse in Buffer:           Yes
    Sample Rate Multiplier:            5.12
    Units for Accel, Vel, and Displ:   g, m/s, mm
    PULSE COMPENSATION -
     Type:                             Pre- and Post-Pulse
     Optimization:                     Double Sided Displacement
     Method:                           Symmetric Acceleration
        Amplitude:                     13.0 %
    PULSE DISPLAY TOLERANCE BANDS -
        Type:                          None
    PULSE DYNAMIC LIMITS -
        Input Volts:                    0.00 V
        Acceleration:                   0.00    g         0.00    g
        Velocity:                       0.00  m/s         0.00  m/s
        Displacement:                   0.00   mm         0.00   mm
        Sample Rate:                    0.00 Hz
    SRS ANALYSIS PARAMETERS -
        SRS Spacing:                    1/3 octave
        SRS Filter Definition:         Absolute Acceleration
        SRS Damping:                    5.00 %
        SRS Q:                         10.00

SAFETY PARAMETERS:
    ALARM/ABORTS -
        Maximum Average Error -
            Alarm:                     20.00 %
            Abort:                     30.00 %
        Maximum Peak Error -
            Alarm:                     40.00 %
            Abort:                     60.00 %
    LOOP CHECK -
        Noise Threshold:               30.00 mV RMS
        Maximum Drive:                 50.00 mV RMS
        Pause after Loop Check:          Yes
    DRIVE SIGNAL -
        Maximum Drive:                  6.00 Vpeak
```

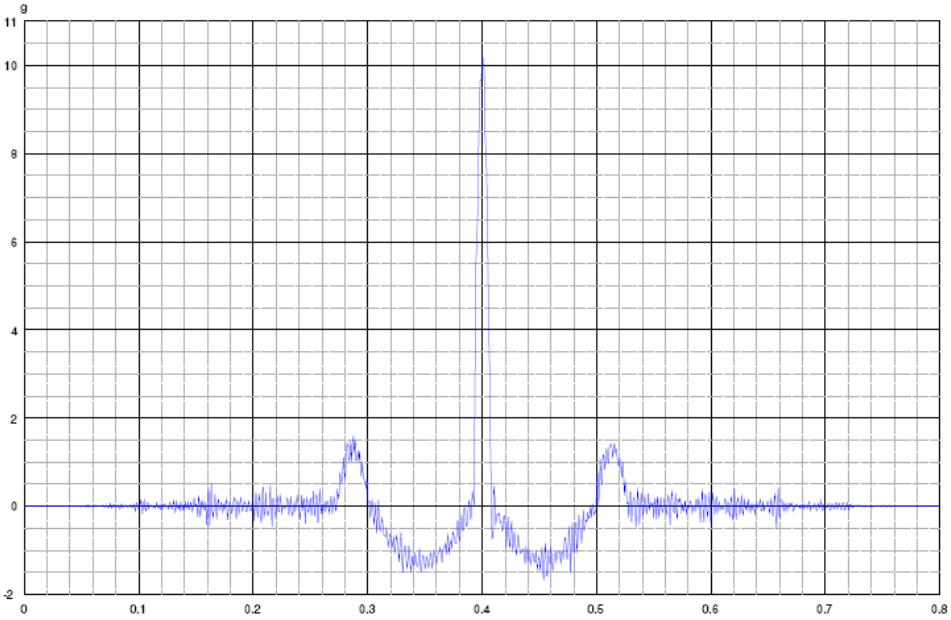
```
CHANNEL TABLE:
Channel Channel Loop   Sensitivity  Channel Label 1                Label 2
Number  Type    Check    (mV/g)
  1     Control  Yes     282.08     Pilote UUT1 ET UUT2
  2  Auxiliary   No      210.92     X SENSOR  UUT1
  3  Auxiliary   No      210.92     Y SENSOR UUT1
  4  Auxiliary   No       97.71     Z SENSOR UUT1
  5  Auxiliary   No      230.85     X SENSOR UUT 2
  6  Auxiliary   No      251.08     Y SENSOR UUT 2
  7  Auxiliary   No          85     Z SENSOR UUT 2

DOCUMENTATION:
    Display Text -
        Title 1: BUMP TEST  POSITIVE  DIRECTION - RTCM/ETSI _ Axe X+
        Title 2: E7555-
    List Only Text -
        Title 3:
        Prompt before Test:            Yes
    Data Storage -
        Mode:                        Every Full Level Pulse
    Message Log -
        Mode:                        Use Run Number
    Printing -
        Auto Plot after Test:          No

REMOTE COMMUNICATION TABLE:
    Enable Remote Communication:       No

SHAKER LIMITS:
    Enable Shaker Limits:              No

End of Classical Shock Test List
```

JournalEssai +X Axis

Shock Message Log
1.00000
%Test: 10gposX_MARTEC.006
09/18/07
10:05:10 Measuring Ambient Noise
10:05:27 System Identification
10:05:40 Using H(f) Equalization
10:05:43 Equalization Complete
10:05:43 Raising To Full Level
11:22:36 Full Level Reached
11:22:36 Automatic Mode Complete
12:44:06 Shutdown Initiated...
12:44:06 Shutdown Complete
12:44:06 Test Complete




| | | | |
|---|---|---|---|
| Projet: BALISE MARTEC | Essai: Choc | Date:18/Sep/2007 12:44:06 | Mesure: —— Pilote UUT1 ET UUT2 |
| Modèle: XS3_GPS | Type: Mesurée | | |
| Référence ITS: E7555 | Nom Essai: 10gposX_MARTEC | | |




| | | | |
|---|---|---|---|
| Projet: BALISE MARTEC | Essai: Choc | Date:18/Sep/2007 12:44:06 | Mesure: —— X SENSOR UUT1 |
| Modèle: XS3_GPS | Type: Mesurée | | |
| Référence ITS: E7555 | Nom Essai: 10gposX_MARTEC | | |

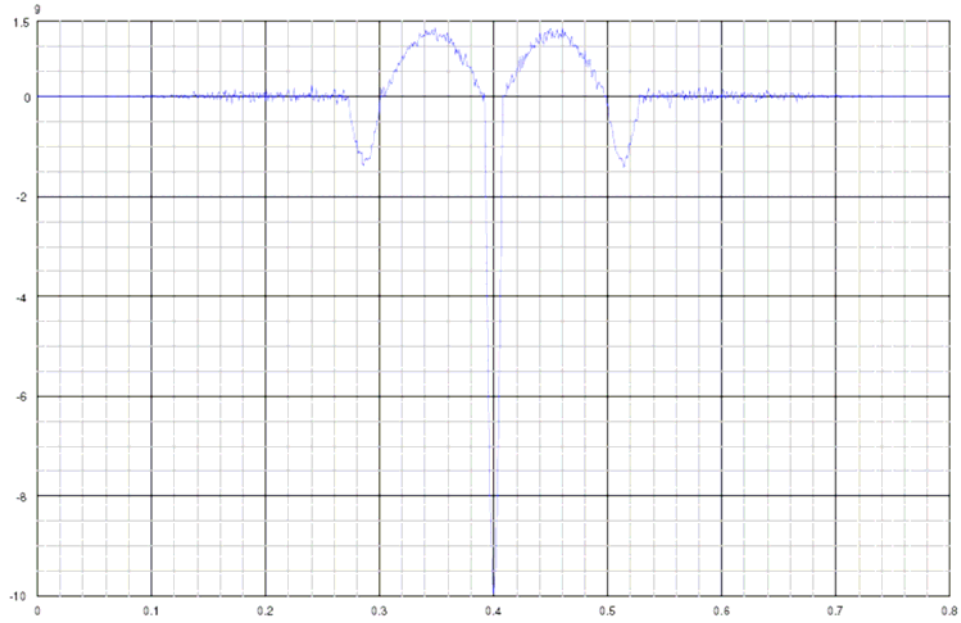
```
Setup
-----
Classical Shock  Test File Listing

File Name:                          10gnegX_MARTEC
Current Date:                       Tue Sep 18 2007  15:10:59

CONTROL PARAMETERS:
    DURATION -
        Number of Full Level Pulses:    2000
        Delay between Pulses:         1500.0 ms
    CONTROL STRATEGY -
        Drive Update:                    On
        Pulse Output Polarity:            -
        Weighting for Averaging:      0.125
        Feedback Gain:                0.750
        Waveform Trend Removal:       Enable
    OPERATION MODE -
        Mode:                         Manual
    EQUALIZATION & SYSTEM IDENTIFICATION-
        Start Level:                 -15.0 dB
        Initial Excitation:           Pulse
        Prestored Drive:                Off
    STARTUP -
        Initial Test Level:          -12.0 dB
        Level Increment:               1.0 dB
        Delay between Pulses:        1500.0 ms

REFERENCE PARAMETERS:
    REFERENCE PULSE -
    Pulse Type:                       Half Sine
        Pulse Amplitude:              10.00 g
        Pulse Duration:               16.00 ms
    Specify Buffer Duration:          No
    Buffer Duration:                 400.00 ms
    Center Pulse in Buffer:          Yes
    Sample Rate Multiplier:           5.12
    Units for Accel, Vel, and Displ:  g, m/s, mm
    PULSE COMPENSATION -
     Type:                            Pre- and Post-Pulse
     Optimization:                    Double Sided Displacement
     Method:                          Symmetric Acceleration
        Amplitude:                    13.0 %
    PULSE DISPLAY TOLERANCE BANDS -
        Type:                         None
    PULSE DYNAMIC LIMITS -
        Input Volts:                   0.00 V
        Acceleration:                  0.00    g          0.00    g
        Velocity:                      0.00  m/s          0.00  m/s
        Displacement:                  0.00   mm          0.00   mm
        Sample Rate:                   0.00 Hz
    SRS ANALYSIS PARAMETERS -
        SRS Spacing:                   1/3 octave
        SRS Filter Definition:        Absolute Acceleration
        SRS Damping:                   5.00 %
        SRS Q:                        10.00

SAFETY PARAMETERS:
    ALARM/ABORTS -
        Maximum Average Error -
            Alarm:                    20.00 %
            Abort:                    30.00 %
        Maximum Peak Error -
            Alarm:                    40.00 %
            Abort:                    60.00 %
    LOOP CHECK -
        Noise Threshold:              30.00 mV RMS
        Maximum Drive:                50.00 mV RMS
        Pause after Loop Check:         Yes
    DRIVE SIGNAL -
        Maximum Drive:                 6.00 Vpeak
```

```
CHANNEL TABLE:
Channel Channel Loop   Sensitivity  Channel Label 1                Label 2
Number  Type    Check    (mV/g)
  1    Control  Yes      282.08     Pilote UUT1 ET UUT2
  2  Auxiliary   No      210.92     X SENSOR  UUT1
  3  Auxiliary   No      210.92     Y SENSOR UUT1
  4  Auxiliary   No       97.71     Z SENSOR UUT1
  5  Auxiliary   No          85     X SENSOR UUT 2
  6  Auxiliary   No        79.4     Y SENSOR UUT 2
  7  Auxiliary   No          73     Z SENSOR UUT 2

DOCUMENTATION:
    Display Text -
        Title 1: BUMP TEST  NEGATIVE  DIRECTION - RTCM/ETSI _ Axe X-
        Title 2: E7555-
    List Only Text -
        Title 3:
        Prompt before Test:            Yes
    Data Storage -
        Mode:                         Every Full Level Pulse
    Message Log -
        Mode:                         Use Run Number
    Printing -
        Auto Plot after Test:           No

REMOTE COMMUNICATION TABLE:
    Enable Remote Communication:        No

SHAKER LIMITS:
    Enable Shaker Limits:               No

End of Classical Shock Test List
```

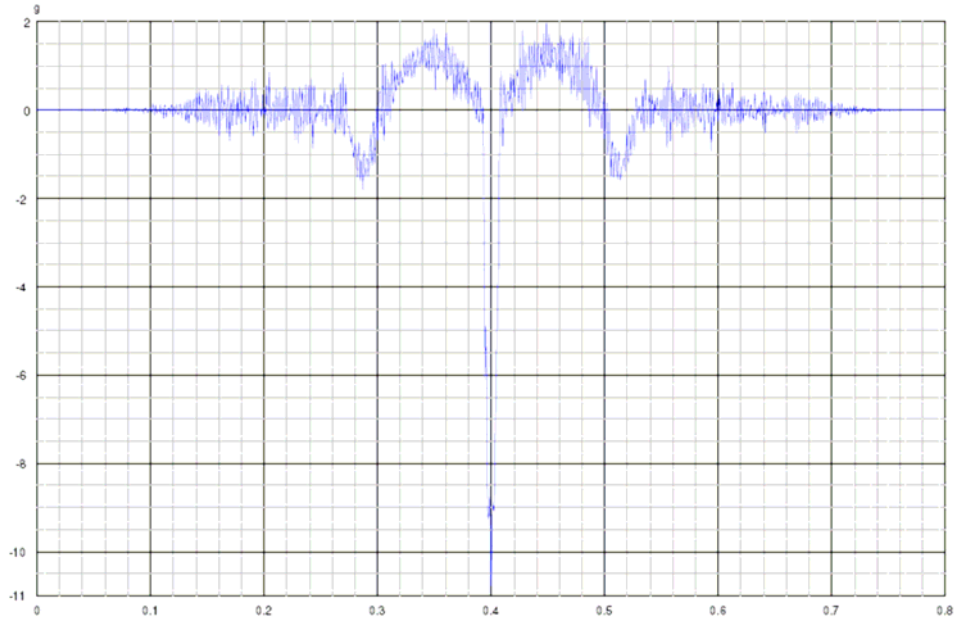
JournalEssai -X Axis

---

Shock Message Log
1.00000
%Test: 10gnegX_MARTEC.008
09/18/07
13:16:00 Measuring Ambient Noise
13:16:15 System Identification
13:16:29 Using H(f) Equalization
13:16:32 Equalization Complete
13:16:32 Ready for Manual Mode
13:16:45 Manual Operation Mode
13:17:52 Automatic Operation Mode
14:34:57 Shutdown Initiated...
14:34:57 Shutdown Complete
14:34:57 Test Complete




| | | | |
|---|---|---|---|
| Projet: BALISE MARTEC | Essai: Choc | Date: 18/Sep/2007 14:34:57 | Mesure: Pilote UUT1 ET UUT2 |
| Modèle: XS3_GPS | Type: Mesurée | | |
| Référence ITS: E7555 | Nom Essai: 10gnegX_MARTEC | | |




| | | | |
|---|---|---|---|
| Projet: BALISE MARTEC | Essai: Choc | Date: 18/Sep/2007 14:34:57 | Mesure: X SENSOR UUT1 |
| Modèle: XS3_GPS | Type: Mesurée | | |
| Référence ITS: E7555 | Nom Essai: 10gnegX_MARTEC | | |

### 4.9.2. BUMP TEST RESULTS ON Y DIRECTION (4000 bumps)

```
Setup
-----
Classical Shock  Test File Listing

File Name:                          10gnegY_MARTEC
Current Date:                       Tue Sep 18 2007  16:29:08

CONTROL PARAMETERS:
    DURATION -
        Number of Full Level Pulses:  2000
        Delay between Pulses:        1500.0 ms
    CONTROL STRATEGY -
        Drive Update:                    On
        Pulse Output Polarity:            -
        Weighting for Averaging:       0.125
        Feedback Gain:                 0.750
        Waveform Trend Removal:        Enable
    OPERATION MODE -
        Mode:                          Manual
    EQUALIZATION & SYSTEM IDENTIFICATION-
        Start Level:                  -15.0 dB
        Initial Excitation:            Pulse
        Prestored Drive:                 Off
    STARTUP -
        Initial Test Level:           -12.0 dB
        Level Increment:                1.0 dB
        Delay between Pulses:         1500.0 ms

REFERENCE PARAMETERS:
    REFERENCE PULSE -
    Pulse Type:                        Half Sine
        Pulse Amplitude:               10.00 g
        Pulse Duration:                16.00 ms
    Specify Buffer Duration:           No
    Buffer Duration:                  400.00 ms
    Center Pulse in Buffer:           Yes
    Sample Rate Multiplier:            5.12
    Units for Accel, Vel, and Displ:   g, m/s, mm
    PULSE COMPENSATION -
     Type:                             Pre- and Post-Pulse
     Optimization:                     Double Sided Displacement
     Method:                           Symmetric Acceleration
        Amplitude:                     13.0 %
    PULSE DISPLAY TOLERANCE BANDS -
        Type:                          None
    PULSE DYNAMIC LIMITS -
        Input Volts:                    0.00 V
        Acceleration:                   0.00    g         0.00    g
        Velocity:                       0.00  m/s         0.00  m/s
        Displacement:                   0.00   mm         0.00   mm
        Sample Rate:                    0.00 Hz
    SRS ANALYSIS PARAMETERS -
        SRS Spacing:                    1/3 octave
        SRS Filter Definition:         Absolute Acceleration
        SRS Damping:                    5.00 %
        SRS Q:                         10.00

SAFETY PARAMETERS:
    ALARM/ABORTS -
        Maximum Average Error -
            Alarm:                     20.00 %
            Abort:                     30.00 %
        Maximum Peak Error -
            Alarm:                     40.00 %
            Abort:                     60.00 %
    LOOP CHECK -
        Noise Threshold:               30.00 mV RMS
        Maximum Drive:                 50.00 mV RMS
        Pause after Loop Check:          Yes
    DRIVE SIGNAL -
        Maximum Drive:                  6.00 Vpeak
```

```
CHANNEL TABLE:
Channel Channel Loop   Sensitivity  Channel Label 1                Label 2
Number  Type    Check    (mV/g)
  1     Control Yes     282.08      Pilote UUT1 ET UUT2
  2  Auxiliary  No      210.92      X SENSOR  UUT1
  3  Auxiliary  No       97.7       Y SENSOR UUT1
  4  Auxiliary  No      97.71       Z SENSOR UUT1
  5  Auxiliary  No         85       X SENSOR UUT 2
  6  Auxiliary  No       79.4       Y SENSOR UUT 2
  7  Auxiliary  No         73       Z SENSOR UUT 2

DOCUMENTATION:
    Display Text -
        Title 1: BUMP TEST  NEGATIVE  DIRECTION - RTCM/ETSI _ Axe Y-
        Title 2: E7555-
    List Only Text -
        Title 3:
        Prompt before Test:            Yes
    Data Storage -
        Mode:                        Every Full Level Pulse
    Message Log -
        Mode:                        Use Run Number
    Printing -
        Auto Plot after Test:           No

REMOTE COMMUNICATION TABLE:
    Enable Remote Communication:        No

SHAKER LIMITS:
    Enable Shaker Limits:               No

End of Classical Shock Test List
```

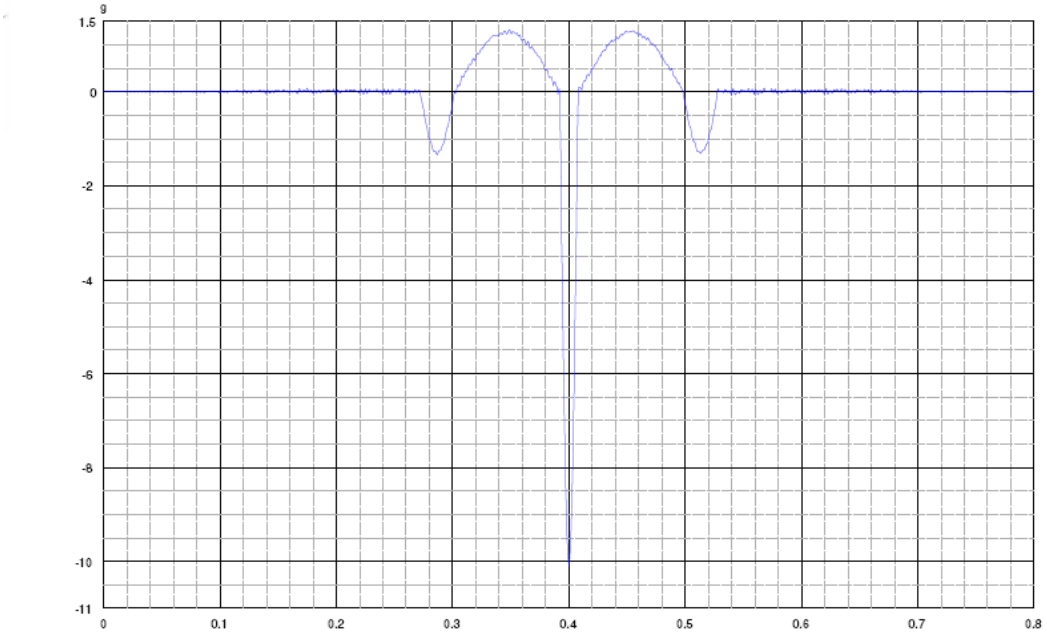
JournalEssai –Y Axis

1st part

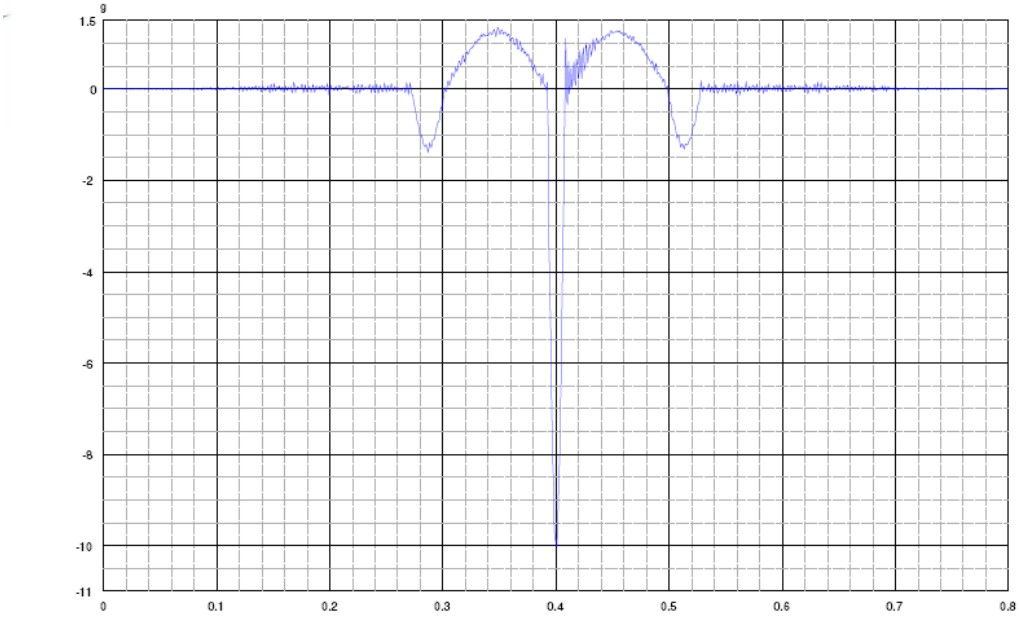
Shock Message Log
1.00000
%Test: 10gnegY_MARTEC.002
09/18/07
15:43:08 Measuring Ambient Noise
15:43:27 System Identification
15:43:40 Using H(f) Equalization
15:43:43 Equalization Complete
15:43:43 Ready for Manual Mode
15:43:49 Manual Operation Mode
16:25:07 Operator Abort
16:25:07 Shutdown Initiated...
16:25:19 Shutdown Complete

2nd part

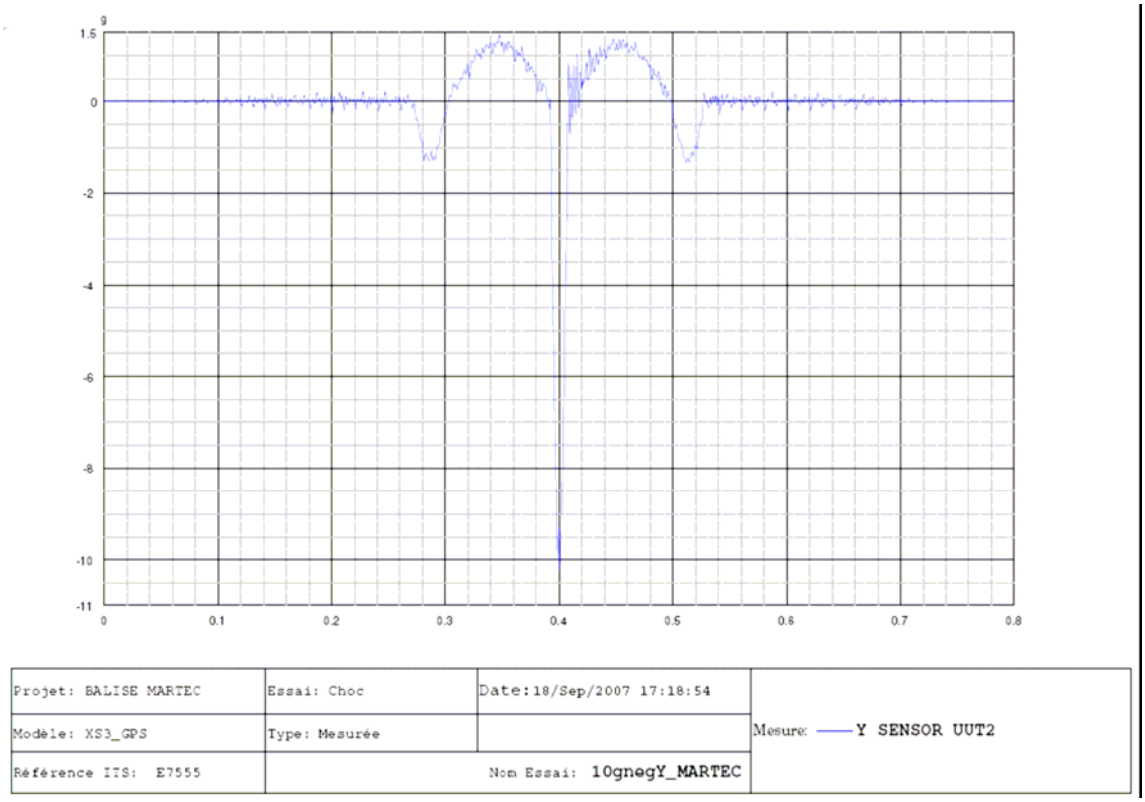
Shock Message Log
1.00000
%Test: 10gnegY_MARTEC.003
09/18/07
16:43:36 Measuring Ambient Noise
16:43:52 System Identification
16:44:06 Using H(f) Equalization
16:44:09 Equalization Complete
16:44:09 Ready for Manual Mode
16:44:11 Manual Operation Mode
17:18:54 Shutdown Initiated...
17:18:54 Shutdown Complete
17:18:54 Test Complete




| | | | |
|---|---|---|---|
| Projet: BALISE MARTEC | Essai: Choc | Date:18/Sep/2007 17:18:54 | Mesure: Pilote UUT1 ET UUT2 |
| Modèle: XS3_GPS | Type: Mesurée | | |
| Référence ITS: E7555 | Nom Essai: 10gnegY_MARTEC | | |




| | | | |
|---|---|---|---|
| Projet: BALISE MARTEC | Essai: Choc | Date:18/Sep/2007 17:18:54 | Mesure: Y SENSOR UUT1 |
| Modèle: XS3_GPS | Type: Mesurée | | |
| Référence ITS: E7555 | Nom Essai: 10gnegY_MARTEC | | |


g
1.5
0
-2
-4
-6
-8
-10
-11
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Projet: BALISE MARTEC
Essai: Choc
Date:18/Sep/2007 17:18:54
Modèle: XS3_GPS
Type: Mesurée
Mesure: Y SENSOR UUT2
Référence ITS: E7555
Nom Essai: 10gnegY_MARTEC

```
Setup
-----
Classical Shock  Test File Listing

File Name:                          10gposY_MARTEC
Current Date:                       Wed Sep 19 2007  09:25:19

CONTROL PARAMETERS:
    DURATION -
        Number of Full Level Pulses:  2000
        Delay between Pulses:        1500.0 ms
    CONTROL STRATEGY -
        Drive Update:                    On
        Pulse Output Polarity:            +
        Weighting for Averaging:       0.125
        Feedback Gain:                 0.750
        Waveform Trend Removal:        Enable
    OPERATION MODE -
        Mode:                          Manual
    EQUALIZATION & SYSTEM IDENTIFICATION-
        Start Level:                  -15.0 dB
        Initial Excitation:            Pulse
        Prestored Drive:                 Off
    STARTUP -
        Initial Test Level:           -12.0 dB
        Level Increment:                1.0 dB
        Delay between Pulses:        1500.0 ms

REFERENCE PARAMETERS:
    REFERENCE PULSE -
    Pulse Type:                        Half Sine
        Pulse Amplitude:               10.00 g
        Pulse Duration:                16.00 ms
    Specify Buffer Duration:           No
    Buffer Duration:                  400.00 ms
    Center Pulse in Buffer:            Yes
    Sample Rate Multiplier:             5.12
    Units for Accel, Vel, and Displ:    g, m/s, mm
    PULSE COMPENSATION -
     Type:                             Pre- and Post-Pulse
     Optimization:                     Double Sided Displacement
     Method:                           Symmetric Acceleration
        Amplitude:                     13.0 %
    PULSE DISPLAY TOLERANCE BANDS -
        Type:                          None
    PULSE DYNAMIC LIMITS -
        Input Volts:                    0.00 V
        Acceleration:                   0.00    g          0.00    g
        Velocity:                       0.00  m/s          0.00  m/s
        Displacement:                   0.00   mm          0.00   mm
        Sample Rate:                    0.00 Hz
    SRS ANALYSIS PARAMETERS -
        SRS Spacing:                    1/3 octave
        SRS Filter Definition:         Absolute Acceleration
        SRS Damping:                    5.00 %
        SRS Q:                         10.00

SAFETY PARAMETERS:
    ALARM/ABORTS -
        Maximum Average Error -
            Alarm:                     20.00 %
            Abort:                     30.00 %
        Maximum Peak Error -
            Alarm:                     40.00 %
            Abort:                     60.00 %
    LOOP CHECK -
        Noise Threshold:               30.00 mV RMS
        Maximum Drive:                 50.00 mV RMS
        Pause after Loop Check:          Yes
    DRIVE SIGNAL -
        Maximum Drive:                  6.00 Vpeak
```

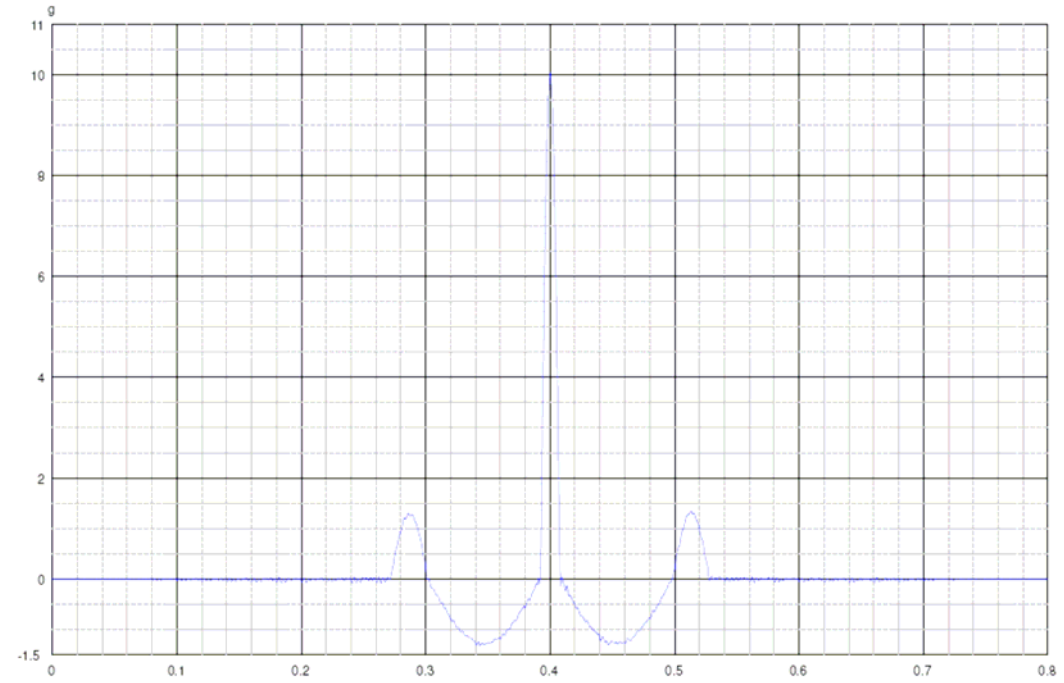
```
CHANNEL TABLE:
Channel Channel Loop   Sensitivity  Channel Label 1               Label 2
Number  Type    Check    (mV/g)
  1    Control  Yes      282.08     Pilote UUT1 ET UUT2
  2  Auxiliary   No      210.92     X SENSOR  UUT1
  3  Auxiliary   No        97.7     Y SENSOR UUT1
  4  Auxiliary   No       97.71     Z SENSOR UUT1
  5  Auxiliary   No          85     X SENSOR UUT 2
  6  Auxiliary   No        79.4     Y SENSOR UUT 2
  7  Auxiliary   No          73     Z SENSOR UUT 2

DOCUMENTATION:
    Display Text -
        Title 1: BUMP TEST  NEGATIVE  DIRECTION - RTCM/ETSI _ Axe Y-
        Title 2: E7555-
    List Only Text -
        Title 3:
        Prompt before Test:            Yes
    Data Storage -
        Mode:                         Every Full Level Pulse
    Message Log -
        Mode:                         Use Run Number
    Printing -
        Auto Plot after Test:            No

REMOTE COMMUNICATION TABLE:
    Enable Remote Communication:         No

SHAKER LIMITS:
    Enable Shaker Limits:                No

End of Classical Shock Test List
```

---

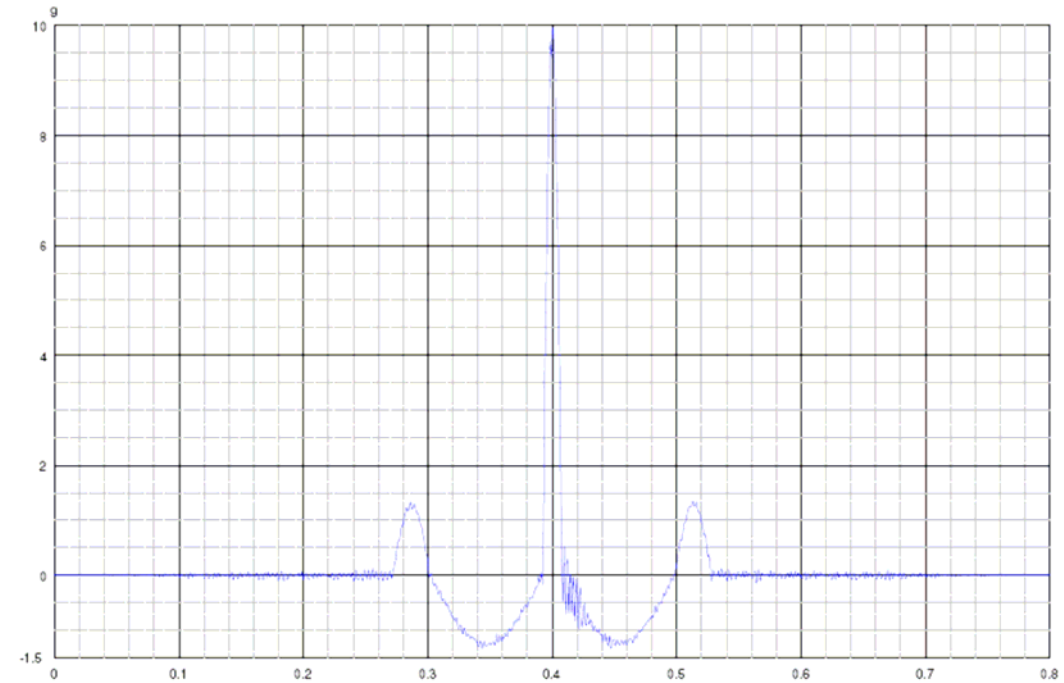
**Journal Essai +Y Axis**

---

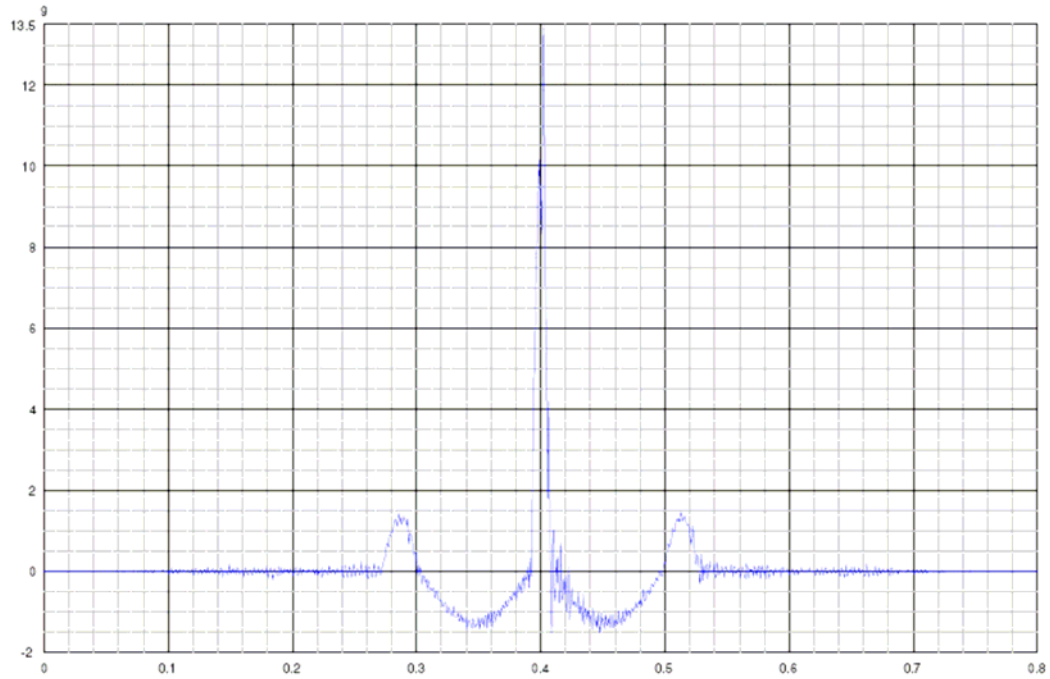
Shock Message Log
1.00000
%Test: 10gposY_MARTEC.001
09/19/07
08:01:56 Measuring Ambient Noise
08:02:11 System Identification
08:02:24 Using H(f) Equalization
08:02:27 Equalization Complete
08:02:27 Ready for Manual Mode
08:02:30 Manual Operation Mode
09:18:23 Shutdown Initiated...
09:18:23 Shutdown Complete
09:18:23 Test Complete




| | | | |
|---|---|---|---|
| Projet: Balise MARTEC | Essai: Choc | Date: 19/Sep/2007 09:18:23 | |
| Modèle: XS3_GPS | Type: Mesurée | shock number : 2000 2000/2000 0.0 | Mesure: Pilote UUT1 ET |
| Réf ITS: E7555 | Nom Essai: 10gposY_MARTEC | | |




| | | | |
|---|---|---|---|
| Projet: Balise MARTEC | Essai: Choc | Date: 19/Sep/2007 09:18:23 | |
| Modèle: XS3_GPS | Type: Mesurée | shock number : 2000 2000/2000 0.0 | Mesure: Y SENSOR UUT1 |
| Réf ITS: E7555 | Nom Essai: 10gposY_MARTEC | | |


g
13.5
12
10
8
6
4
2
0
-2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Projet: Balise MARTEC
Essai: Choc
Date: 19/Sep/2007 09:18:23
Modèle: XS3_GPS
Type: Mesurée
shock number : 2000 2000/2000 0.0
Mesure: Y SENSOR UUT 2
Réf ITS: E7555
Nom Essai: 10gposY_MARTEC

### 4.9.3. BUMP TEST RESULTS ON Z DIRECTION (4000 bumps)

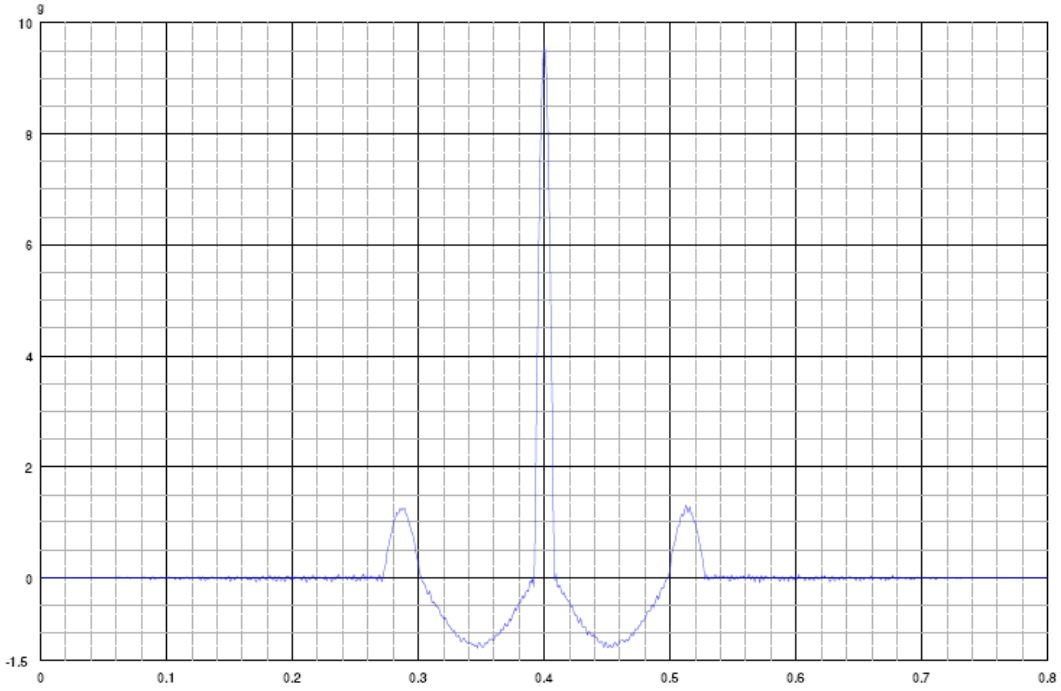
```
Setup
-----
Classical Shock  Test File Listing

File Name:                          10gposZ_MARTEC
Current Date:                       Wed Sep 19 2007  18:07:19

CONTROL PARAMETERS:
    DURATION -
        Number of Full Level Pulses:  2000
        Delay between Pulses:        1500.0 ms
    CONTROL STRATEGY -
        Drive Update:                    On
        Pulse Output Polarity:            +
        Weighting for Averaging:       0.125
        Feedback Gain:                 0.750
        Waveform Trend Removal:        Enable
    OPERATION MODE -
        Mode:                          Manual
    EQUALIZATION & SYSTEM IDENTIFICATION-
        Start Level:                  -15.0 dB
        Initial Excitation:            Pulse
        Prestored Drive:                 Off
    STARTUP -
        Initial Test Level:           -12.0 dB
        Level Increment:                1.0 dB
        Delay between Pulses:         1500.0 ms

REFERENCE PARAMETERS:
    REFERENCE PULSE -
    Pulse Type:                        Half Sine
        Pulse Amplitude:               10.00 g
        Pulse Duration:                16.00 ms
    Specify Buffer Duration:           No
    Buffer Duration:                  400.00 ms
    Center Pulse in Buffer:           Yes
    Sample Rate Multiplier:            5.12
    Units for Accel, Vel, and Displ:   g, m/s, mm
    PULSE COMPENSATION -
     Type:                             Pre- and Post-Pulse
     Optimization:                     Double Sided Displacement
     Method:                           Symmetric Acceleration
        Amplitude:                     13.0 %
    PULSE DISPLAY TOLERANCE BANDS -
        Type:                          None
    PULSE DYNAMIC LIMITS -
        Input Volts:                    0.00 V
        Acceleration:                   0.00    g          0.00    g
        Velocity:                       0.00  m/s          0.00  m/s
        Displacement:                   0.00   mm          0.00   mm
        Sample Rate:                    0.00 Hz
    SRS ANALYSIS PARAMETERS -
        SRS Spacing:                    1/3 octave
        SRS Filter Definition:         Absolute Acceleration
        SRS Damping:                    5.00 %
        SRS Q:                         10.00

SAFETY PARAMETERS:
    ALARM/ABORTS -
        Maximum Average Error -
            Alarm:                     20.00 %
            Abort:                     30.00 %
        Maximum Peak Error -
            Alarm:                     40.00 %
            Abort:                     60.00 %
    LOOP CHECK -
        Noise Threshold:               30.00 mV RMS
        Maximum Drive:                 50.00 mV RMS
        Pause after Loop Check:          Yes
    DRIVE SIGNAL -
        Maximum Drive:                  6.00 Vpeak
```

```
CHANNEL TABLE:
Channel Channel Loop   Sensitivity  Channel Label 1                Label 2
Number  Type    Check    (mV/g)
  1     Control  Yes     282.08     Pilote UUT1 ET UUT2
  2  Auxiliary   No      210.92     X SENSOR  UUT1
  3  Auxiliary   No       97.7      Y SENSOR UUT1
  4  Auxiliary   No       210.9     Z SENSOR UUT1
  5  Auxiliary   No          85     X SENSOR UUT 2
  6  Auxiliary   No        79.4     Y SENSOR UUT 2
  7  Auxiliary   No          73     Z SENSOR UUT 2

DOCUMENTATION:
    Display Text -
        Title 1: BUMP TEST  POSITIF  DIRECTION - RTCM/ETSI _ Axe Z+
        Title 2: E7555-
    List Only Text -
        Title 3:
        Prompt before Test:            Yes
    Data Storage -
        Mode:                         Every Full Level Pulse
    Message Log -
        Mode:                         Use Run Number
    Printing -
        Auto Plot after Test:            No

REMOTE COMMUNICATION TABLE:
    Enable Remote Communication:         No

SHAKER LIMITS:
    Enable Shaker Limits:                No

End of Classical Shock Test List
```

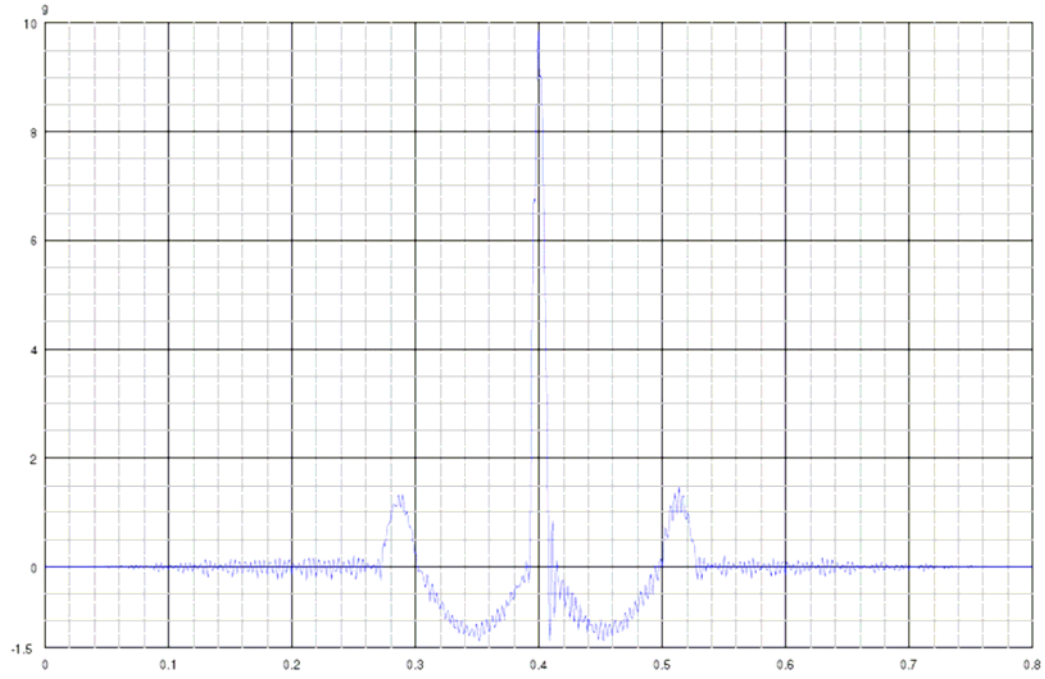
**Journal Essai +Z Axis**

---

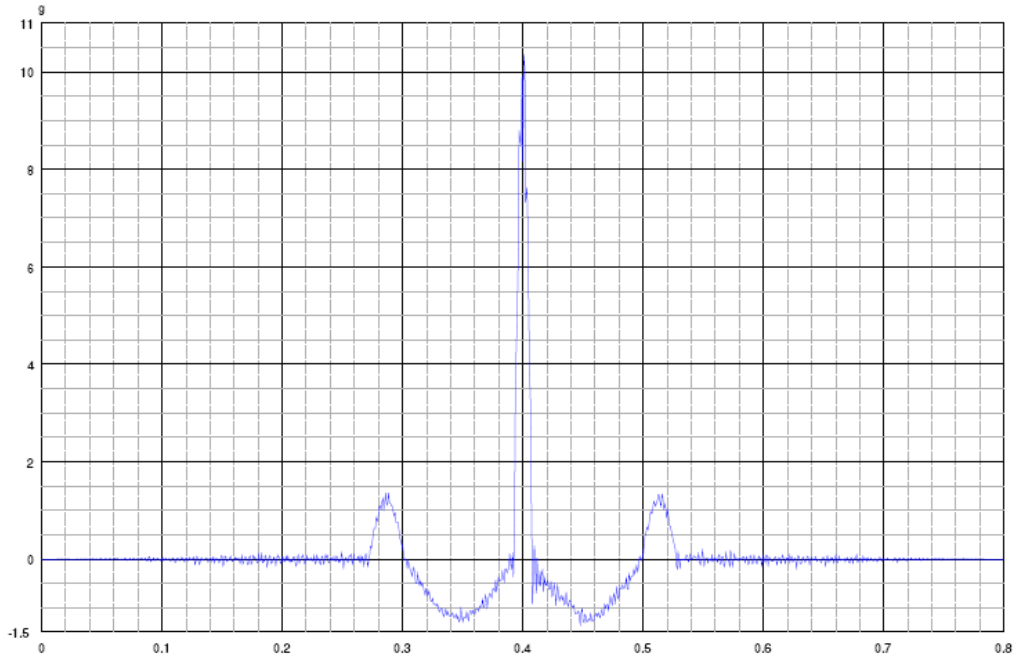
Shock Message Log
1.00000
%Test: 10gposZ_MARTEC.017
09/19/07
16:52:14 Measuring Ambient Noise
16:52:32 System Identification
16:52:45 Using H(f) Equalization
16:52:48 Equalization Complete
16:52:48 Ready for Manual Mode
16:52:49 Manual Operation Mode
18:07:19 Shutdown Initiated...
18:07:19 Shutdown Complete
18:07:19 Test Complete




| | | | |
|---|---|---|---|
| Projet: BALISE MARTEC | Essai: Choc | Date: 19/Sep/2007 18:07:19 | |
| Modèle: XS3_GPS | Type: Mesurée | shock number : 82 81/81 0.0 | Mesure: Pilote UUT1 ET |
| Réf ITS: E7555 | Nom Essai: 10gposZ_MARTEC | | |




| | | | |
|---|---|---|---|
| Projet: BALISE MARTEC | Essai: Choc | Date: 19/Sep/2007 18:07:19 | |
| Modèle: XS3_GPS | Type: Mesurée | shock number : 82 81/81 0.0 | Mesure: Z SENSOR UUT1 |
| Réf ITS: E7555 | Nom Essai: 10gposZ_MARTEC | | |




| | | | |
|---|---|---|---|
| Projet: BALISE MARTEC | Essai: Choc | Date: 19/Sep/2007 18:07:19 | |
| Modèle: XS3_GPS | Type: Mesurée | shock number : 82 81/81 0.0 | Mesure: Z SENSOR UUT 2 |
| Réf ITS: E7555 | Nom Essai: 10gposZ_MARTEC | | |

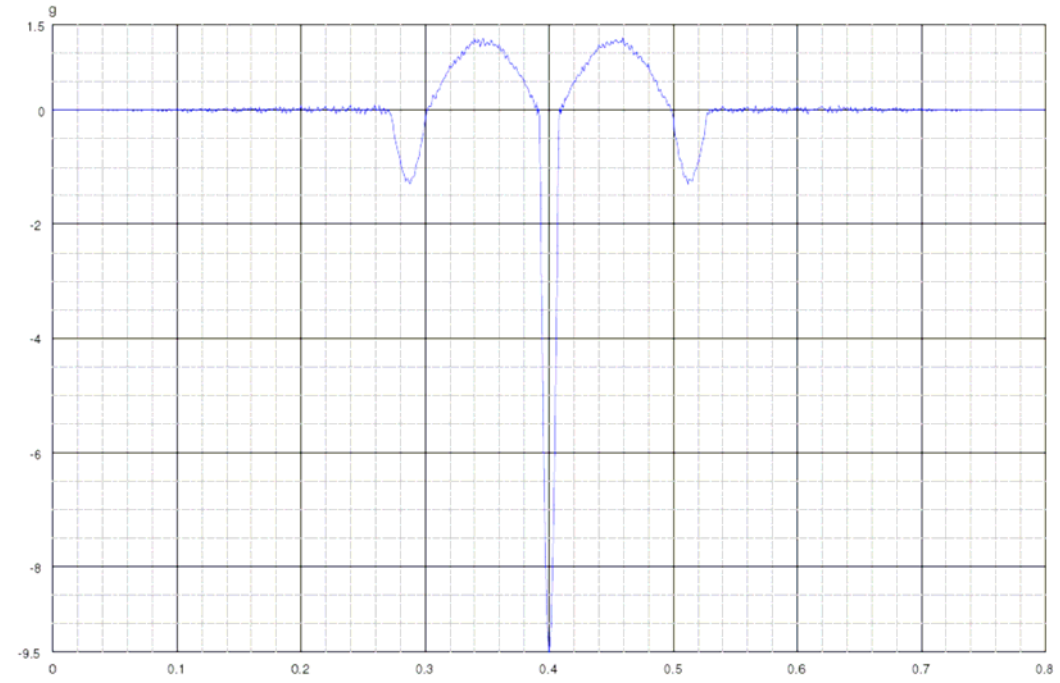
```
Setup
-----
Classical Shock  Test File Listing

File Name:                          10gnegZ_MARTEC
Current Date:                       Thu Sep 20 2007  11:54:21

CONTROL PARAMETERS:
    DURATION -
        Number of Full Level Pulses:  2000

        Delay between Pulses:         1500.0 ms
    CONTROL STRATEGY -
        Drive Update:                     On
        Pulse Output Polarity:             -
        Weighting for Averaging:        0.125
        Feedback Gain:                  0.750
        Waveform Trend Removal:         Enable
    OPERATION MODE -
        Mode:                           Manual
    EQUALIZATION & SYSTEM IDENTIFICATION-
        Start Level:                   -15.0 dB
        Initial Excitation:             Pulse
        Prestored Drive:                  Off
    STARTUP -
        Initial Test Level:            -12.0 dB
        Level Increment:                 1.0 dB
        Delay between Pulses:         1500.0 ms

REFERENCE PARAMETERS:
    REFERENCE PULSE -
    Pulse Type:                         Half Sine
        Pulse Amplitude:                 9.50 g
        Pulse Duration:                 16.00 ms
    Specify Buffer Duration:            No
    Buffer Duration:                   400.00 ms
    Center Pulse in Buffer:            Yes
    Sample Rate Multiplier:             5.12
    Units for Accel, Vel, and Displ:    g, m/s, mm
    PULSE COMPENSATION -
     Type:                              Pre- and Post-Pulse
     Optimization:                      Double Sided Displacement
     Method:                            Symmetric Acceleration
        Amplitude:                      13.0 %
    PULSE DISPLAY TOLERANCE BANDS -
        Type:                           None
    PULSE DYNAMIC LIMITS -
        Input Volts:                     0.00 V
        Acceleration:                    0.00    g          0.00    g
        Velocity:                        0.00  m/s          0.00  m/s
        Displacement:                    0.00   mm          0.00   mm
        Sample Rate:                     0.00 Hz
    SRS ANALYSIS PARAMETERS -
        SRS Spacing:                     1/3 octave
        SRS Filter Definition:          Absolute Acceleration
        SRS Damping:                     5.00 %
        SRS Q:                          10.00

SAFETY PARAMETERS:
    ALARM/ABORTS -
        Maximum Average Error -
            Alarm:                      20.00 %
            Abort:                      30.00 %
        Maximum Peak Error -
            Alarm:                      40.00 %
            Abort:                      60.00 %
    LOOP CHECK -
        Noise Threshold:                30.00 mV RMS
        Maximum Drive:                  50.00 mV RMS
        Pause after Loop Check:           Yes
    DRIVE SIGNAL -
        Maximum Drive:                   6.00 Vpeak
```

```
CHANNEL TABLE:
Channel Channel Loop   Sensitivity  Channel Label 1                Label 2
Number  Type    Check    (mV/g)
  1     Control  Yes      282.08     Pilote UUT1 ET UUT2
  2  Auxiliary   No       210.92     X SENSOR  UUT1
  3  Auxiliary   No         97.7     Y SENSOR UUT1
  4  Auxiliary   No        210.9     Z SENSOR UUT1
  5  Auxiliary   No           85     X SENSOR UUT 2
  6  Auxiliary   No         79.4     Y SENSOR UUT 2
  7  Auxiliary   No           73     Z SENSOR UUT 2

DOCUMENTATION:
    Display Text -
        Title 1: BUMP TEST  NEGATIF  DIRECTION - RTCM/ETSI _ Axe Z-
        Title 2: E7555-
    List Only Text -
        Title 3:
        Prompt before Test:            Yes
    Data Storage -
        Mode:                         Every Full Level Pulse
    Message Log -
        Mode:                         Use Run Number
    Printing -
        Auto Plot after Test:            No

REMOTE COMMUNICATION TABLE:
    Enable Remote Communication:         No

SHAKER LIMITS:
    Enable Shaker Limits:                No

End of Classical Shock Test List
```

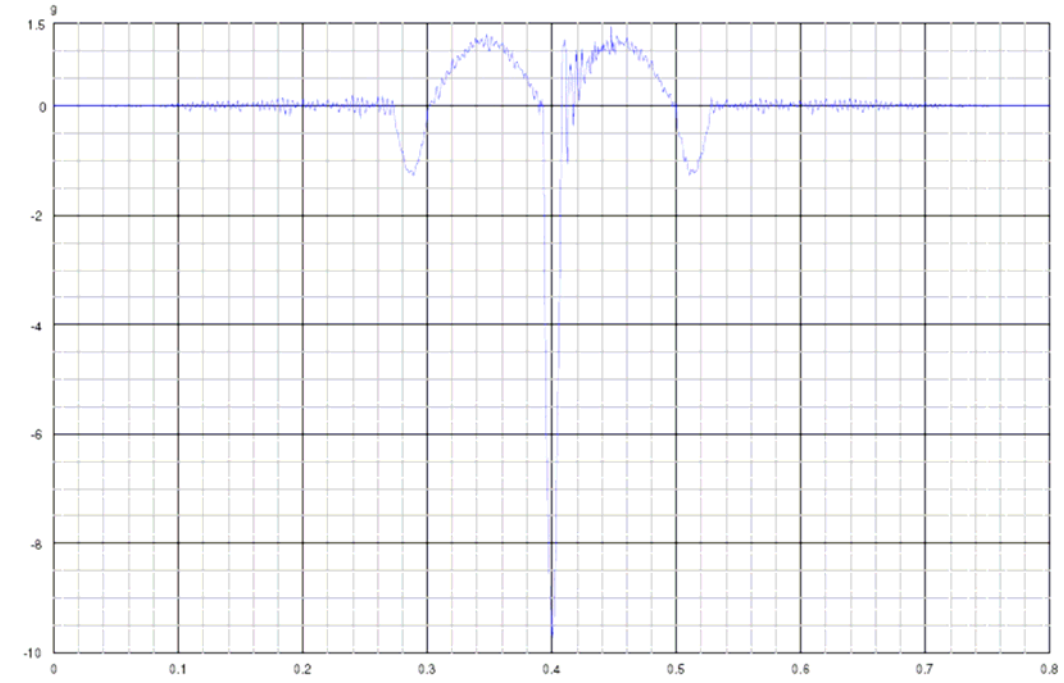
**Journal Essai –Z Axis**

---

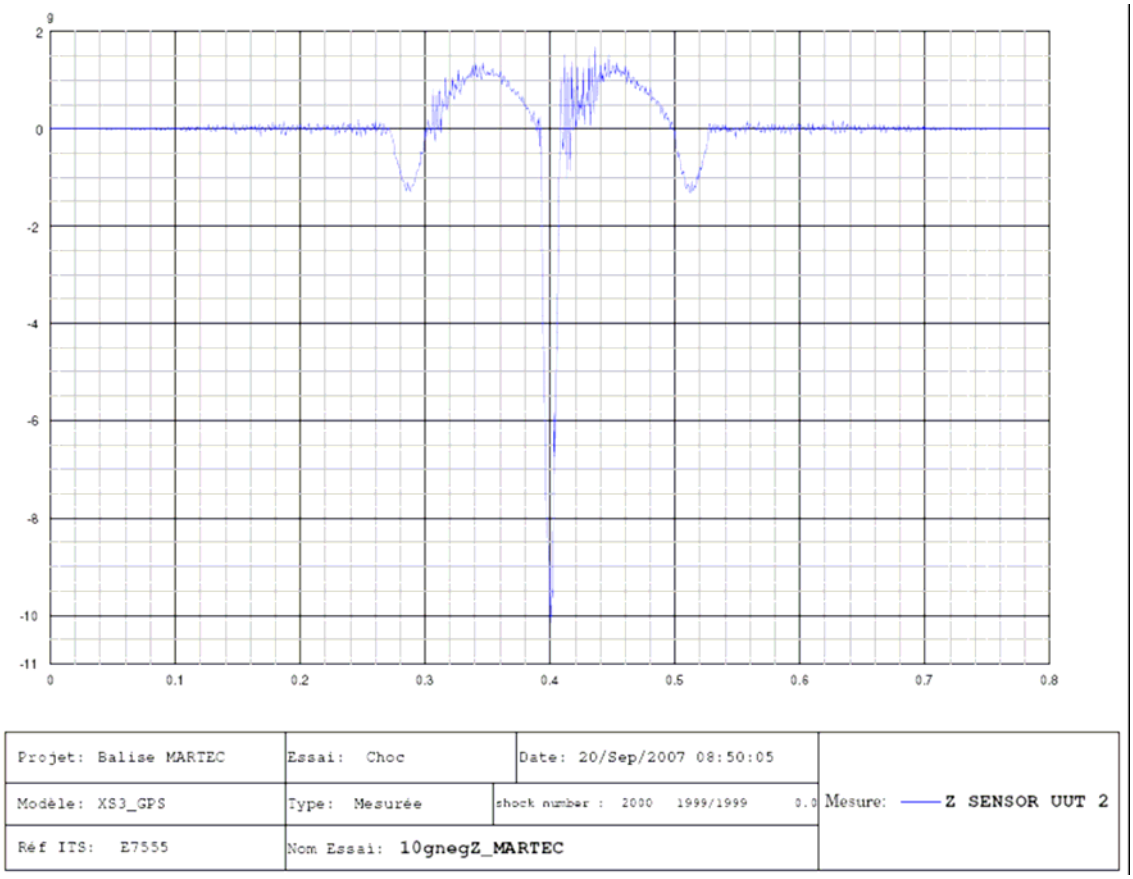
Shock Message Log
1.00000
%Test: 10gnegZ_MARTEC.001
09/20/07
07:30:39 Measuring Ambient Noise
07:31:00 System Identification
07:31:13 Using H(f) Equalization
07:31:16 Equalization Complete
07:31:16 Ready for Manual Mode
07:31:22 Manual Operation Mode
08:50:05 Shutdown Initiated...
08:50:05 Shutdown Complete
08:50:05 Test Complete




| | | | |
|---|---|---|---|
| Projet: Balise MARTEC | Essai: Choc | Date: 20/Sep/2007 08:50:05 | |
| Modèle: XS3_GPS | Type: Mesurée | shock number : 2000 1999/1999 0.0 | Mesure: Pilote UUT1 ET |
| Réf ITS: E7555 | Nom Essai: 10gnegZ_MARTEC | | |




| | | | |
|---|---|---|---|
| Projet: Balise MARTEC | Essai: Choc | Date: 20/Sep/2007 08:50:05 | |
| Modèle: XS3_GPS | Type: Mesurée | shock number : 2000 1999/1999 0.0 | Mesure: Z SENSOR UUT1 |
| Réf ITS: E7555 | Nom Essai: 10gnegZ_MARTEC | | |


9
2
0
-2
-4
-6
-8
-10
-11
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Projet: Balise MARTEC
Essai: Choc
Date: 20/Sep/2007 08:50:05
Modèle: XS3_GPS
Type: Mesurée
shock number : 2000 1999/1999 0.0
Mesure: Z SENSOR UUT 2
Réf ITS: E7555
Nom Essai: 10gnegZ_MARTEC

### 4.9.4. BEACON CHECKOUT

Test using a portable test bench and visual inspection confirmed that the beacon does not activate in an untimely manner during vibration testing.

### 4.9.5. FINAL CONTROL

4.9.5.1.External mechanical inspection.

A visual inspection was done on all external mechanical parts.

Result : nominal.

4.9.5.2.Aliveness test results

**BUMP ALIVENESS TEST RESULTS**

Beacon Unit : UUT1
Name : MARTEC / KANNAD
Type : 406XS3 GPS
Number : UT1

Date : September 20th, 2007

406 MHz Measurements

| | | | |
|---|---|---|---|
| **1 - Environmental Temperature (° C )** | | | + 22° C |
| **2 - POWER OUTPUT** | | | |
| - Transmission power | dBm | 37 ± 2 | 37.17 |
| - Power risetime | ms | < 5 | 0.020 |
| - Power falltime | ms | < 5 | 0.040 |
| **3 - SPURIOUS OUTPUT** | | | |
| - In band | | | OK |
| - Carrier harmonics | | | |
| **4 -DIGITAL MESSAGE GENERATOR** | | | |
| - Repetition rate | | | - |
| - Bit rate | bits/S | 400 ± 4 | 401.48 |
| - Transmission time | ms | 440 ± 4.4 / 520 ± 5.2 | 519.64 |
| - CW preamble | ms | 160 ± 1.6 | 160.48 |
| **5 – DIGITAL MESSAGE** | | | |
| - Bit and frame sync | bits | 1-24 | FFFE2F |
| - Format flag | bit | 25 | 1 |
| - Protocol flag | bit | 26 | 0 |
| - Country code | bits | 27-36 | 0227 |
| - Protocol | bits | 37-40 | 1110 |
| - Encoded Position Data Source | bits | 111 | 1 |
| - Homing | bits | 112 | 1 |
| - BCH 1 code read / calculated | bits | 86-106 / 25-85 | 1ABFEB / 1ABFEB |
| - BCH 2 code read / calculated | bits | 133-144 / 107-132 | 1F0 / 1F0 |
| **6 - FREQUENCY** | KHz | 406 025 ± 2 or | |
| - Nominal value | | 406 028 ± 1 | 406 027.813 |
| - Short term stability | | $< 210^{-9}$/100 ms | $9.5 \times 10^{-11}$ |

**Certification Test at 22°C** Date of test : 20-sept-2007

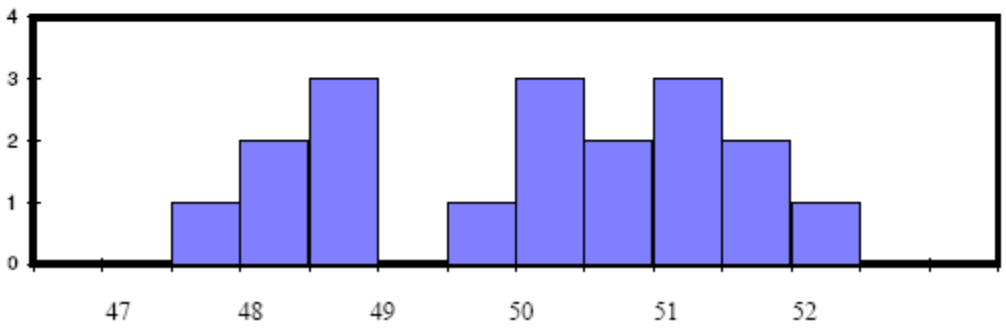
Manufacturer : MARTEC
Beacon Type : XS3-GPS
Number : UUT1 after_bumps

**Message**

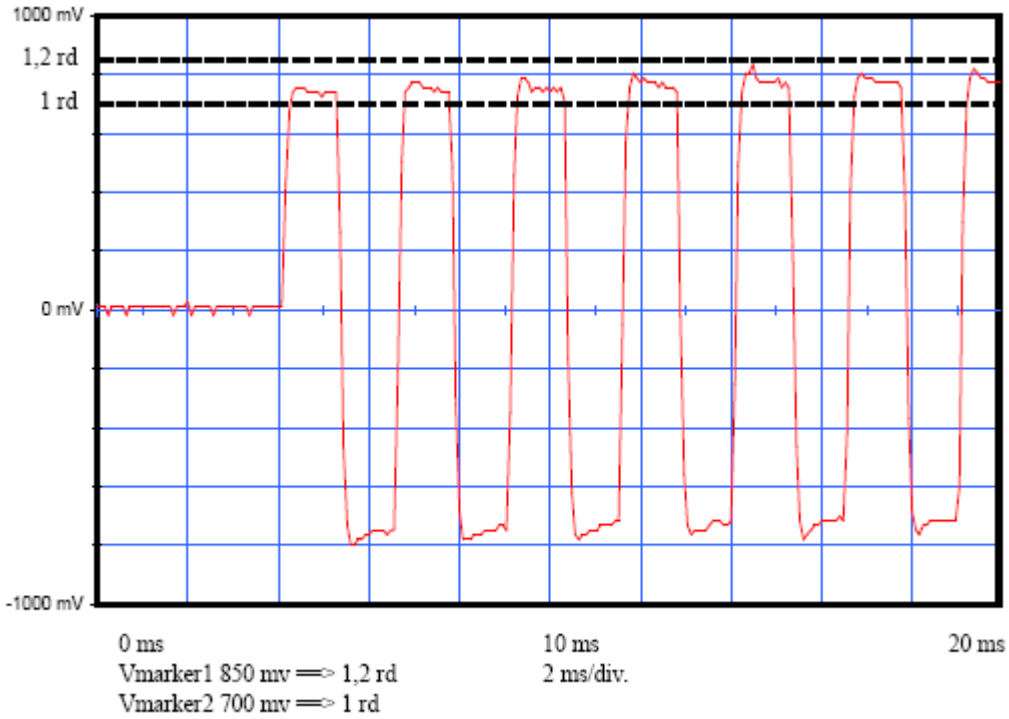
| | | | |
|---|---|---|---|
| Message received | | FFFE2F8E3E2295E02B8036AFFAF78E4141F0 | |
| Format Flag | 25 | 1 | |
| Protocol flag | 26 | 0 | |
| Ident./Position code | 27-85 | 0 | |
| Country Code/Country | 27-36 | 227 / FRANCE | |
| Protocol Code : U/Std-Nat | 37-39/37-40 | 1110 | |
| Protocol Code Used | 37-39/37-40 | Test-Standard Location | |
| Identification Data | 40-85/41-64/41-58 | | |
| Identification Used | | 0 | |
| Calculated BCH1 | 25-85 | 1ABFEB | |
| Encoded BCH1 | 86-106 | 1ABFEB | |
| Homing | 112 | 1 | |
| Em.cod/nat.use/supp.data | 107-112 | 110111 | |
| Encod pos data | 111 | 1 | Internal |
| Fixed Data "1" | 108 | 1 | OK |
| Calculated BCH2 | 107-132 | 1F0 | |
| Encoded BCH2 | 133-144 | 1F0 | |
| Latitude position | | Nord 43° 33' 36" | |
| Longitude position | | Est 1° 28' 44" | |
| Delta position < 0,5 km | | 0,076 km | |

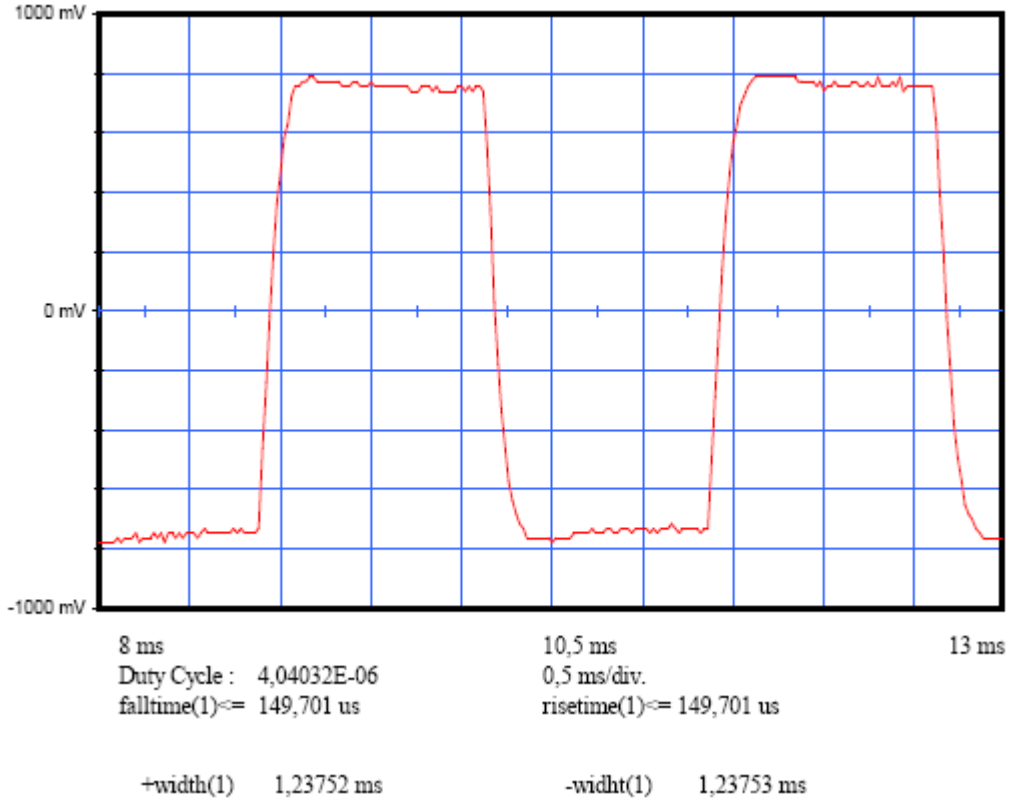
**Electrical and other parameters**

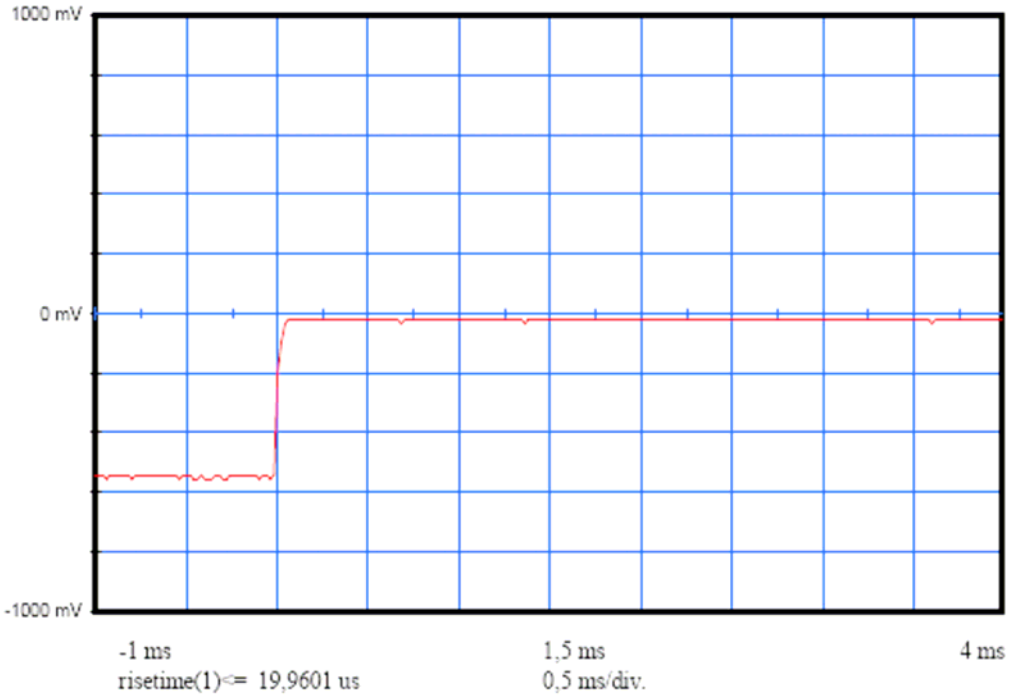
| | | | |
|---|---|---|---|
| CW preamble | ms 158,4 < | < 161,6 | 160,38 |
| Total transmission time | ms 514,8 < | <525,2 | 519,64 |
| Modulation frequency | Hz 396< | < 404 | 401,48 |
| Phase deviation : total | rd | <=2,40 | 2,16 |
| Phase deviation : positive | rd 1,00 < | < 1,20 | 1,08 |
| Phase deviation : negative | rd -1,20 < | < -1,00 | -1,08 |
| Symmetry measurement | % | <=5 % | 4E-04 |
| Nominal frequency : F2 | Hz | | 406027812,72 |
| Short term2 | | | 1,50E-10 |
| Short term3 | | | 9,46E-11 |
| Slope | | | -1,40E-10 |
| Residual | | | 9,53E-11 |
| 406 MHz power output | dBm | | 36,1 |
| Homing frequency | MHz | | 121,502 |
| 121,5 MHz power output | dBm | | 17,9 |
| Soak temperature | °C | | 24,1 |
| Extra feature | | | No |
| First Burst Delay | > 47,5 sec | | > 50 sec |

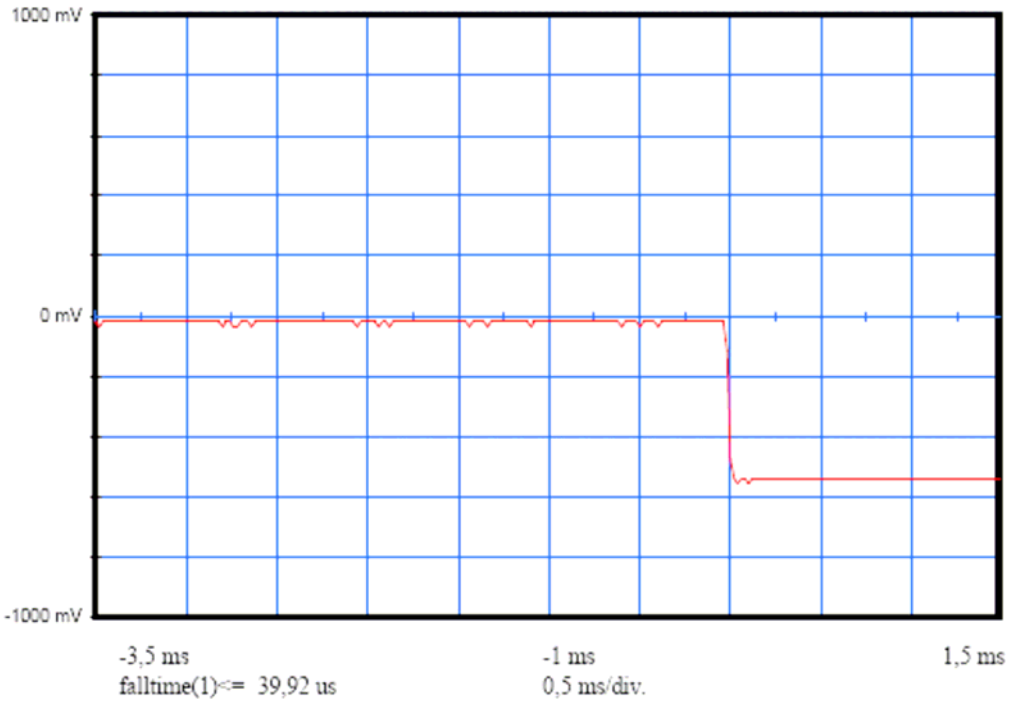


## Oscilloscopes

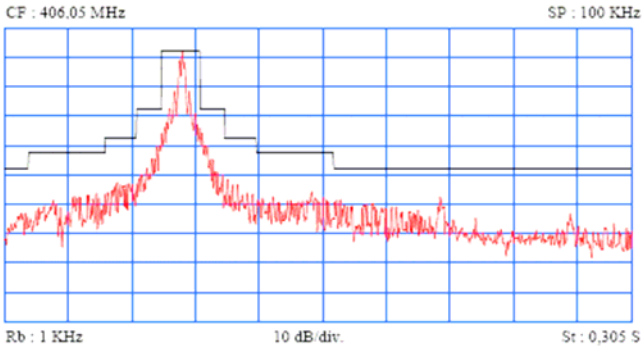


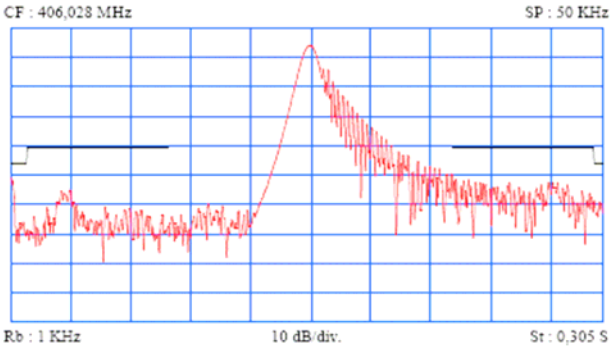



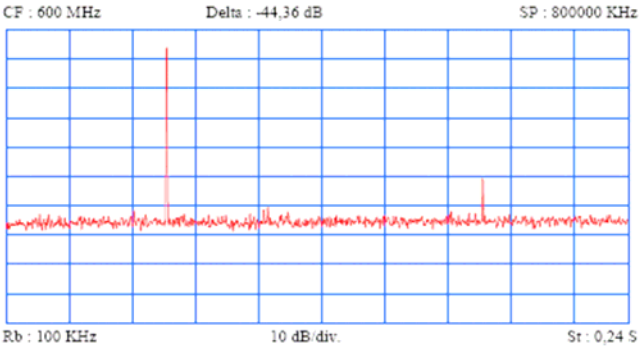

1000 mV
0 mV
-1000 mV
-1 ms
1,5 ms
4 ms
risetime(1)<= 19,9601 us
0,5 ms/div.


1000 mV
0 mV
-1000 mV
-3,5 ms
-1 ms
1,5 ms
falltime(1)<= 39,92 us
0,5 ms/div.

MARTEC
XS3-GPS
UUT1 after_bumps
Certification nominale
406 MHz
22 °C

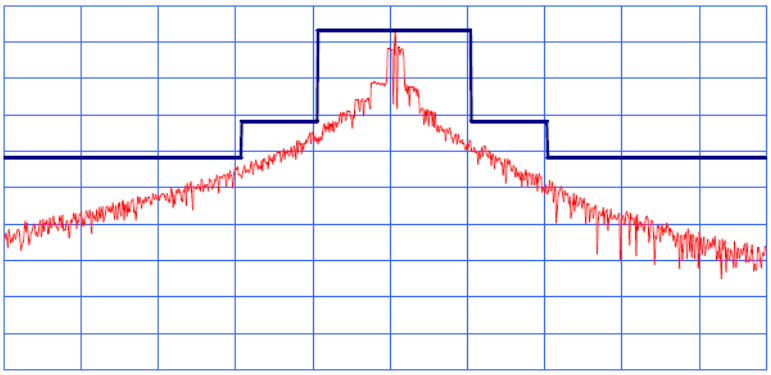



**MARTEC**
**XS3-GPS**
**UUT1 after_bumps**
**Certification nominale**
**121,5 MHz**
**22 °C**

CF : 121,5 MHz SP : 125 KHz



Rb : 0,1 KHz 10 dB/div. St : 37,5 S

**SELF TEST RESULTS OF THE SECOND BEACON AFTER BUMPS**

Beacon Unit : 2/2
Name : MARTEC / KANNAD
Type : XS3 GPS
Number : UT2

Date : September 20th, 2007

**SELF-TEST MODE CONTROL ON**
**MARTEC**
**XS3-GPS**
**N° UUT2 after_bumps**
**at 22° C**

**Message at 22°C**

| | |
|---|---|
| Manufacturer | MARTEC |
| Beacon model | XS3-GPS |
| Serial number | UUT2 |
| Date of test | 20-sept-07 |
| Temperature | 22,9 |
| Message received | FFFED08E3E2293E07FDFFDF6D23783E0F66C |
| Frame synchro. pattern | 011010000 |

| | | | | |
|---|---|---|---|---|
| Total transmission time | ms | 514.8< | <525.2 | 519,55 |