AUTOMATED
ENGINEERING
SERVICES

GE09-437024923-200
Revision 0

JUSTIFICATION OF SRSS COMBINATION OF DYNAMIC RESPONSES FOR ESBWR

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Date: 4/10/2009

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1.0 Introduction

ESBWR design and analysis requires the combination of responses to dynamic loads. The SRSS (Square-Root of the-Sum-of-the-Squares) method is widely employed; however, its use in the case of ESBWR design must be justified.

This report provides justification for the use of the SRSS method in combining dynamic responses other than SSE and LOCA for the ESBWR in accordance with NUREG-0484 Revision 1 (Ref. 1) requirements.

2.0 ESBWR Data

Dynamic response of the ESBWR containment for seismic and hydrodynamic loads is evaluated using two distinct models. A 3D stick model (Ref. 3) was used to evaluate seismic loads, while a 3D finite element model (Ref. 2) was used to evaluate the hydrodynamic loads (e.g. SRV and chugging). Acceleration responses from each model at the following four (4) general locations on the containment were selected for this evaluation:

- RCCV Lower Drywell Wall (RPV Pedestal) Base
- RCCV Wall at the Suppression Pool Slab
- RCCV Wall at the Diaphragm Floor
- RCCV Wall at Top Slab

The seismic model provides acceleration response data (in g's) at a single node corresponding to each general location on the containment, while the more refined model used to perform the hydrodynamic analysis provides acceleration data at up to 8 nodes for each general location. Each group of nodes for each general location in the hydrodynamic model is called a "node family", and each node within a family is called a "family member".

The correspondence between the seismic model "node" and the hydrodynamic model "node family" is as follows:

Seismic Model Node	Hydrodynamic Model Node Family
2	1019
203	1089
206	1109
208	1119

SRV acceleration response time histories (in m/sec^2) were considered at each node within each family for the following load cases:

SRV Case	Description
VH1-H1	5 Hz load applied horizontally – case 1
VH1 H2	5 Hz load applied horizontally – case 2
VH1 V1	5 Hz load applied vertically
VH2-H1	12 Hz load applied horizontally – case 1
VH2 H2	12 Hz load applied horizontally – case 2
VH2 V1	12 Hz load applied vertically
VH3-H1	6 Hz load applied horizontally – case 1
VH3 H2	6 Hz load applied horizontally – case 2
VH3 V1	6 Hz load applied vertically
VH4-H1	8 Hz load applied horizontally – case 1
VH4 H2	8 Hz load applied horizontally – case 2
VH4 V1	8 Hz load applied vertically
VH5-H1	10.2 Hz load applied horizontally – case 1
VH5 H2	10.2 Hz load applied horizontally – case 2
VH5 V1	10.2 Hz load applied vertically

Chugging acceleration response time histories (in m/sec^2) were considered at each node within each family for the following load cases:

Original Chugging Case	Description
CH1 VH1 H1	subcase 1 applied horizontally – case 1
CH1 VH1 H2	subcase 1 applied horizontally – case 2
CH1 VH1 V1	subcase 1 applied vertically
CH1 VH2 H1	subcase 2 applied horizontally – case 1
CH1 VH2 H2	subcase 2 applied horizontally – case 2
CH1 VH2 V1	subcase 2 applied vertically
CH1 VH3 H1	subcase 3 applied horizontally – case 1
CH1 VH3 H2	subcase 3 applied horizontally – case 2
CH1 VH3 V1	subcase 3 applied vertically
CH1 VH4 H1	subcase 4 applied horizontally – case 1
CH1 VH4 H2	subcase 4 applied horizontally – case 2
CH1 VH4 V1	subcase 4 applied vertically
CH1 VH5 H1	subcase 5 applied horizontally – case 1
CH1 VH5 H2	subcase 5 applied horizontally – case 2
CH1 VH5 V1	subcase 5 applied vertically
CH1 VH6 H1	subcase 6 applied horizontally – case 1
CH1 VH6 H2	subcase 6 applied horizontally – case 2
CH1 VH6 V1	subcase 6 applied vertically
CH1 VH7 H1	subcase 7 applied horizontally – case 1
CH1 VH7 H2	subcase 7 applied horizontally – case 2
CH1 VH7 V1	subcase 7 applied vertically
CH1 VH8 H1	subcase 8 applied horizontally – case 1
CH1 VH8 H2	subcase 8 applied horizontally – case 2
CH1 VH8 V1	subcase 8 applied vertically

Adjusted Chugging Case	Description
CH2 VH1 H1	subcase 1 applied horizontally – case 1
CH2 VH1 H2	subcase 1 applied horizontally – case 2
CH2 VH1 V1	subcase 1 applied vertically
CH2 VH2 H1	subcase 2 applied horizontally – case 1
CH2 VH2 H2	subcase 2 applied horizontally – case 2
CH2 VH2 V1	subcase 2 applied vertically
CH2 VH3 H1	subcase 3 applied horizontally – case 1
CH2 VH3 H2	subcase 3 applied horizontally – case 2
CH2 VH3 V1	subcase 3 applied vertically
CH2 VH4 H1	subcase 4 applied horizontally – case 1
CH2 VH4 H2	subcase 4 applied horizontally – case 2
CH2 VH4 V1	subcase 4 applied vertically
CH2 VH5 H1	subcase 5 applied horizontally – case 1
CH2 VH5 H2	subcase 5 applied horizontally – case 2
CH2 VH5 V1	subcase 5 applied vertically
CH2 VH6 H1	subcase 6 applied horizontally – case 1
CH2 VH6 H2	subcase 6 applied horizontally – case 2
CH2 VH6 V1	subcase 6 applied vertically
CH2 VH7 H1	subcase 7 applied horizontally – case 1
CH2 VH7 H2	subcase 7 applied horizontally – case 2
CH2 VH7 V1	subcase 7 applied vertically
CH2 VH8 H1	subcase 8 applied horizontally – case 1
CH2 VH8 H2	subcase 8 applied horizontally – case 2
CH2 VH8 V1	subcase 8 applied vertically

- Seismic time histories considered total:
  4 nodes x 3 DOF's/node = 12
- SRV time histories considered total:
  4 node families x 8 nodes/family x 3 DOF's/node x 15 load cases = 1440
- Chugging time histories considered total:
  4 node families x 8 nodes/family x 3 DOF's/node x 48 load cases = 4608

In order to limit the scope of the review, the following selected responses were placed on the review list. Only those nodes corresponding to family member number 1 were reviewed. The SRV load cases selected for review were as follows:

VH1-H1	5 Hz load applied horizontally – case 1
VH2-H1	12 Hz load applied horizontally – case 1
VH3-H1	6 Hz load applied horizontally – case 1
VH4-H1	8 Hz load applied horizontally – case 1
VH5-H1	10.2 Hz load applied horizontally – case 1

The chugging load cases selected for review were as follows:

CH1 VH1 H1	original subcase 1 applied horizontally – case 1
CH1 VH2 H1	original subcase 2 applied horizontally – case 1
CH1 VH3 H1	original subcase 3 applied horizontally – case 1
CH1 VH4 H1	original subcase 4 applied horizontally – case 1
CH1 VH5 H1	original subcase 5 applied horizontally – case 1
CH1 VH6 H1	original subcase 6 applied horizontally – case 1
CH1 VH7 H1	original subcase 7 applied horizontally – case 1
CH1 VH8 H1	original subcase 8 applied horizontally – case 1

Considering the above selections:

- Seismic time histories reviewed total:
  4 nodes x 3 DOF's/node = 12
- SRV time histories reviewed total:
  4 node families x 1 node/family x 3 DOF's/node x 5 load cases = 60
- Chugging time histories reviewed total:
  4 node families x 1 node/family x 3 DOF's/node x 8 load cases = 96

Attachment A contains plots of the 12 seismic time histories reviewed. Attachment B contains plots of the 60 SRV time histories reviewed. Attachment C contains plots of the 96 chugging time histories reviewed.

3.0 Methodology

Reference 1 provides conditions that shall be met for acceptance of SRSS use in combining dynamic responses other than SSE and LOCA. The following dynamic load combinations are evaluated for acceptance:

- SSE + SRV
- SRV + Chugging

These are the same combinations considered in the Mark III SRSS evaluation (Ref. 4).

Reference 1 states that SRSS may be employed when the following two conditions have been satisfied (*ESBWR evaluation included in italics*).

Condition A

i) The dynamic response time function must be rapidly varying. *As can be observed from Attachments A thru C, all time histories oscillate about zero displaying a significant number of cycles over the time periods evaluated.*

ii) The duration of the strong motion portion of the function must be short. *The seismic time histories of Attachment A are distinguished by a readily observable strong motion segment within the first half of the transient. SRV time histories of Attachment B build quickly to a peak and then taper off gradually. Strong motion is limited to approximately ½ the transient. The chugging time histories of Attachment C build quickly to a peak and also taper off quickly. Strong motion is limited to approximately ¼ of the transient.*

iii) The functions must consist of a few distinct high peaks which are random with respect to time. *Each of the time histories contained in Attachments A thru C contains distinct peaks within the strong motion portion of the transient and the peaks of the response functions of various load types are random with respect to time.*

iv) The response must be calculated on a linear elastic basis. *All ESBWR analysis models are linear and elastic.*

v) The time-phase relationship among functions to be combined must be random. *The ESBWR dynamic events considered occur randomly with respect to each other.*

Condition B

i) The loads must be defined at approximately the 84th percentile or 1.15 times the median, whichever is greater. *All ESBWR loads meet this requirement.*
ii) The SRSS value of the response combination has a Probability-of-Non-Exceedence (PNE) $\geq$ 50%.
iii) 1.2 times the SRSS value of the response combination has a PNE $\geq$ 85%.

Conditions B(ii) and B(iii) are addressed in Section 4.0 wherein PNE's are computed by developing Cumulative Distribution Functions (CDFs) assuming random phasing and using the procedures outlined in Section N-1723 of Appendix N of the ASME Code (Ref. 5).

4.0 Analysis

In order to justify the use of the SRSS methodology when combining dynamic loads, a rigorous statistical analysis of the ESBWR data is required. This entails systematically pairing dynamic time histories, developing CDFs, demonstrating that the SRSS of the peak values from the two time histories have a PNE $\geq$ 50% and that 1.2 x the SRSS of the peak values have a PNE $\geq$ 85%.

The statistical analysis is performed in a similar manner with the Mark III SRSS evaluation (Ref. 4) and the details are contained in Attachment D. Guidance was also taken from the ASME Code, Section N-1723 of Appendix N (Ref. 5). The application of Appendix N methods is summarized as follows:

Given:

time history A
time history B

Step 1

Determine the peak amplitude from time history A (P_A) and then for time history B (P_B) and let SRSS = $(P^2_A + P^2_B)^{1/2}$.

Step 2

Re-digitize each time history to a uniform time step, Δt.

Step 3

Select one time history as the "reference" time history and the other as the "moving" time history. For example, time history A = reference time history and time history B = moving time history.

Step 4

Superimpose time history B over time history A with the t = 0 sec time point of B aligned with the t = 0 sec time point of A.

Step 5

Develop the direct summation of the two time histories and determine the peak amplitude (P_1).

Step 6

Superimpose time history B over time history A with the t = 0 sec time point of B aligned with the t = Δt sec time point of A.

Step 7

Develop the direct summation of the two time histories and determine peak amplitude (P_2).

Step 8

Report the superposition and summation steps until the first time point of time history B aligns with the last time point of time history A resulting in amplitudes $P_3, P_4, P_5 \ldots P_n$.

Step 9

Sort the calculated P_i, i=1, n from the lowest to highest value. This represents the CDF.

Step 10

Determine how many P_i values are $\leq$ SRSS. Let the number be m. The PNE of the SRSS value = m/n *100.

ESBWR time histories were re-digitized using a time step of 0.001 seconds.

Only the strong motion portion of the seismic time history was considered when combining with SRV. The strong motion portion of the seismic time history begins when the amplitude first reaches 50% of the peak value, and ends when the amplitude last reaches 50% of the peak value. When an SRV time history is swept thru a seismic time history, the first superposition takes place when the start of the SRV time history aligns with the start of the strong motion and ends when the start of the SRV time history aligns with the end of the strong motion.

Multiple chugging cycles were considered when combining with SRV. The reference chugging time history was assembled with several back-to-back chugging time histories such that when the SRV is swept thru the first chugging cycle, the end of the SRV time history does not extend beyond the end of the last chugging cycle.

The following table presents the findings from that analysis.

Node Family	DOF	Comb	PNE^{50}	PNE^{85}	R^{50}/SRSS
1019	X	SSE+SRV	93.2	100.0	
		Chug+SRV	63.7	91.3	
	Y	SSE+SRV	93.1	99.3	
		Chug+SRV	52.6	88.9	
	Z	SSE+SRV	80.1	100.0	
		Chug+SRV	56.5	86.7	
1089	X	SSE+SRV	88.2	100.0	
		Chug+SRV	61.6	94.0	
	Y	SSE+SRV	85.4	97.7	
		Chug+SRV	52.3	87.8	
	Z	SSE+SRV	80.3	100.0	
		Chug+SRV	56.7	96.1	
1109	X	SSE+SRV	90.8	100.0	
		Chug+SRV	41.6	85.8	1.0290
	Y	SSE+SRV	84.2	100.0	
		Chug+SRV	46.2	89.8	1.0121
	Z	SSE+SRV	76.0	100.0	
		Chug+SRV	51.5	87.7	
1119	X	SSE+SRV	88.9	100.0	
		Chug+SRV	65.8	94.5	
	Y	SSE+SRV	78.3	100.0	
		Chug+SRV	41.1	87.6	1.0216
	Z	SSE+SRV	85.6	100.0	
		Chug+SRV	62.5	93.7	

The column labeled PNE^{50} presents PNE's for the SRSS of the absolute magnitudes i.e., Condition B(ii). The column labeled PNE^{85} presents PNE's for 1.2 x the SRSS of the absolute magnitudes i.e., Condition B(iii). When a PNE^{50} value is < 50%, the CDF value corresponding to a 50% PNE (R^{50}) is determined. The table represents that value divided by the SRSS value which provides a relative indication of how close to compliance the outlier actually was.

Twenty one (21) of the twenty four (24) combinations have PNE^{50} values ≥ 50%. 21/24 = 87.5% compliance compares favorably with the 83.2% compliance of the Mark III in Reference 4. Twenty four (24) of the twenty four (24) combinations have PNE^{85} values ≥ 85%. 24/24 = 100% compliance compares favorably with the 97.6% compliance of the Mark III in Reference 4. Also note that 100% of the trials have R^{50}/SRSS values ≤ 1.029 which compares very favorably with the Mark III, where 100% of the trials had R^{50}/SRSS values < 1.1000 in Reference 4.

5.0 Conclusion

Based on the foregoing, it is concluded that combining dynamic loads for the SSE + SRV combination and the chugging + SRV combination satisfy the conditions stipulated in Reference 1 and accordingly the use of SRSS for combining dynamic loads other than SSE and LOCA is justified for the ESBWR.

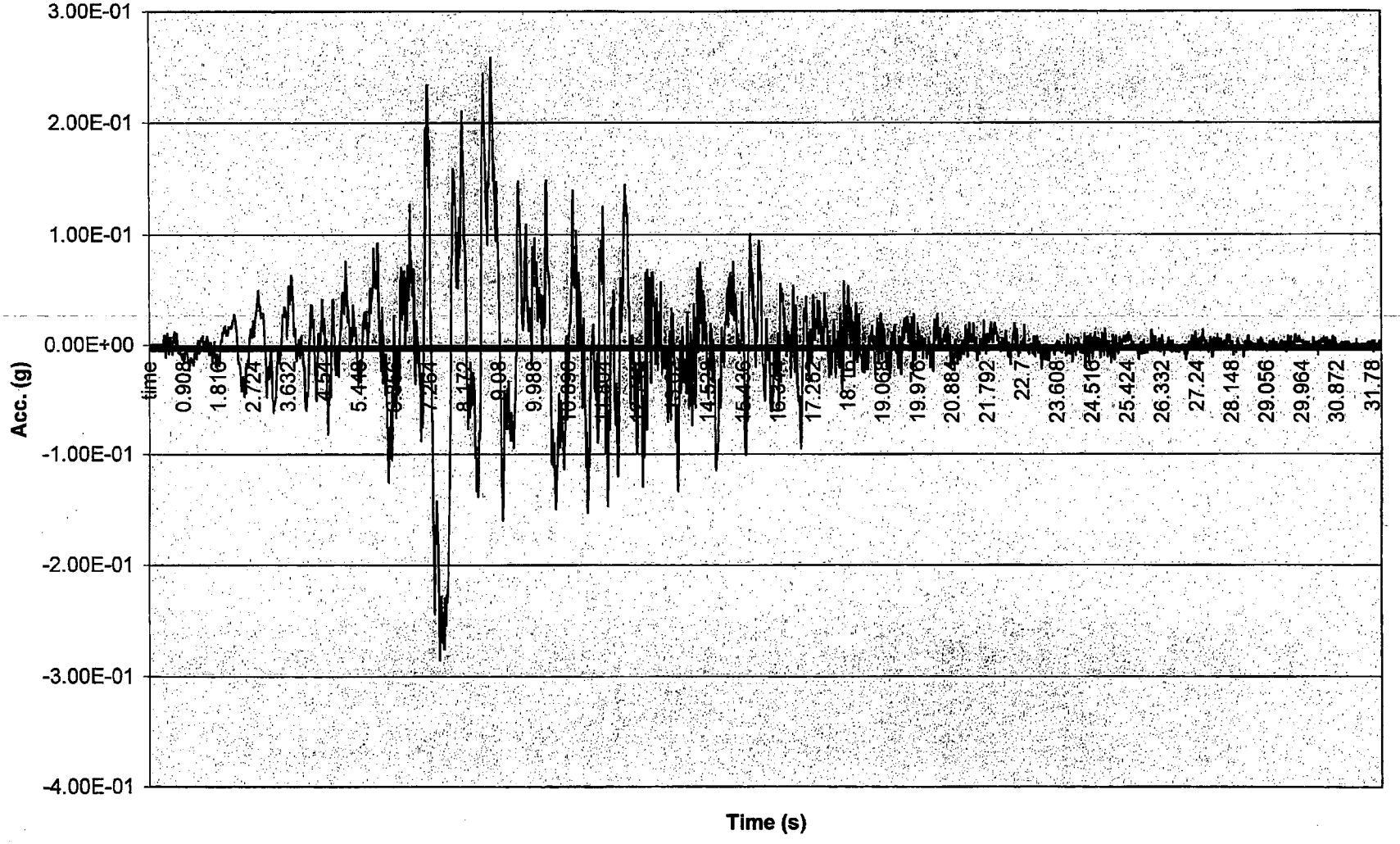
6.0 References

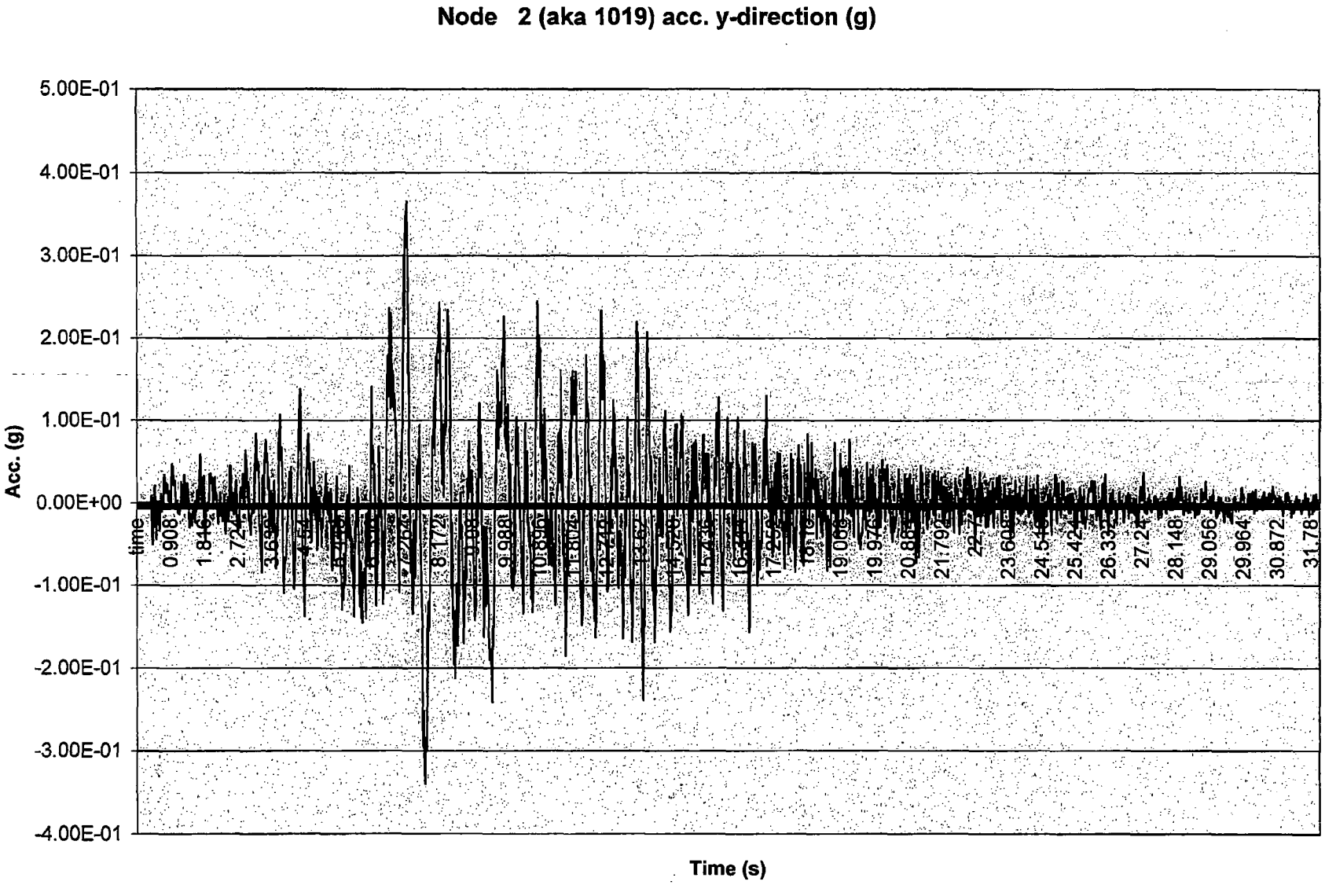
1. NUREG-0484, Rev. 1, "Methodology for Combining Dynamic Responses", May 1980
2. GEH ESBWR Report 092-134-C-C-00014, Revision 2, September 2008, "Dynamic Response Analysis of Containment Loads"
3. GEH ESBWR Report 26A6647, Revision 4, June 2008, "Seismic Analysis of Reactor/Fuel Building Complex"
4. Structural Mechanics Associates report SMA 12109.01-R001, November, 1981, "Study to Demonstrate the Generic Applicability of SRSS Combination of Dynamic Responses for Mark III Nuclear Steam Supply System and Balance-of-Plant Piping and Equipment Components"
5. ASME Boiler & Pressure Vessel Code, Section III, Appendix N, "Dynamic Analysis Methods", 2004

Attachment A

ESBWR Seismic Time History Plots

Node 2 (aka 1019) acc. x-direction (g)




Node 2 (aka 1019) acc. y-direction (g)
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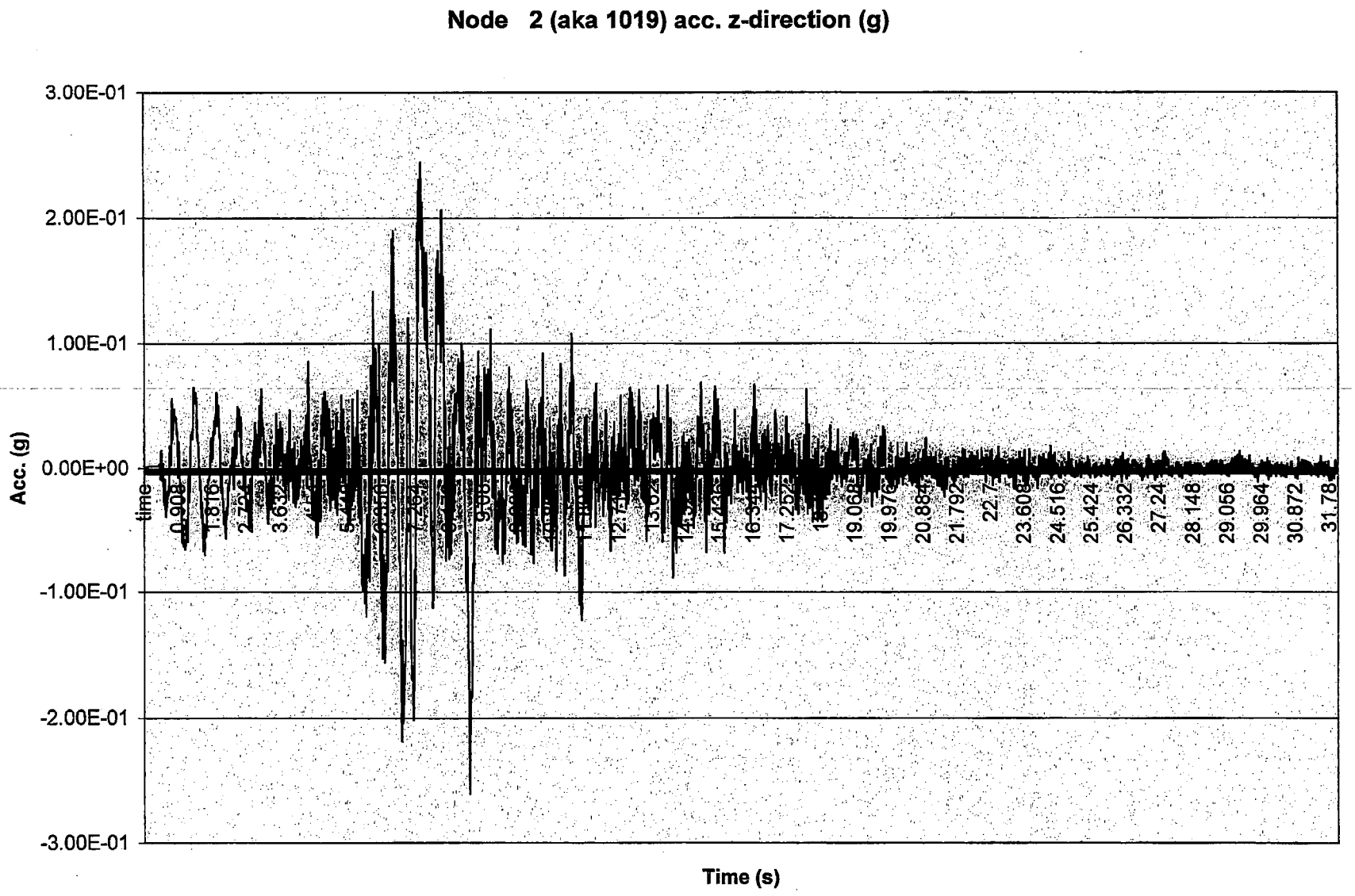
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
-4.00E-01
Acc. (g)
Time (s)


Node 2 (aka 1019) acc. z-direction (g)
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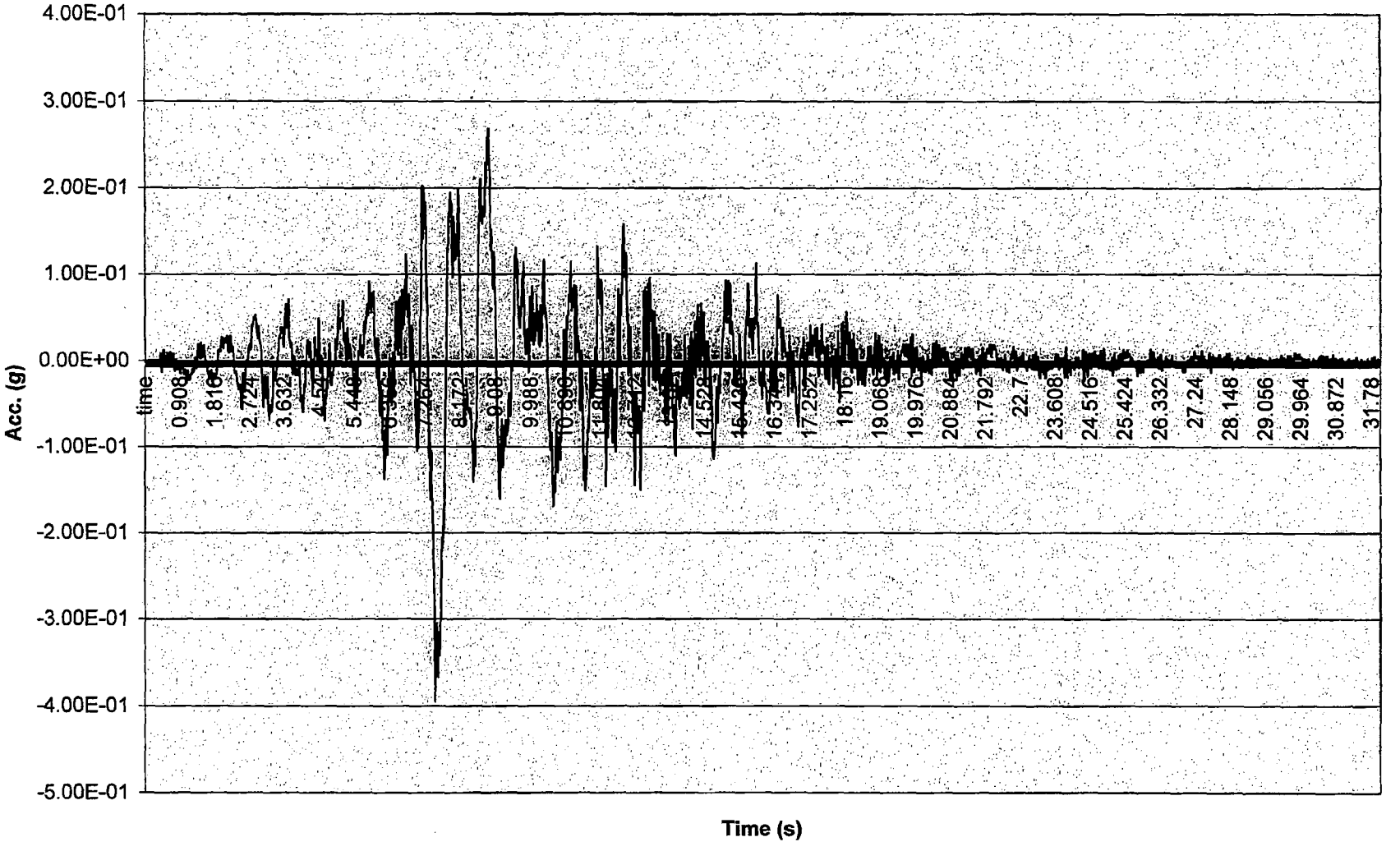
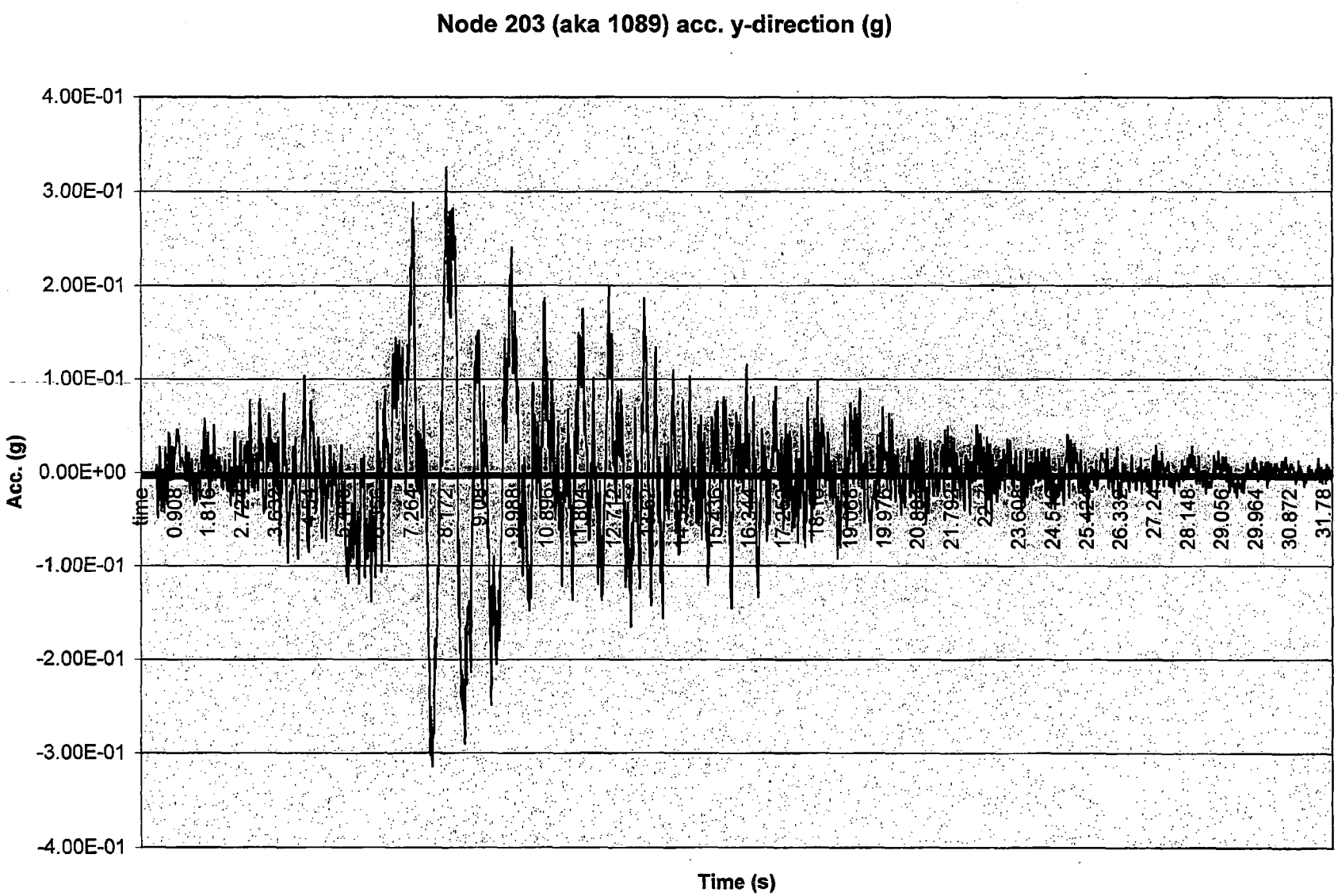
-2.00E-01
-3.00E-01
Acc. (g)
Time (s)

Node 203 (aka 1089) acc. x-direction (g)

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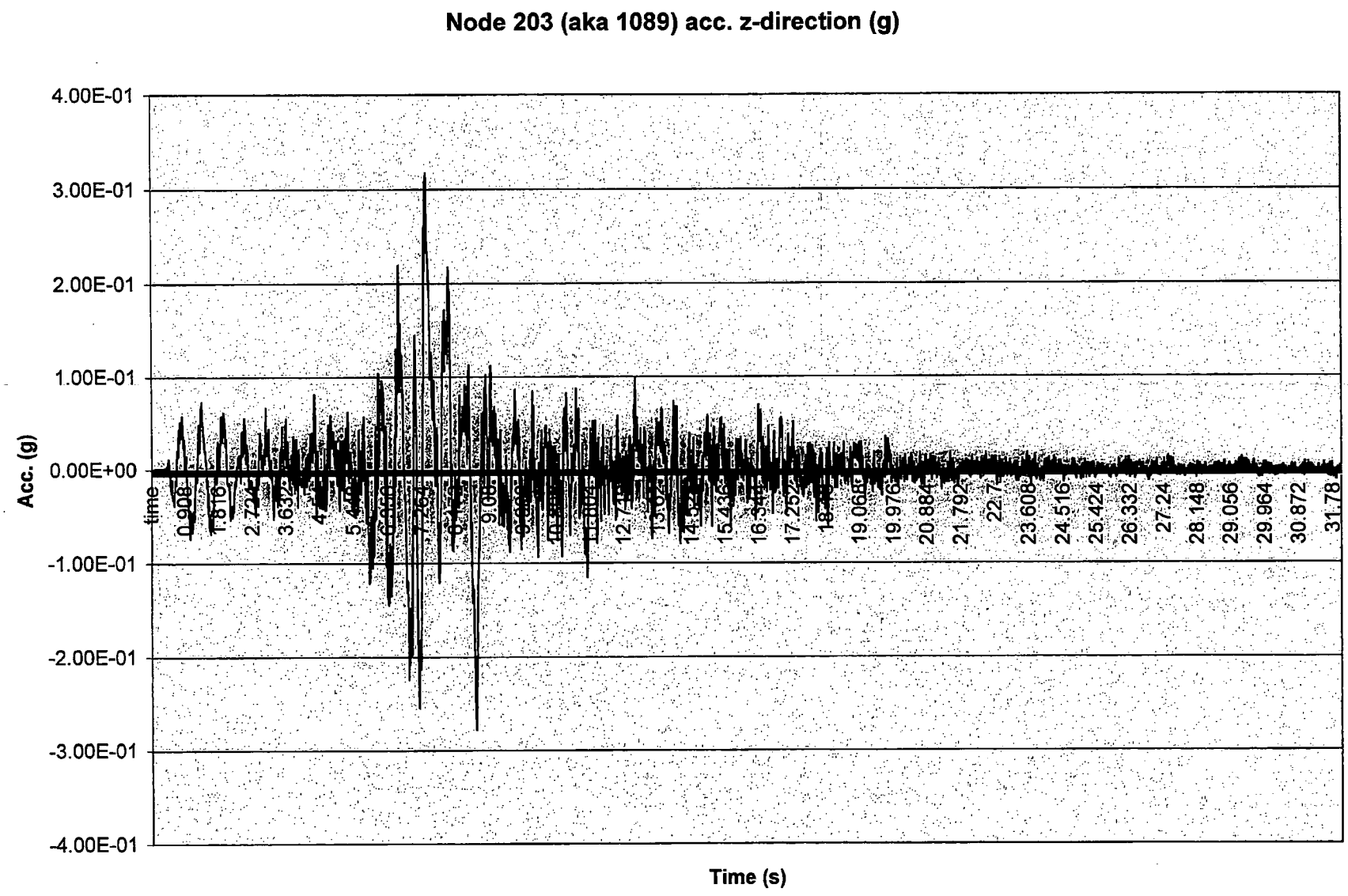
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
-4.00E-01
Acc. (g)
Time (s)
time
0.908
1.816
7.264
8.172
9.988
10.896
12.712
16.344
19.976
20.884
21.792
23.608
24.516
25.424
26.332
27.24
28.148
29.056
29.964
30.872
31.78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1.00E-01
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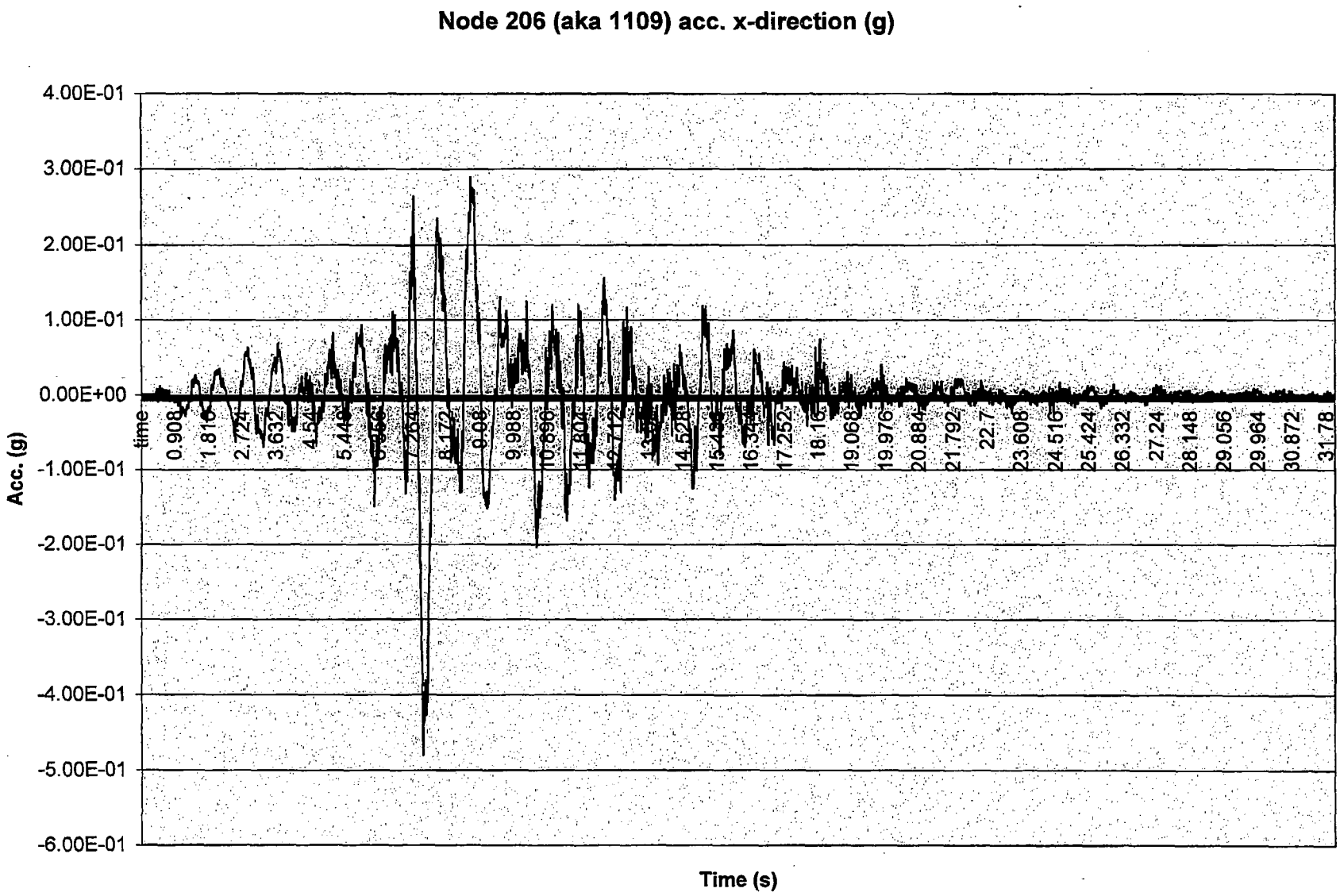
-2.00E-01
-3.00E-01
-4.00E-01
Acc. (g)
Time (s)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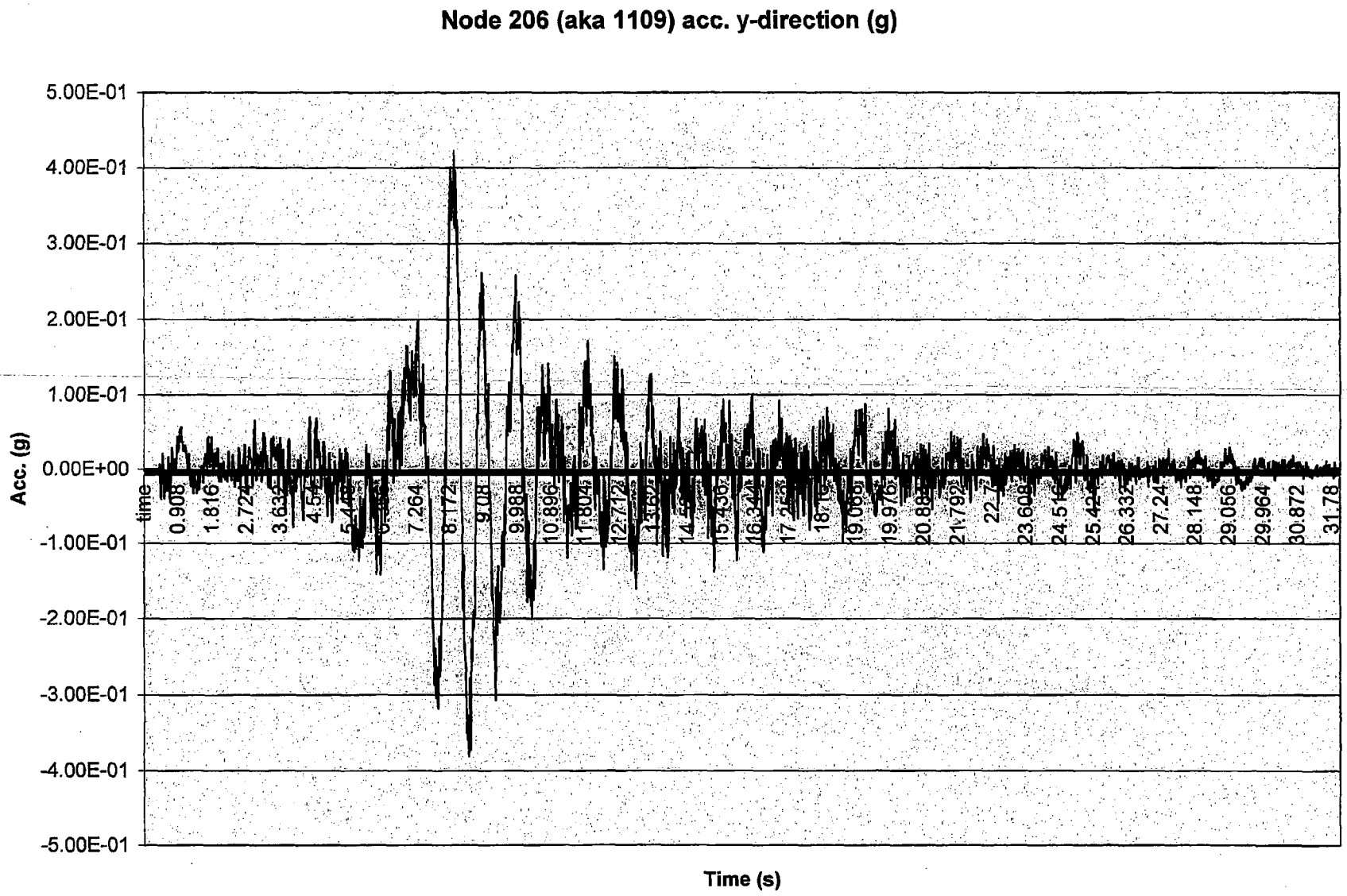
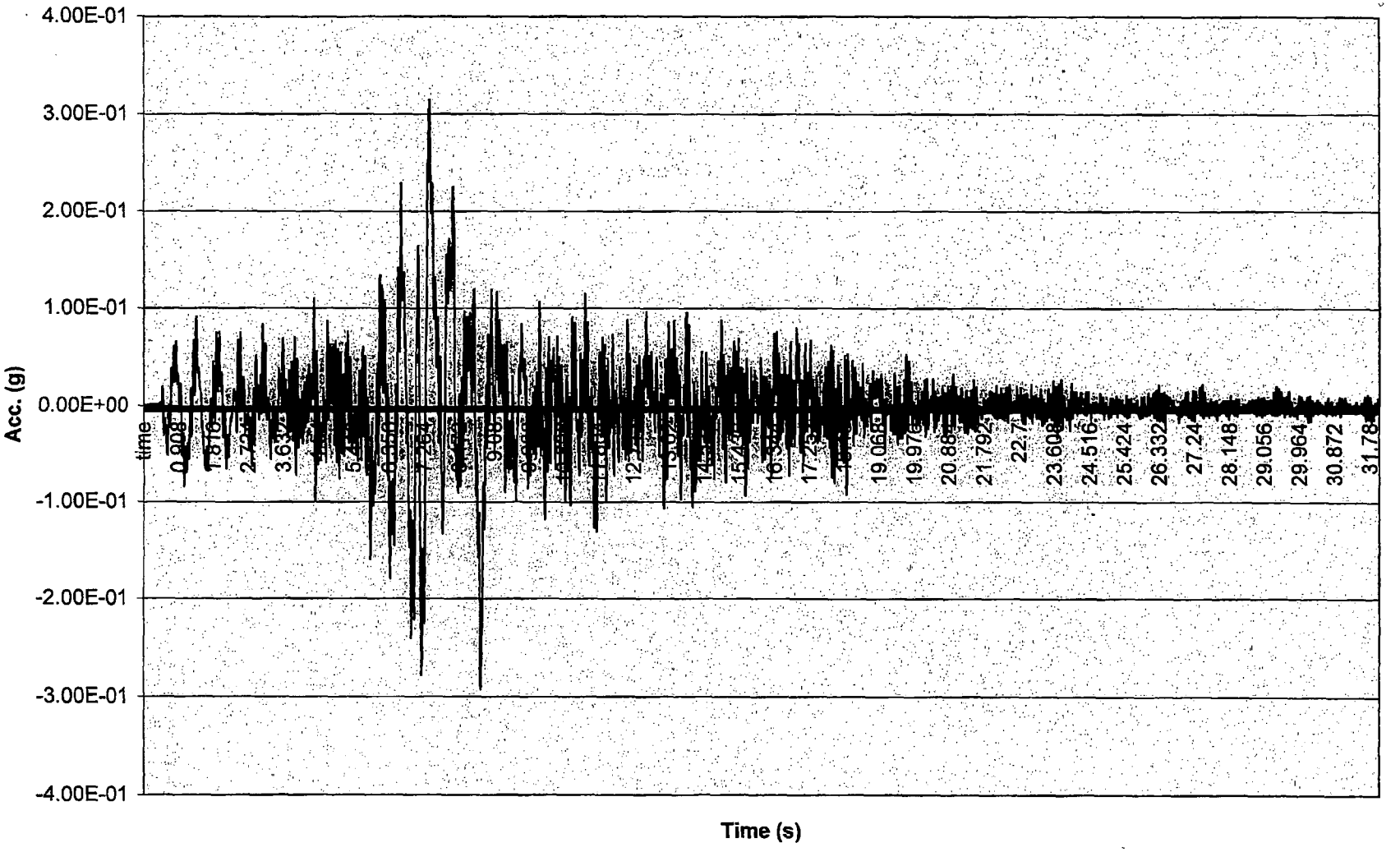
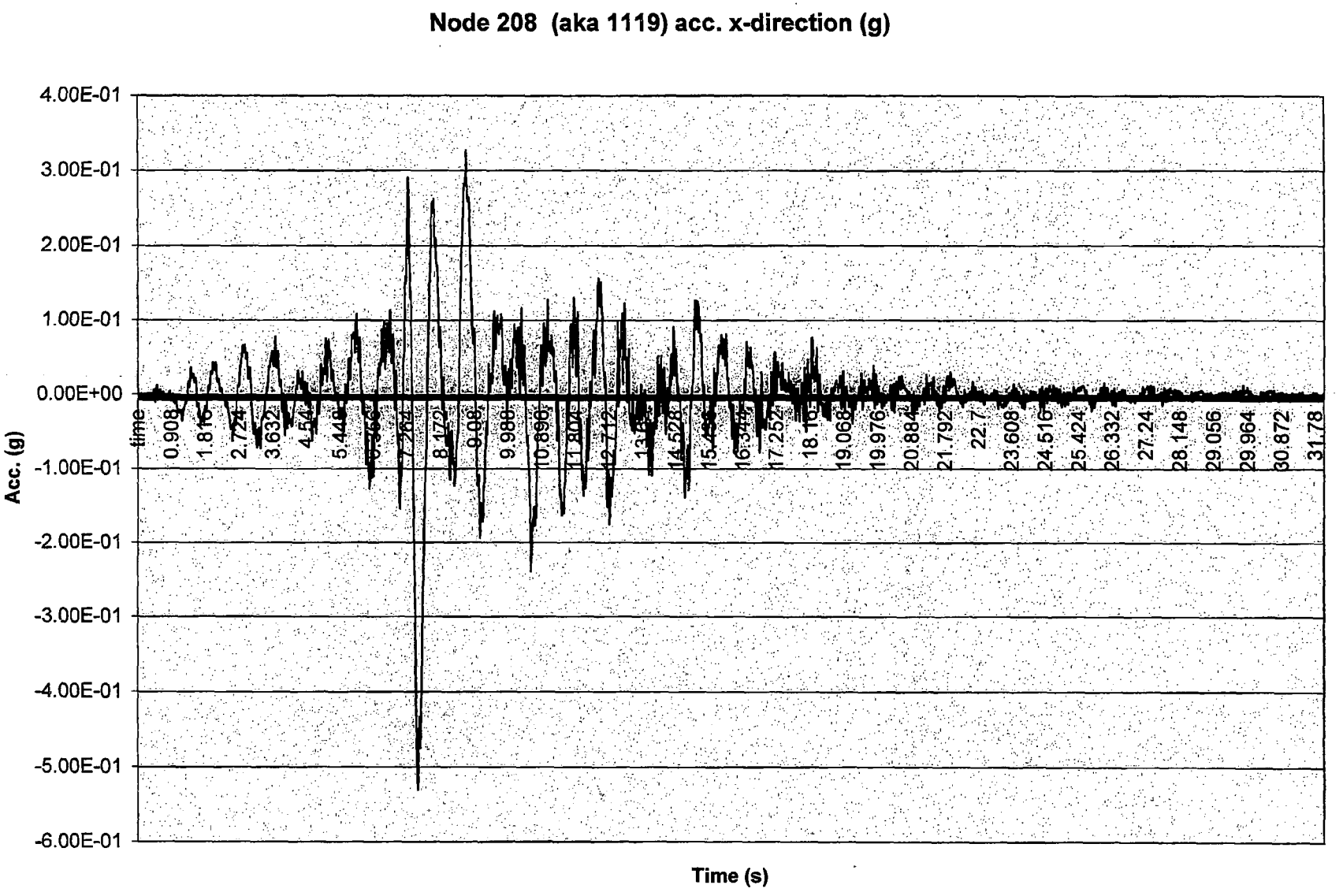
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
-4.00E-01
-5.00E-01
-6.00E-01
Acc. (g)
time
0.908
1.816
2.724
3.632
4.54
5.448
6.356
7.264
8.172
9.08
9.988
10.896
11.804
12.712
13.62
14.528
15.436
16.344
17.252
18.16
19.068
19.976
20.884
21.792
22.7
23.608
24.516
25.424
26.332
27.24
28.148
29.056
29.964
30.872
31.78
Time (s)


Node 206 (aka 1109) acc. y-direction (g)
5.00E-01
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
-4.00E-01
-5.00E-01
Acc. (g)
time
0.908
1.816
2.724
7.264
9.08
9.988
10.896
11.804
12.712
19.976
20.88
21.792
23.608
24.516
25.424
26.332
27.24
28.148
29.056
29.964
30.872
31.78
Time (s)

Node 206 (aka 1109) acc. z-direction (g)




Node 208 (aka 1119) acc. x-direction (g)
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3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
-4.00E-01
-5.00E-01
-6.00E-01
Acc. (g)
time
0.908
1.816
2.724
3.632
4.544
5.440
8.172
9.08
9.988
10.896
11.804
12.712
14.528
15.436
17.252
18.16
19.068
19.976
20.884
21.792
22.7
23.608
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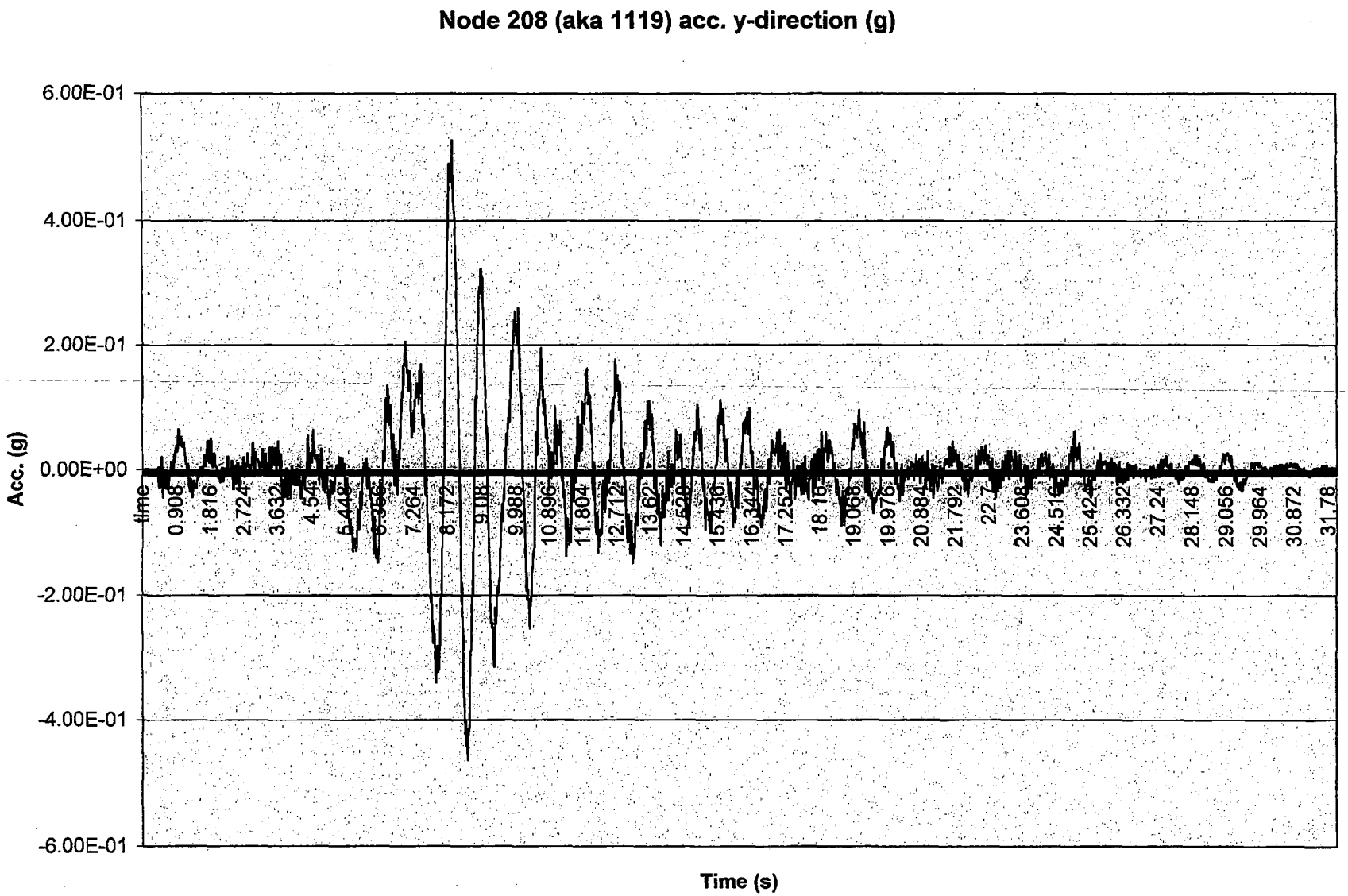
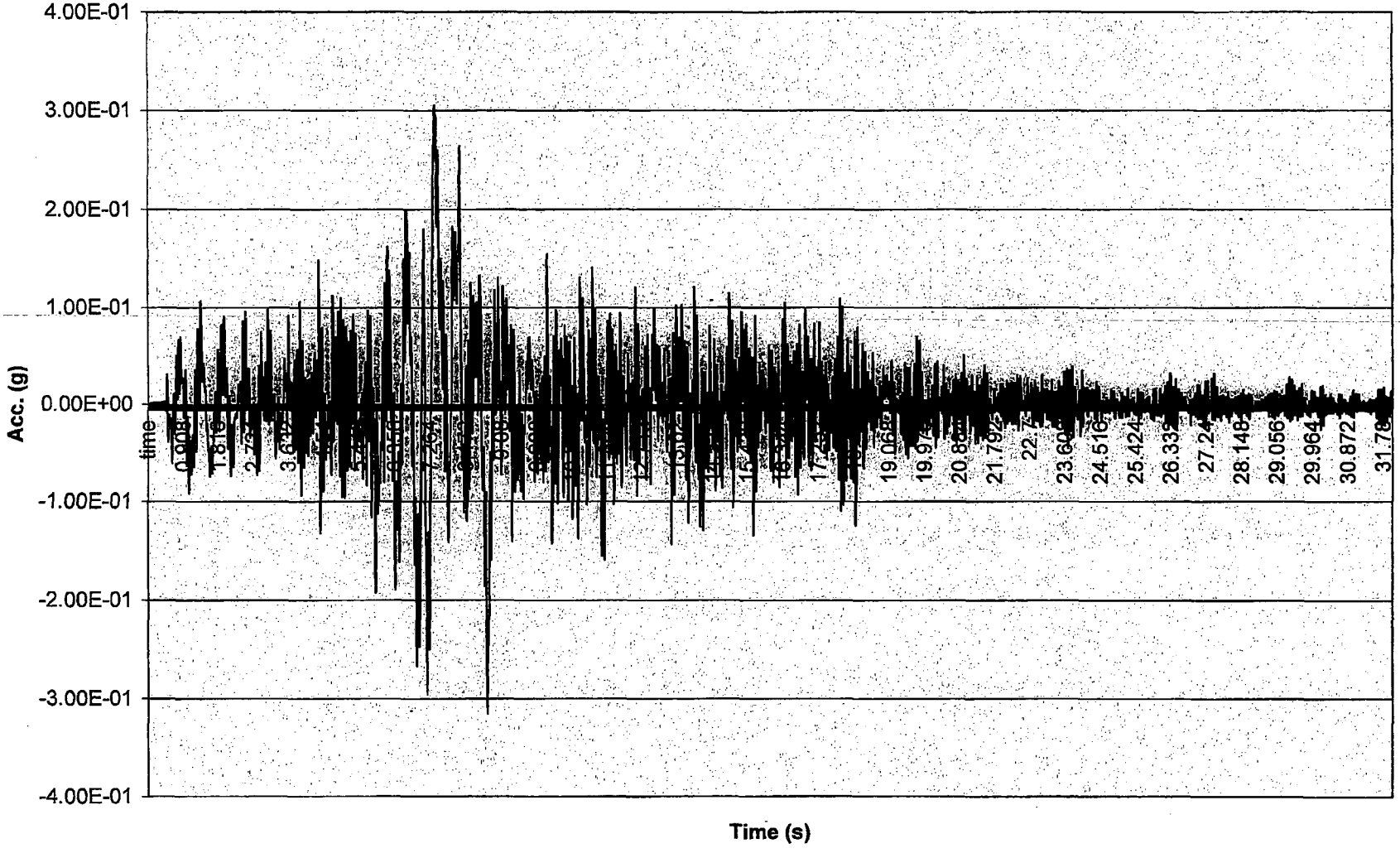
25.424
26.332
27.24
28.148
29.056
29.964
30.872
31.78
Time (s)


Node 208 (aka 1119) acc. y-direction (g)
6.00E-01
4.00E-01
2.00E-01
0.00E+00
-2.00E-01
-4.00E-01
-6.00E-01
Acc. (g)
time
0.908
1.816
2.724
3.632
4.54
5.448
6.356
7.264
8.172
9.08
9.988
10.896
11.804
12.712
13.62
14.528
15.436
16.344
17.252
18.16
19.068
19.976
20.884
21.792
22.7
23.608
24.516
25.424
26.332
27.24
28.148
29.056
29.964
30.872
31.78
Time (s)

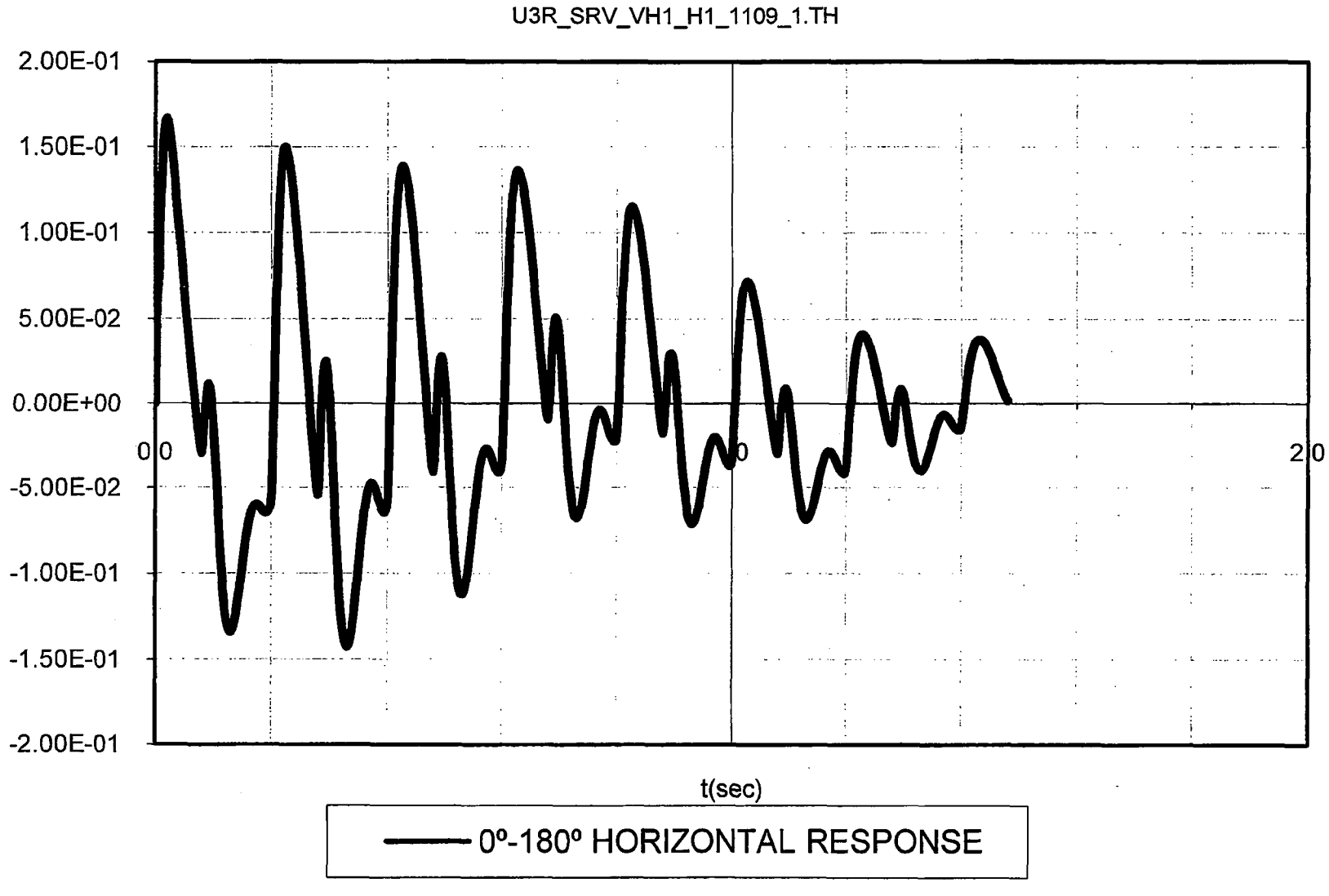
Node 208 (aka 1119) acc. z-direction (g)



Attachment B

ESBWR SRV Time History Plots

There are only 54 time histories rather than 60. Only 4 SRV load cases exist for Node Families 1019 & 1089.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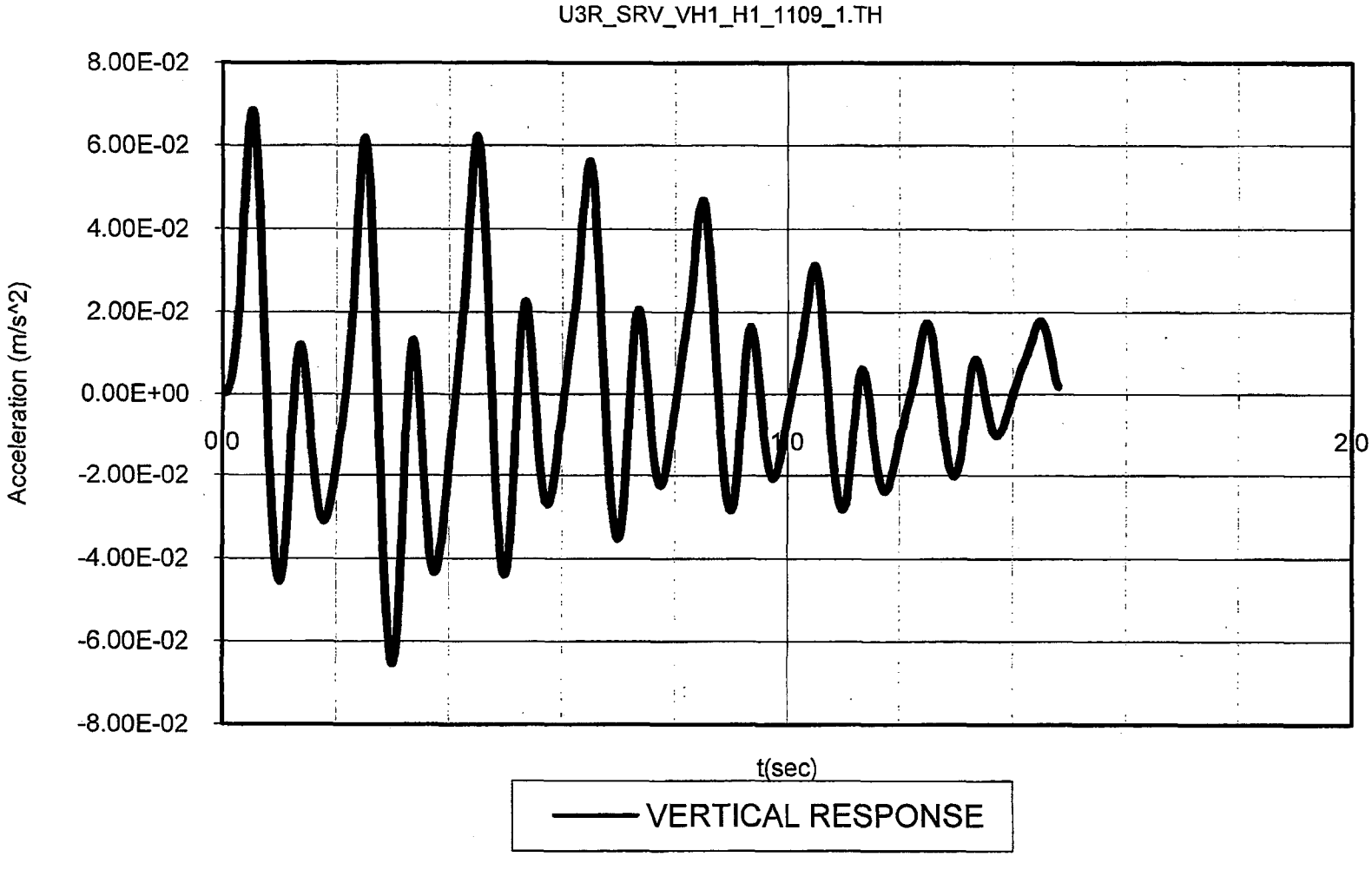
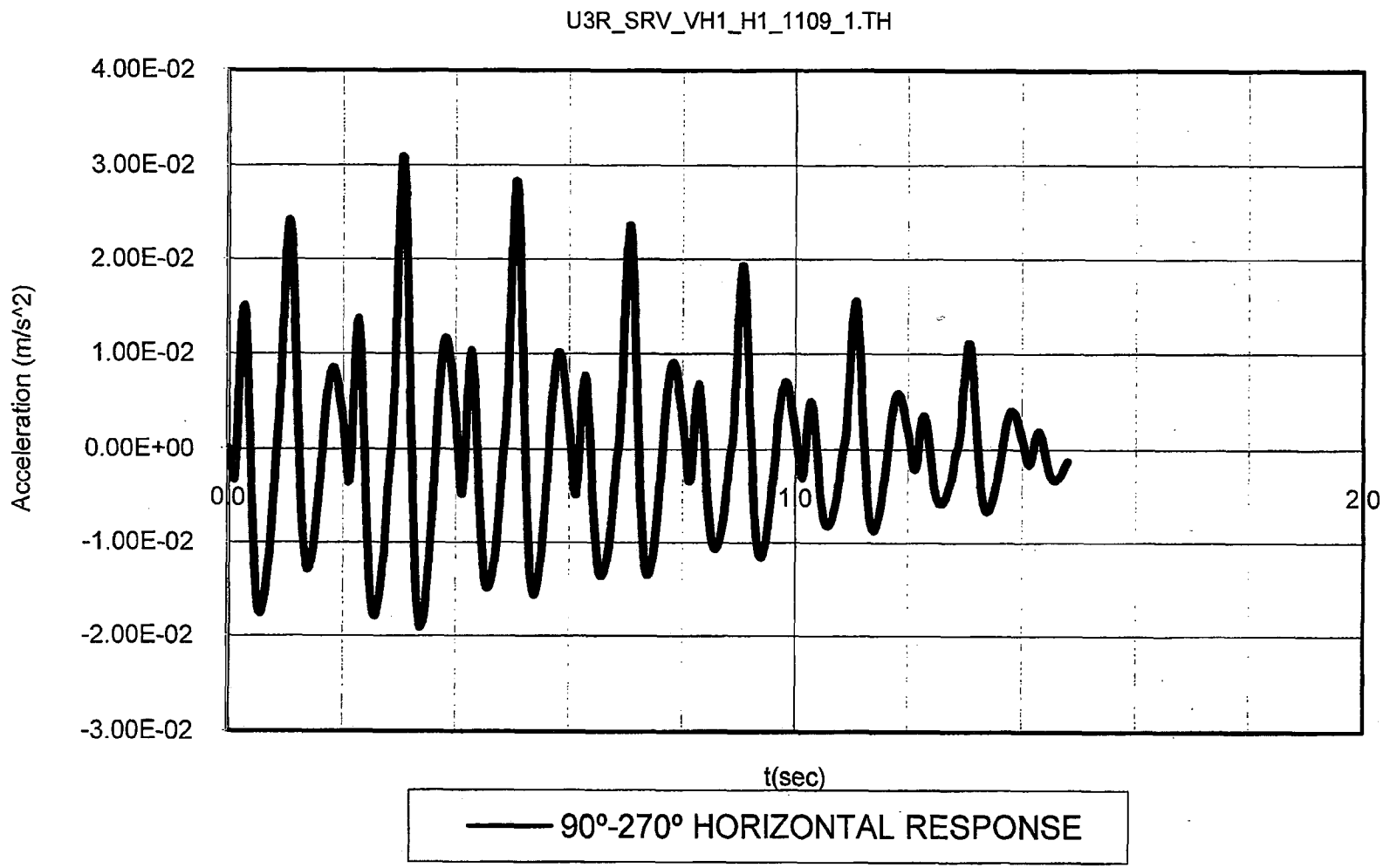
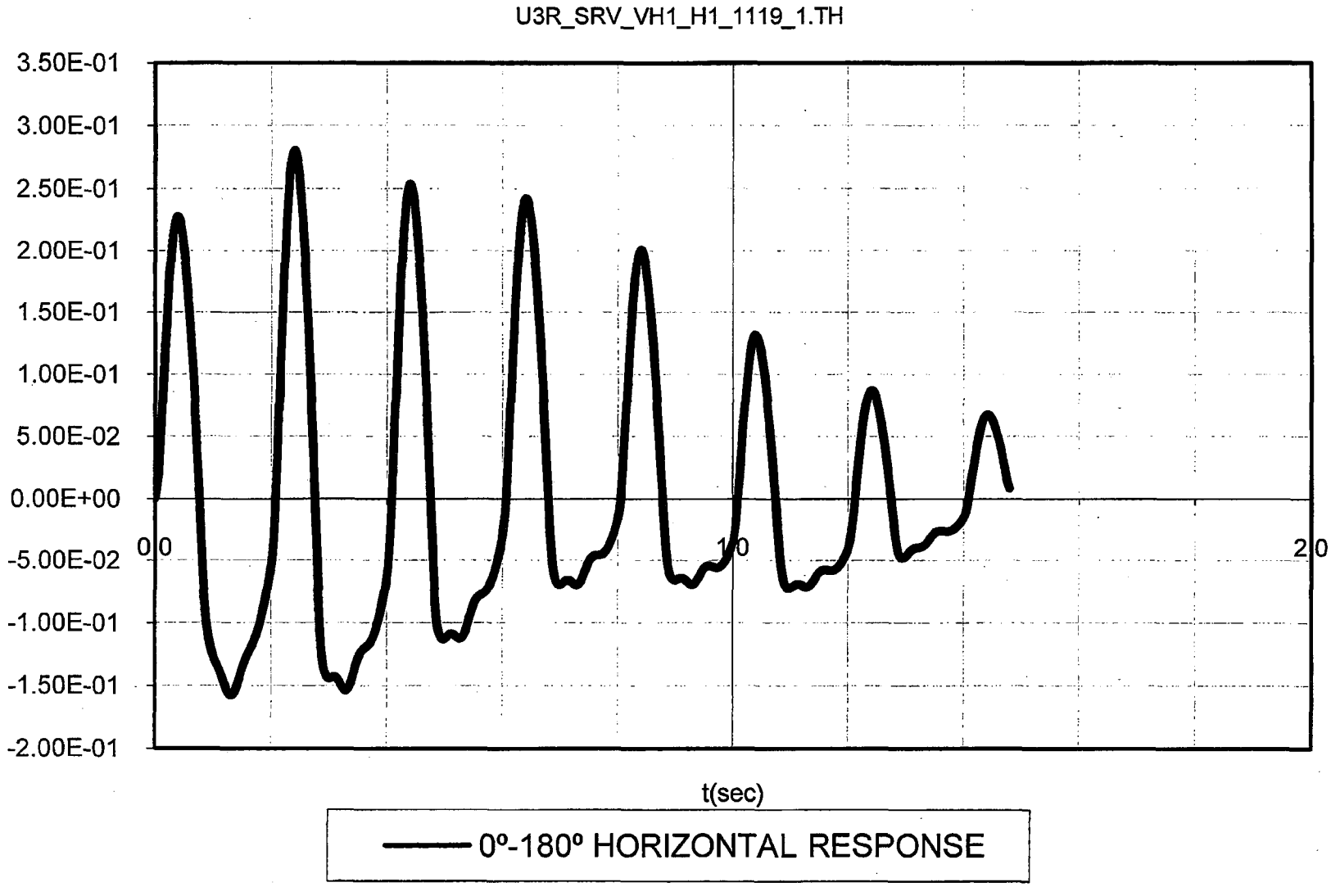
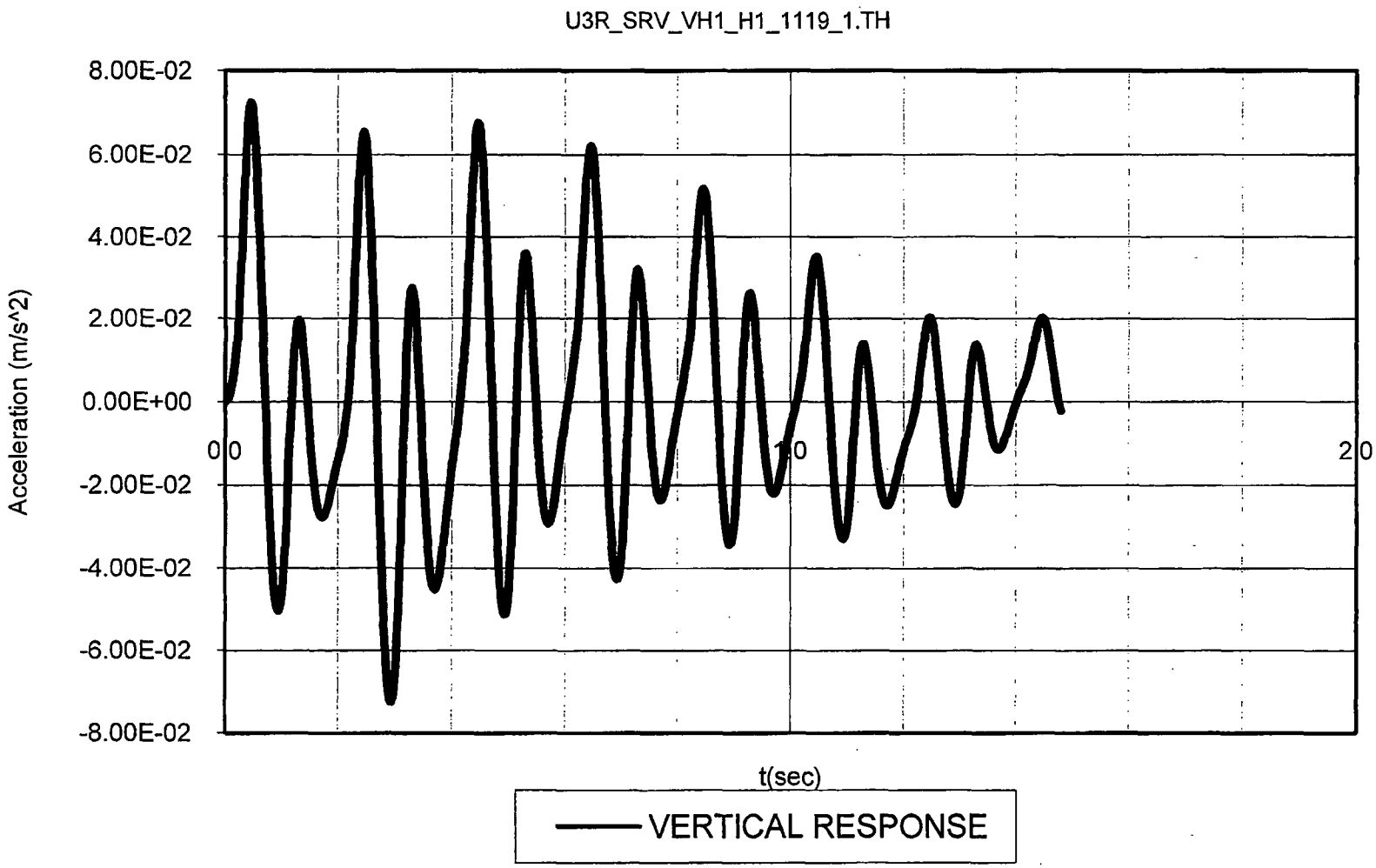
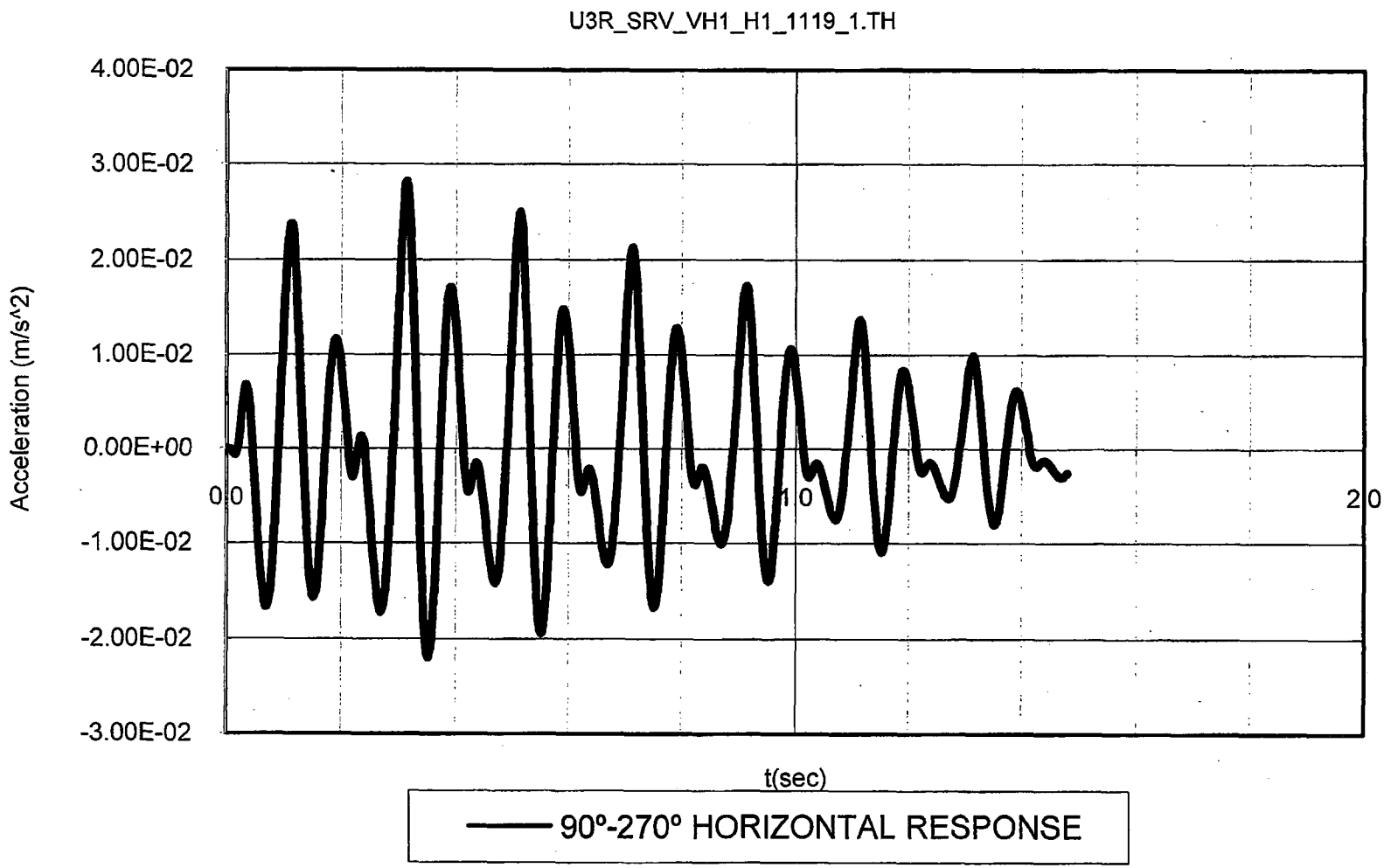
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
-1.50E-01
-2.00E-01
Acceleration (m/s^2)
0.0
10
20
t(sec)
0°-180° HORIZONTAL RESPONSE

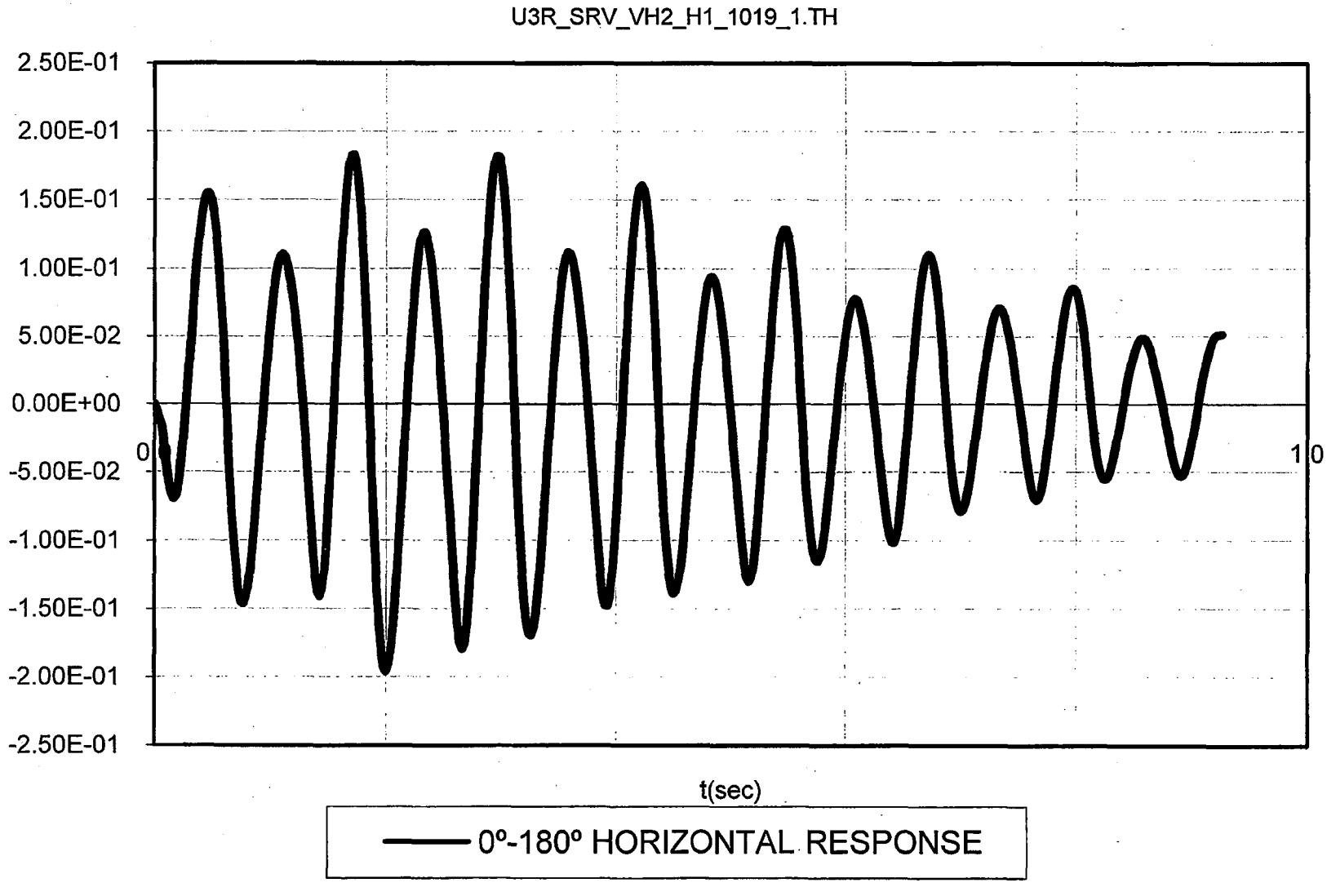

U3R_SRV_VH1_H1_1109_1.TH
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
-2.00E-02
-4.00E-02
-6.00E-02
-8.00E-02
Acceleration (m/s^2)
0
10
20
t(sec)
VERTICAL RESPONSE

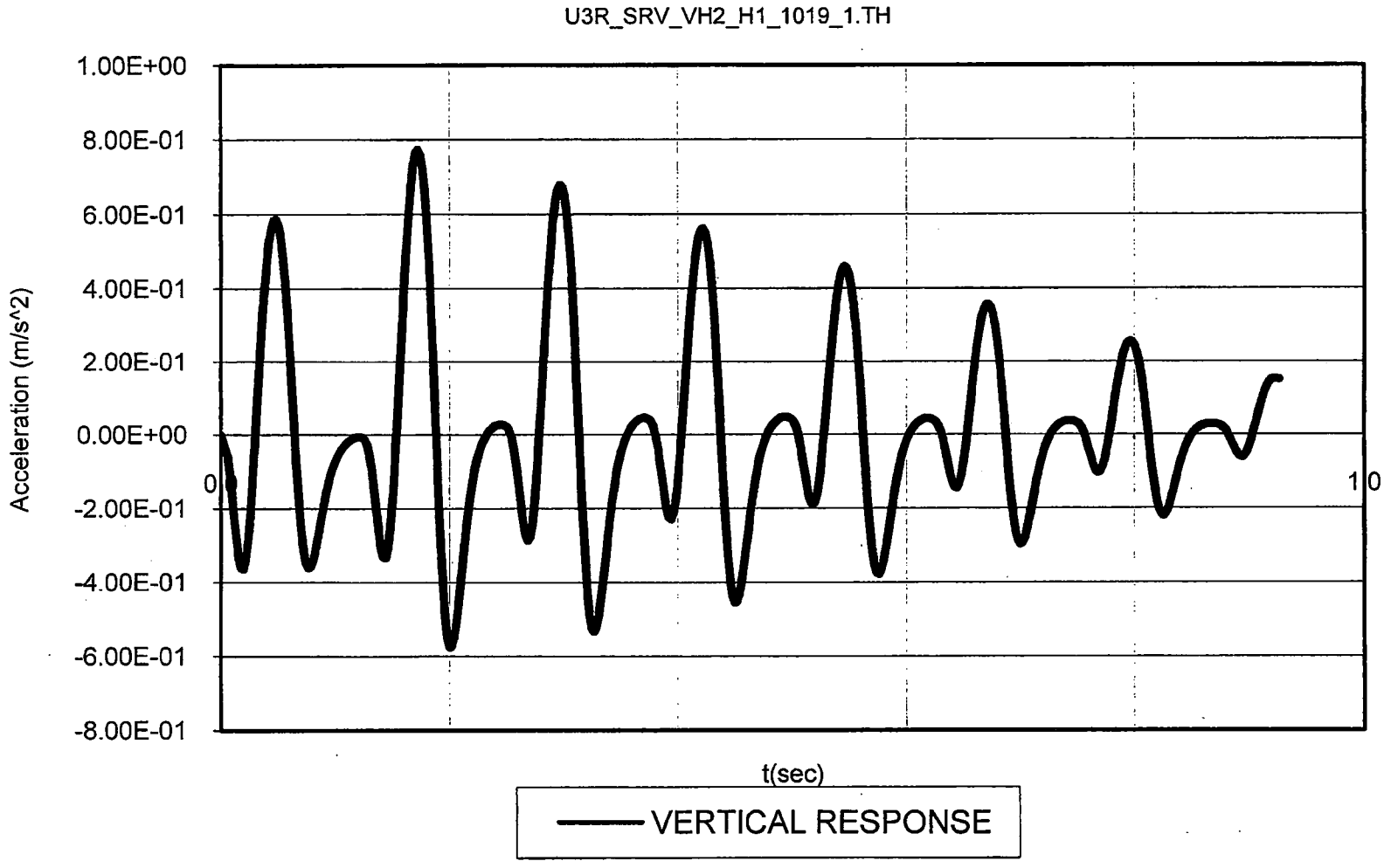

U3R_SRV_VH1_H1_1109_1.TH
4.00E-02
3.00E-02
2.00E-02
1.00E-02
0.00E+00
-1.00E-02
-2.00E-02
-3.00E-02
Acceleration (m/s^2)
0.0
10
20
t(sec)
90°-270° HORIZONTAL RESPONSE

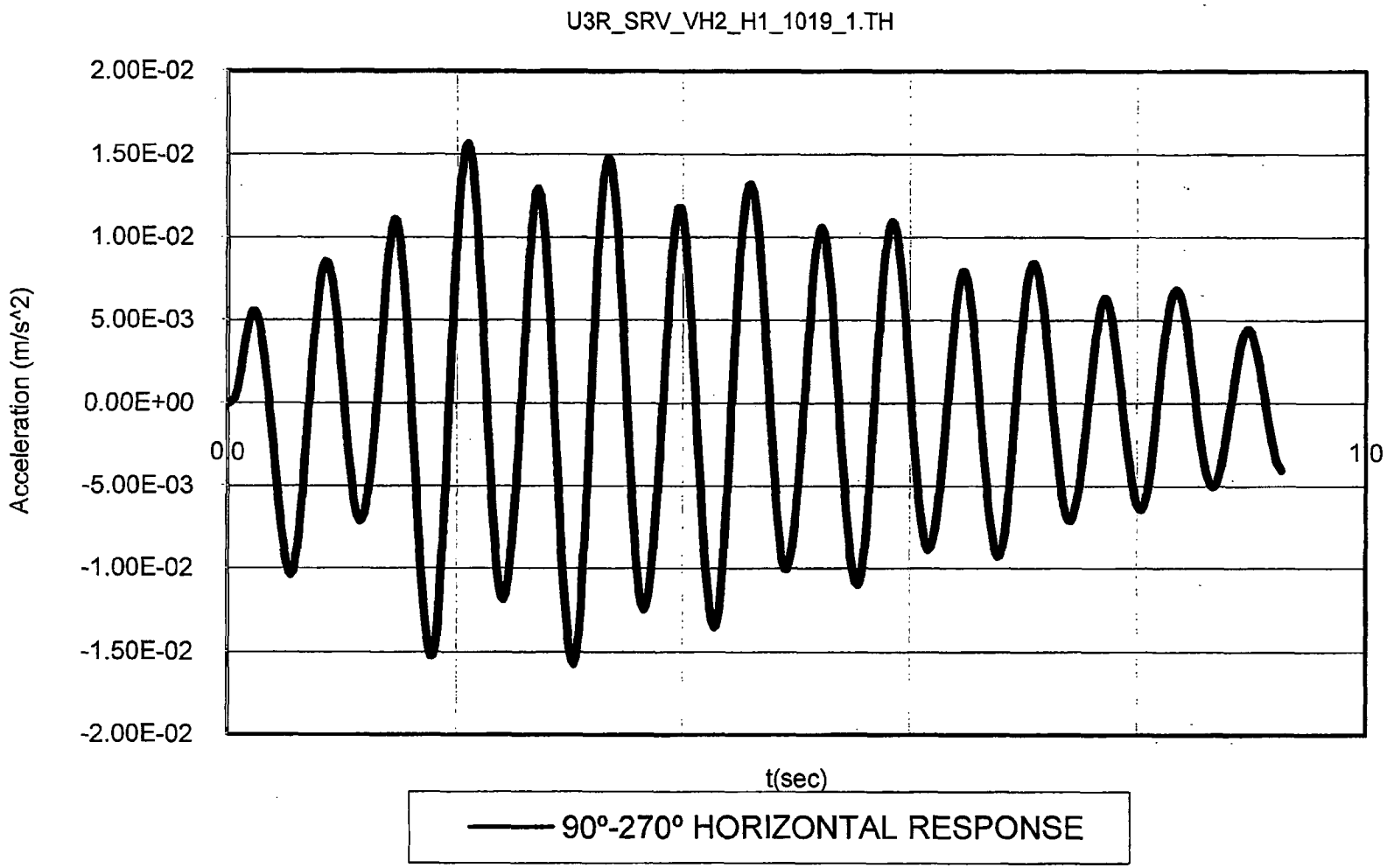

U3R_SRV_VH1_H1_1119_1.TH
3.50E-01
3.00E-01
2.50E-01
2.00E-01
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
-1.50E-01
-2.00E-01
Acceleration (m/s^2)
0.0
10
20
t(sec)
0º-180º HORIZONTAL RESPONSE

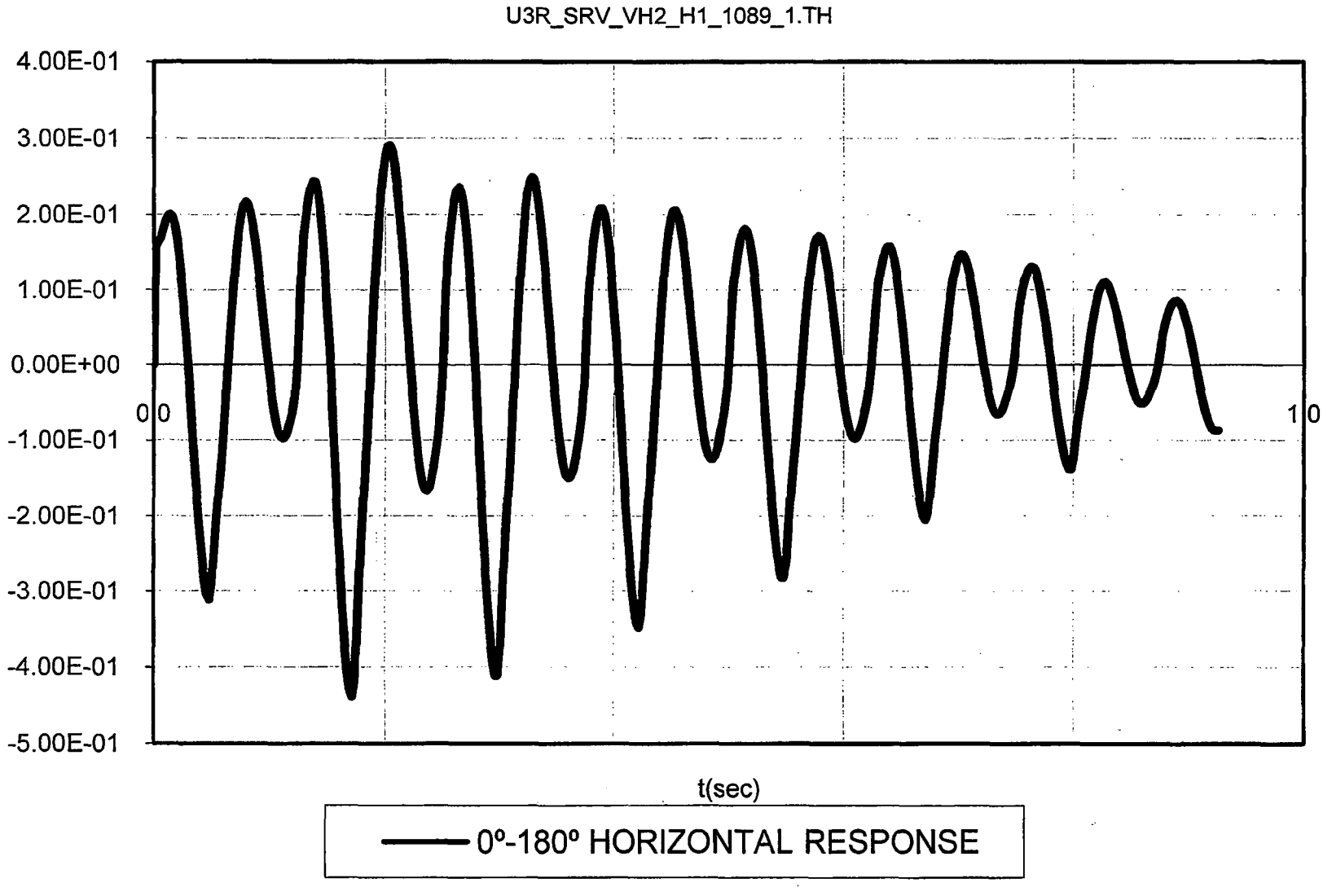

U3R_SRV_VH1_H1_1119_1.TH
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
-2.00E-02
-4.00E-02
-6.00E-02
-8.00E-02
Acceleration (m/s^2)
0
10
20
t(sec)
VERTICAL RESPONSE

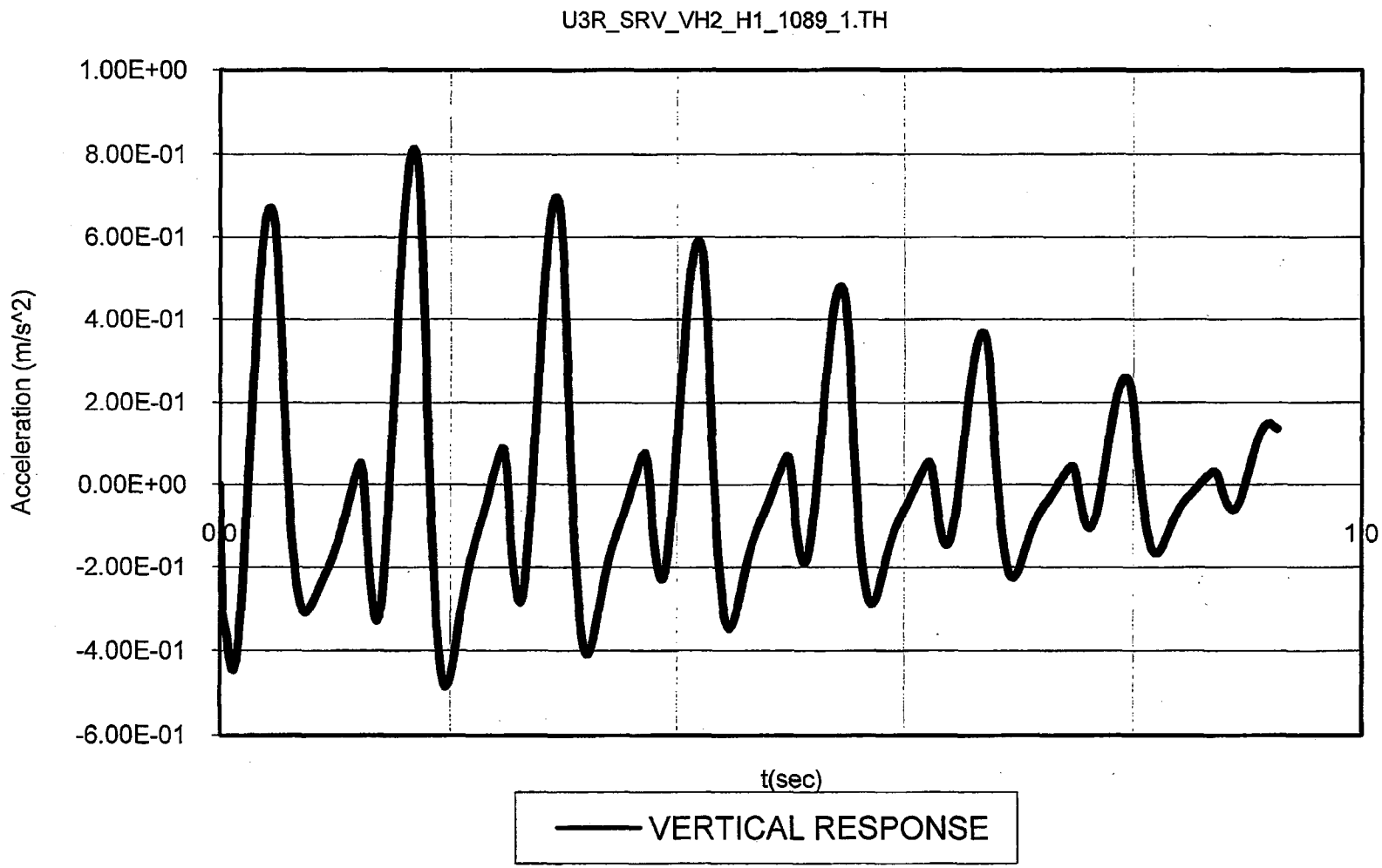

U3R_SRV_VH1_H1_1119_1.TH
4.00E-02
3.00E-02
2.00E-02
1.00E-02
0.00E+00
-1.00E-02
-2.00E-02
-3.00E-02
Acceleration (m/s^2)
0.0
10
20
t(sec)
90°-270° HORIZONTAL RESPONSE

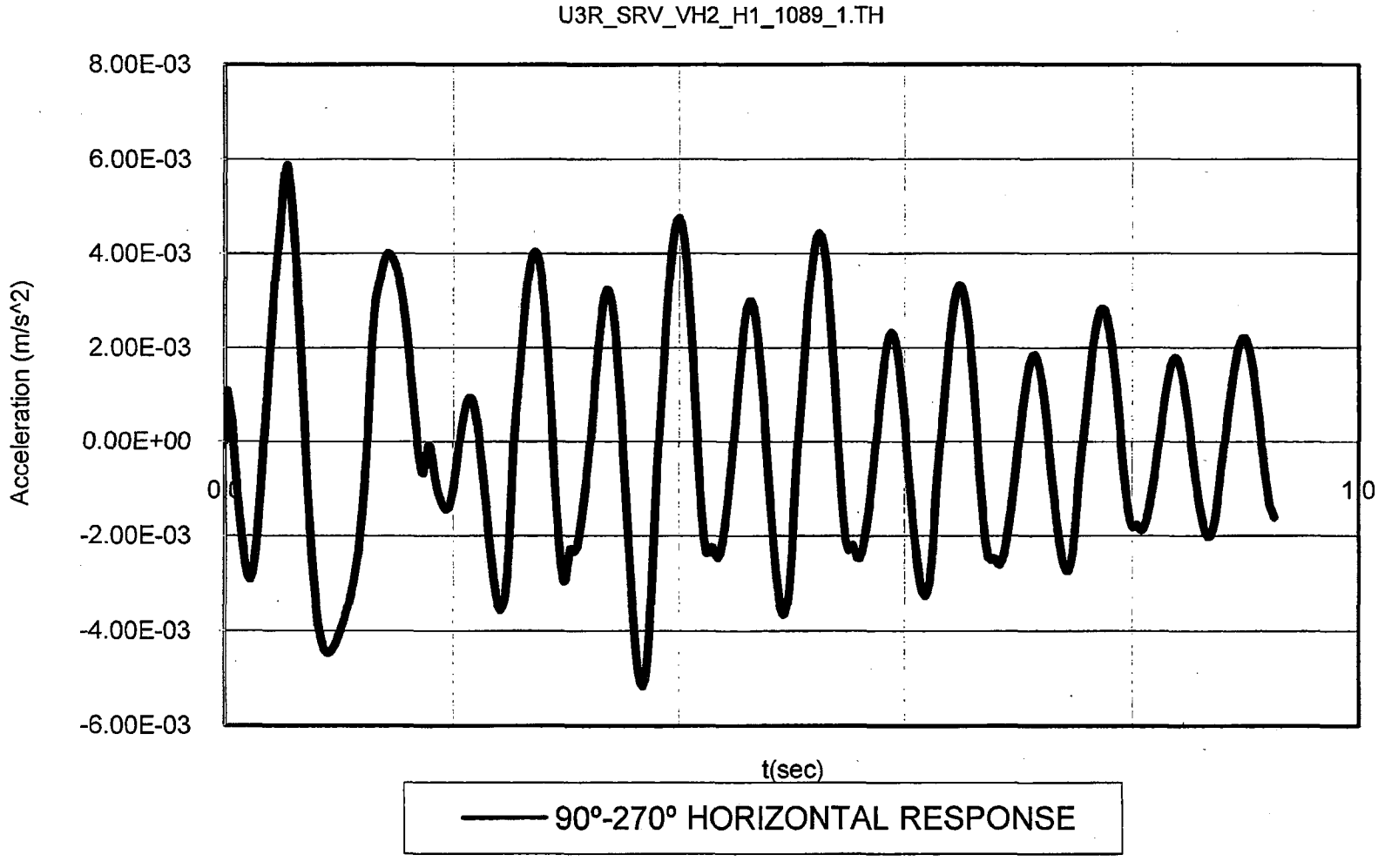

U3R_SRV_VH2_H1_1019_1.TH
2.50E-01
2.00E-01
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
-1.50E-01
-2.00E-01
-2.50E-01
Acceleration (m/s^2)
0
10
t(sec)
0º-180º HORIZONTAL RESPONSE

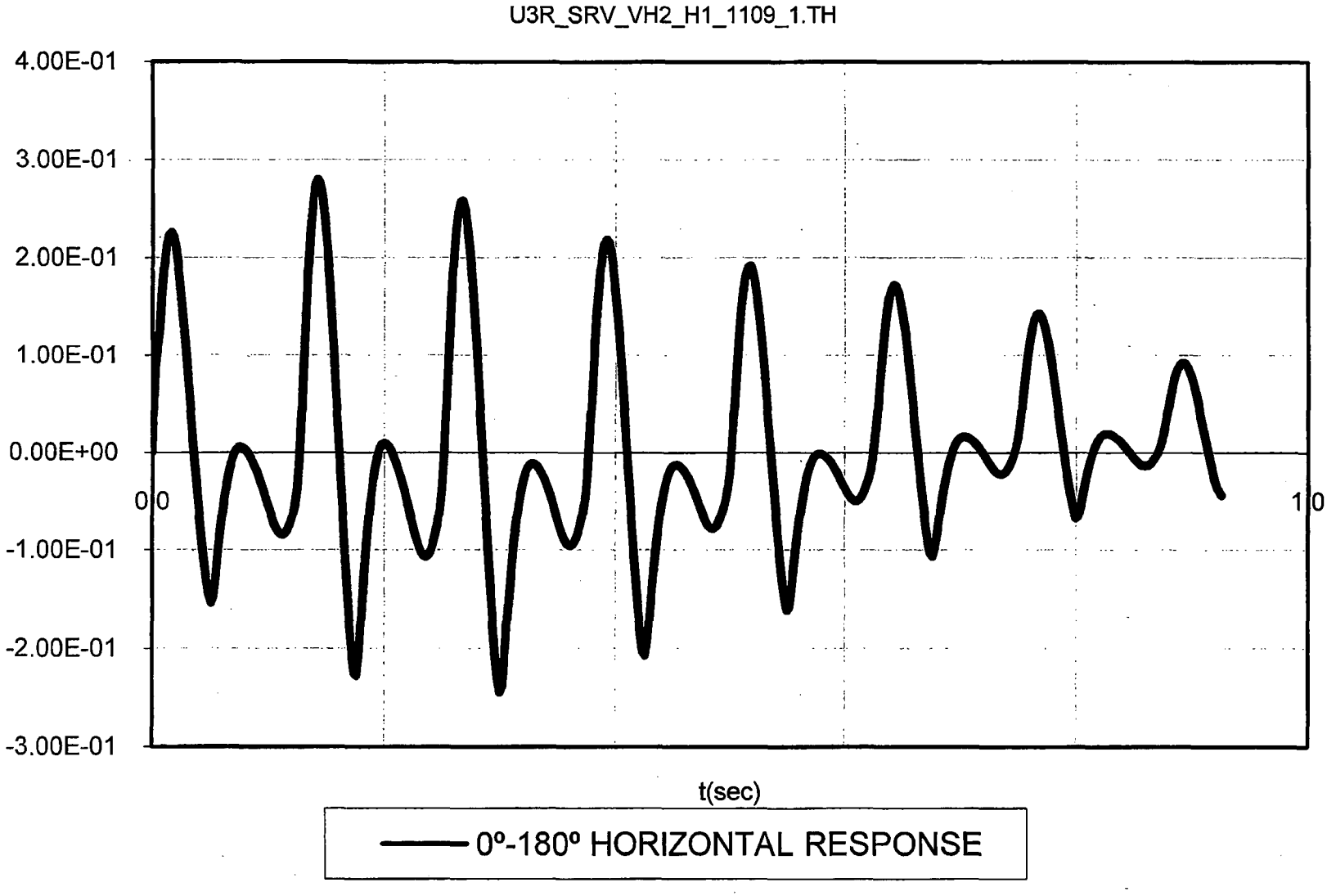

U3R_SRV_VH2_H1_1019_1.TH
1.00E+00
8.00E-01
6.00E-01
4.00E-01
2.00E-01
0.00E+00
-2.00E-01
-4.00E-01
-6.00E-01
-8.00E-01
Acceleration (m/s^2)
0
10
t(sec)
VERTICAL RESPONSE

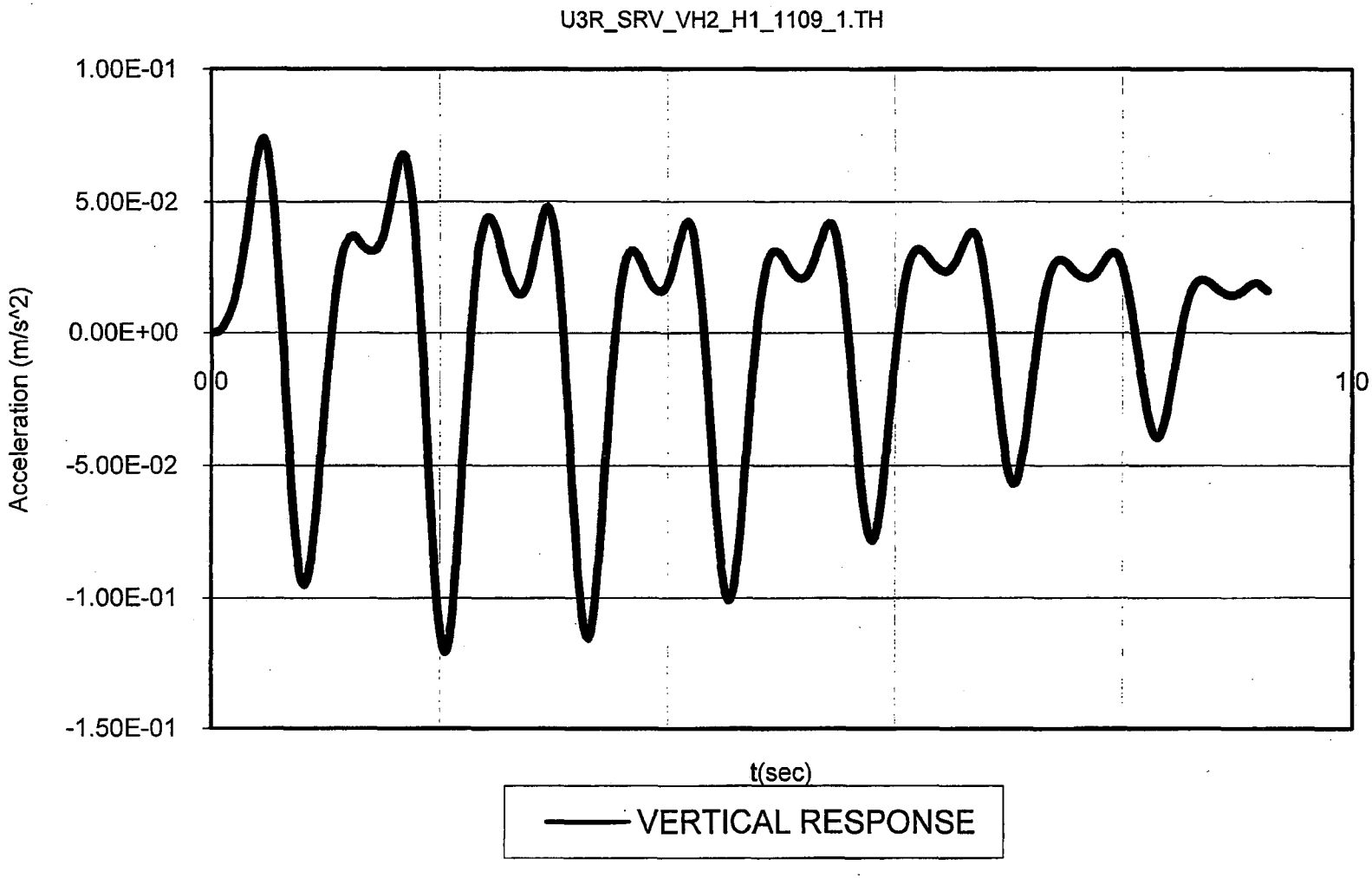

U3R_SRV_VH2_H1_1019_1.TH
2.00E-02
1.50E-02
1.00E-02
5.00E-03
0.00E+00
-5.00E-03
-1.00E-02
-1.50E-02
-2.00E-02
Acceleration (m/s^2)
0
0
10
t(sec)
90°-270° HORIZONTAL RESPONSE

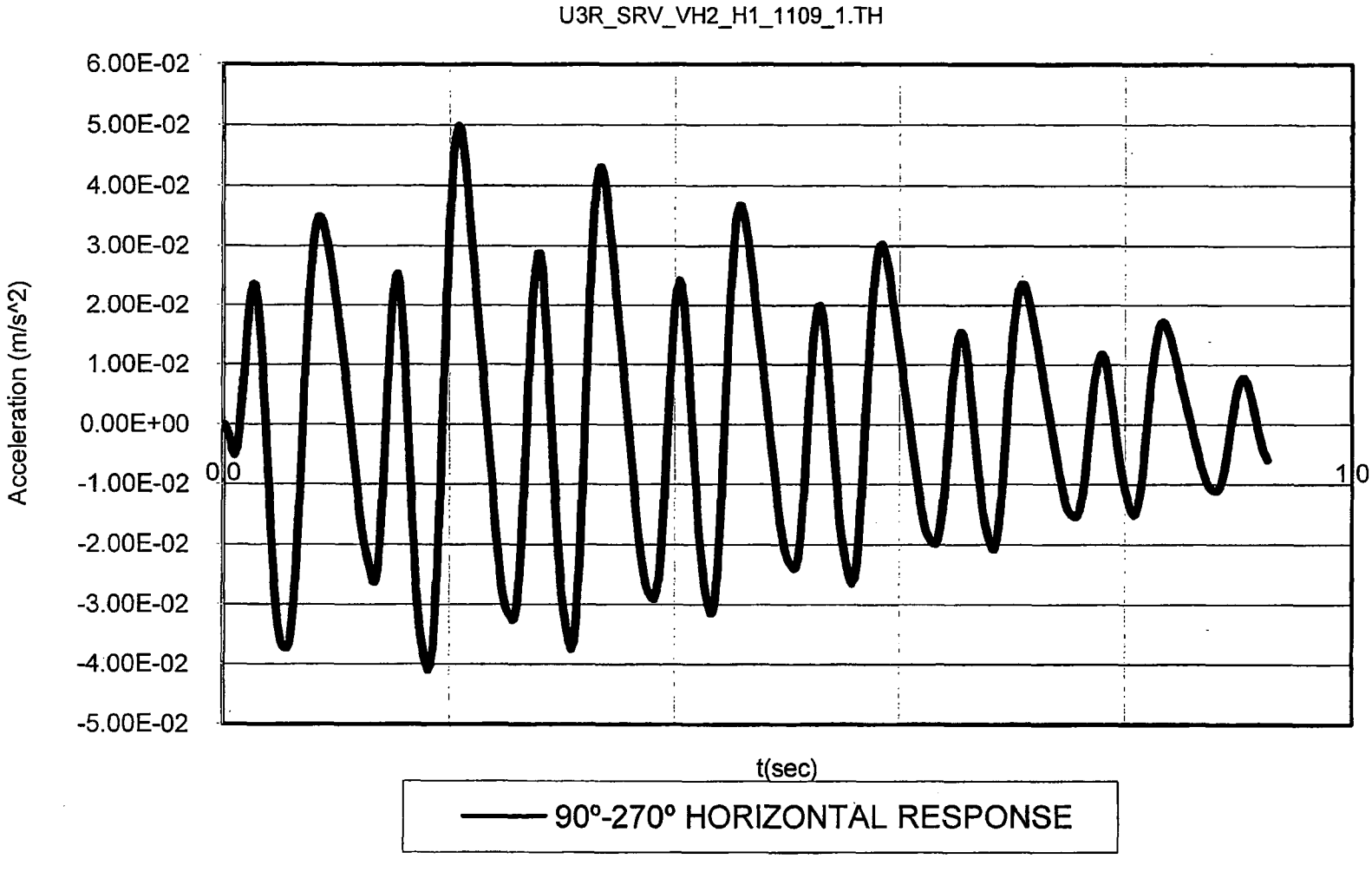

U3R_SRV_VH2_H1_1089_1.TH
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
-4.00E-01
-5.00E-01
0.0
1.0
Acceleration (m/s^2)
t(sec)
0°-180° HORIZONTAL RESPONSE

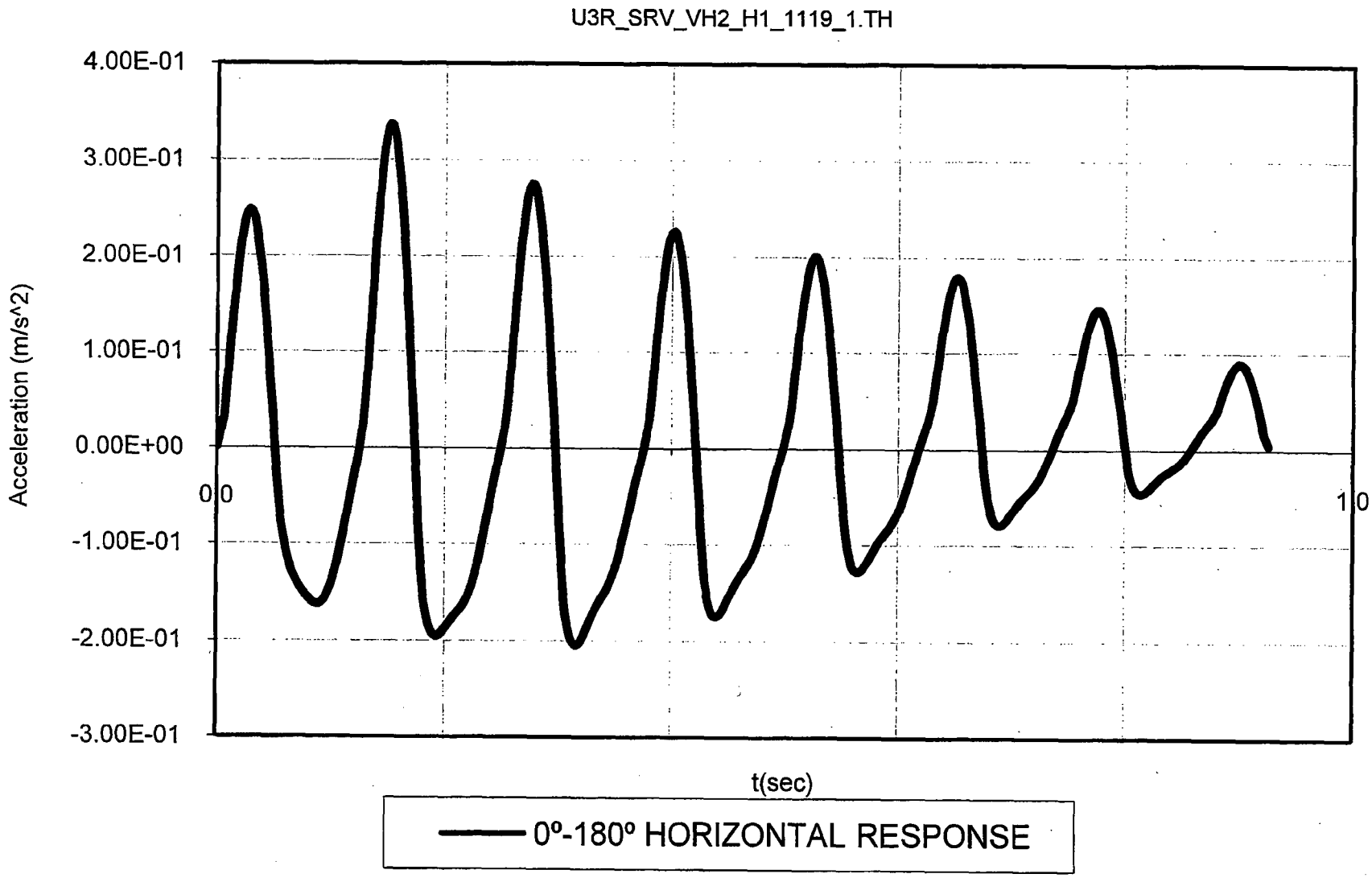

U3R_SRV_VH2_H1_1089_1.TH
1.00E+00
8.00E-01
6.00E-01
4.00E-01
2.00E-01
0.00E+00
-2.00E-01
-4.00E-01
-6.00E-01
Acceleration (m/s^2)
0.0
1.0
t(sec)
VERTICAL RESPONSE

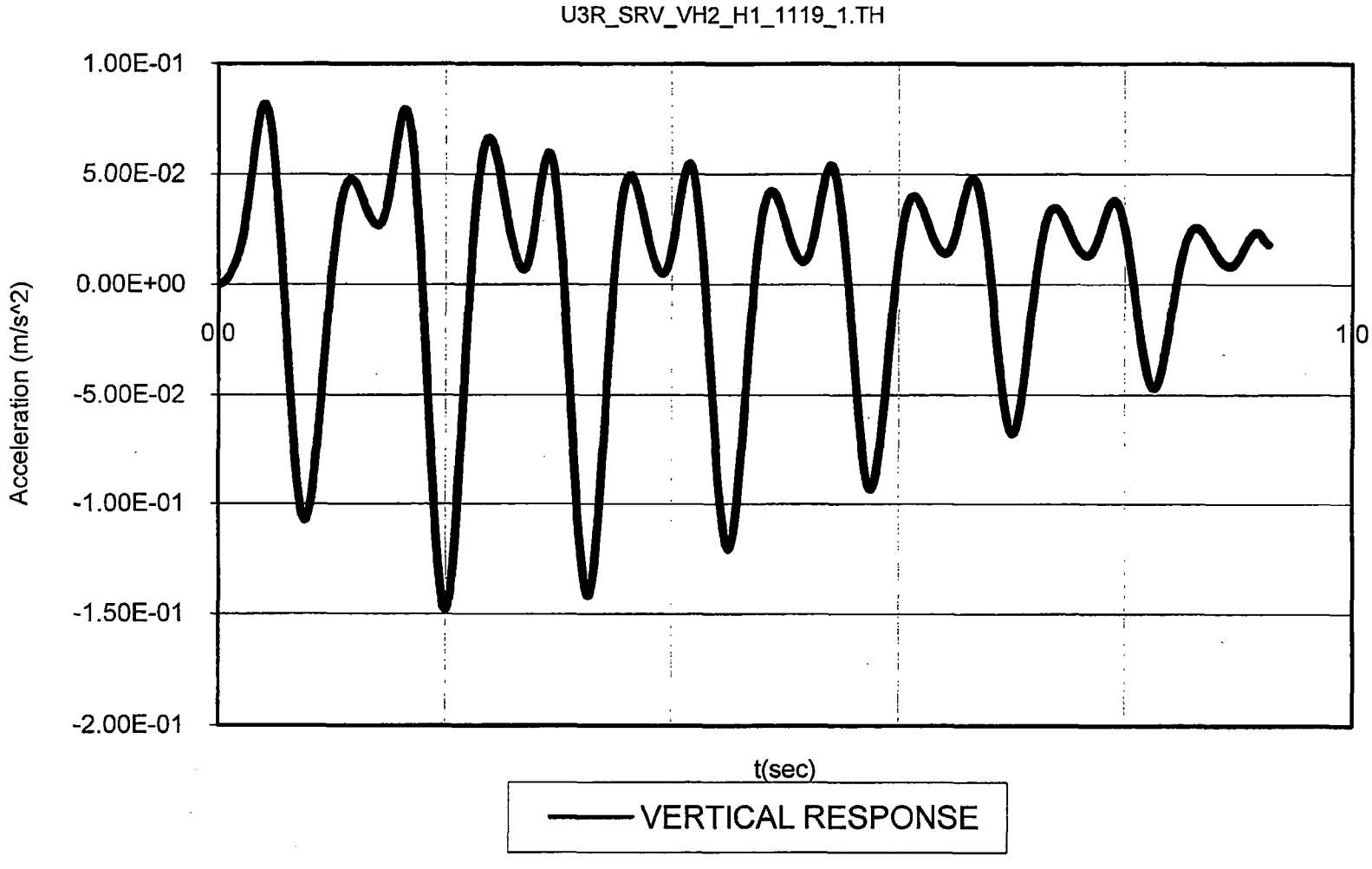

U3R_SRV_VH2_H1_1089_1.TH
8.00E-03
6.00E-03
4.00E-03
2.00E-03
0.00E+00
-2.00E-03
-4.00E-03
-6.00E-03
Acceleration (m/s^2)
0
10
t(sec)
90°-270° HORIZONTAL RESPONSE

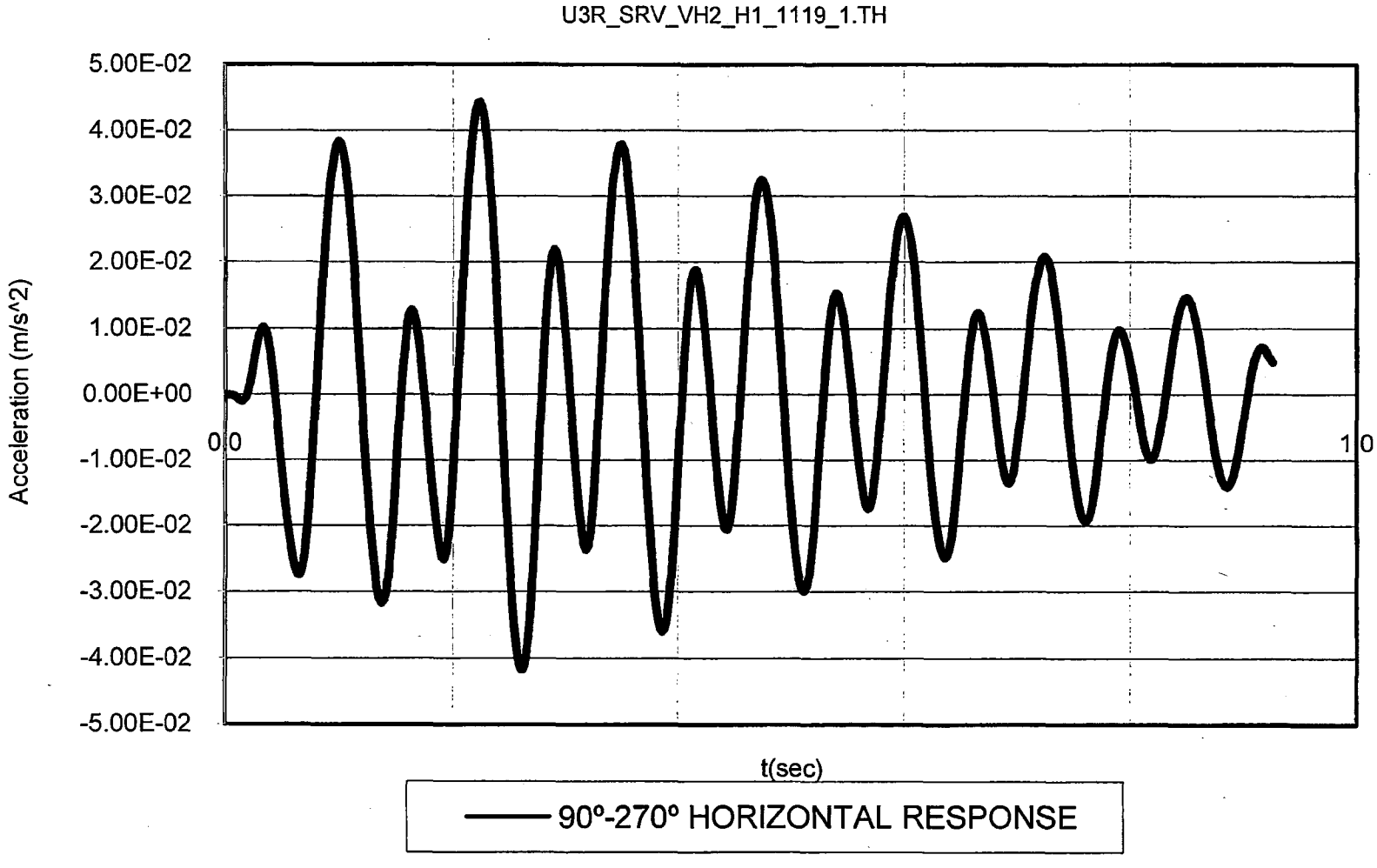

U3R_SRV_VH2_H1_1109_1.TH
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
Acceleration (m/s^2)
0
0
1
0
t(sec)
0º-180º HORIZONTAL RESPONSE

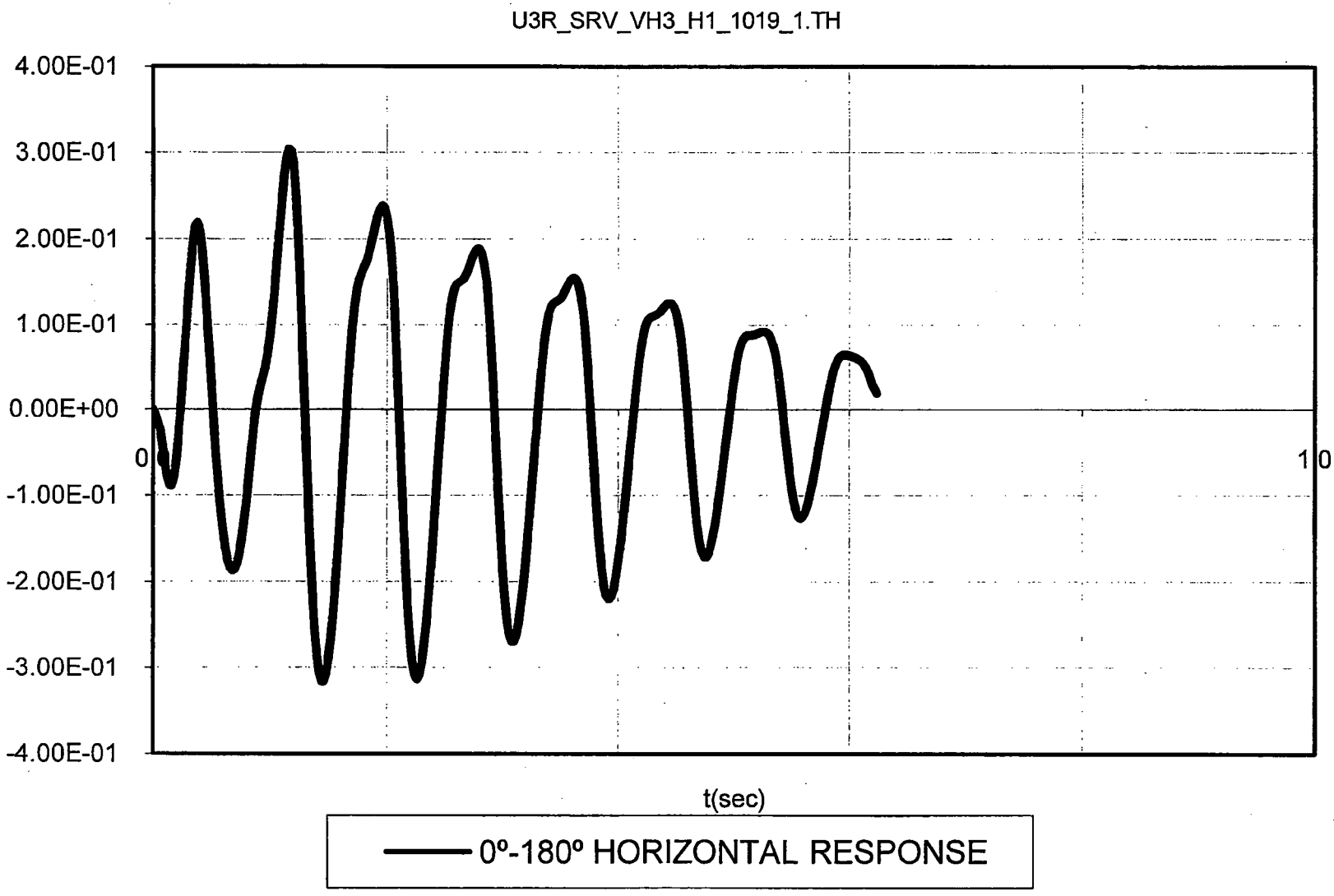

U3R_SRV_VH2_H1_1109_1.TH
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
-1.50E-01
Acceleration (m/s^2)
0.0
10
t(sec)
VERTICAL RESPONSE

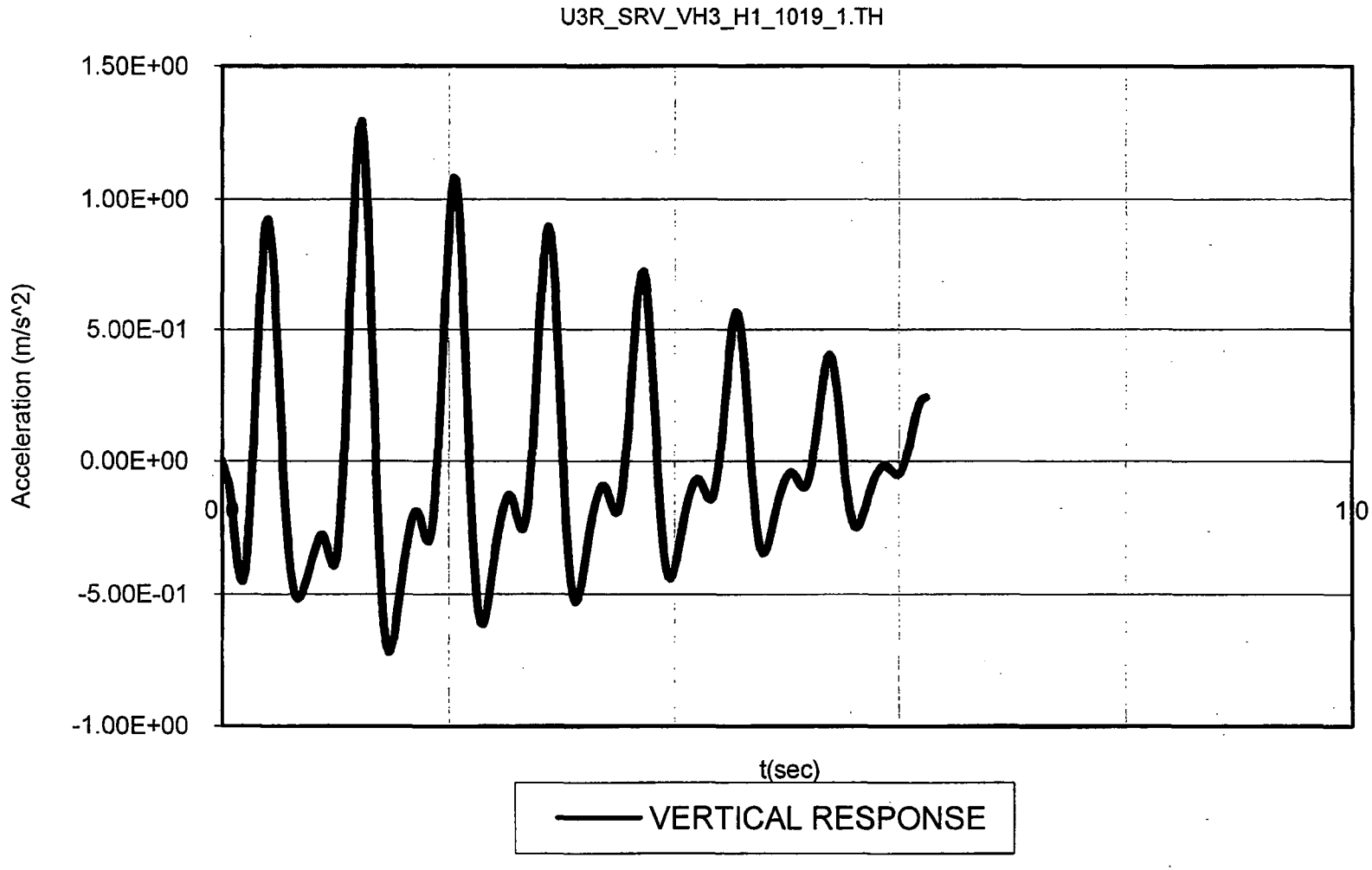

U3R_SRV_VH2_H1_1109_1.TH
6.00E-02
5.00E-02
4.00E-02
3.00E-02
2.00E-02
1.00E-02
0.00E+00
-1.00E-02
-2.00E-02
-3.00E-02
-4.00E-02
-5.00E-02
Acceleration (m/s^2)
0.0
1.0
t(sec)
90°-270° HORIZONTAL RESPONSE

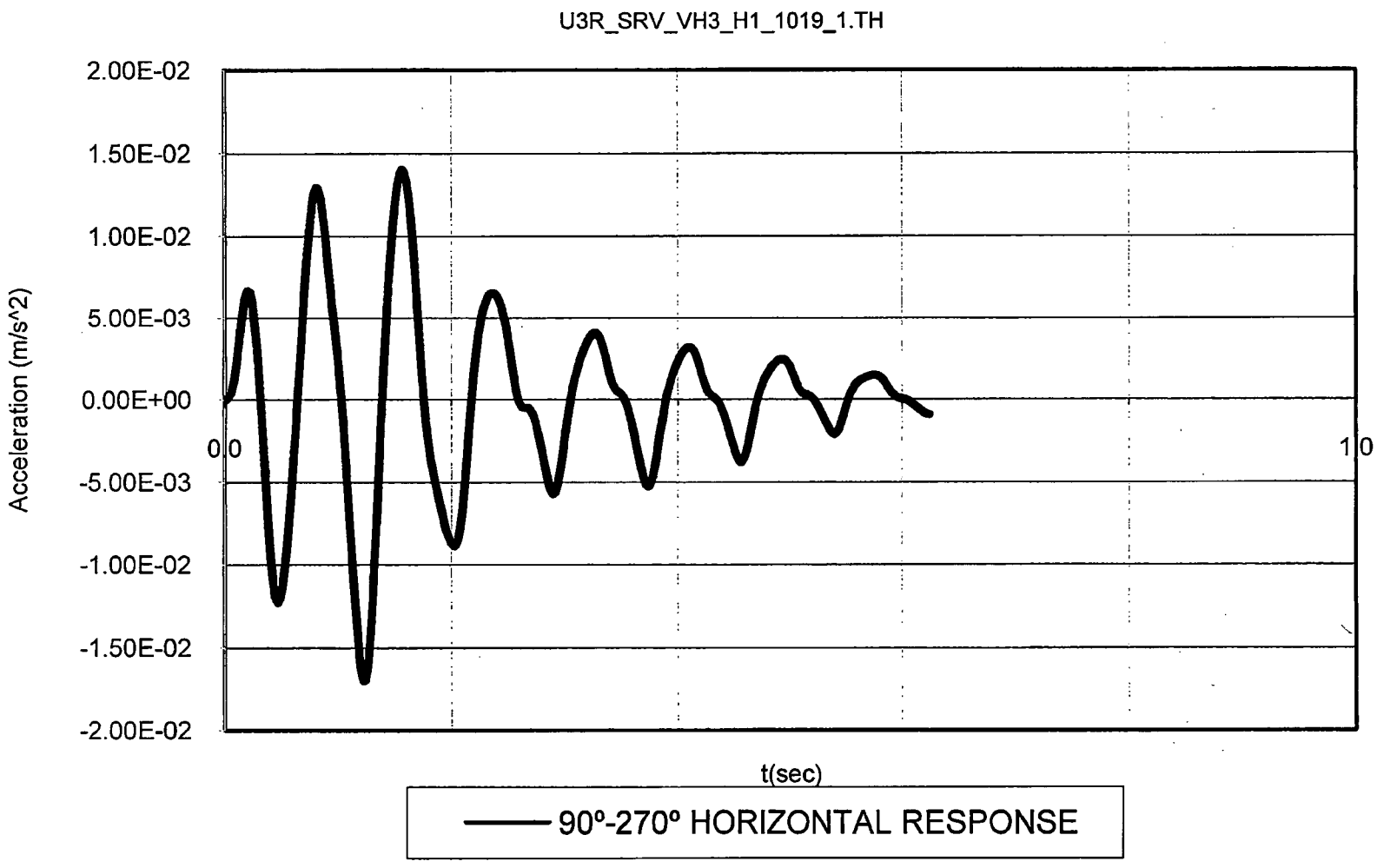

U3R_SRV_VH2_H1_1119_1.TH
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
Acceleration (m/s^2)
0
0
10
t(sec)
0º-180º HORIZONTAL RESPONSE

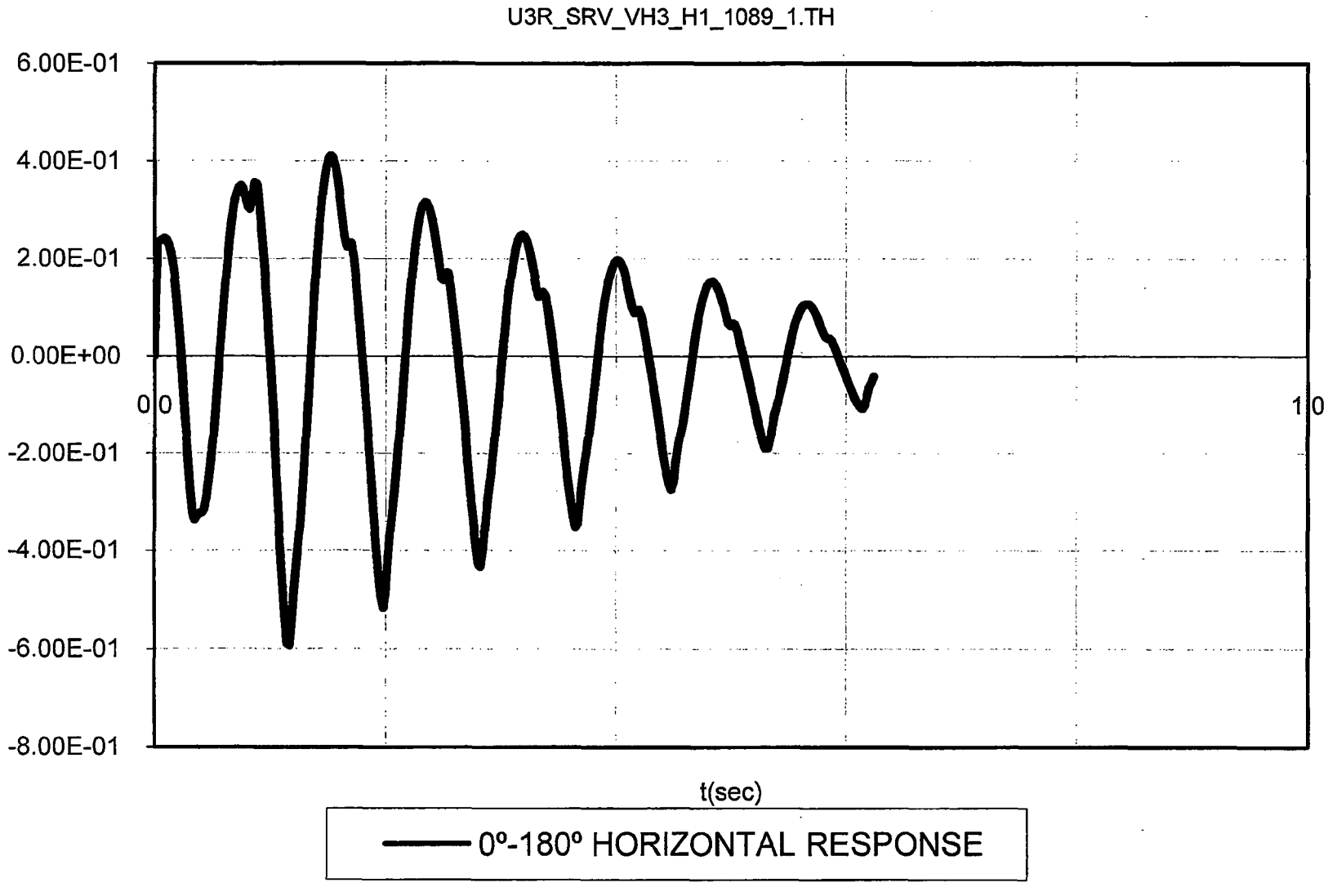

U3R_SRV_VH2_H1_1119_1.TH
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
-1.50E-01
-2.00E-01
Acceleration (m/s^2)
0.0
1.0
t(sec)
VERTICAL RESPONSE

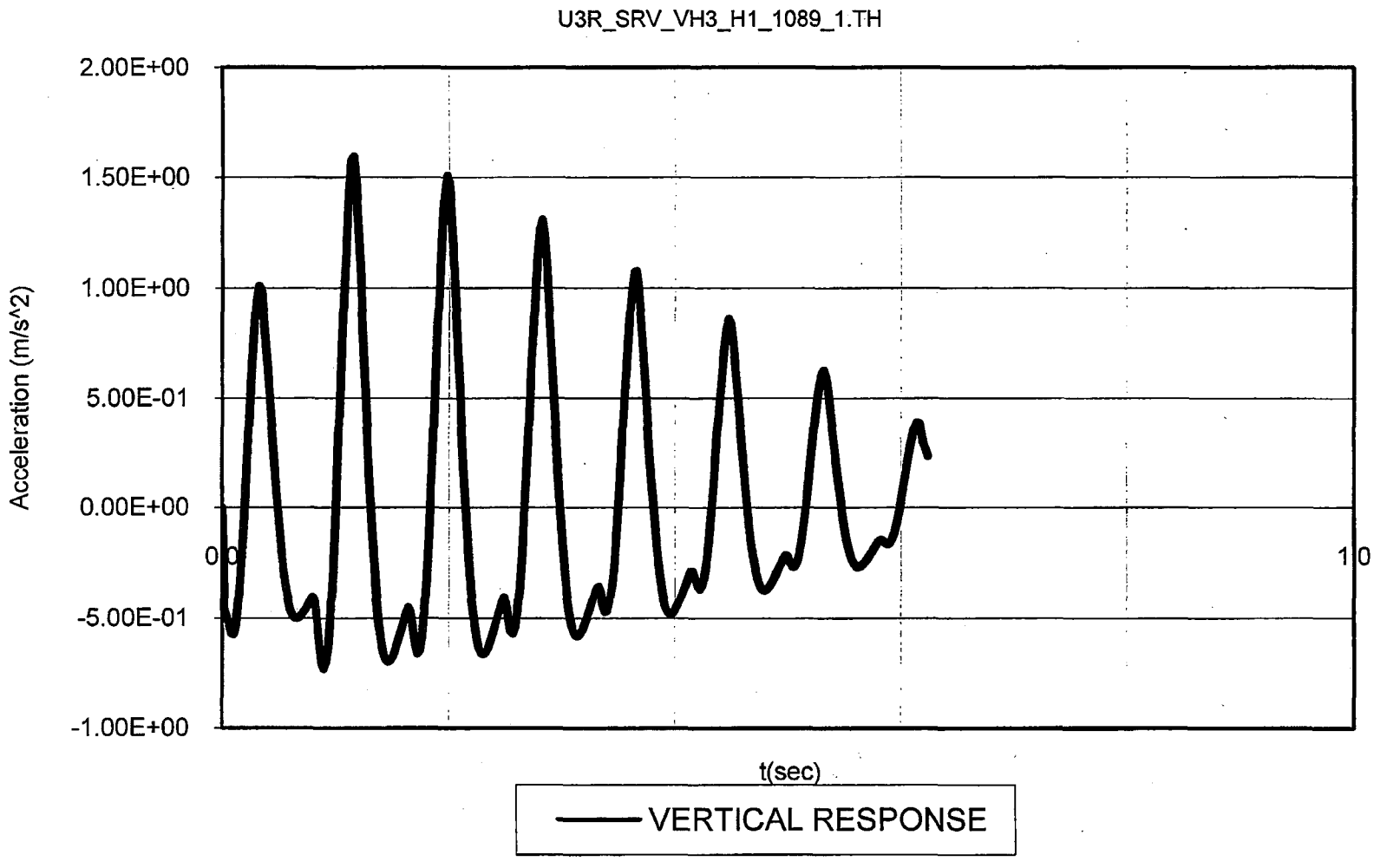

U3R_SRV_VH2_H1_1119_1.TH
5.00E-02
4.00E-02
3.00E-02
2.00E-02
1.00E-02
0.00E+00
-1.00E-02
-2.00E-02
-3.00E-02
-4.00E-02
-5.00E-02
Acceleration (m/s^2)
0.0
1.0
t(sec)
90°-270° HORIZONTAL RESPONSE

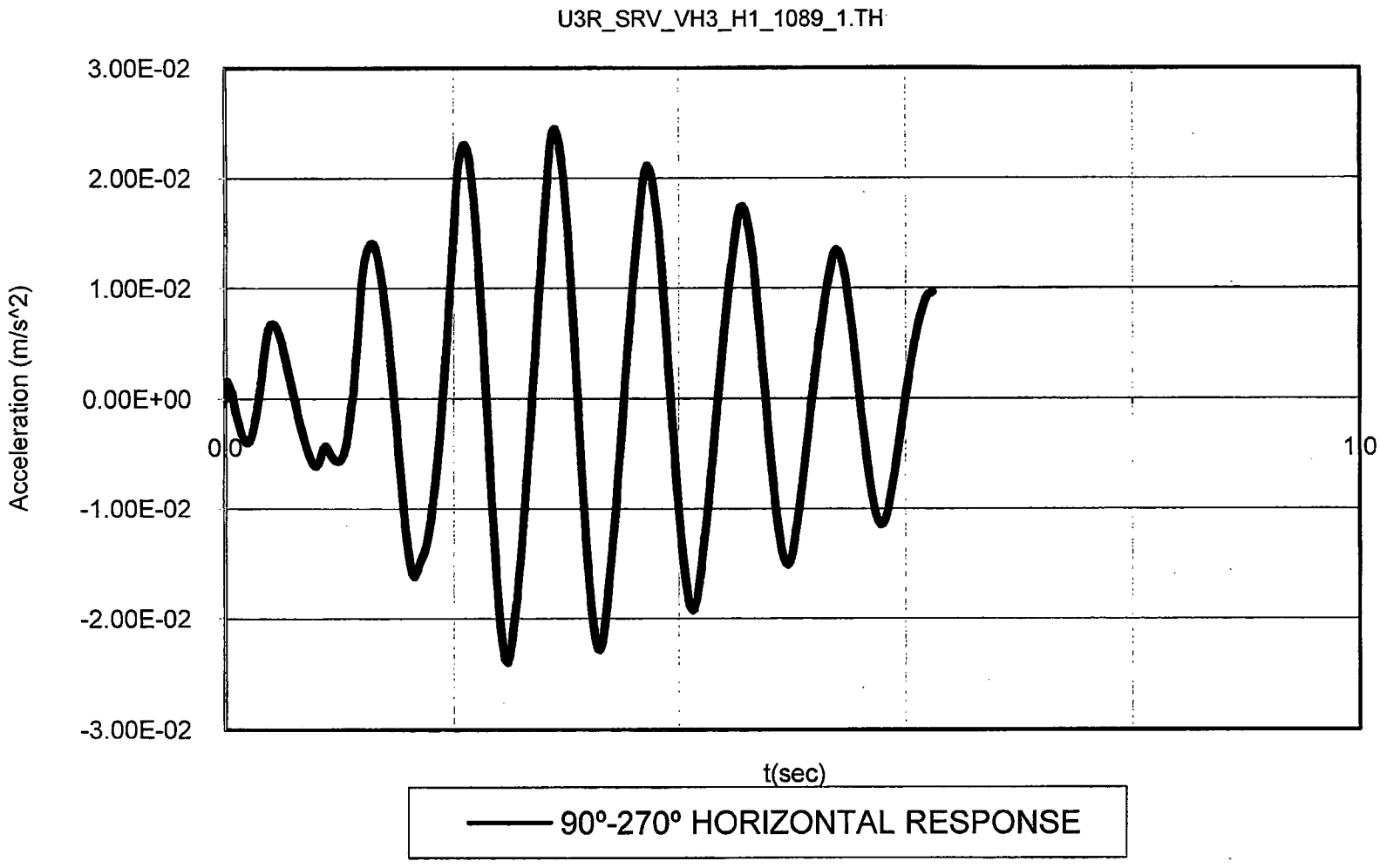

U3R_SRV_VH3_H1_1019_1.TH
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
-4.00E-01
0
10
Acceleration (m/s^2)
t(sec)
0°-180° HORIZONTAL RESPONSE

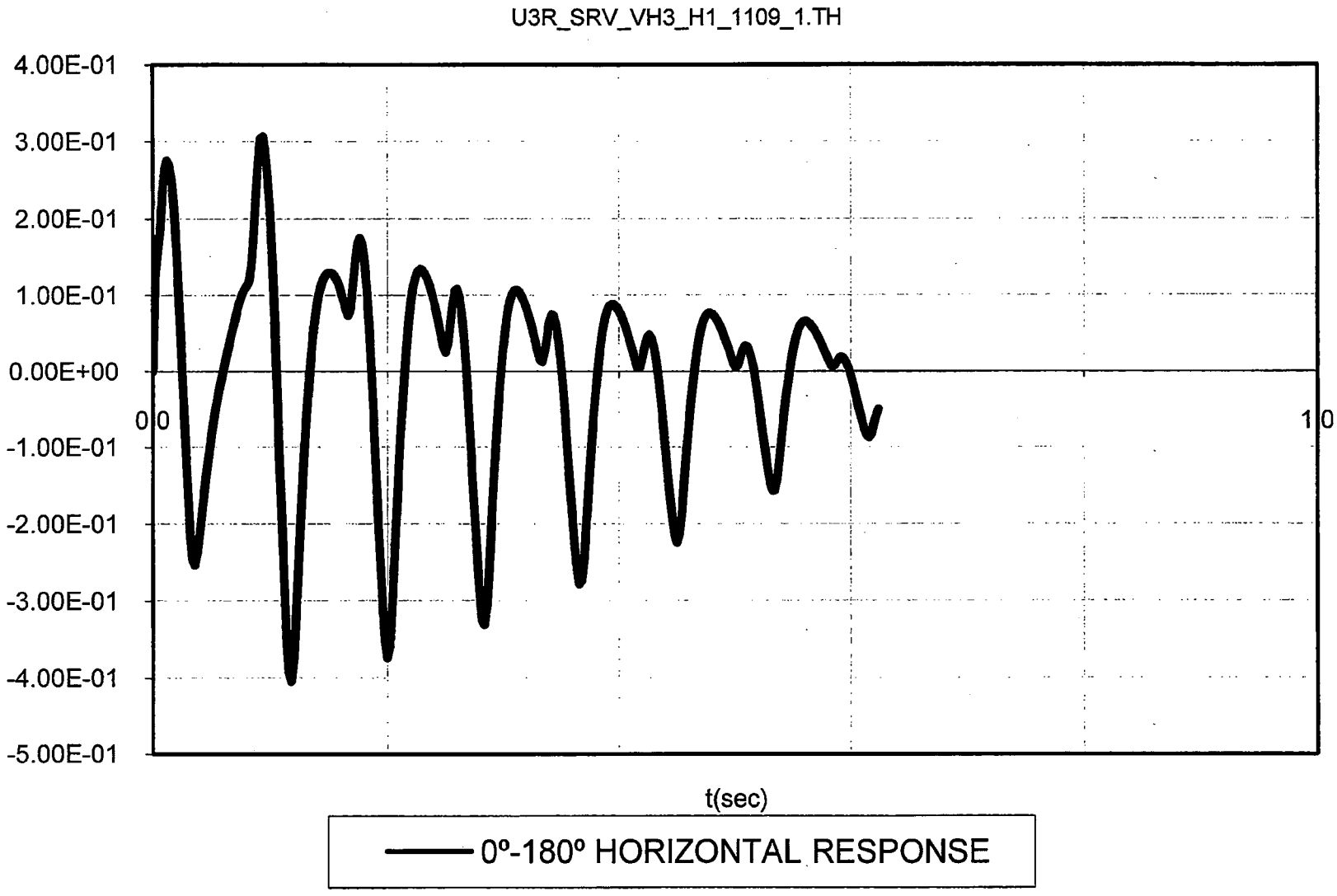

U3R_SRV_VH3_H1_1019_1.TH
1.50E+00
1.00E+00
5.00E-01
0.00E+00
-5.00E-01
-1.00E+00
Acceleration (m/s^2)
0
10
t(sec)
VERTICAL RESPONSE

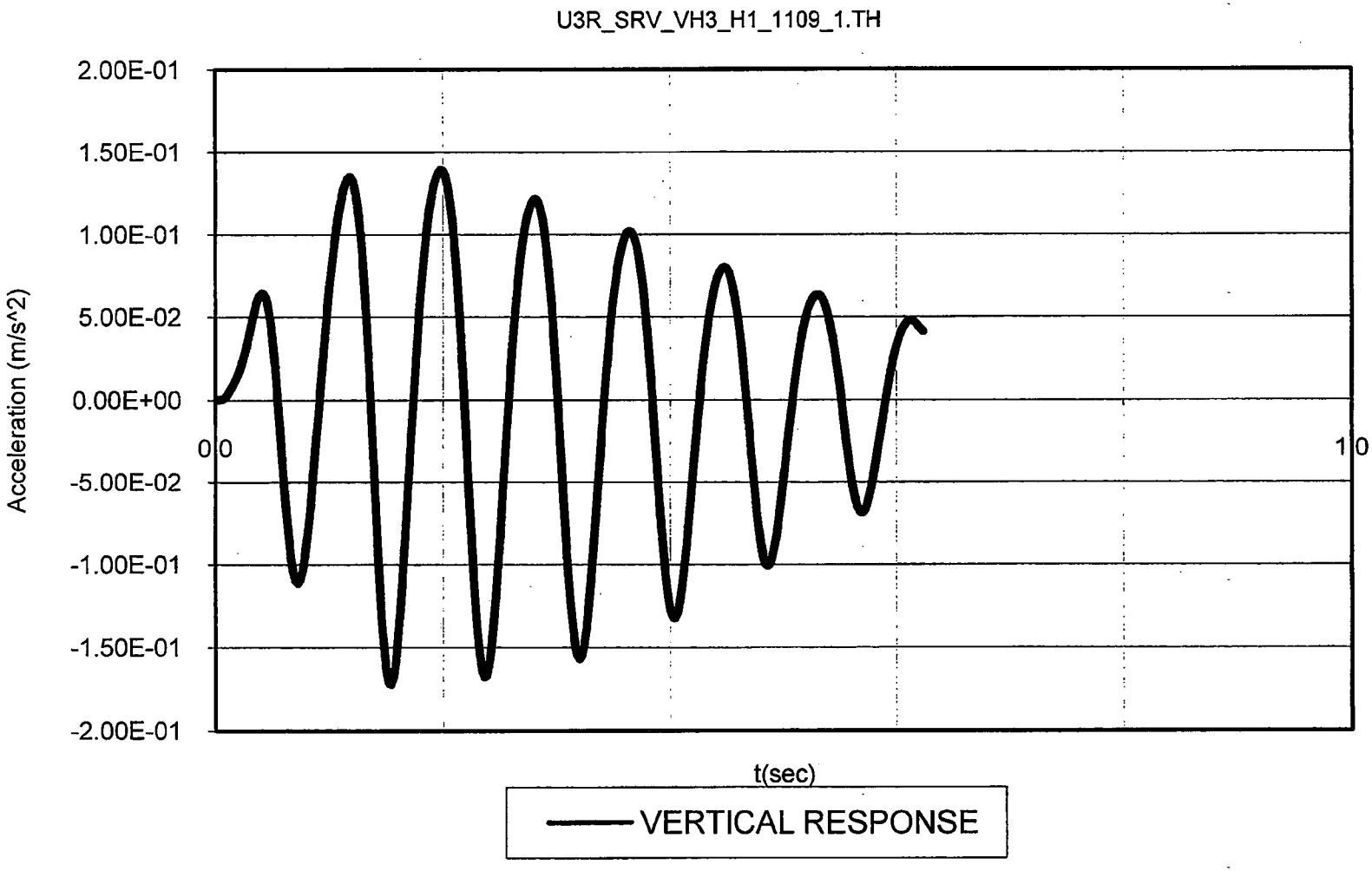

U3R_SRV_VH3_H1_1019_1.TH
2.00E-02
1.50E-02
1.00E-02
5.00E-03
0.00E+00
-5.00E-03
-1.00E-02
-1.50E-02
-2.00E-02
Acceleration (m/s^2)
0.0
1.0
t(sec)
90°-270° HORIZONTAL RESPONSE

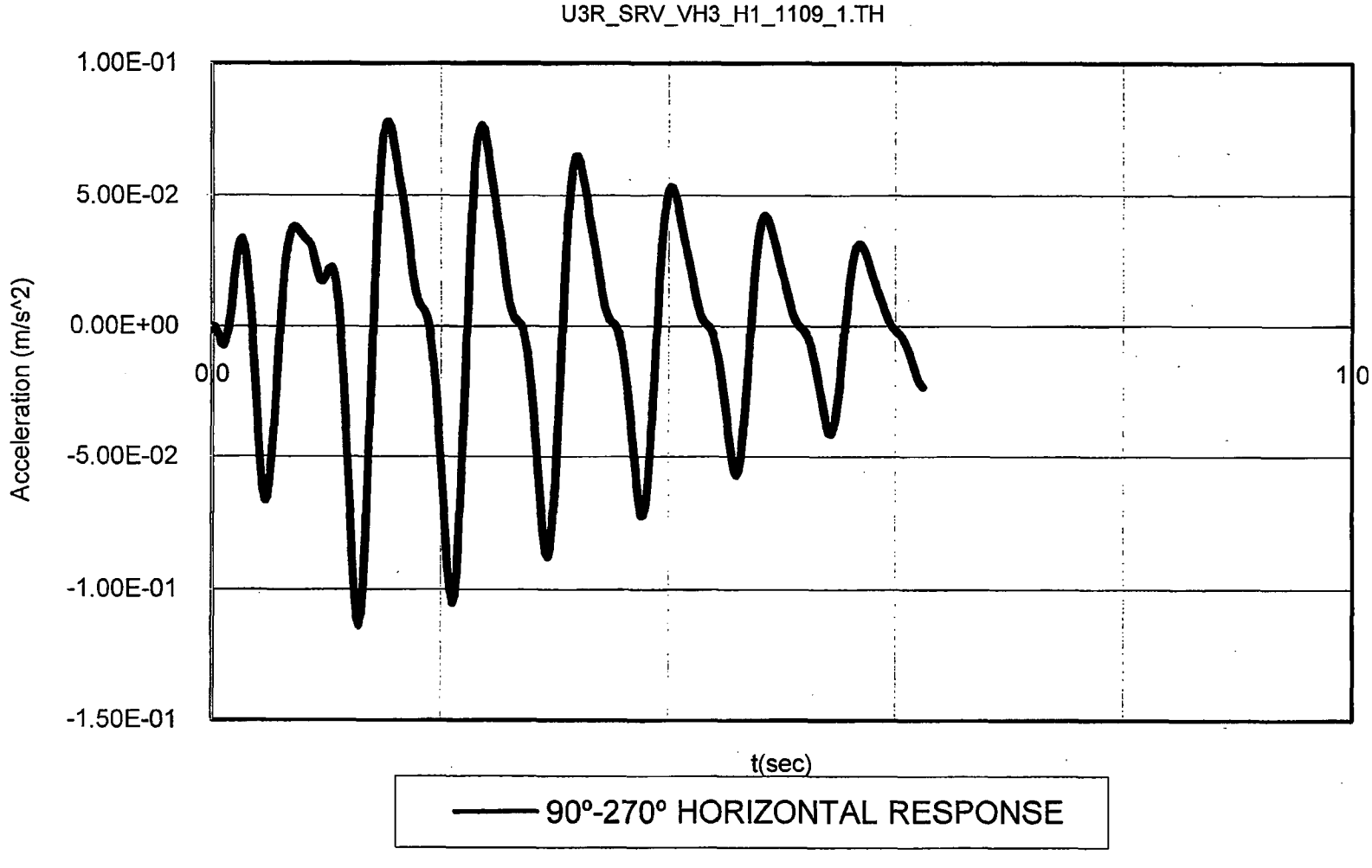

U3R_SRV_VH3_H1_1089_1.TH
6.00E-01
4.00E-01
2.00E-01
0.00E+00
-2.00E-01
-4.00E-01
-6.00E-01
-8.00E-01
Acceleration (m/s^2)
0
0
1
0
t(sec)
0º-180º HORIZONTAL RESPONSE

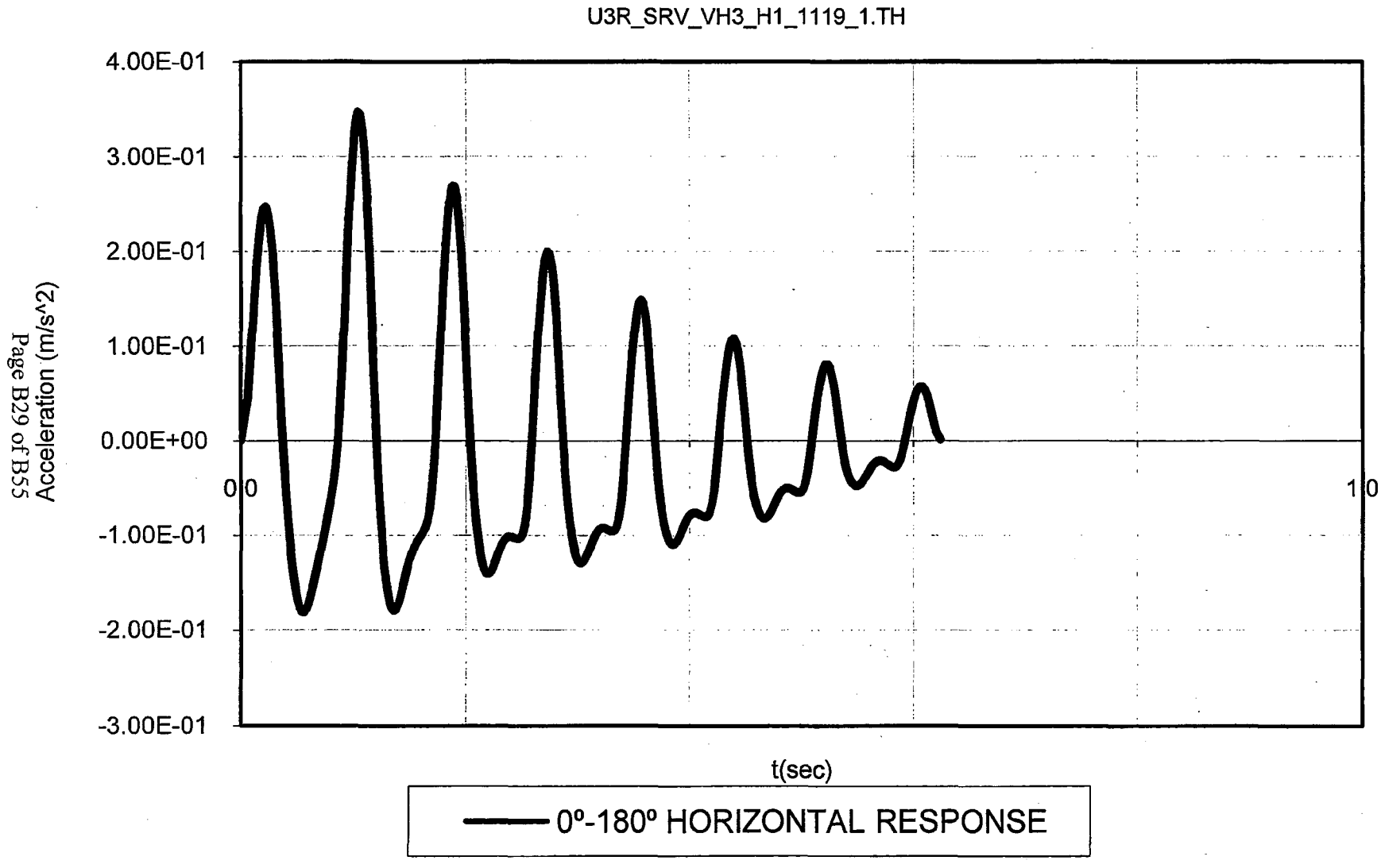

U3R_SRV_VH3_H1_1089_1.TH
2.00E+00
1.50E+00
1.00E+00
5.00E-01
0.00E+00
-5.00E-01
-1.00E+00
Acceleration (m/s^2)
0.0
1.0
t(sec)
VERTICAL RESPONSE

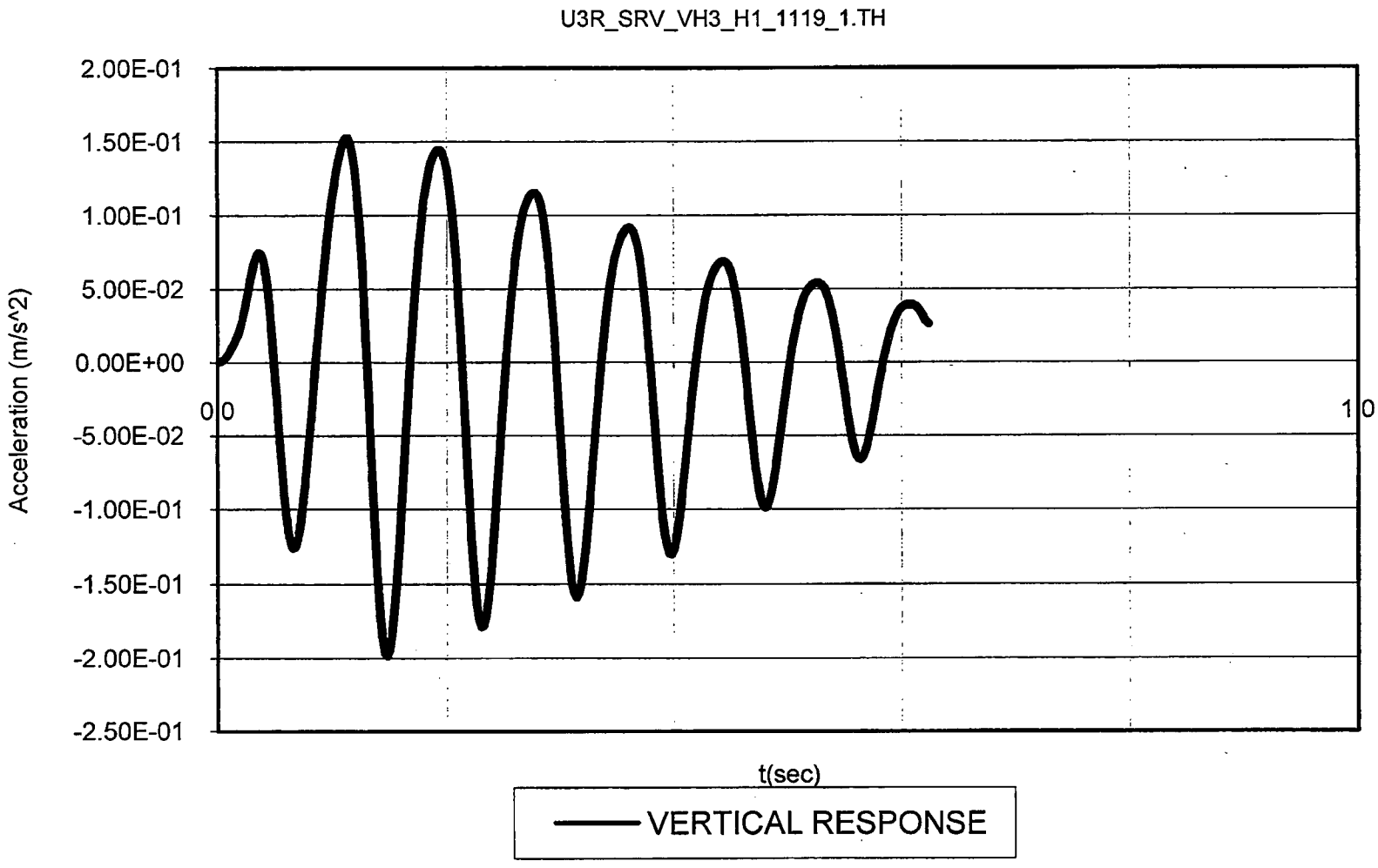

U3R_SRV_VH3_H1_1089_1.TH
3.00E-02
2.00E-02
1.00E-02
0.00E+00
-1.00E-02
-2.00E-02
-3.00E-02
Acceleration (m/s^2)
0.0
1.0
t(sec)
90°-270° HORIZONTAL RESPONSE

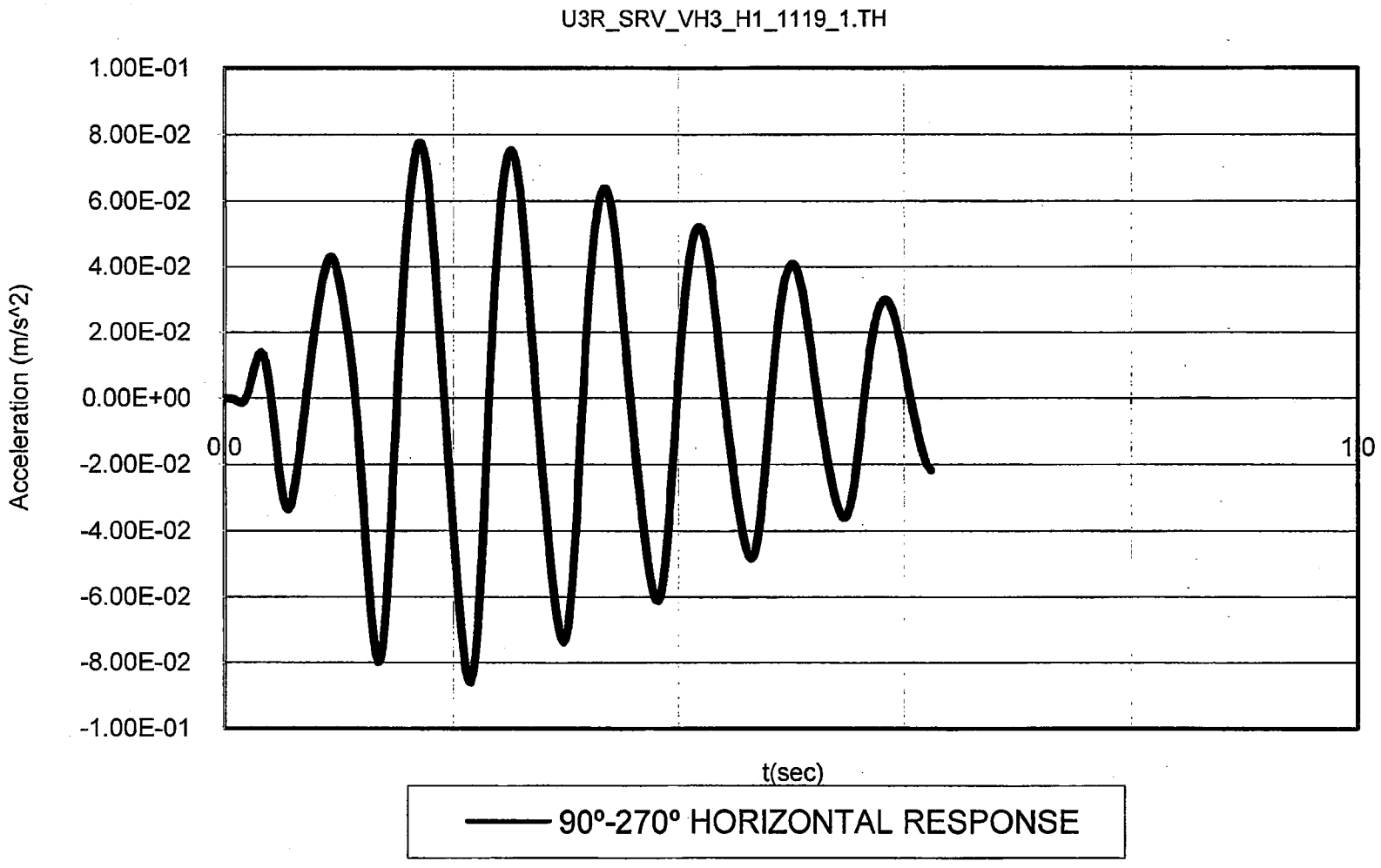

U3R_SRV_VH3_H1_1109_1.TH
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
-4.00E-01
-5.00E-01
Acceleration (m/s^2)
0
0
1
0
t(sec)
0º-180º HORIZONTAL RESPONSE

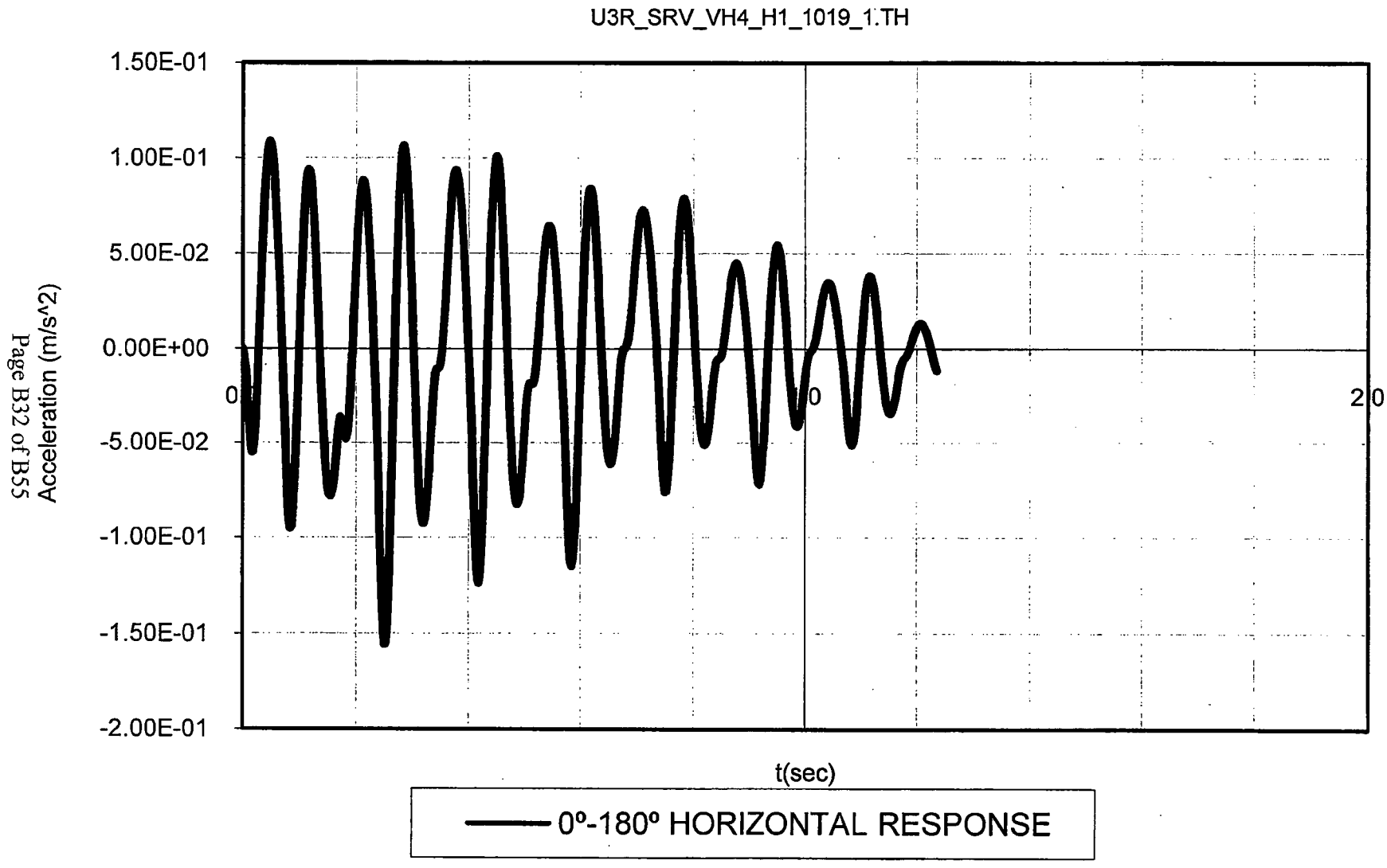

U3R_SRV_VH3_H1_1109_1.TH
2.00E-01
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
-1.50E-01
-2.00E-01
Acceleration (m/s^2)
0.0
1.0
t(sec)
VERTICAL RESPONSE

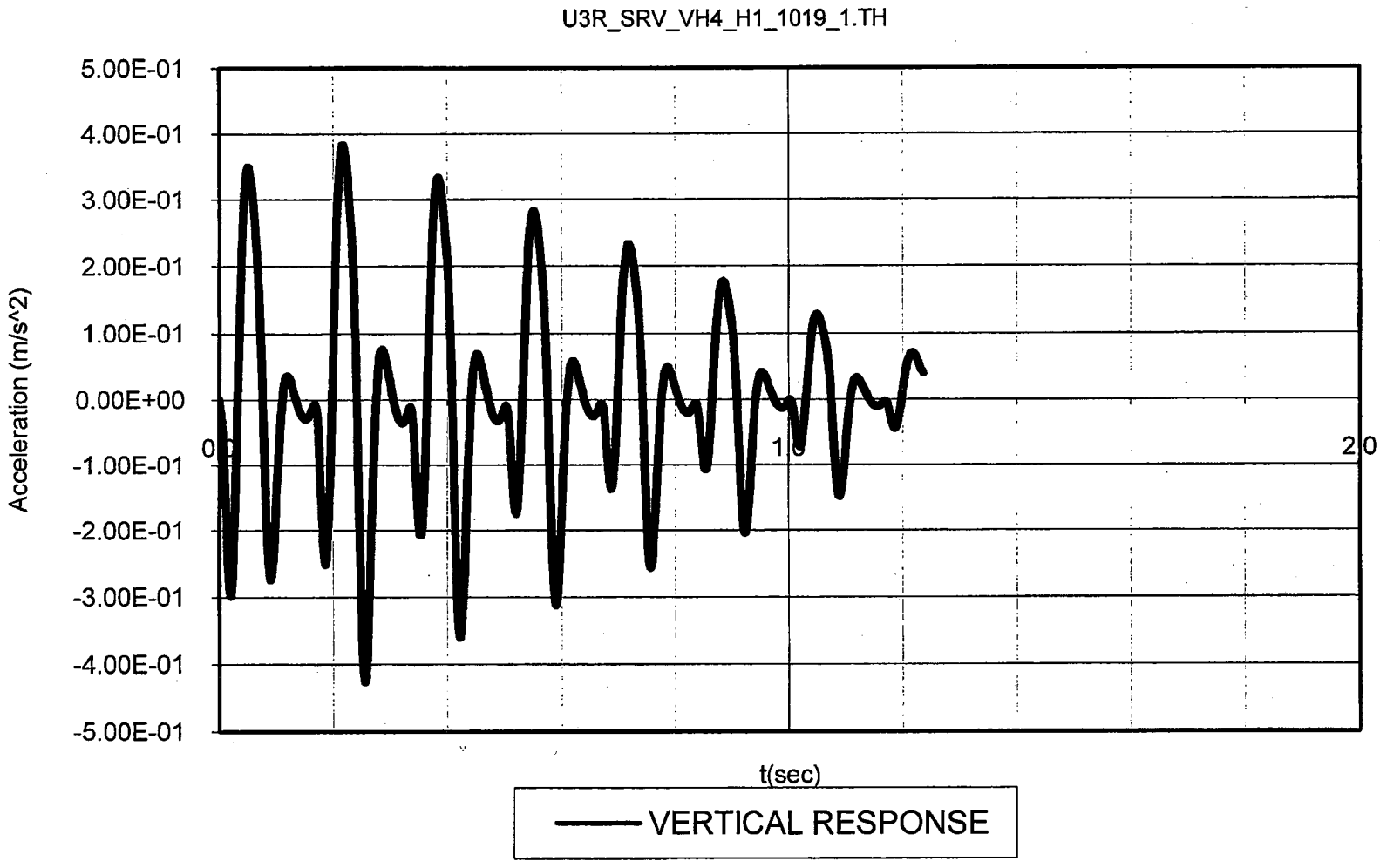

U3R_SRV_VH3_H1_1109_1.TH
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
-1.50E-01
Acceleration (m/s^2)
0
0
1
0
t(sec)
90°-270° HORIZONTAL RESPONSE

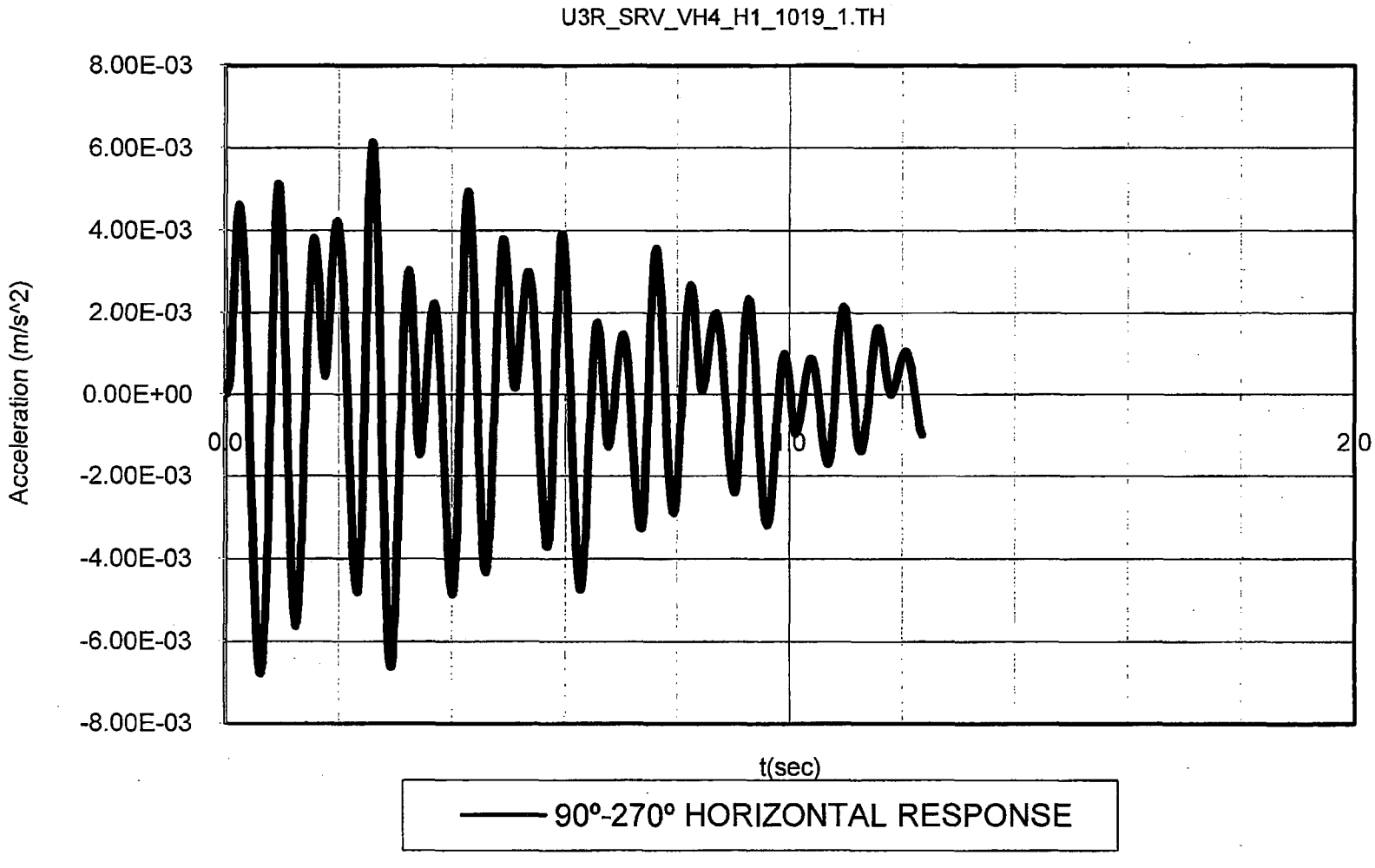

U3R_SRV_VH3_H1_1119_1.TH
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
Acceleration (m/s^2)
0.0
1.0
t(sec)
0º-180º HORIZONTAL RESPONSE

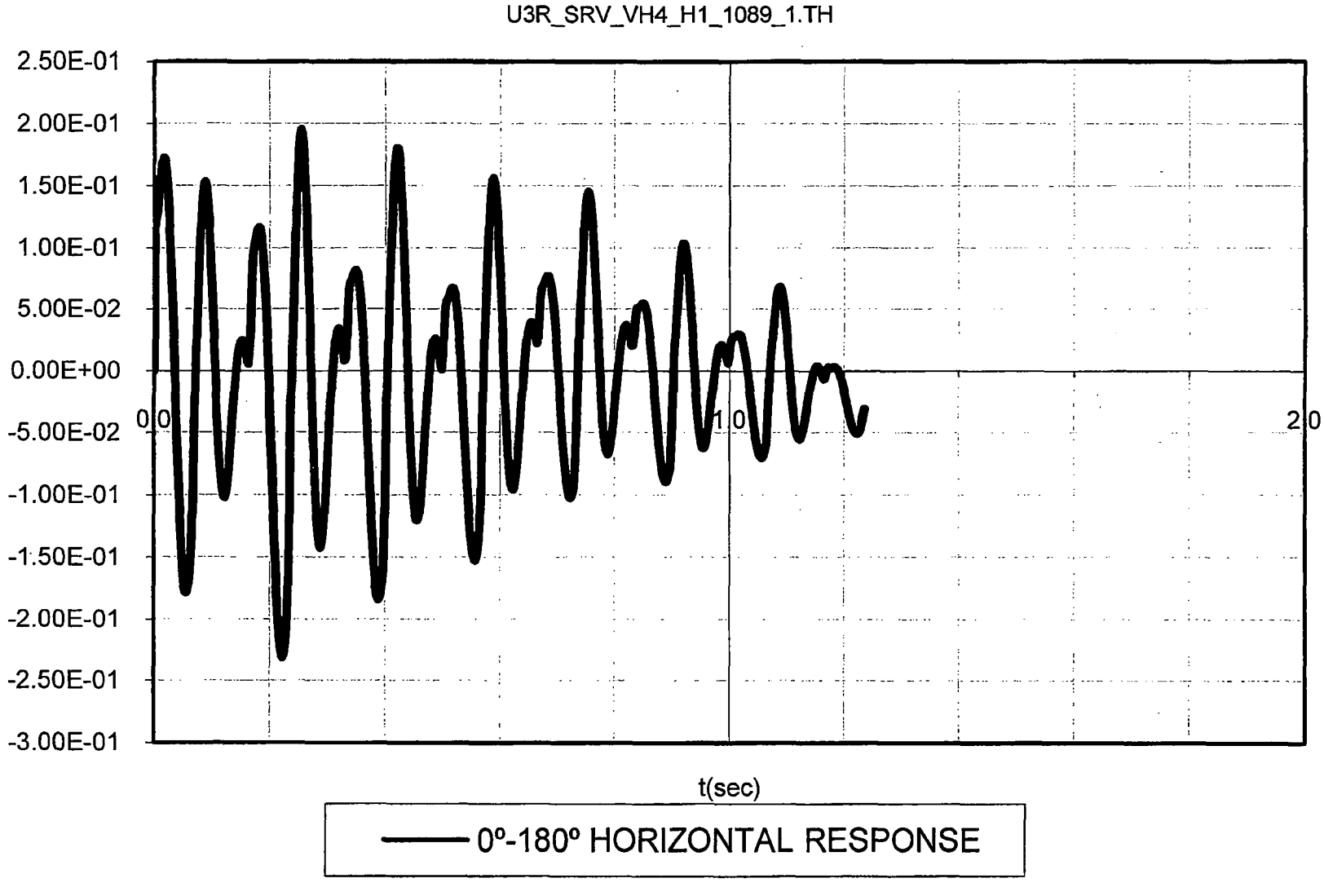

U3R_SRV_VH3_H1_1119_1.TH
2.00E-01
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
-1.50E-01
-2.00E-01
-2.50E-01
Acceleration (m/s^2)
0
0
10
t(sec)
VERTICAL RESPONSE

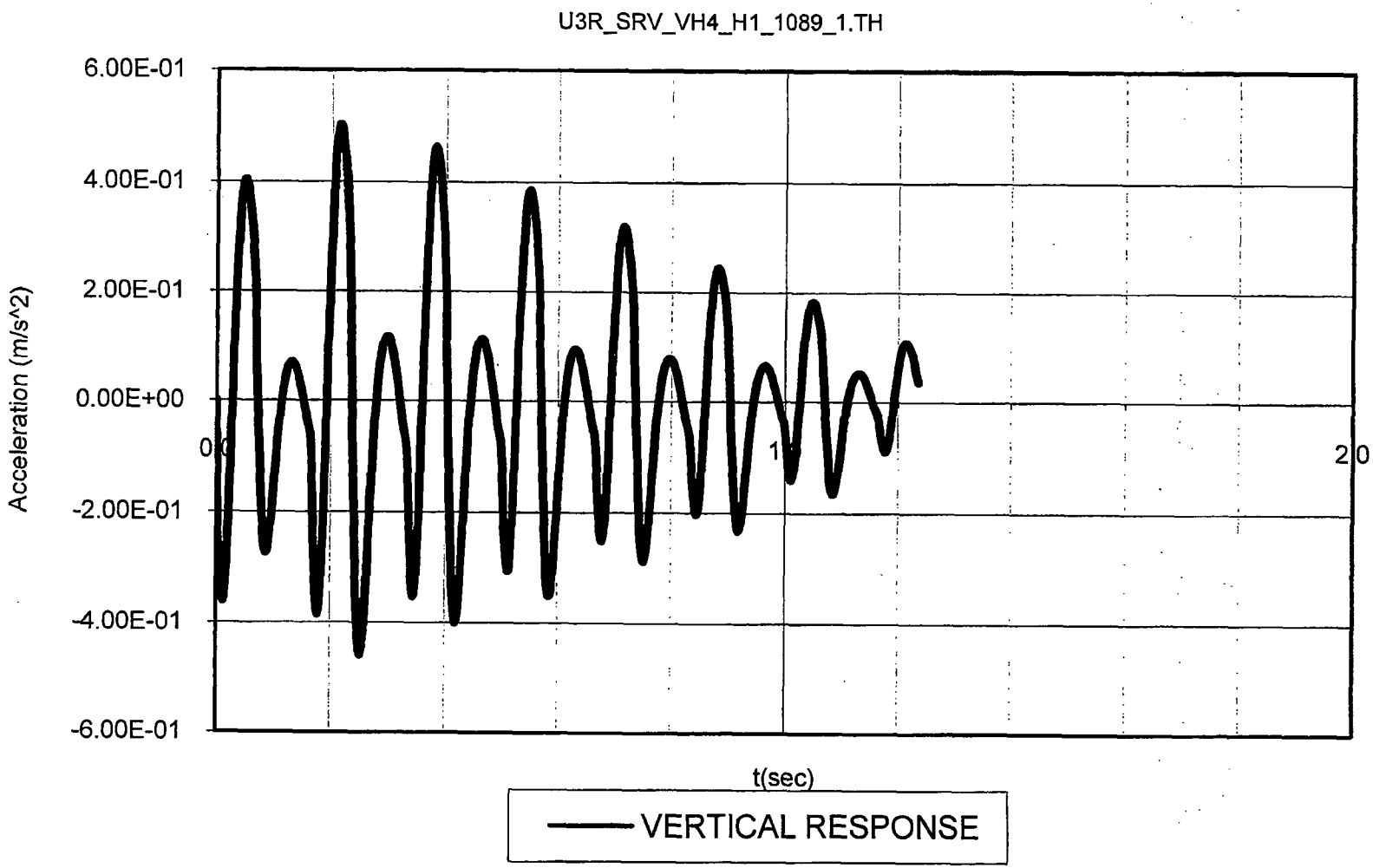

U3R_SRV_VH3_H1_1119_1.TH
1.00E-01
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
-2.00E-02
-4.00E-02
-6.00E-02
-8.00E-02
-1.00E-01
Acceleration (m/s^2)
0.0
10
t(sec)
90°-270° HORIZONTAL RESPONSE

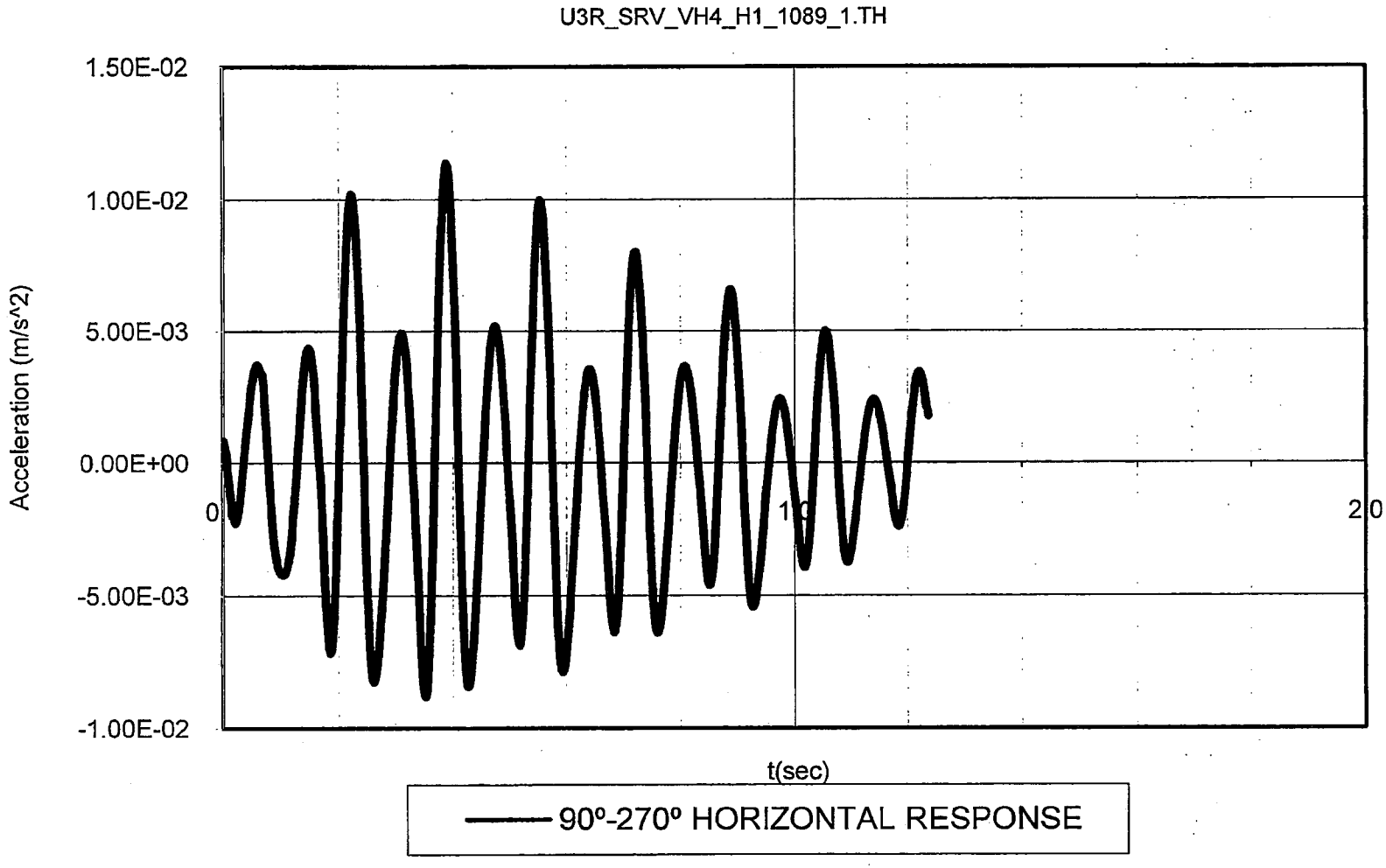

U3R_SRV_VH4_H1_1019_1.TH
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
-1.50E-01
-2.00E-01
Acceleration (m/s^2)
0
10
20
t(sec)
0°-180° HORIZONTAL RESPONSE

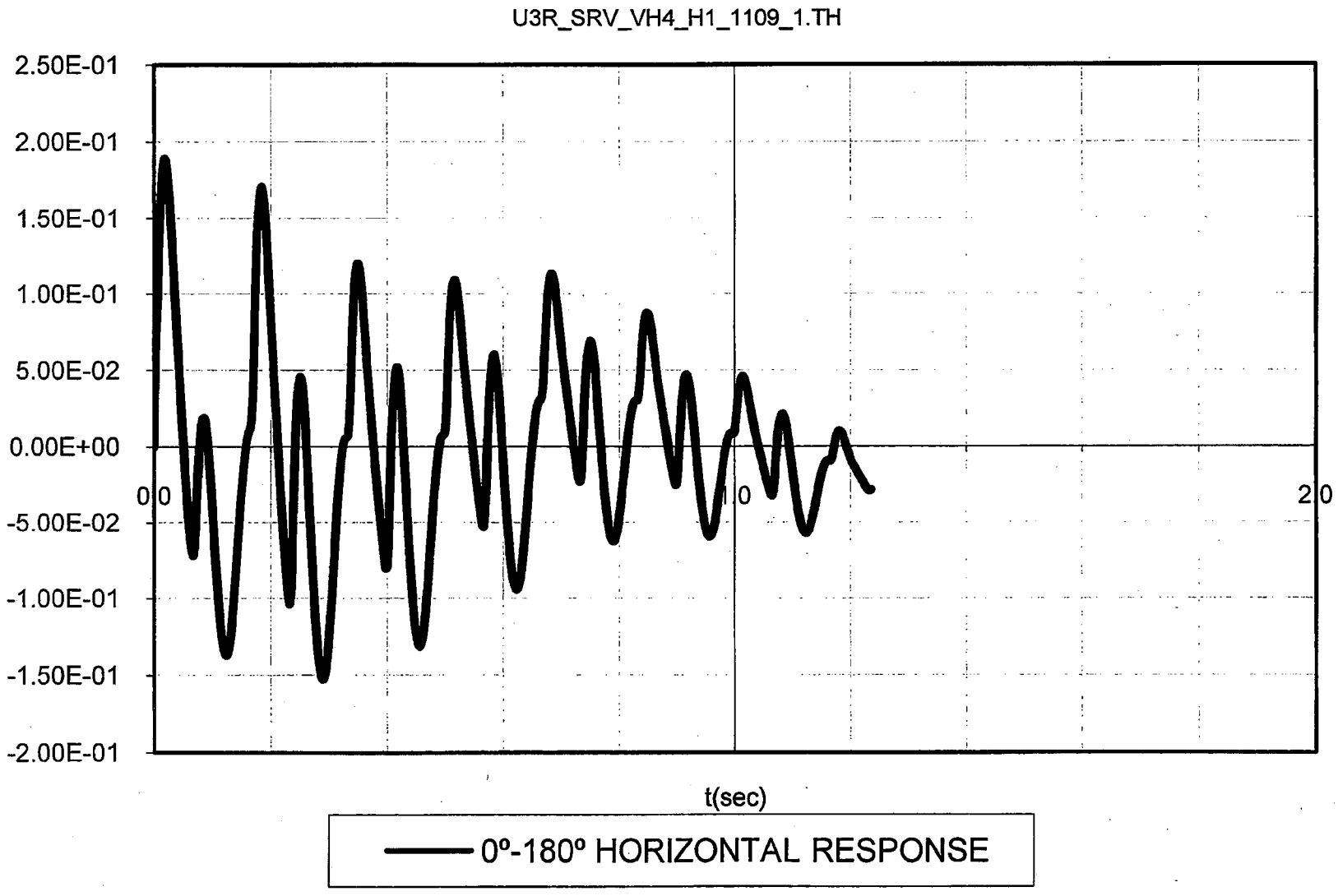

U3R_SRV_VH4_H1_1019_1.TH
5.00E-01
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
-4.00E-01
-5.00E-01
Acceleration (m/s^2)
0.0
10
20
t(sec)
VERTICAL RESPONSE

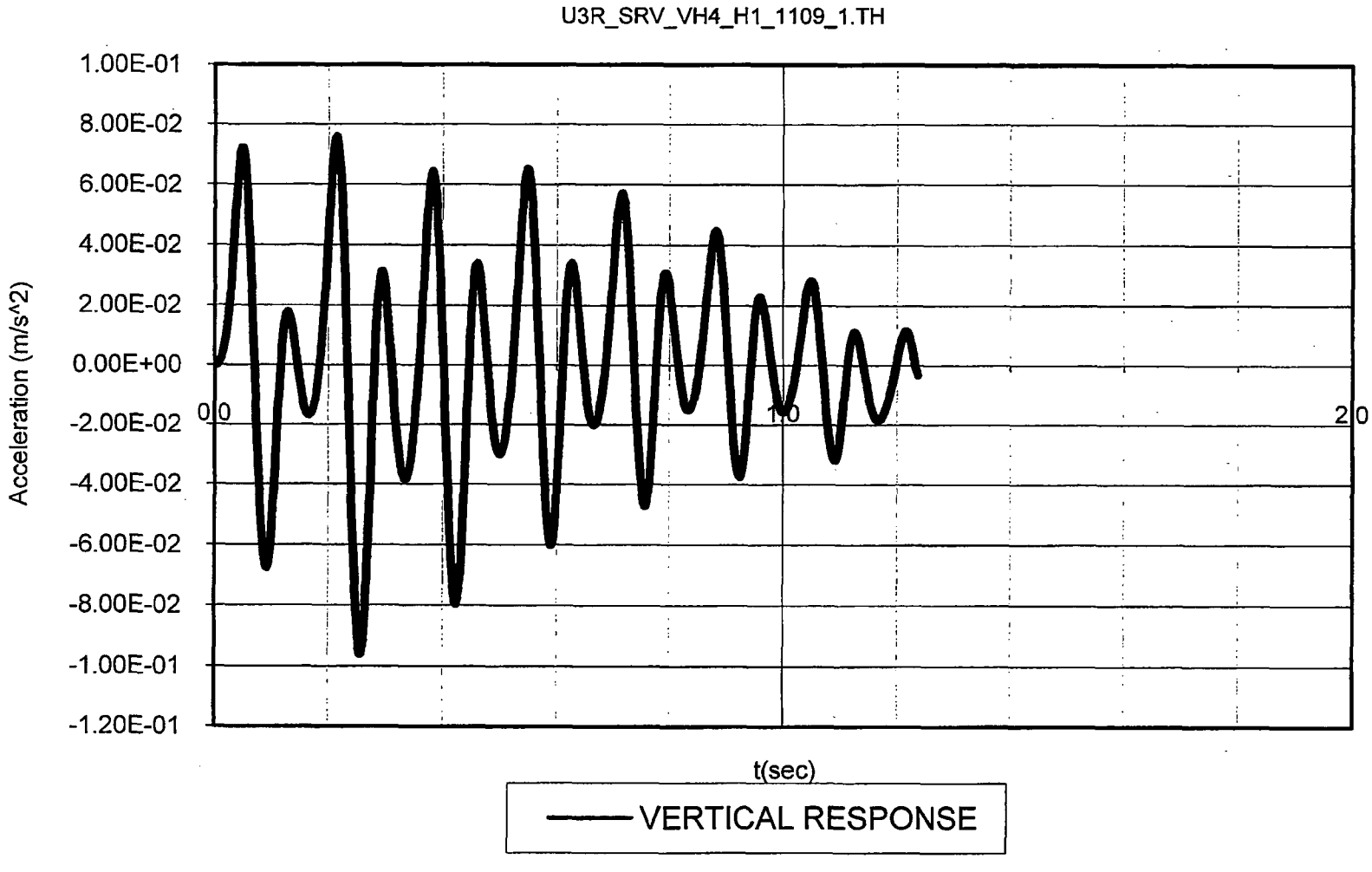

U3R_SRV_VH4_H1_1019_1.TH
8.00E-03
6.00E-03
4.00E-03
2.00E-03
0.00E+00
-2.00E-03
-4.00E-03
-6.00E-03
-8.00E-03
Acceleration (m/s^2)
0
10
20
t(sec)
90°-270° HORIZONTAL RESPONSE

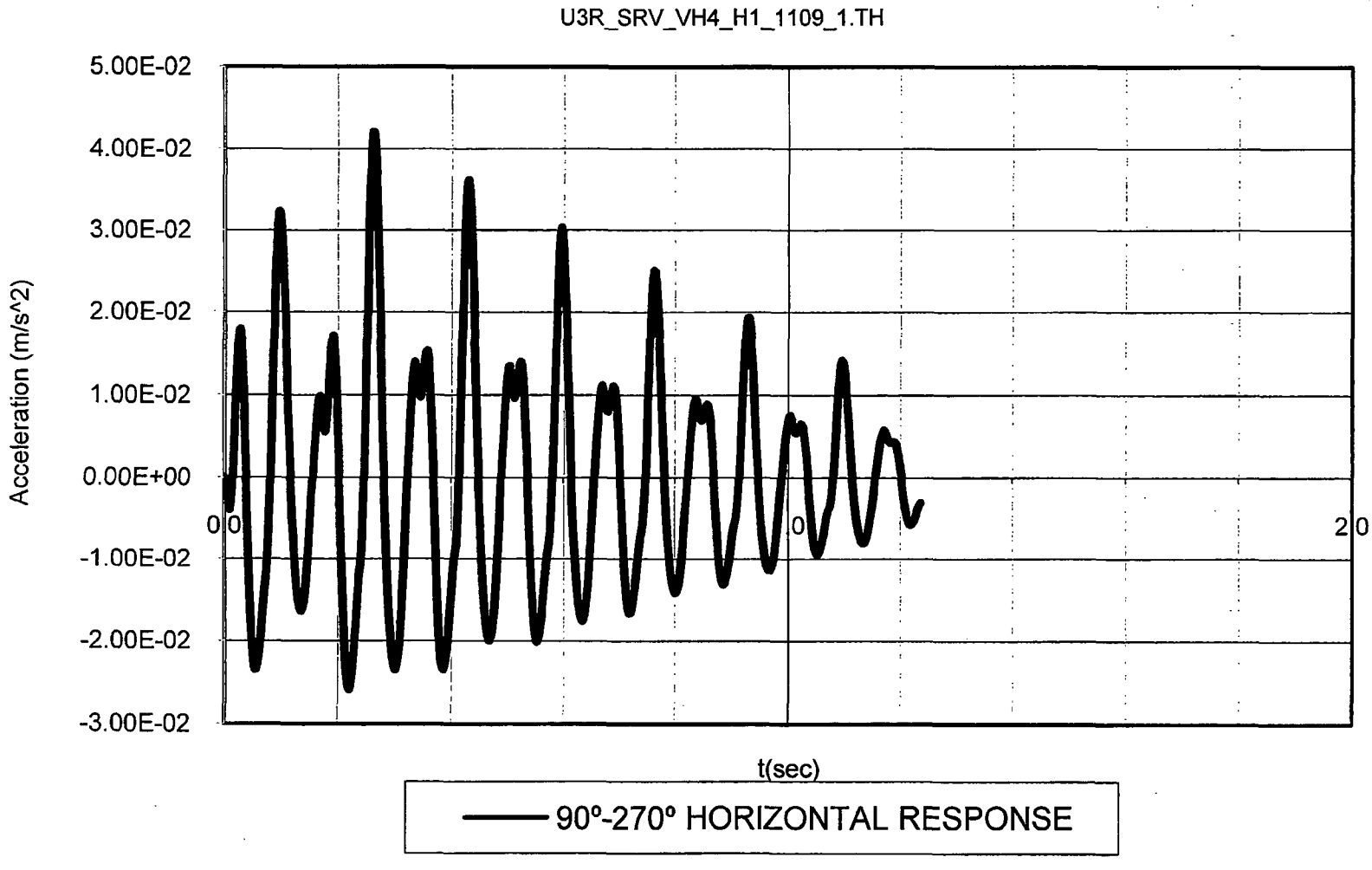

U3R_SRV_VH4_H1_1089_1.TH
2.50E-01
2.00E-01
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
-1.50E-01
-2.00E-01
-2.50E-01
-3.00E-01
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
0º-180º HORIZONTAL RESPONSE

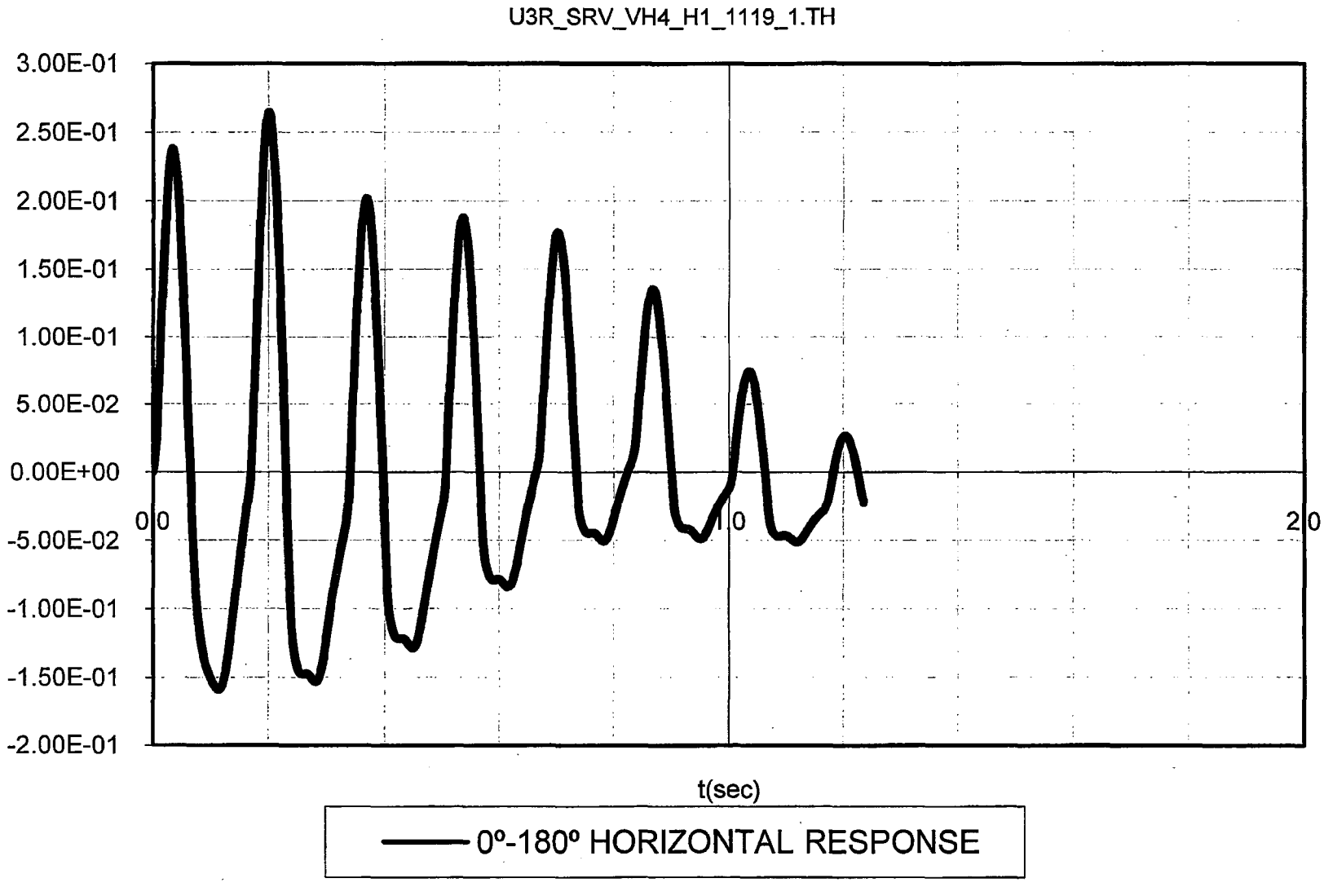

U3R_SRV_VH4_H1_1089_1.TH
6.00E-01
4.00E-01
2.00E-01
0.00E+00
-2.00E-01
-4.00E-01
-6.00E-01
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
VERTICAL RESPONSE

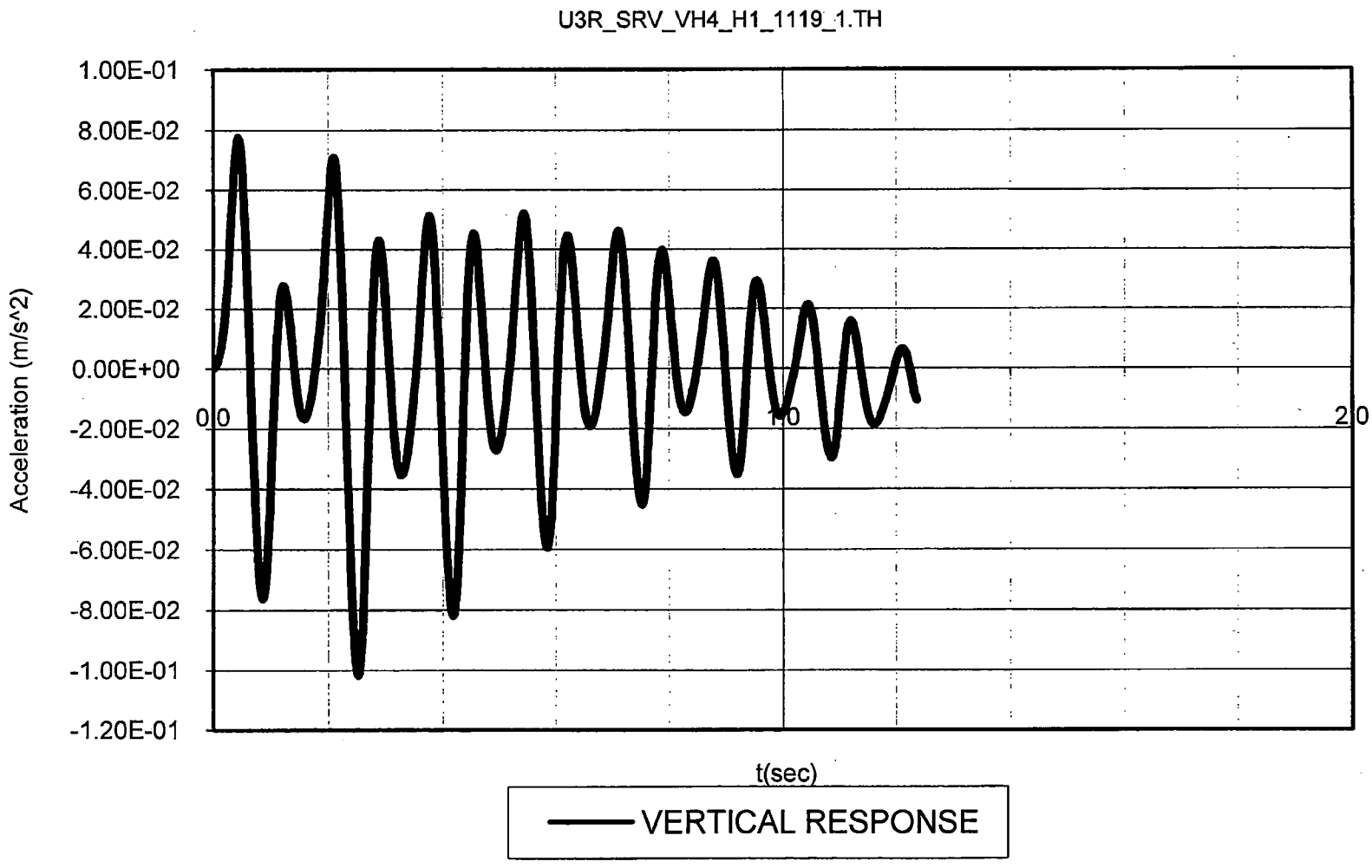

U3R_SRV_VH4_H1_1089_1.TH
1.50E-02
1.00E-02
5.00E-03
0.00E+00
-5.00E-03
-1.00E-02
Acceleration (m/s^2)
0
10
20
t(sec)
90º-270º HORIZONTAL RESPONSE

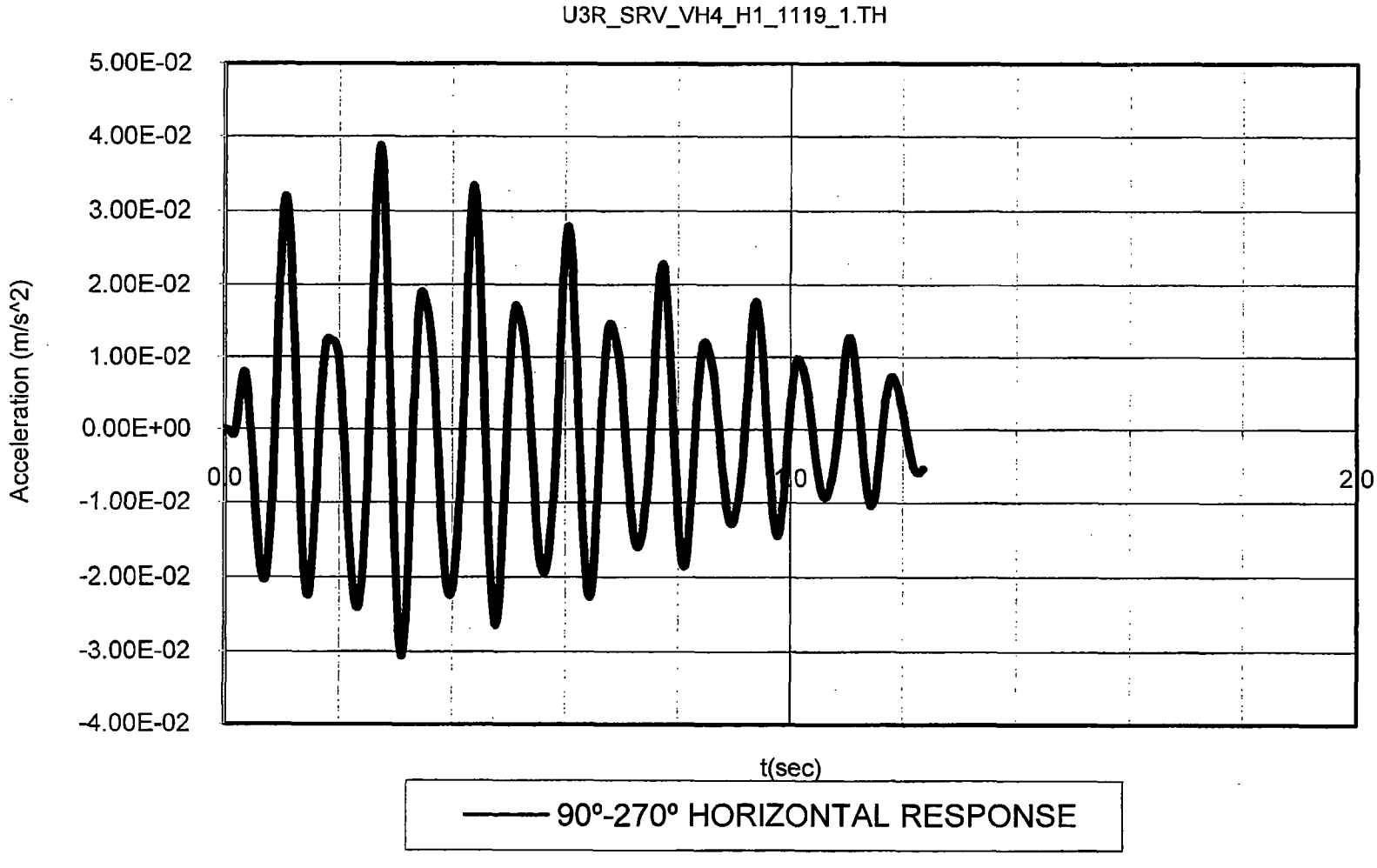

U3R_SRV_VH4_H1_1109_1.TH
2.50E-01
2.00E-01
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
-1.50E-01
-2.00E-01
Acceleration (m/s^2)
0.0
10
20
t(sec)
0°-180° HORIZONTAL RESPONSE

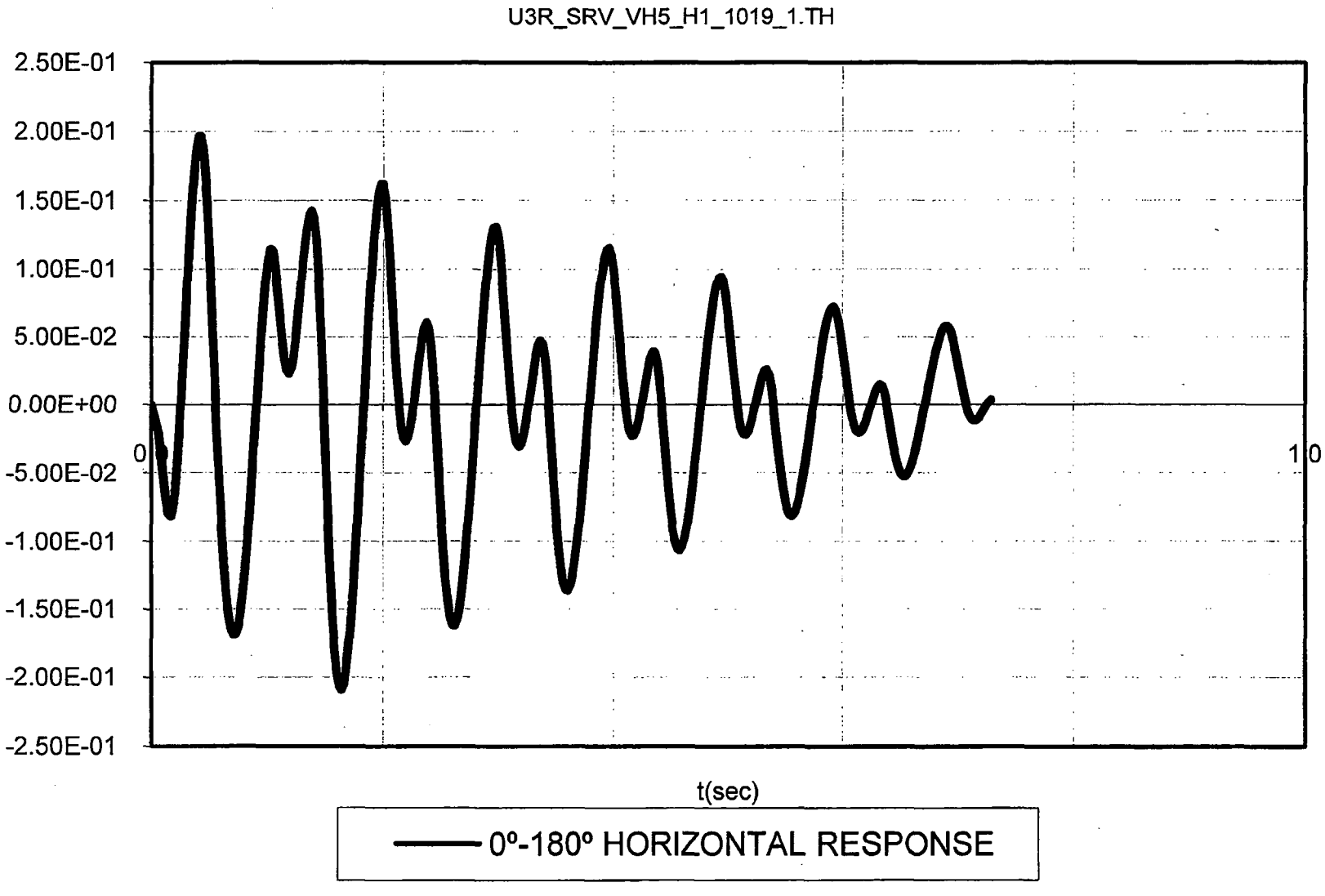

U3R_SRV_VH4_H1_1109_1.TH
1.00E-01
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
-2.00E-02
-4.00E-02
-6.00E-02
-8.00E-02
-1.00E-01
-1.20E-01
Acceleration (m/s^2)
0.0
10
20
t(sec)
VERTICAL RESPONSE

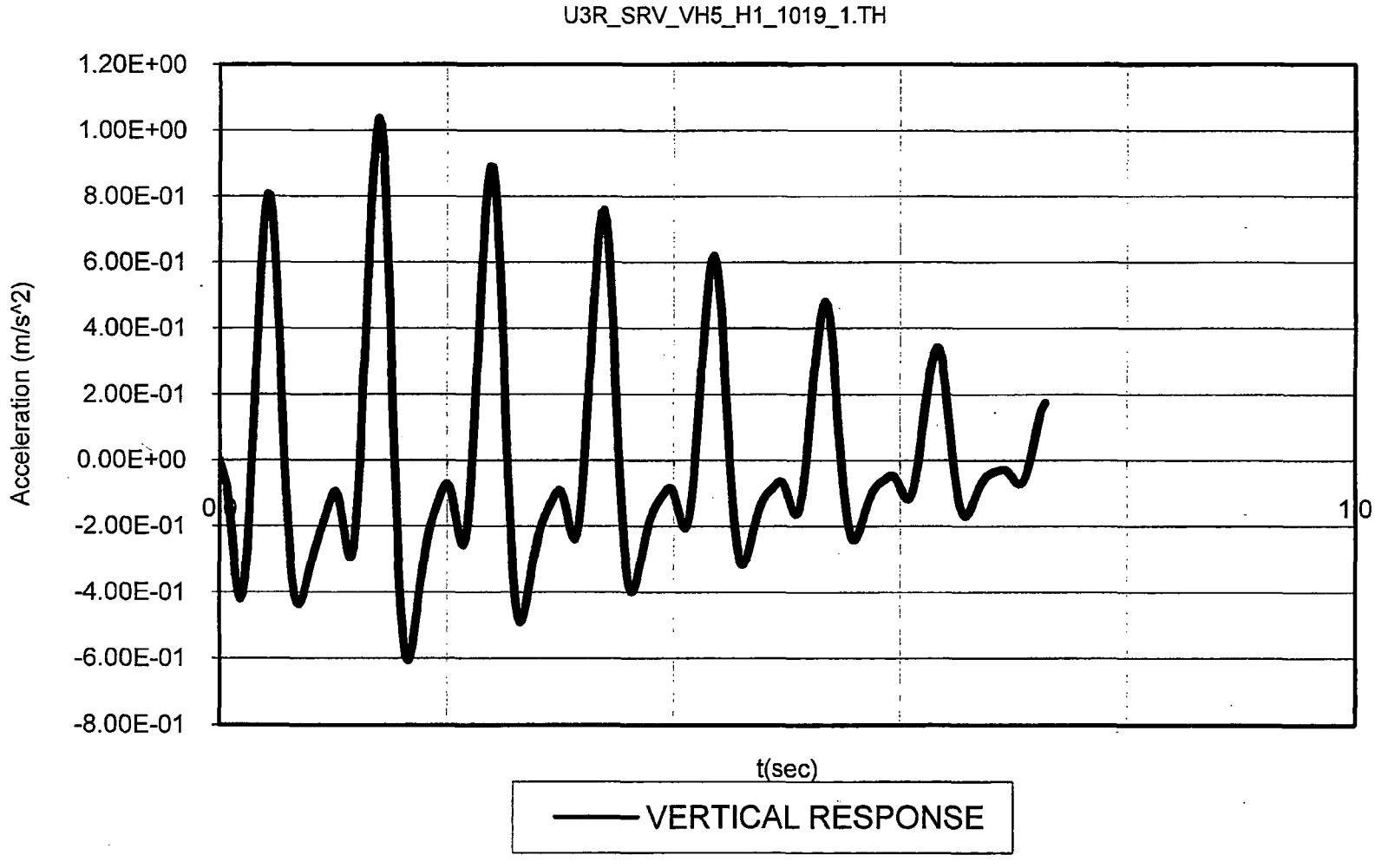

U3R_SRV_VH4_H1_1109_1.TH
5.00E-02
4.00E-02
3.00E-02
2.00E-02
1.00E-02
0.00E+00
-1.00E-02
-2.00E-02
-3.00E-02
Acceleration (m/s^2)
0
0
0
20
t(sec)
90°-270° HORIZONTAL RESPONSE

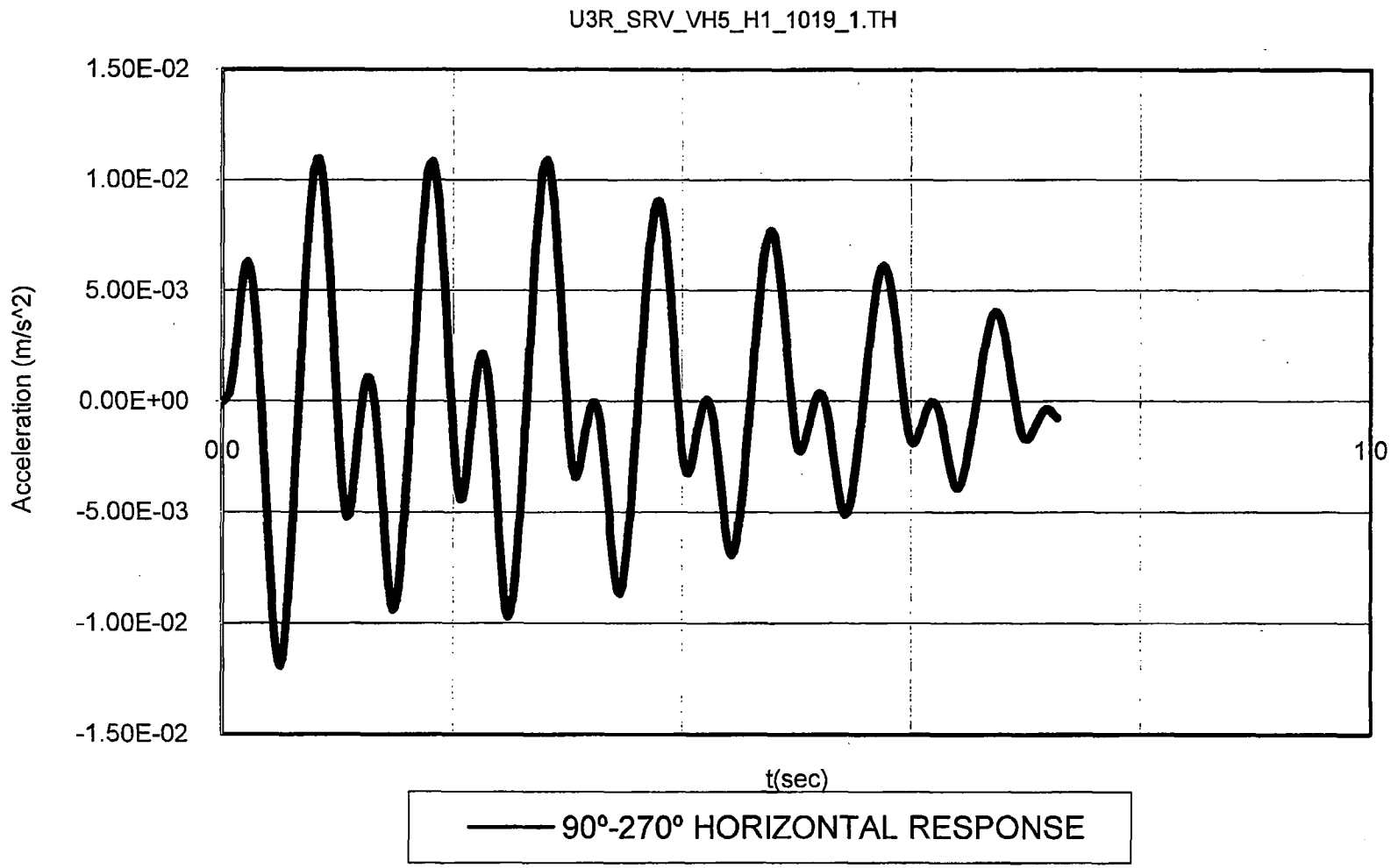

U3R_SRV_VH4_H1_1119_1.TH
3.00E-01
2.50E-01
2.00E-01
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
-1.50E-01
-2.00E-01
Acceleration (m/s^2)
0.0
10
20
t(sec)
0º-180º HORIZONTAL RESPONSE

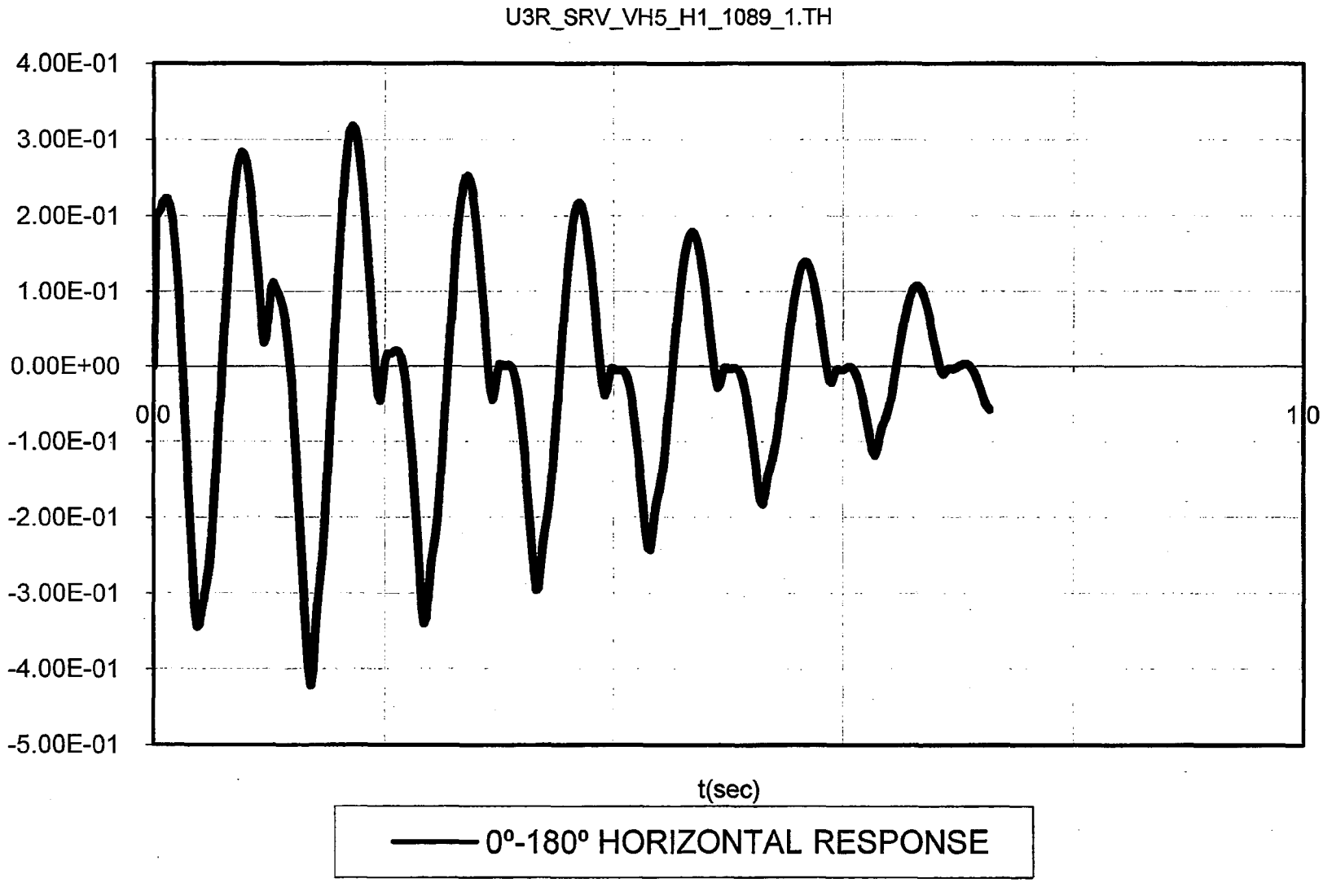

U3R_SRV_VH4_H1_1119_1.TH
1.00E-01
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
-2.00E-02
-4.00E-02
-6.00E-02
-8.00E-02
-1.00E-01
-1.20E-01
Acceleration (m/s^2)
0.0
10
20
t(sec)
VERTICAL RESPONSE

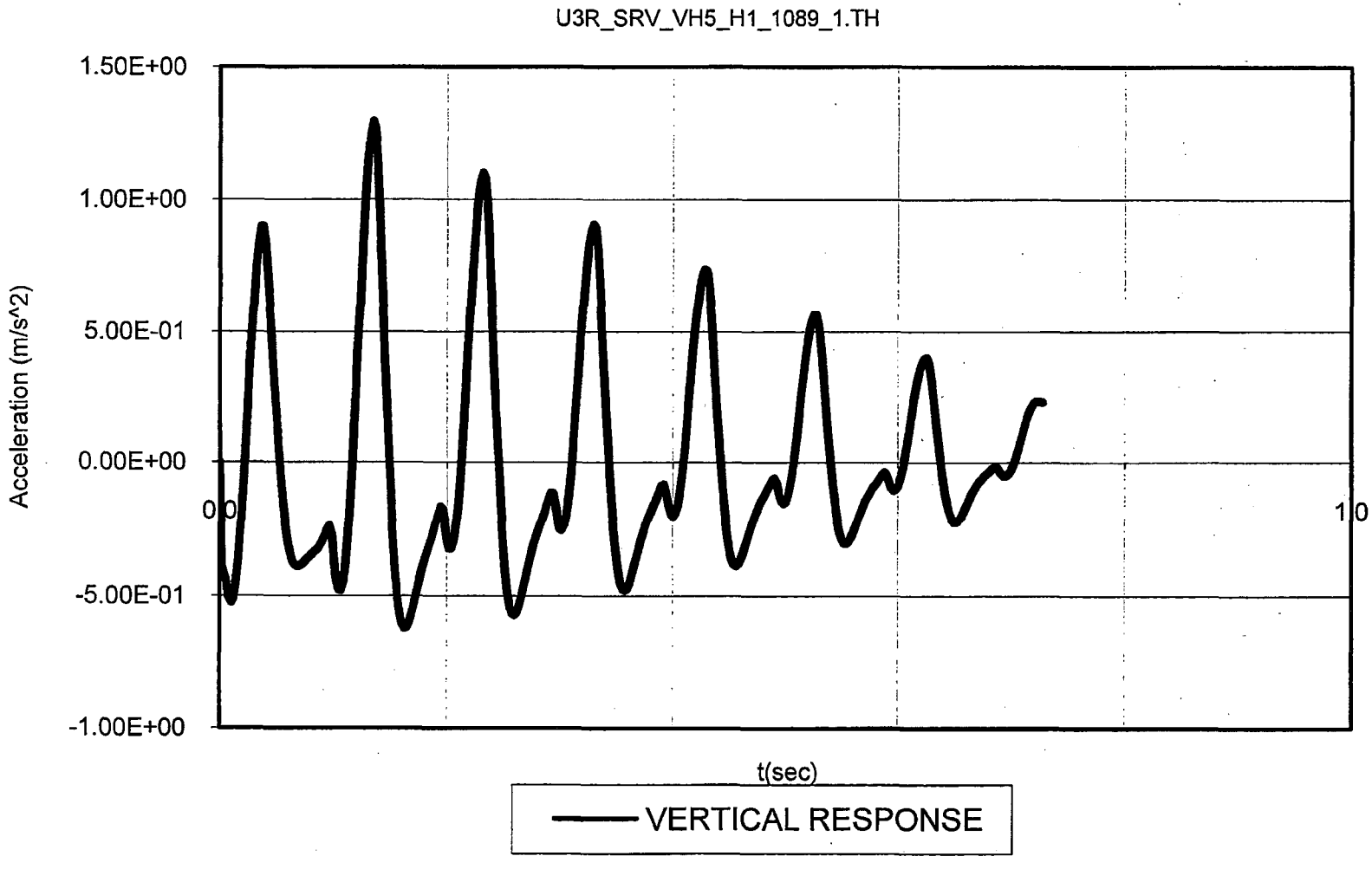

U3R_SRV_VH4_H1_1119_1.TH
5.00E-02
4.00E-02
3.00E-02
2.00E-02
1.00E-02
0.00E+00
-1.00E-02
-2.00E-02
-3.00E-02
-4.00E-02
Acceleration (m/s^2)
0.0
10.0
20.0
t(sec)
90°-270° HORIZONTAL RESPONSE

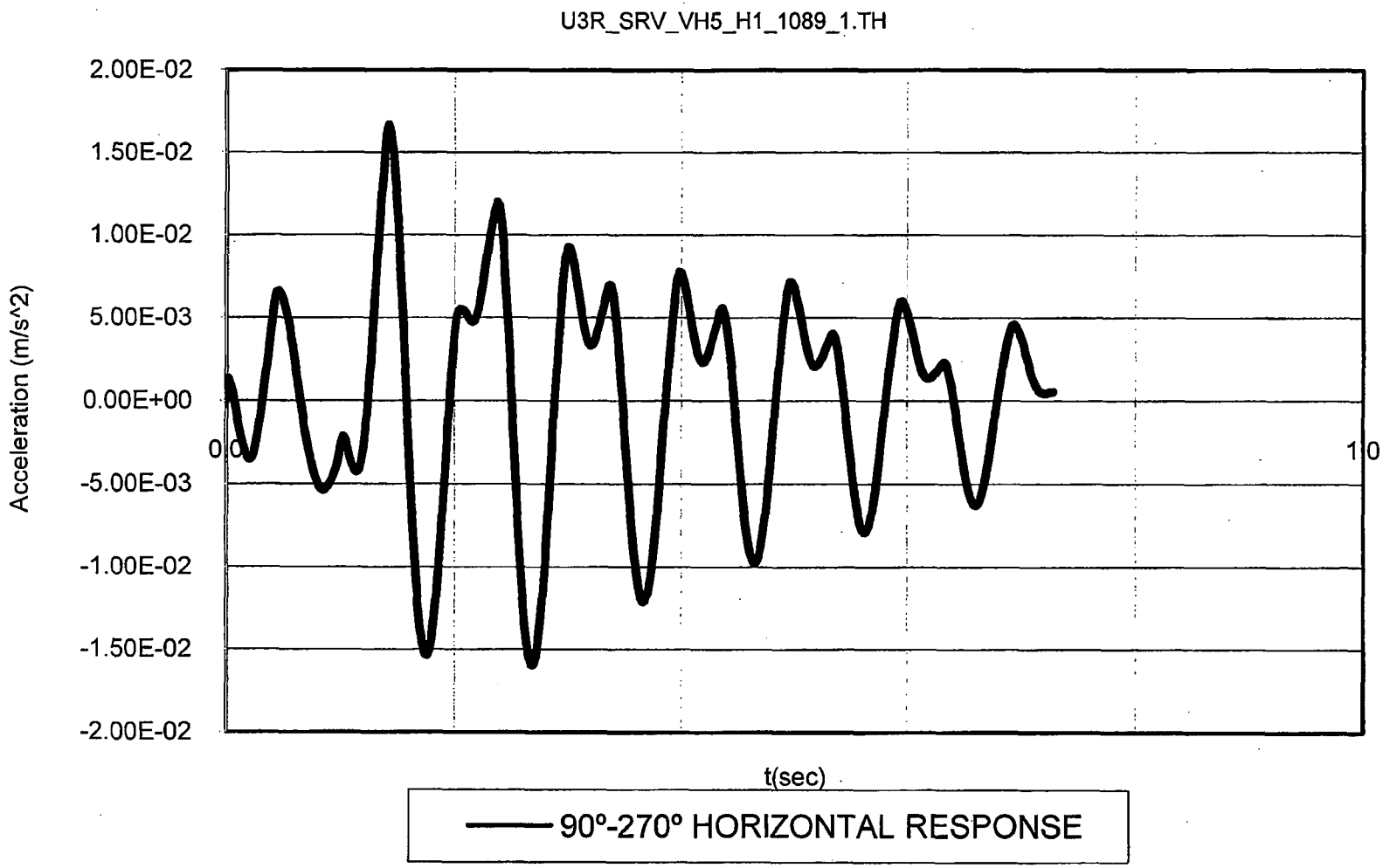

U3R_SRV_VH5_H1_1019_1.TH
2.50E-01
2.00E-01
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
-1.50E-01
-2.00E-01
-2.50E-01
Acceleration (m/s^2)
0
10
t(sec)
0°-180° HORIZONTAL RESPONSE

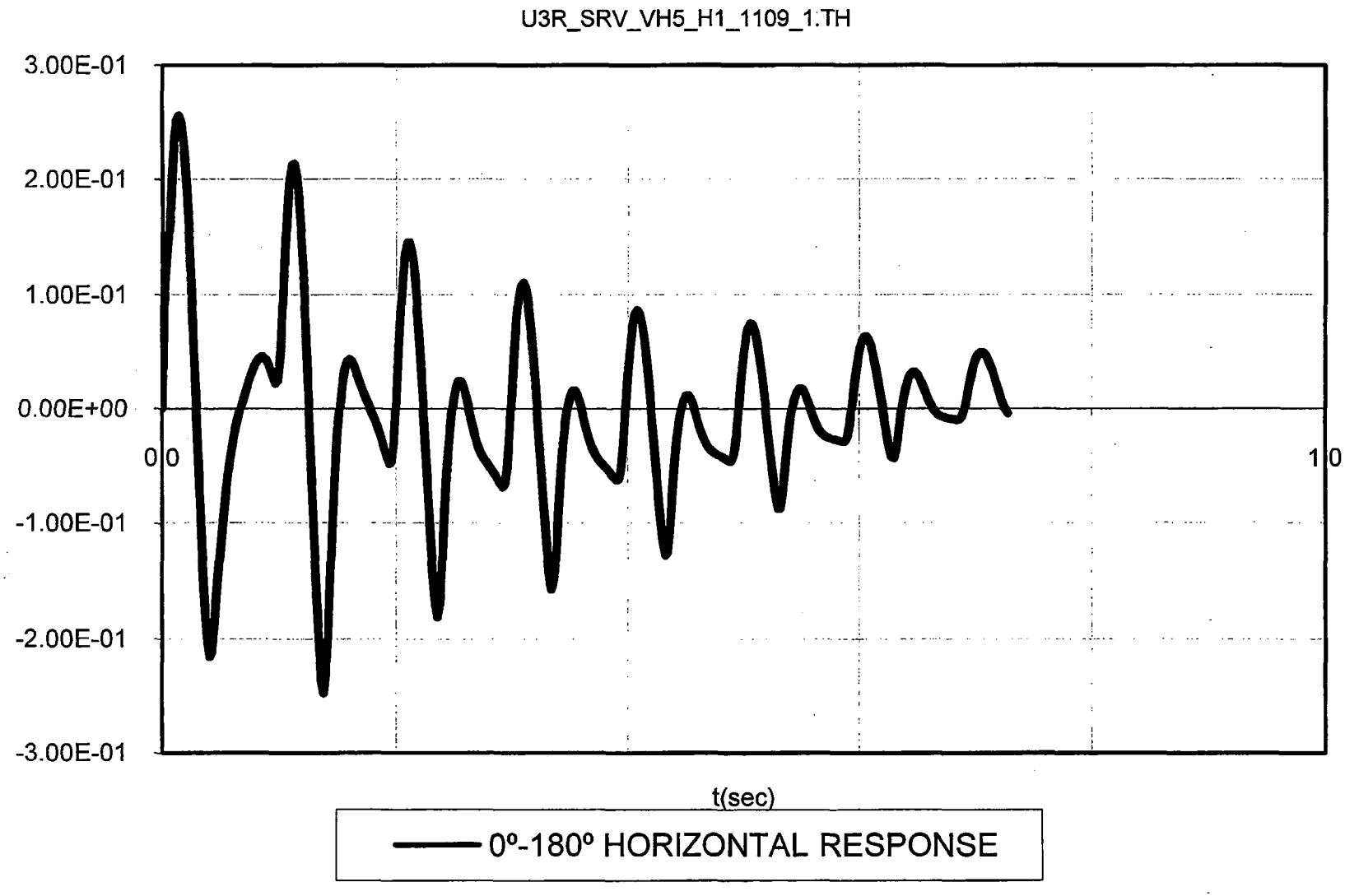

U3R_SRV_VH5_H1_1019_1.TH
1.20E+00
1.00E+00
8.00E-01
6.00E-01
4.00E-01
2.00E-01
0.00E+00
-2.00E-01
-4.00E-01
-6.00E-01
-8.00E-01
Acceleration (m/s^2)
0
10
t(sec)
VERTICAL RESPONSE

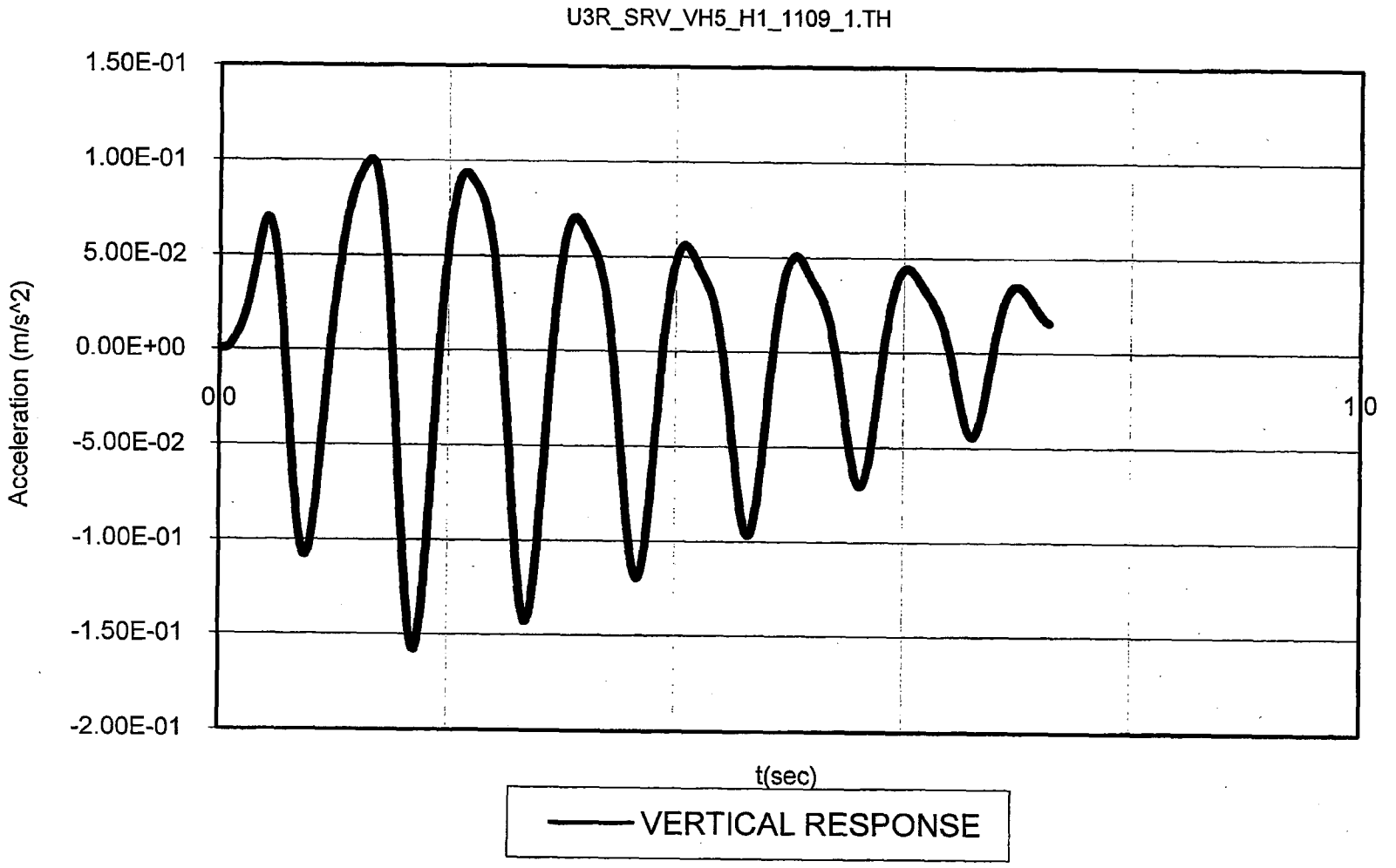

U3R_SRV_VH5_H1_1019_1.TH
1.50E-02
1.00E-02
5.00E-03
0.00E+00
-5.00E-03
-1.00E-02
-1.50E-02
Acceleration (m/s^2)
0
0
1
0
t(sec)
90°-270° HORIZONTAL RESPONSE

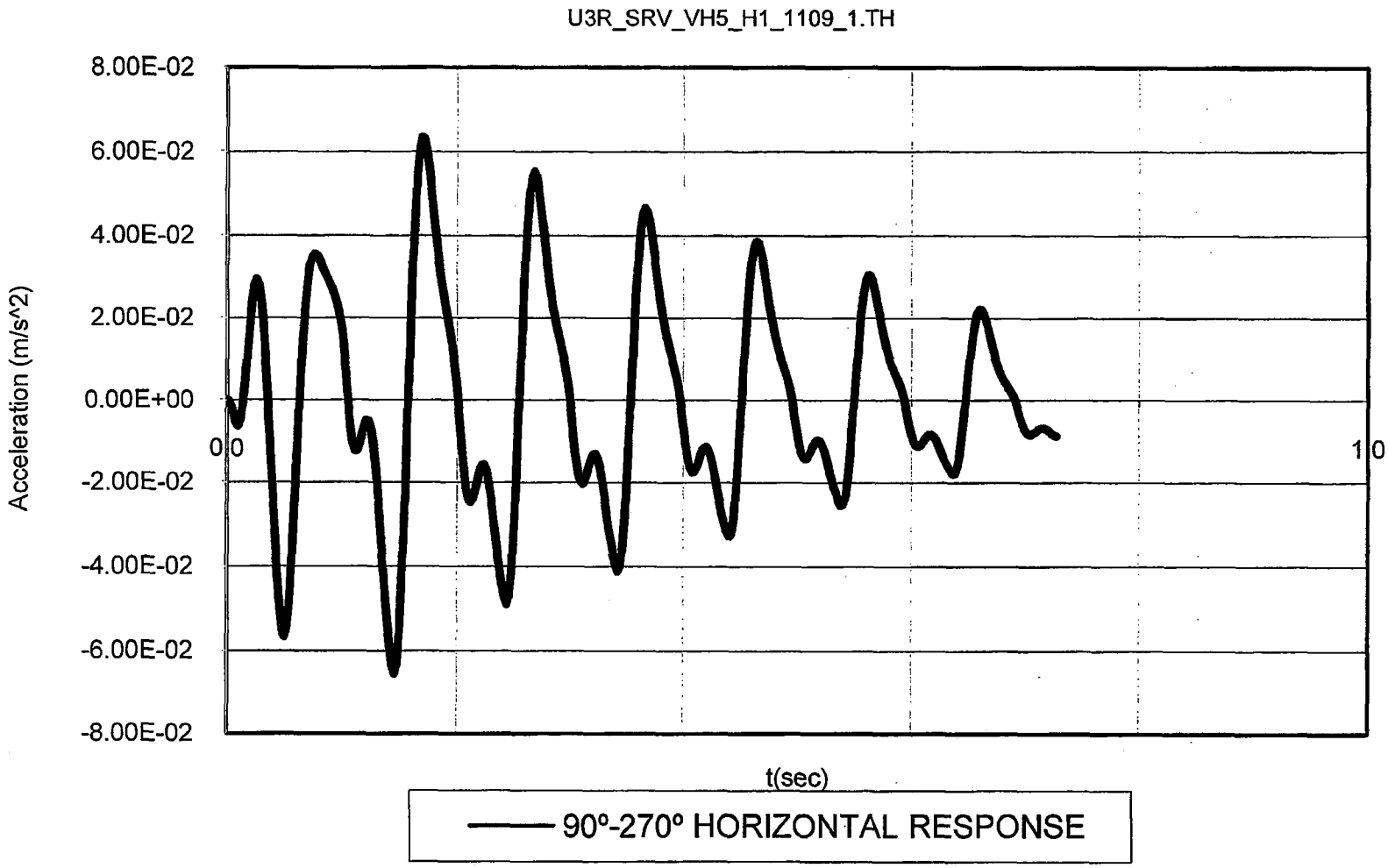

U3R_SRV_VH5_H1_1089_1.TH
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
-4.00E-01
-5.00E-01
0.0
1.0
Acceleration (m/s^2)
t(sec)
0°-180° HORIZONTAL RESPONSE

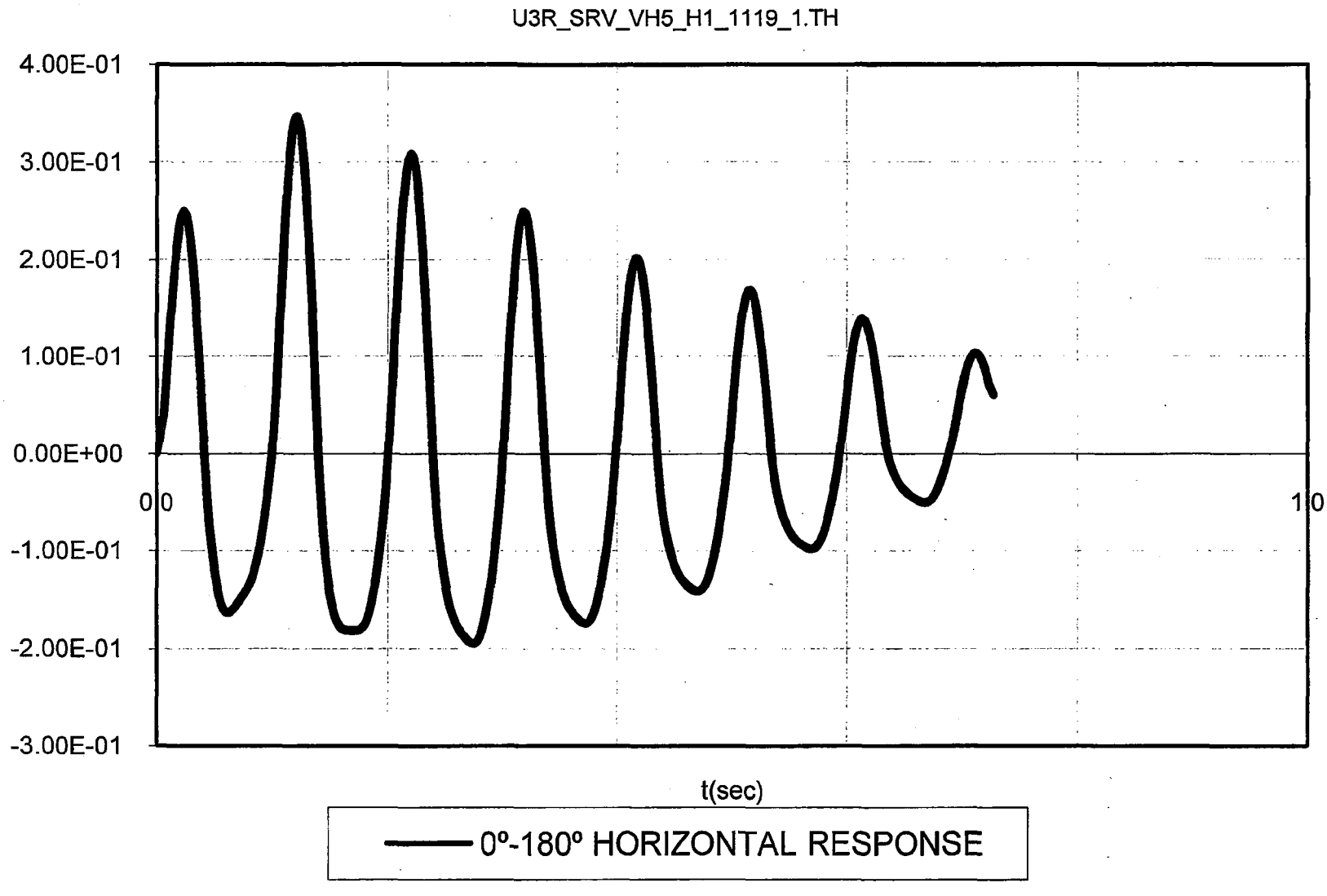

U3R_SRV_VH5_H1_1089_1.TH
1.50E+00
1.00E+00
5.00E-01
0.00E+00
-5.00E-01
-1.00E+00
Acceleration (m/s^2)
0.0
1.0
t(sec)
VERTICAL RESPONSE

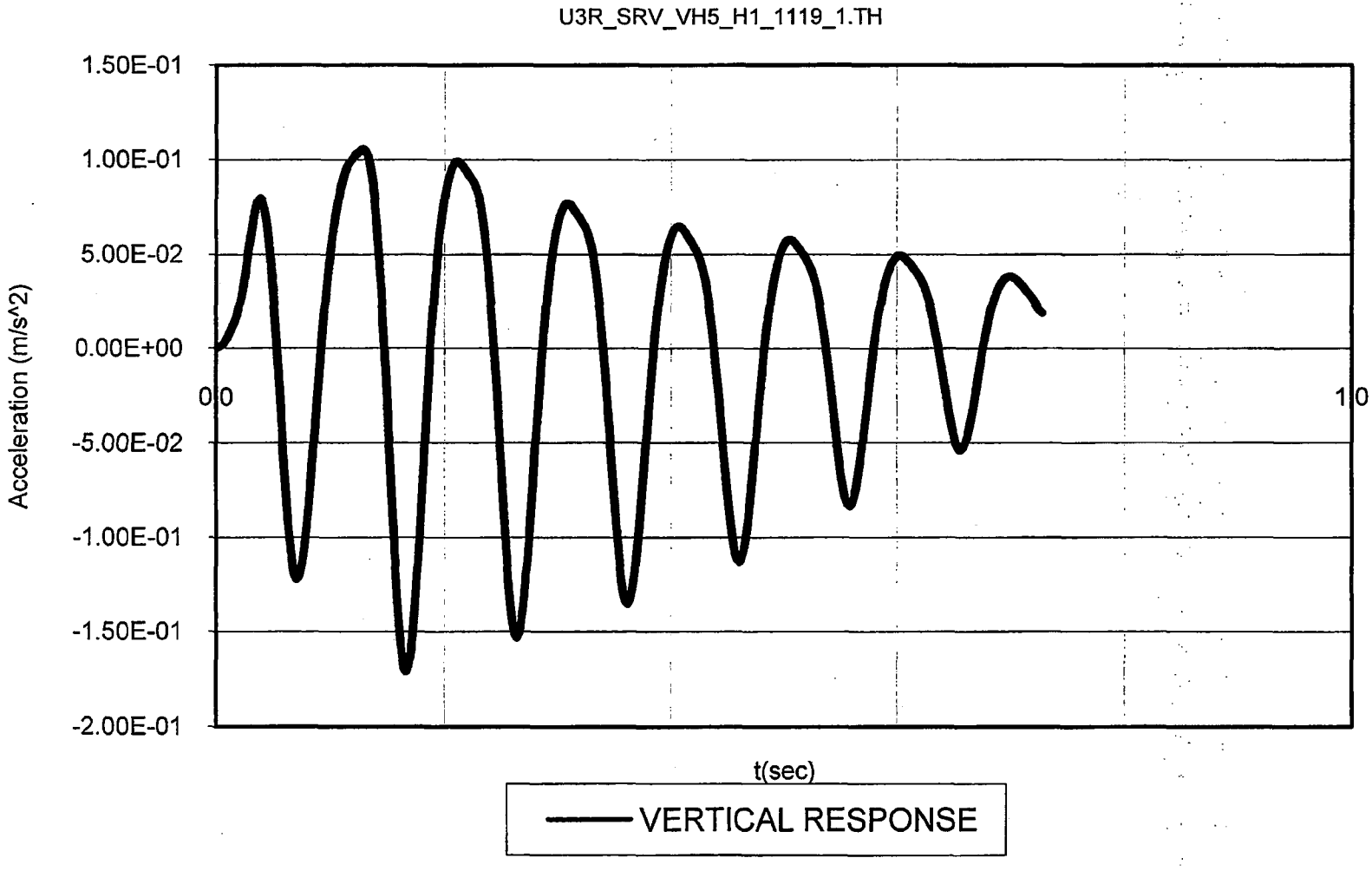

U3R_SRV_VH5_H1_1089_1.TH
2.00E-02
1.50E-02
1.00E-02
5.00E-03
0.00E+00
-5.00E-03
-1.00E-02
-1.50E-02
-2.00E-02
Acceleration (m/s^2)
0.0
1.0
t(sec)
90°-270° HORIZONTAL RESPONSE

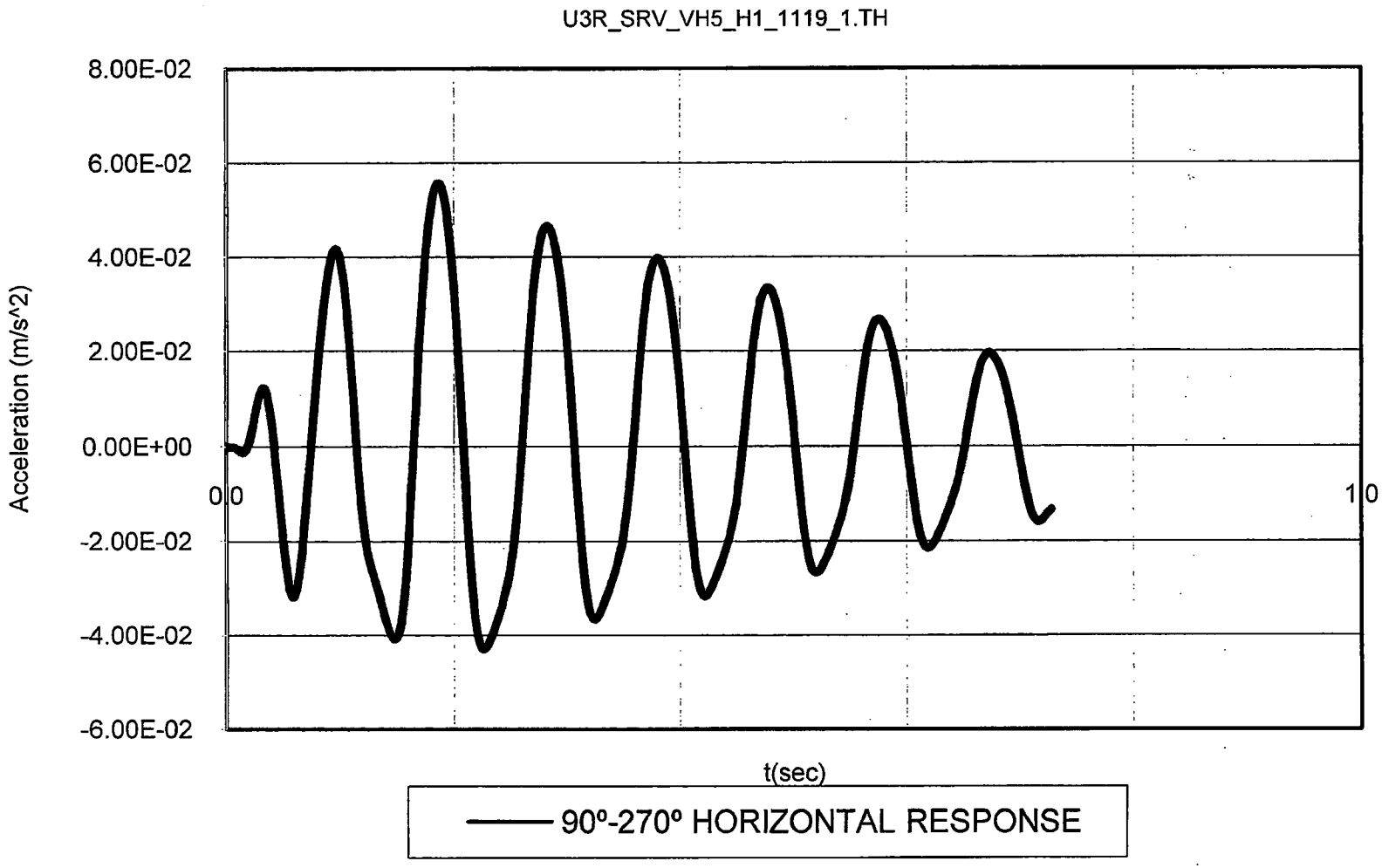

U3R_SRV_VH5_H1_1109_1.TH
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
Acceleration (m/s^2)
0
0
1
0
t(sec)
0º-180º HORIZONTAL RESPONSE


U3R_SRV_VH5_H1_1109_1.TH
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
-1.50E-01
-2.00E-01
Acceleration (m/s^2)
0.0
1.0
t(sec)
VERTICAL RESPONSE


U3R_SRV_VH5_H1_1109_1.TH
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
-2.00E-02
-4.00E-02
-6.00E-02
-8.00E-02
Acceleration (m/s^2)
0
0
1
0
t(sec)
90°-270° HORIZONTAL RESPONSE

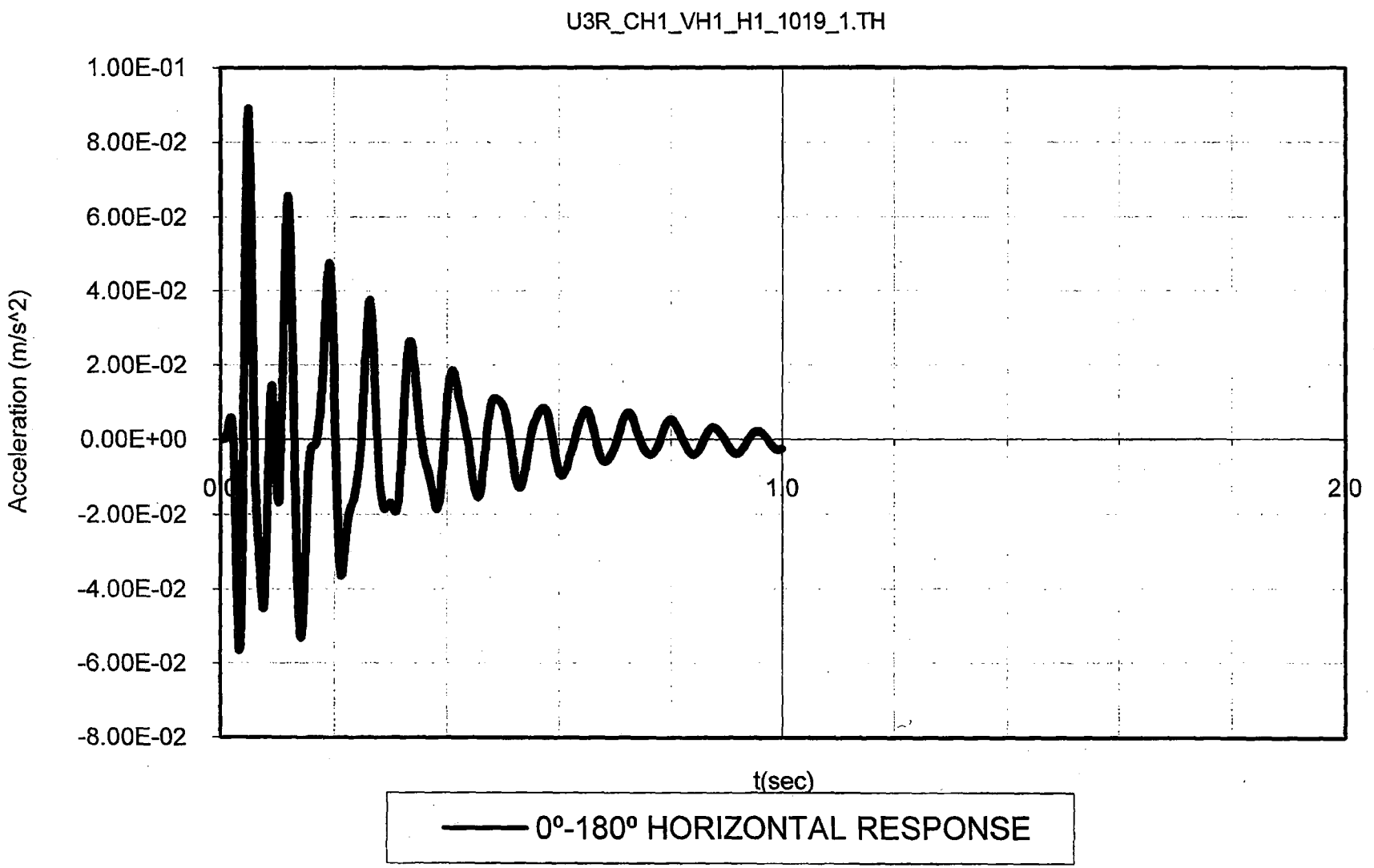

U3R_SRV_VH5_H1_1119_1.TH
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
Acceleration (m/s^2)
0
0
1
0
t(sec)
0º-180º HORIZONTAL RESPONSE

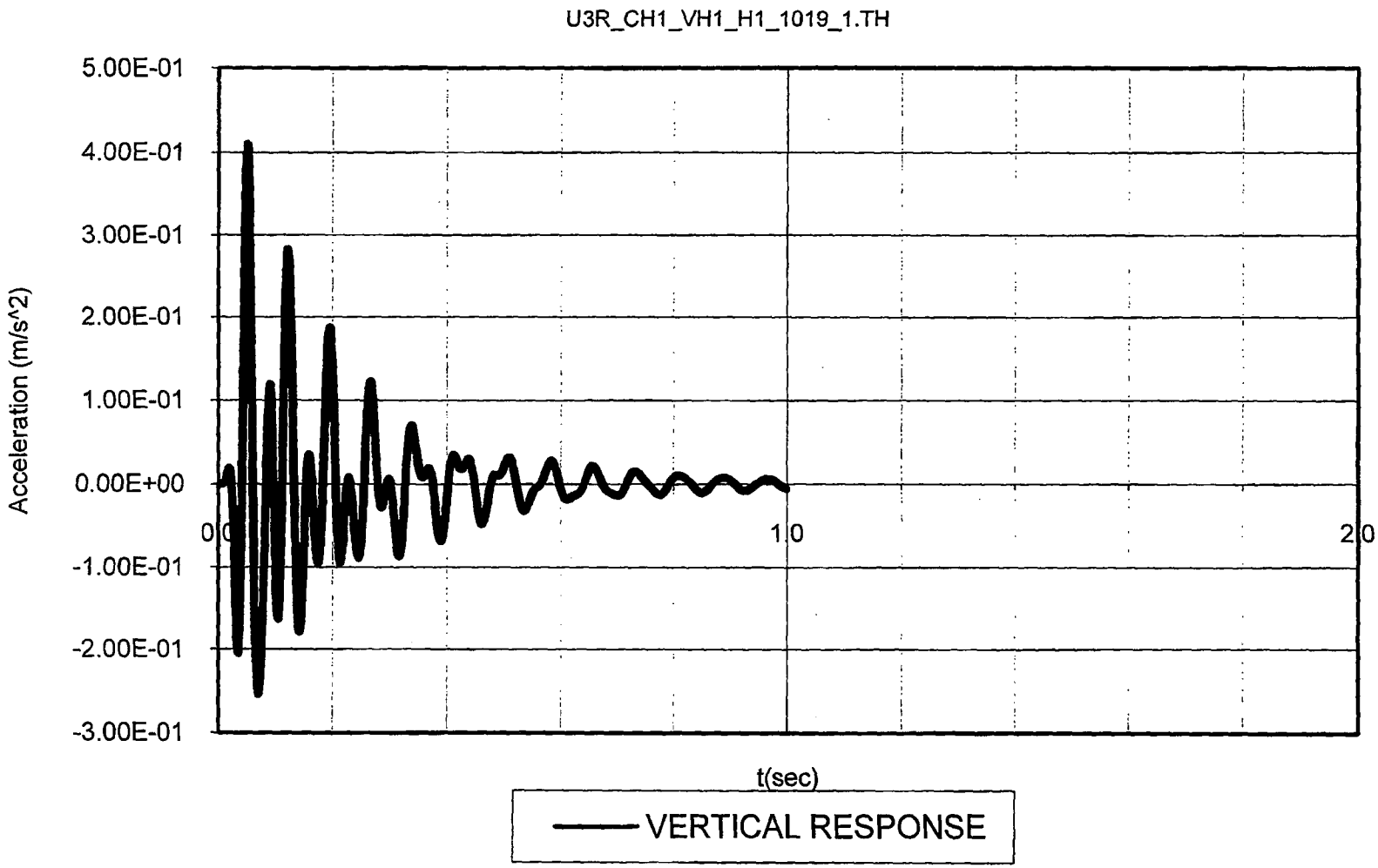

U3R_SRV_VH5_H1_1119_1.TH
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
-1.50E-01
-2.00E-01
Acceleration (m/s^2)
0.0
1.0
t(sec)
VERTICAL RESPONSE

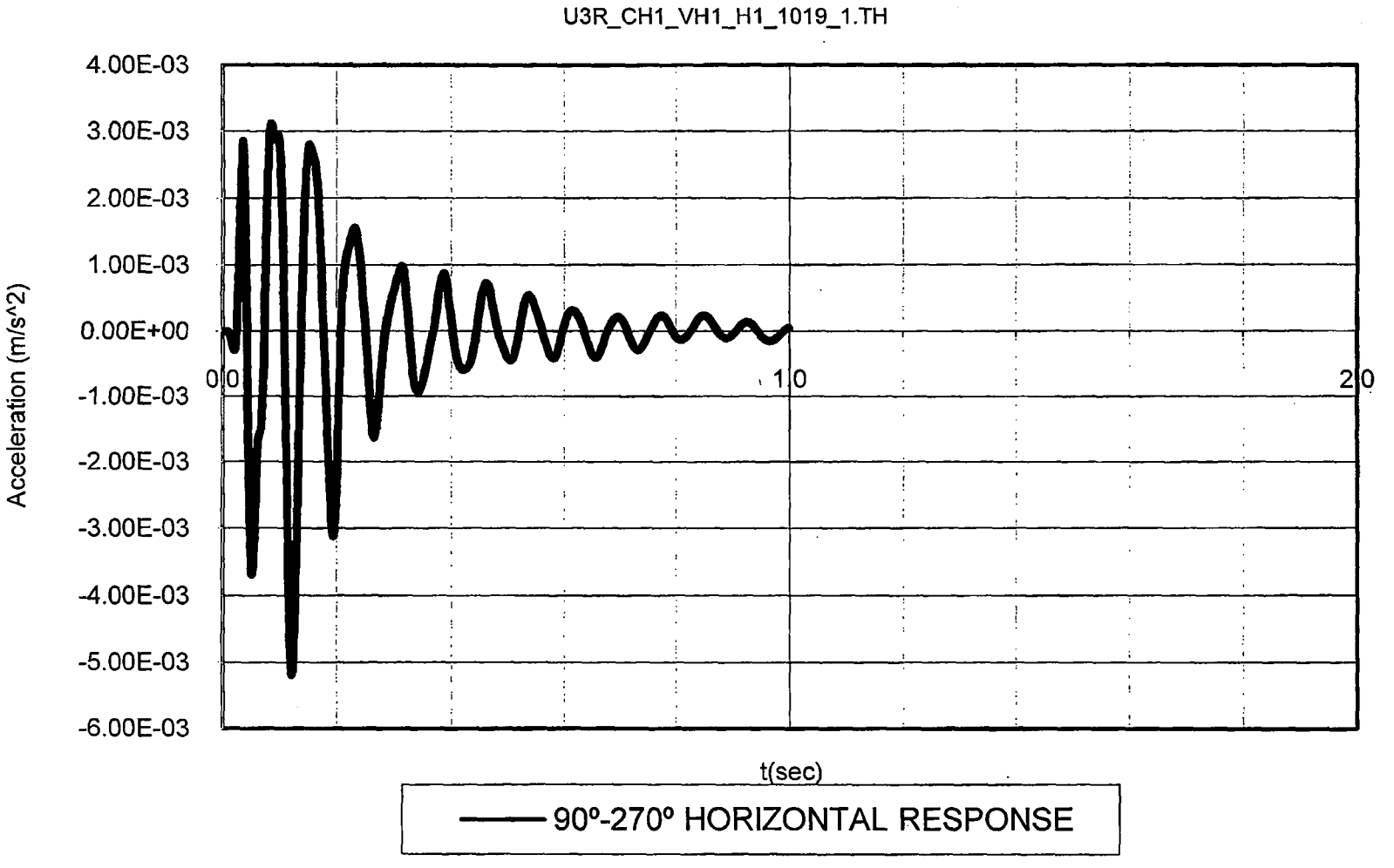

U3R_SRV_VH5_H1_1119_1.TH
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
-2.00E-02
-4.00E-02
-6.00E-02
Acceleration (m/s^2)
0
0
10
t(sec)
90º-270º HORIZONTAL RESPONSE

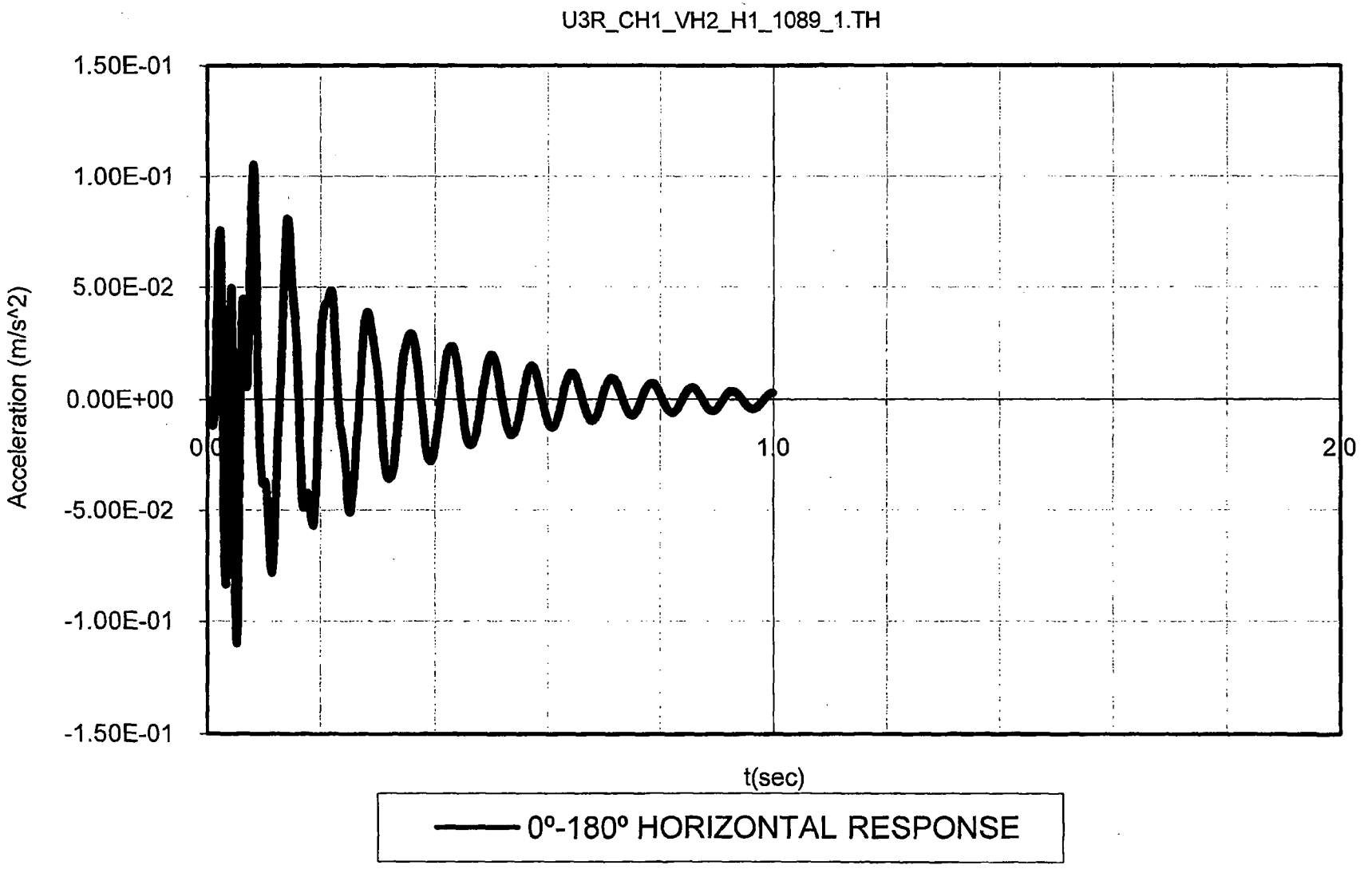
Attachment C

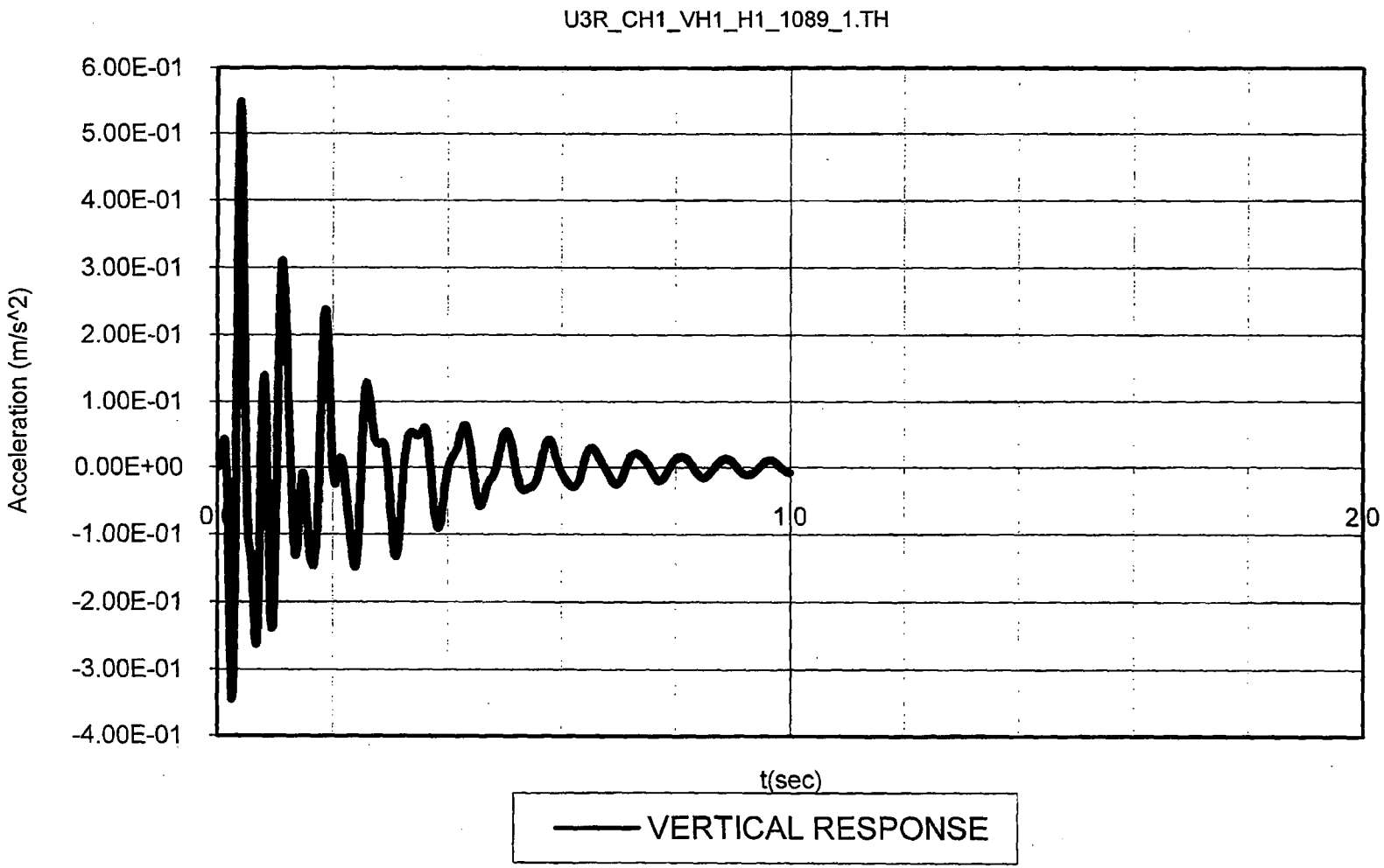
ESBWR Chugging Time History Plots

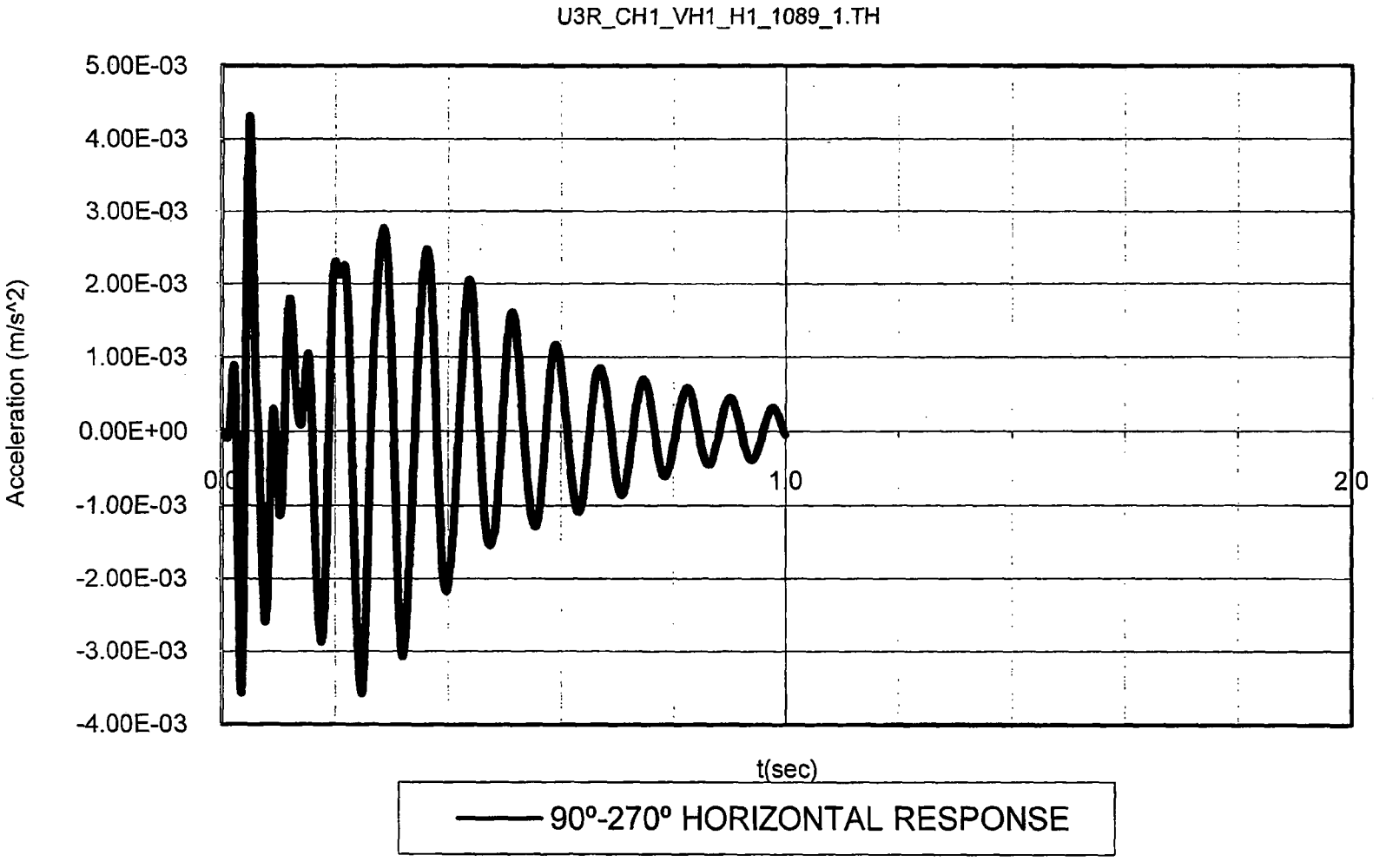

U3R_CH1_VH1_H1_1019_1.TH
1.00E-01
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
-2.00E-02
-4.00E-02
-6.00E-02
-8.00E-02
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
0º-180º HORIZONTAL RESPONSE

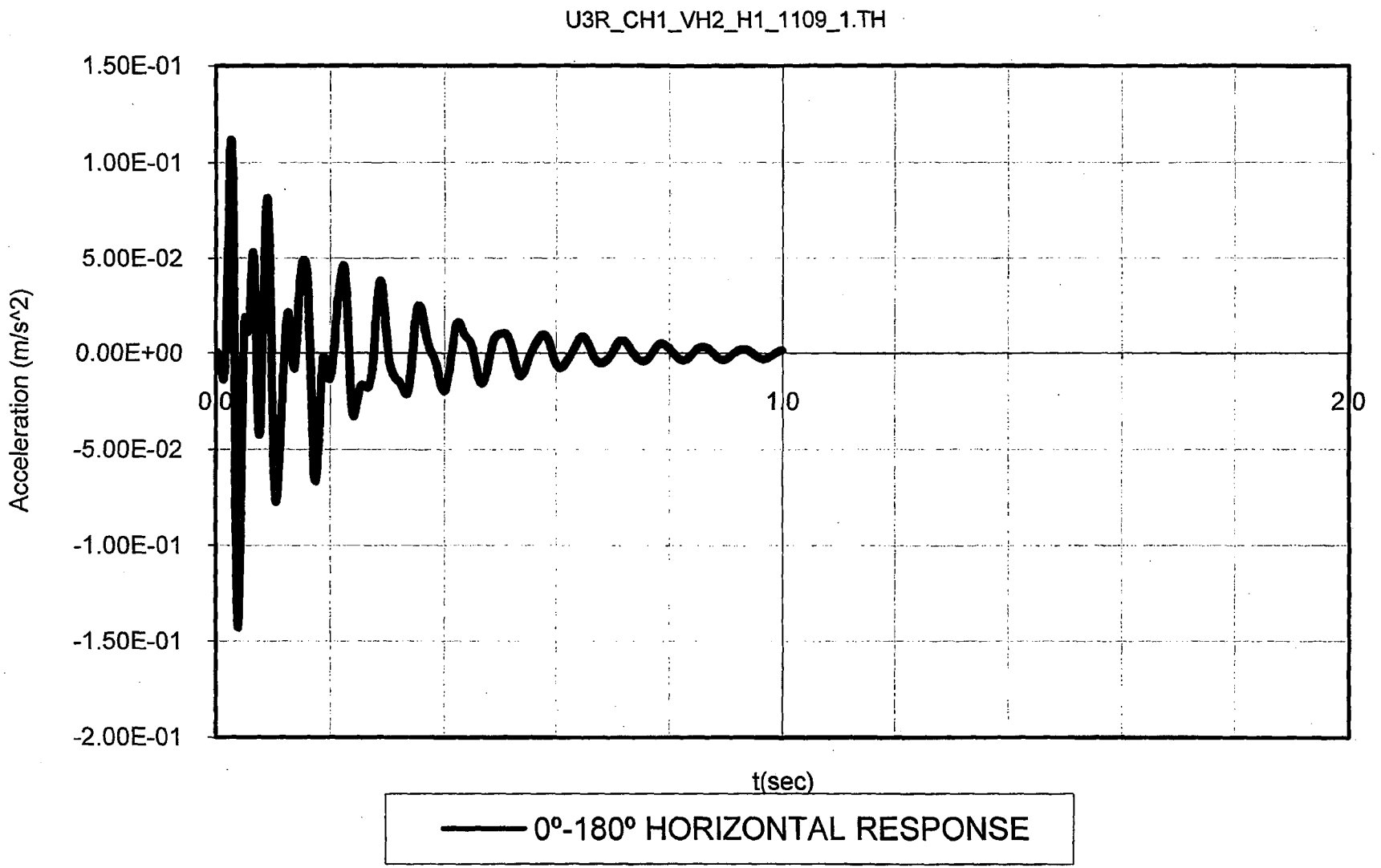

U3R_CH1_VH1_H1_1019_1.TH
5.00E-01
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
VERTICAL RESPONSE

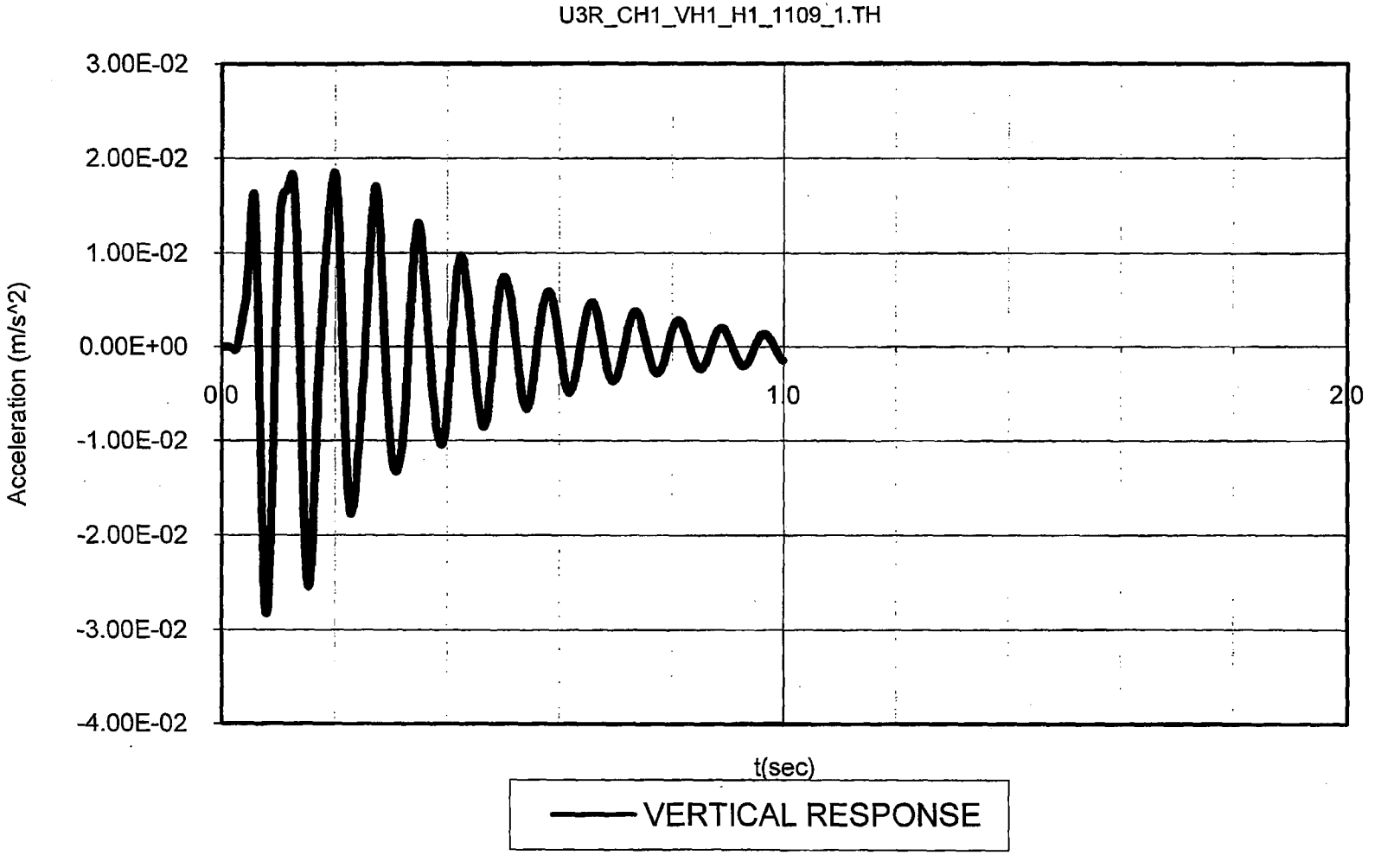

U3R_CH1_VH1_H1_1019_1.TH
4.00E-03
3.00E-03
2.00E-03
1.00E-03
0.00E+00
-1.00E-03
-2.00E-03
-3.00E-03
-4.00E-03
-5.00E-03
-6.00E-03
Acceleration (m/s^2)
0.0
10
20
t(sec)
90º-270º HORIZONTAL RESPONSE

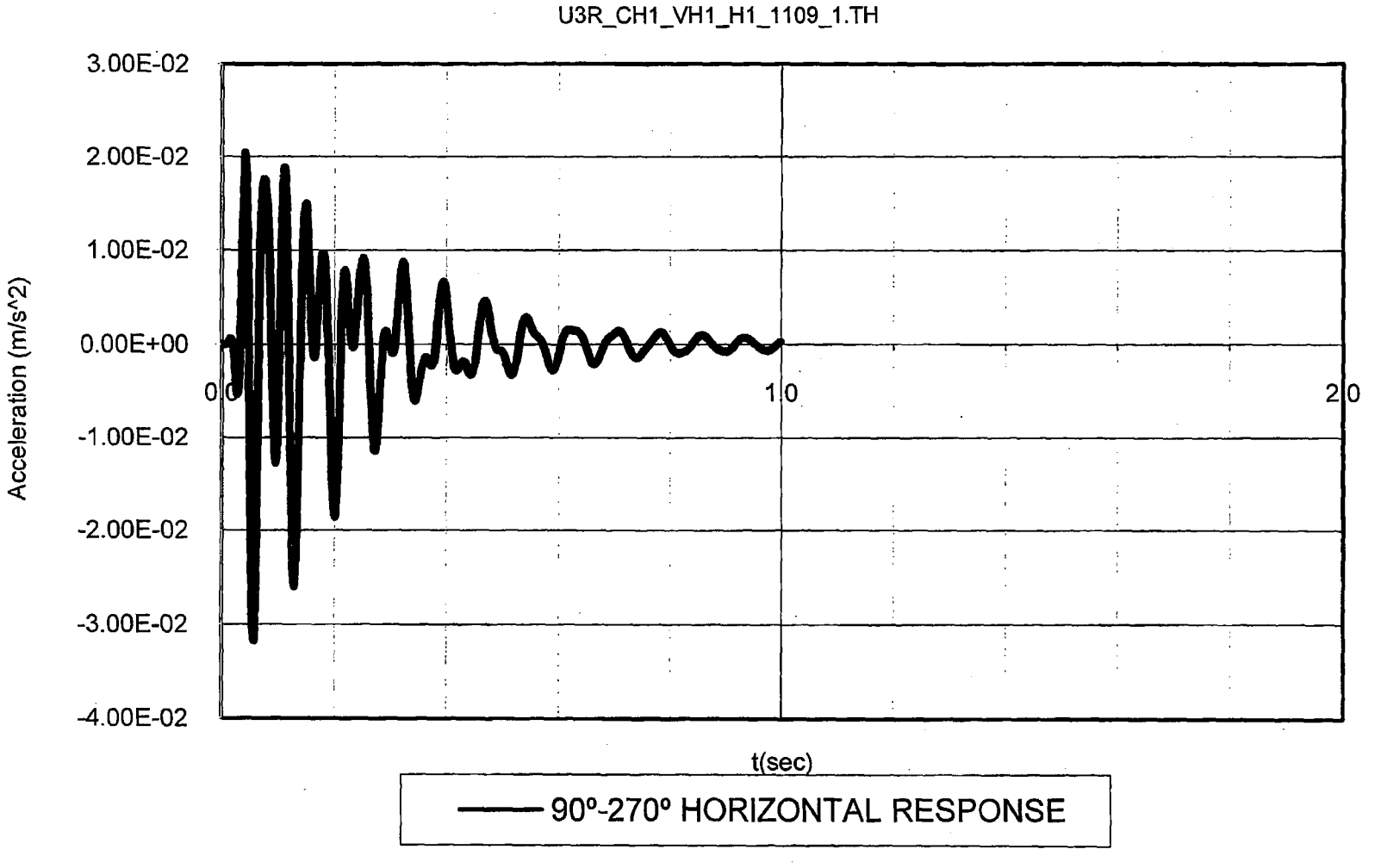

U3R_CH1_VH2_H1_1089_1.TH
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
-1.50E-01
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
0°-180° HORIZONTAL RESPONSE

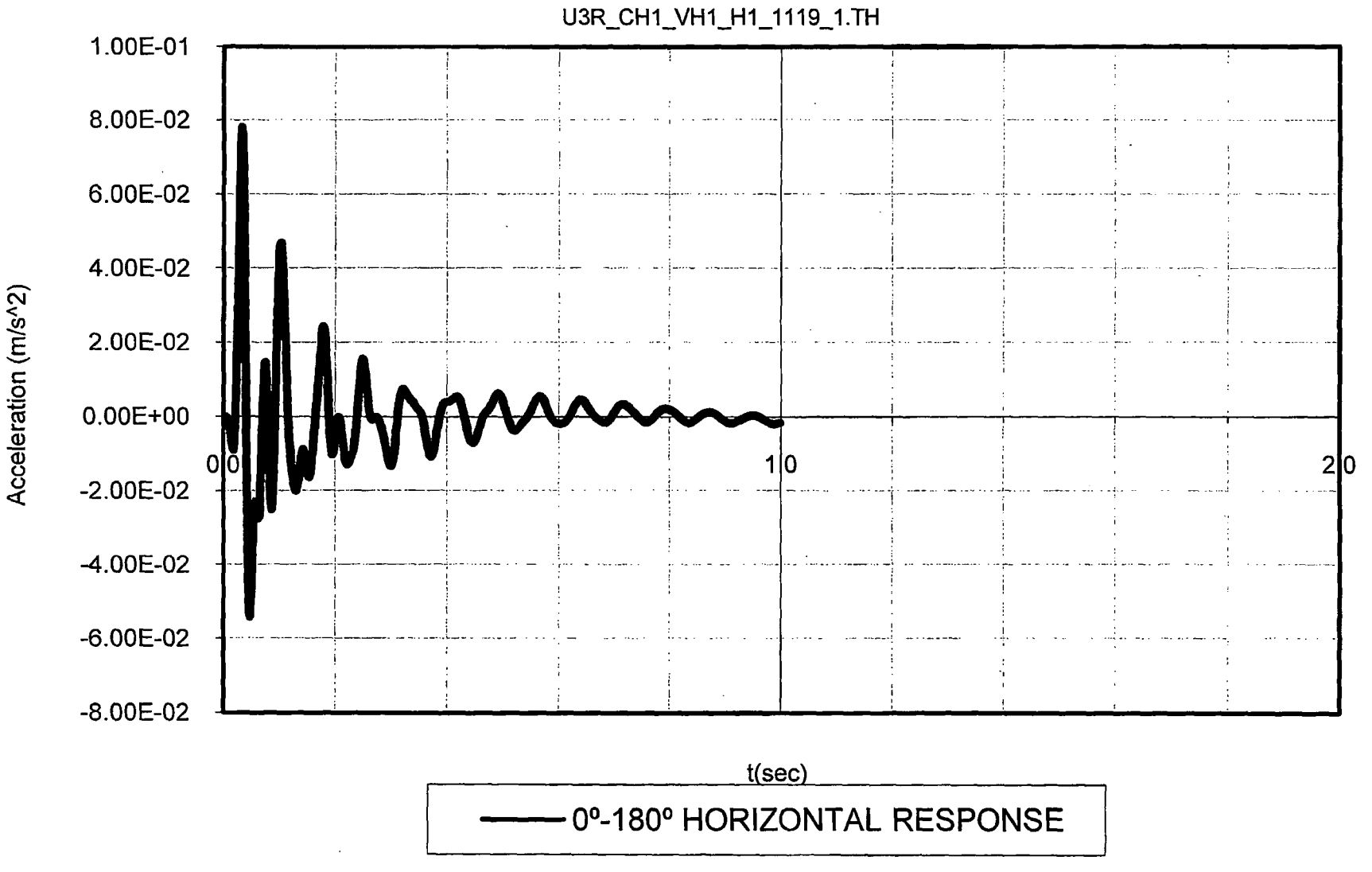

U3R_CH1_VH1_H1_1089_1.TH
6.00E-01
5.00E-01
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
-4.00E-01
Acceleration (m/s^2)
0
10
20
t(sec)
VERTICAL RESPONSE

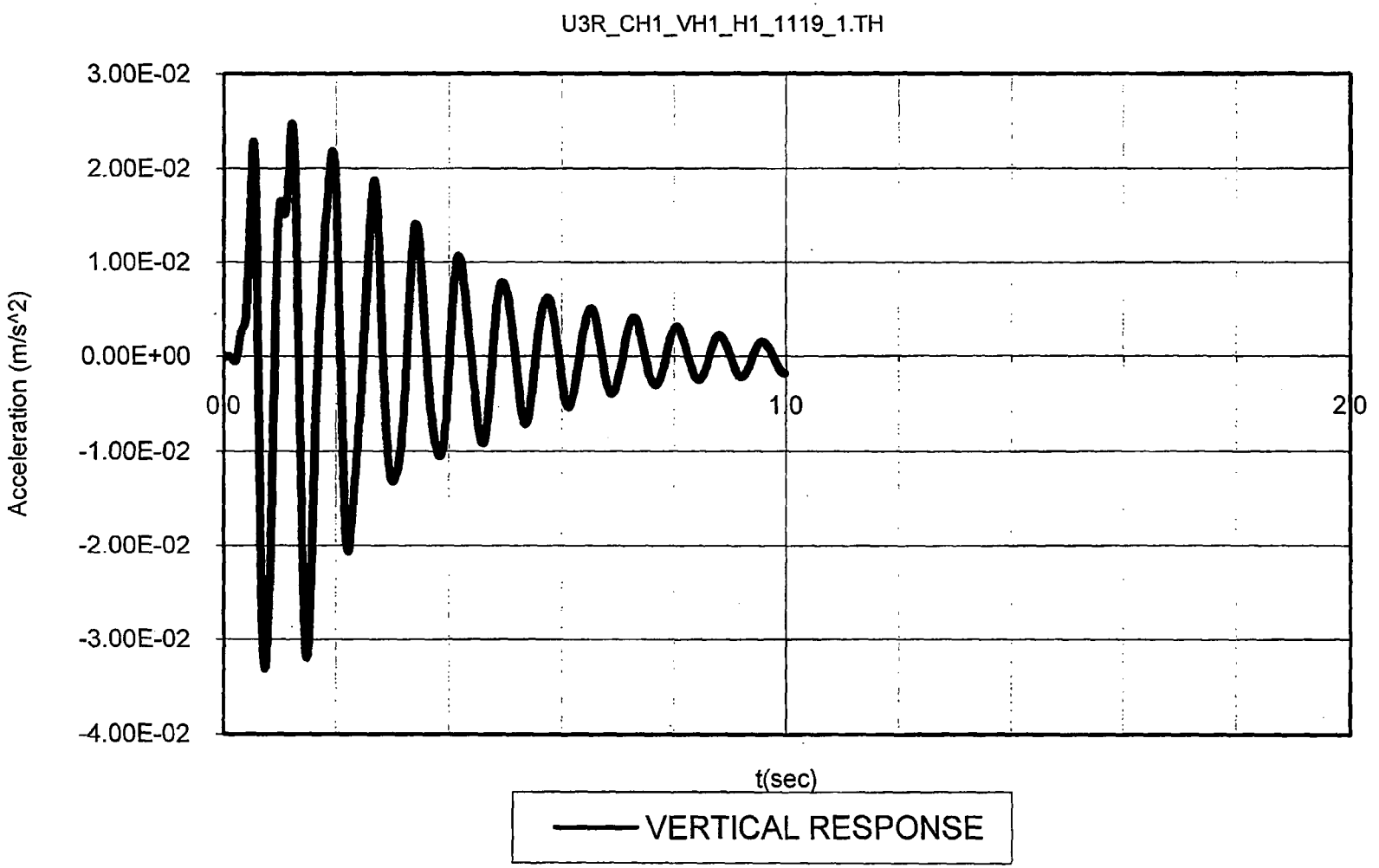

U3R_CH1_VH1_H1_1089_1.TH
5.00E-03
4.00E-03
3.00E-03
2.00E-03
1.00E-03
0.00E+00
-1.00E-03
-2.00E-03
-3.00E-03
-4.00E-03
Acceleration (m/s^2)
0.0
10
20
t(sec)
90º-270º HORIZONTAL RESPONSE

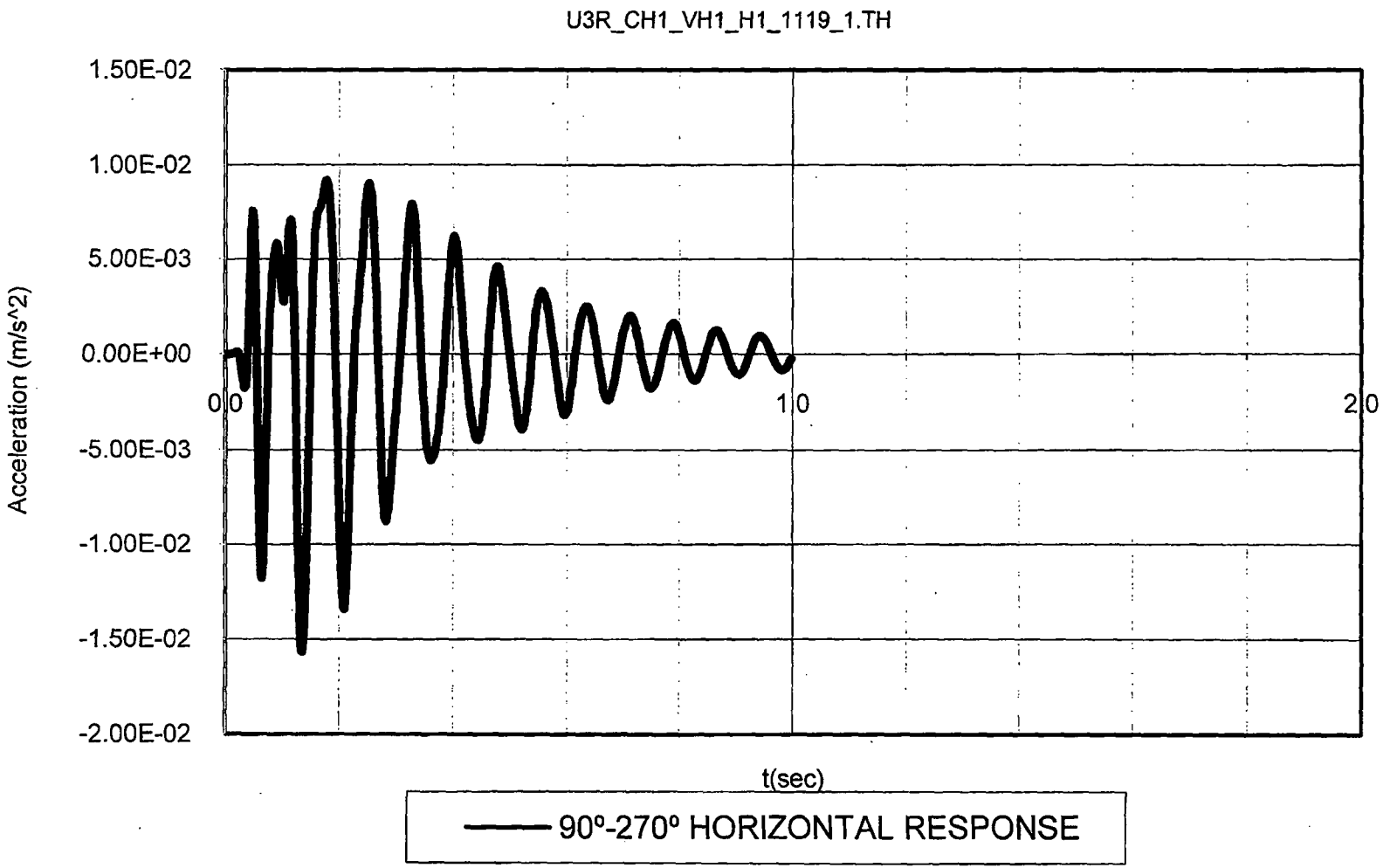

U3R_CH1_VH2_H1_1109_1.TH
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
-1.50E-01
-2.00E-01
Acceleration (m/s^2)
0.0
10
20
t(sec)
0º-180º HORIZONTAL RESPONSE

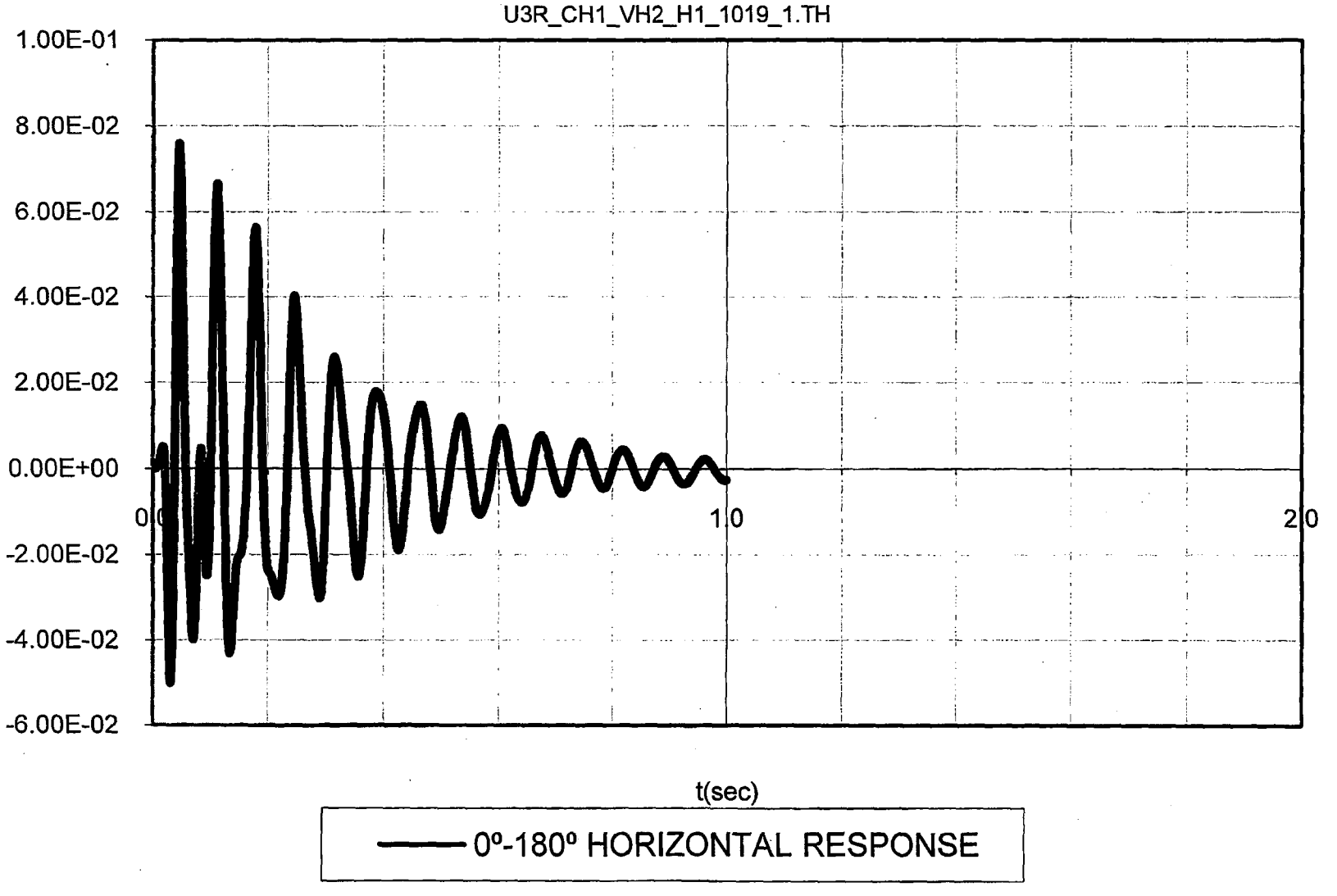

U3R_CH1_VH1_H1_1109_1.TH
3.00E-02
2.00E-02
1.00E-02
0.00E+00
-1.00E-02
-2.00E-02
-3.00E-02
-4.00E-02
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
VERTICAL RESPONSE

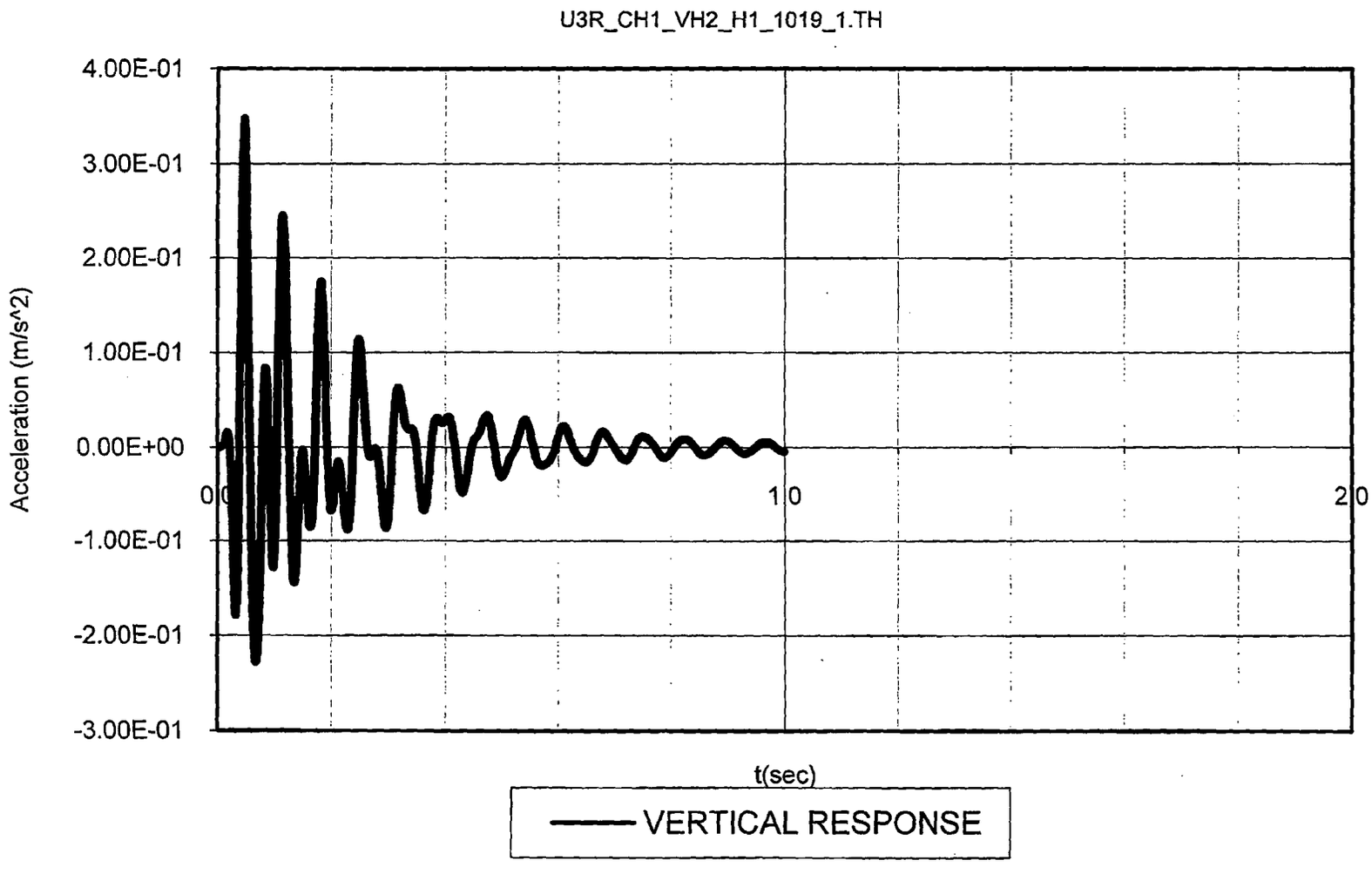

U3R_CH1_VH1_H1_1109_1.TH
3.00E-02
2.00E-02
1.00E-02
0.00E+00
-1.00E-02
-2.00E-02
-3.00E-02
-4.00E-02
Acceleration (m/s^2)
0.0
10
20
t(sec)
90°-270° HORIZONTAL RESPONSE

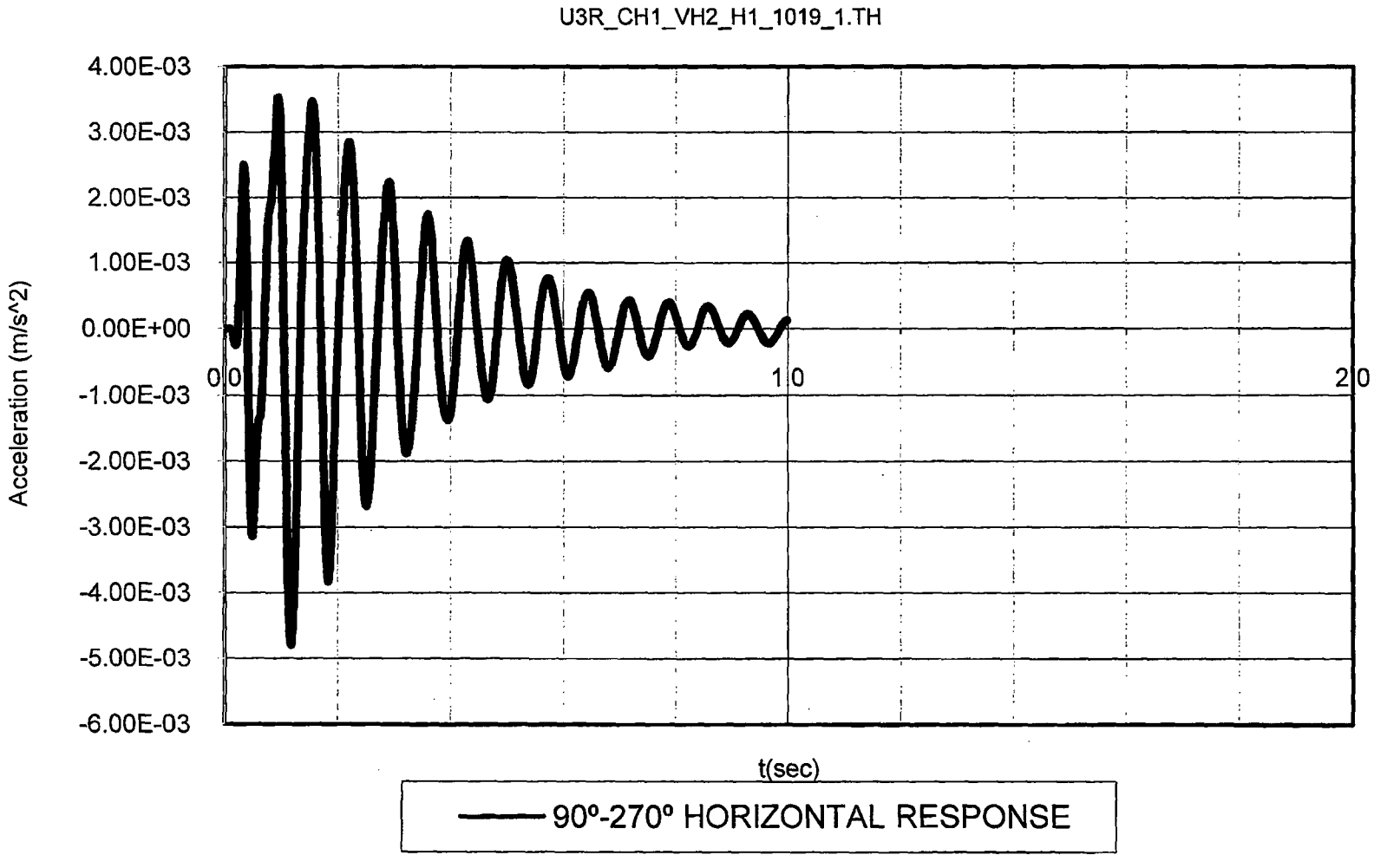

U3R_CH1_VH1_H1_1119_1.TH
1.00E-01
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
-2.00E-02
-4.00E-02
-6.00E-02
-8.00E-02
Acceleration (m/s^2)
0.0
10
20
t(sec)
0°-180° HORIZONTAL RESPONSE

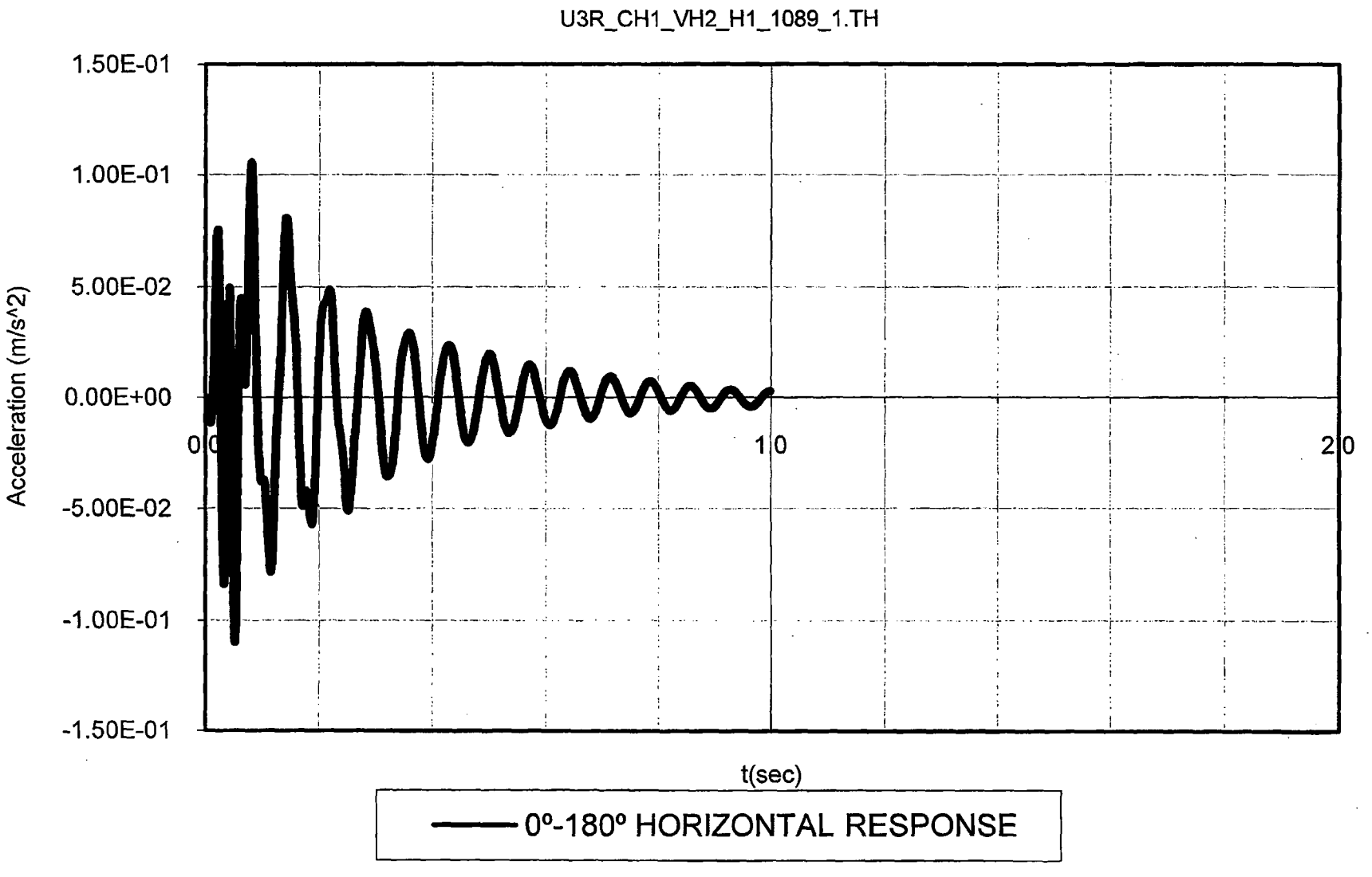

U3R_CH1_VH1_H1_1119_1.TH
3.00E-02
2.00E-02
1.00E-02
0.00E+00
-1.00E-02
-2.00E-02
-3.00E-02
-4.00E-02
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
VERTICAL RESPONSE

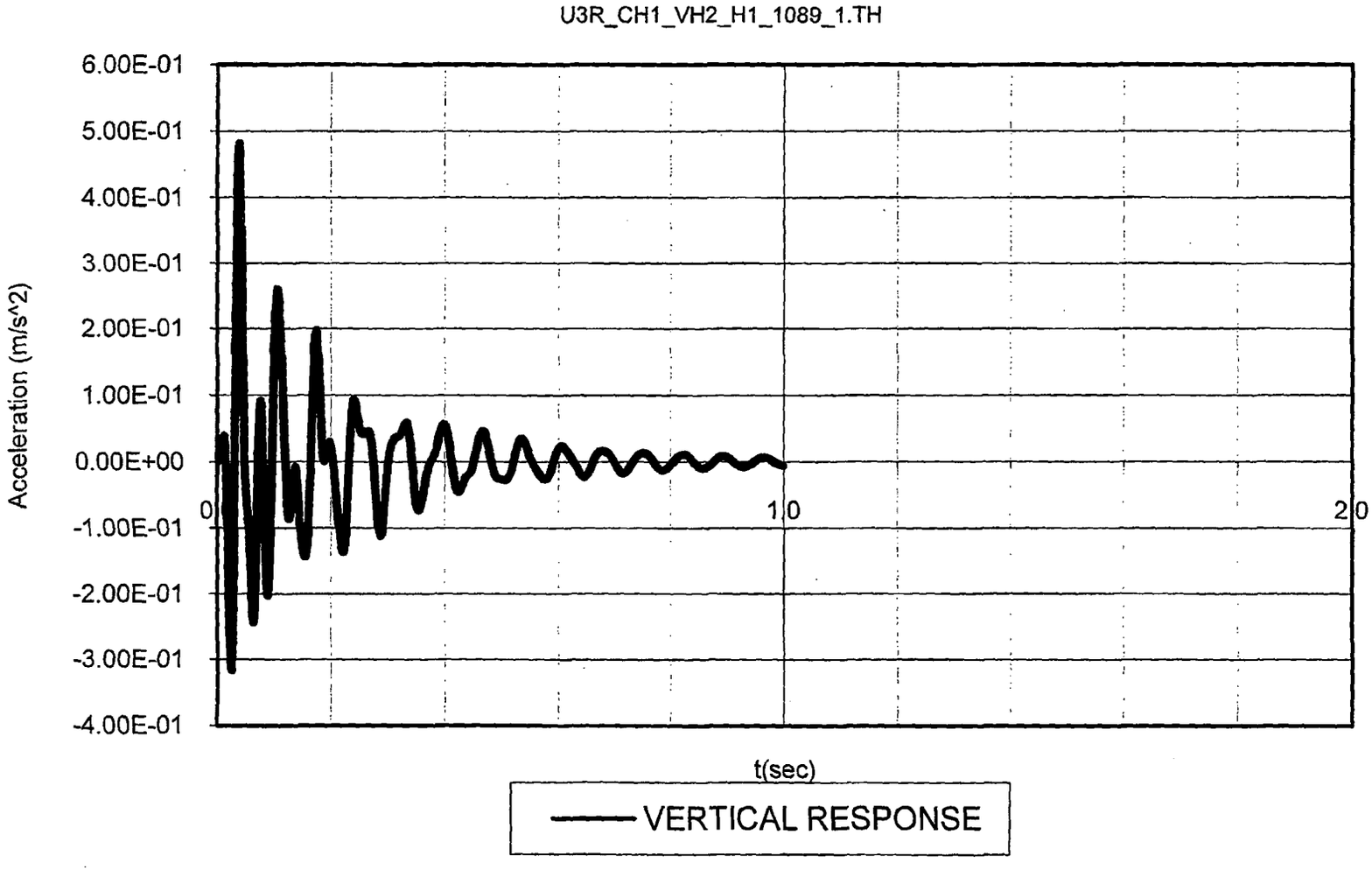

U3R_CH1_VH1_H1_1119_1.TH
1.50E-02
1.00E-02
5.00E-03
0.00E+00
-5.00E-03
-1.00E-02
-1.50E-02
-2.00E-02
Acceleration (m/s^2)
0.0
10.0
20.0
t(sec)
90°-270° HORIZONTAL RESPONSE

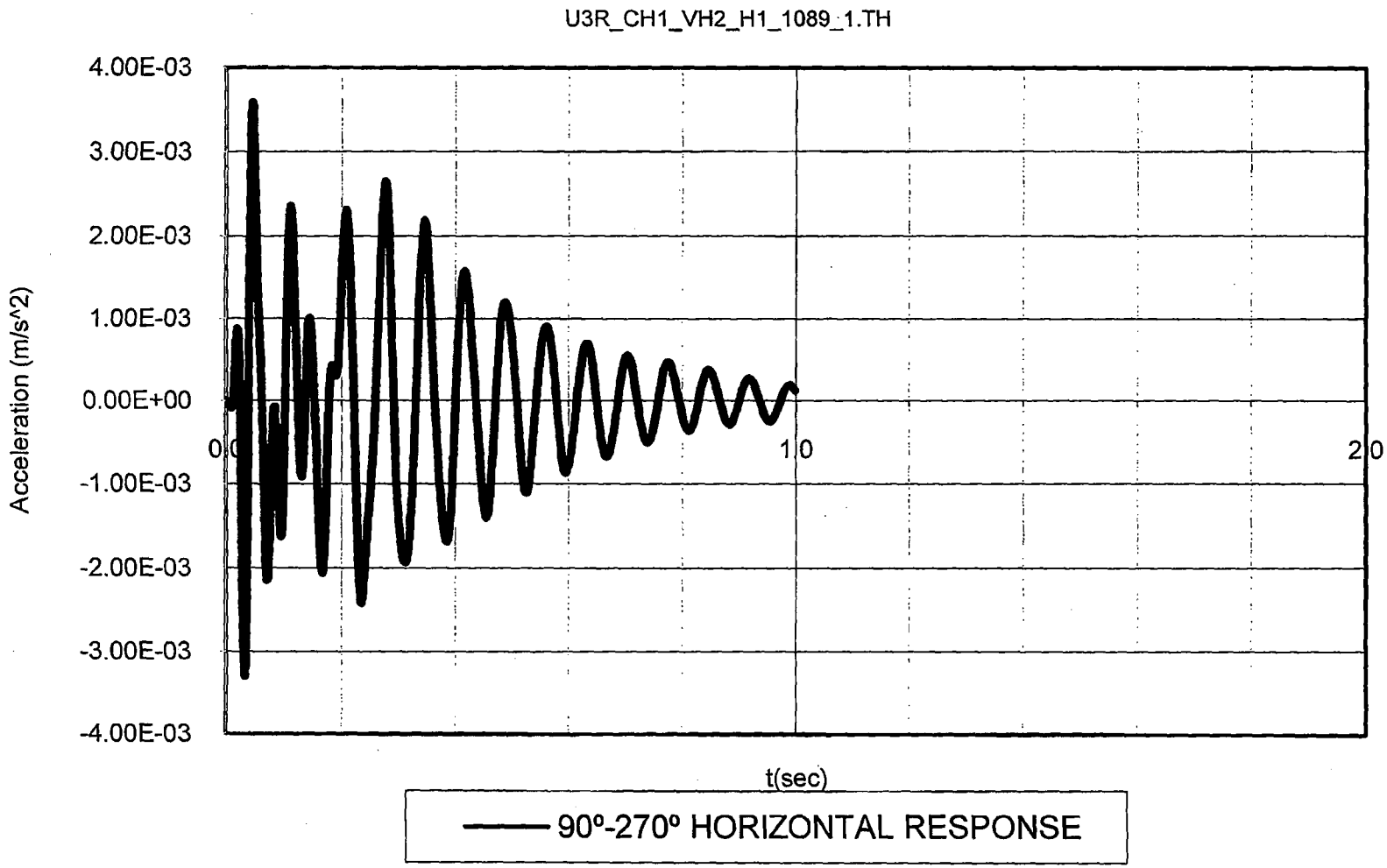

U3R_CH1_VH2_H1_1019_1.TH
1.00E-01
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
-2.00E-02
-4.00E-02
-6.00E-02
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
0º-180º HORIZONTAL RESPONSE

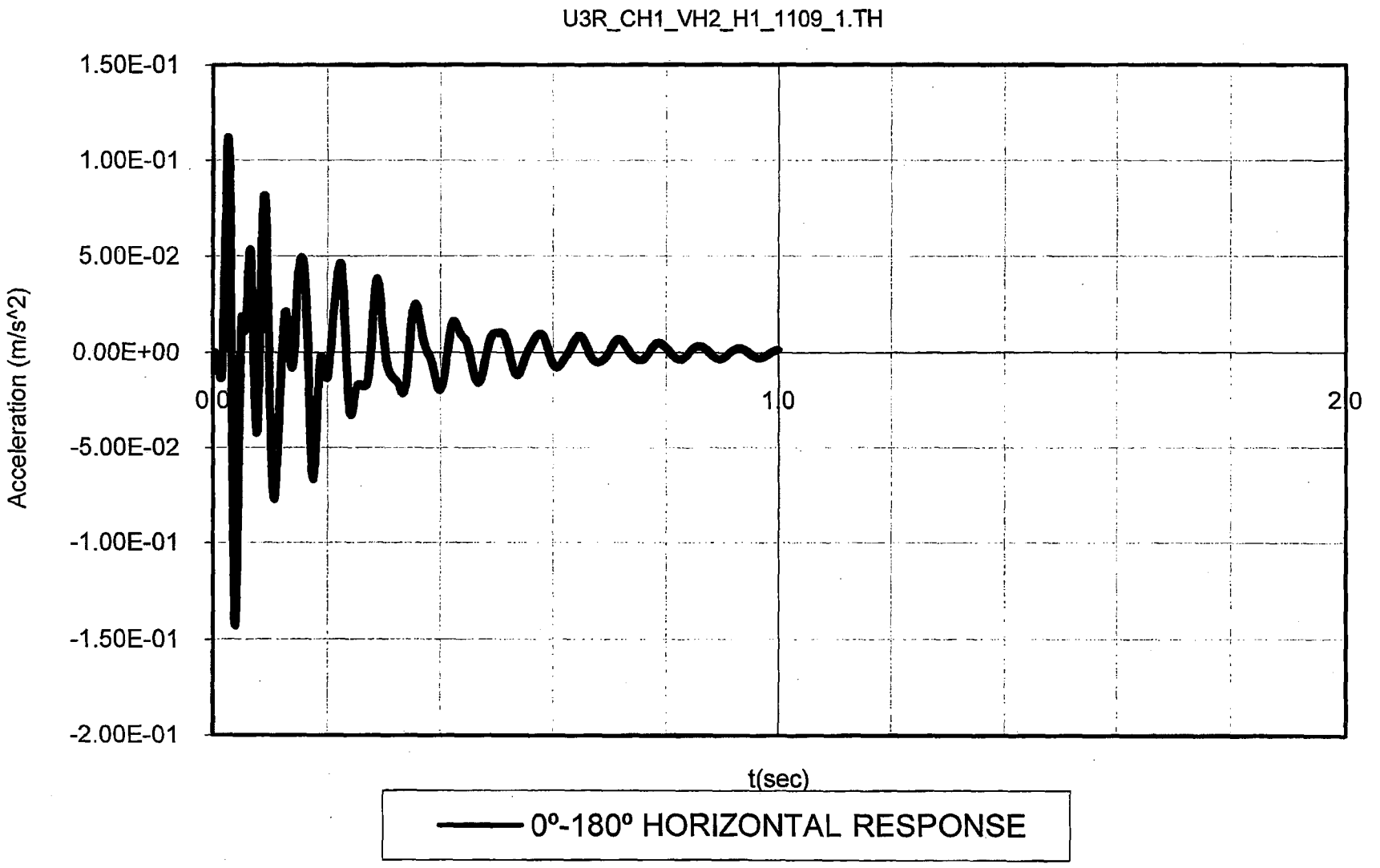

U3R_CH1_VH2_H1_1019_1.TH
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
Acceleration (m/s^2)
0.0
10
20
t(sec)
VERTICAL RESPONSE

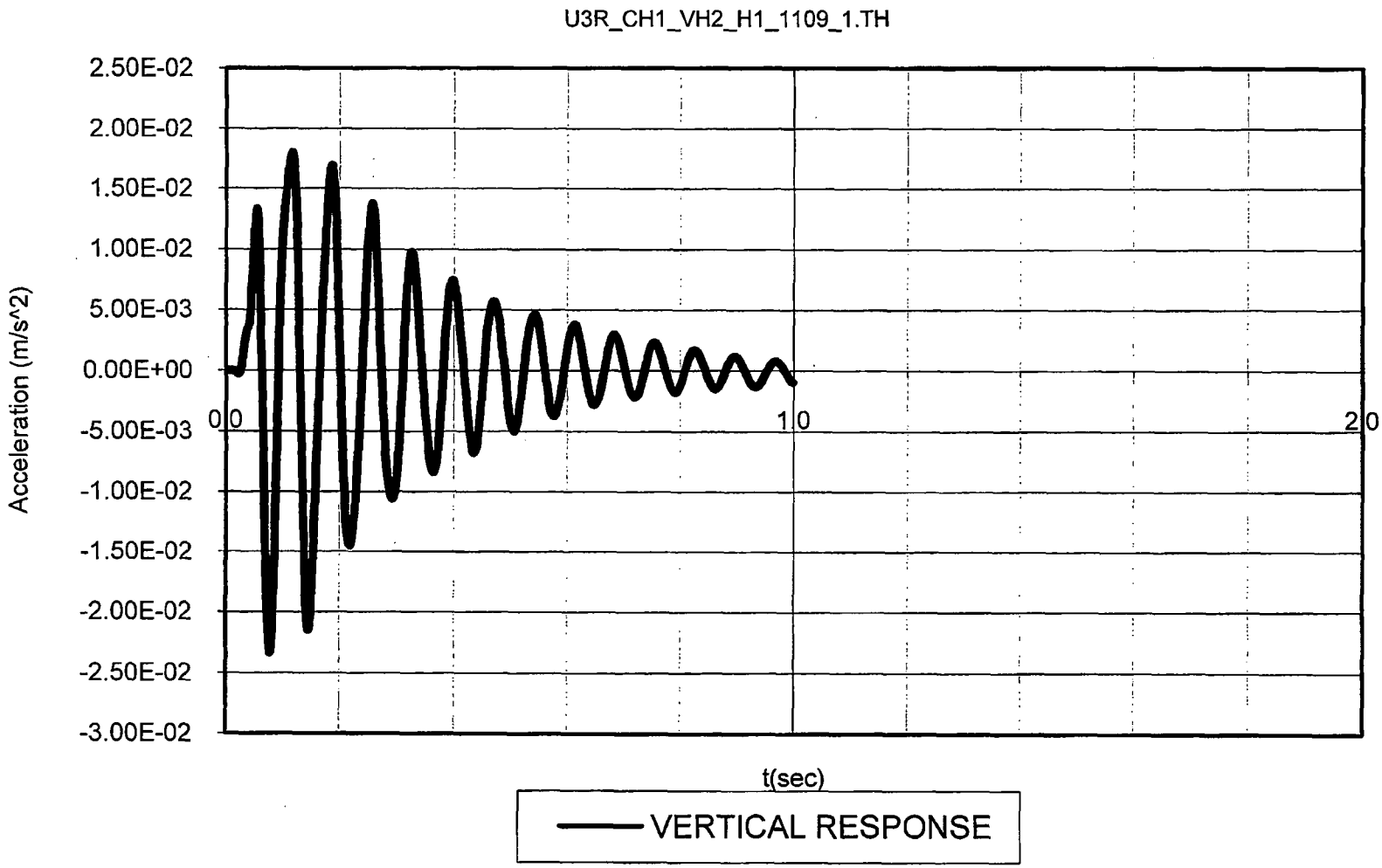

U3R_CH1_VH2_H1_1019_1.TH
4.00E-03
3.00E-03
2.00E-03
1.00E-03
0.00E+00
-1.00E-03
-2.00E-03
-3.00E-03
-4.00E-03
-5.00E-03
-6.00E-03
Acceleration (m/s^2)
0.0
10
20
t(sec)
90º-270º HORIZONTAL RESPONSE

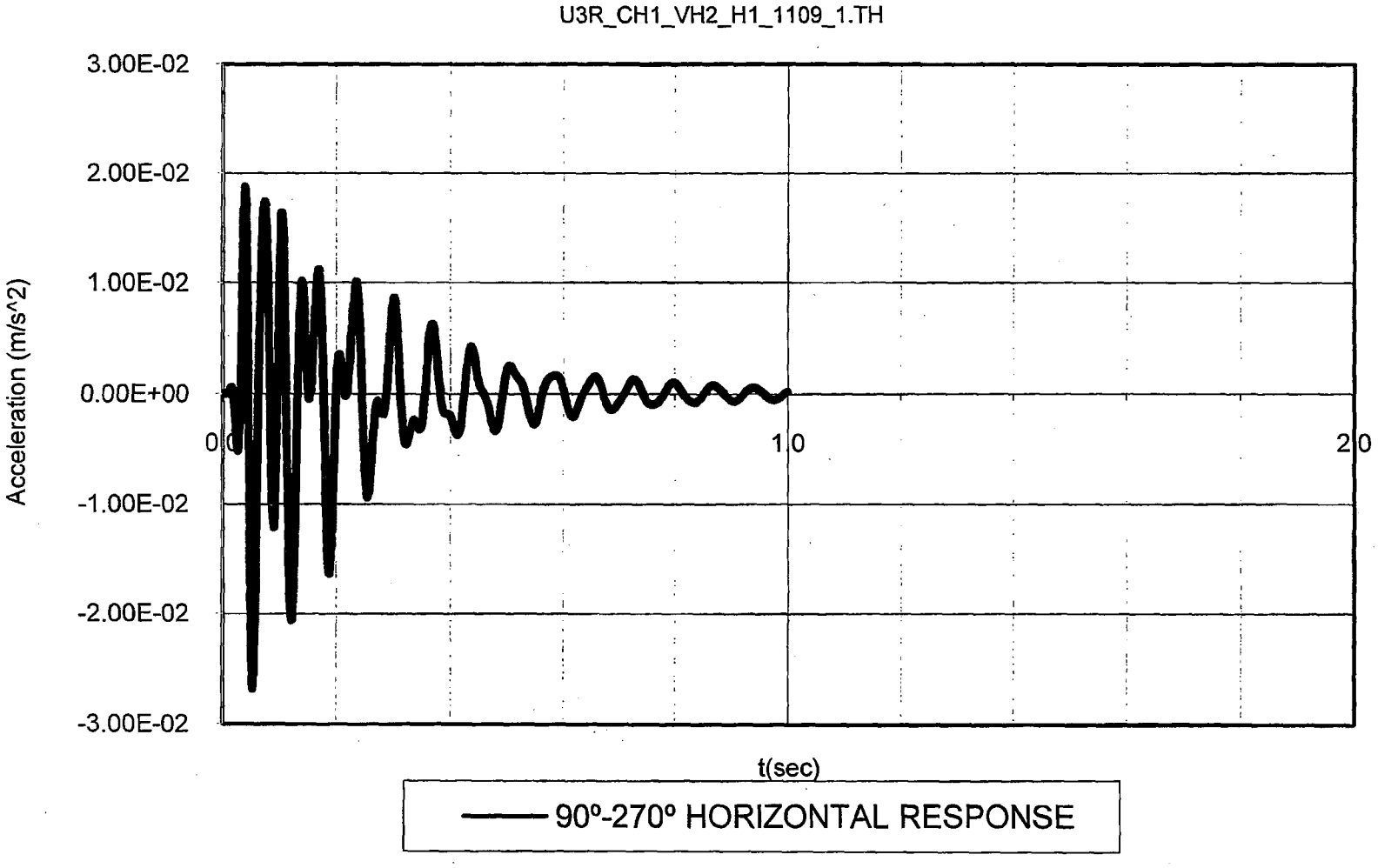

U3R_CH1_VH2_H1_1089_1.TH
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
-1.50E-01
Acceleration (m/s^2)
0.0
10
20
t(sec)
0°-180° HORIZONTAL RESPONSE

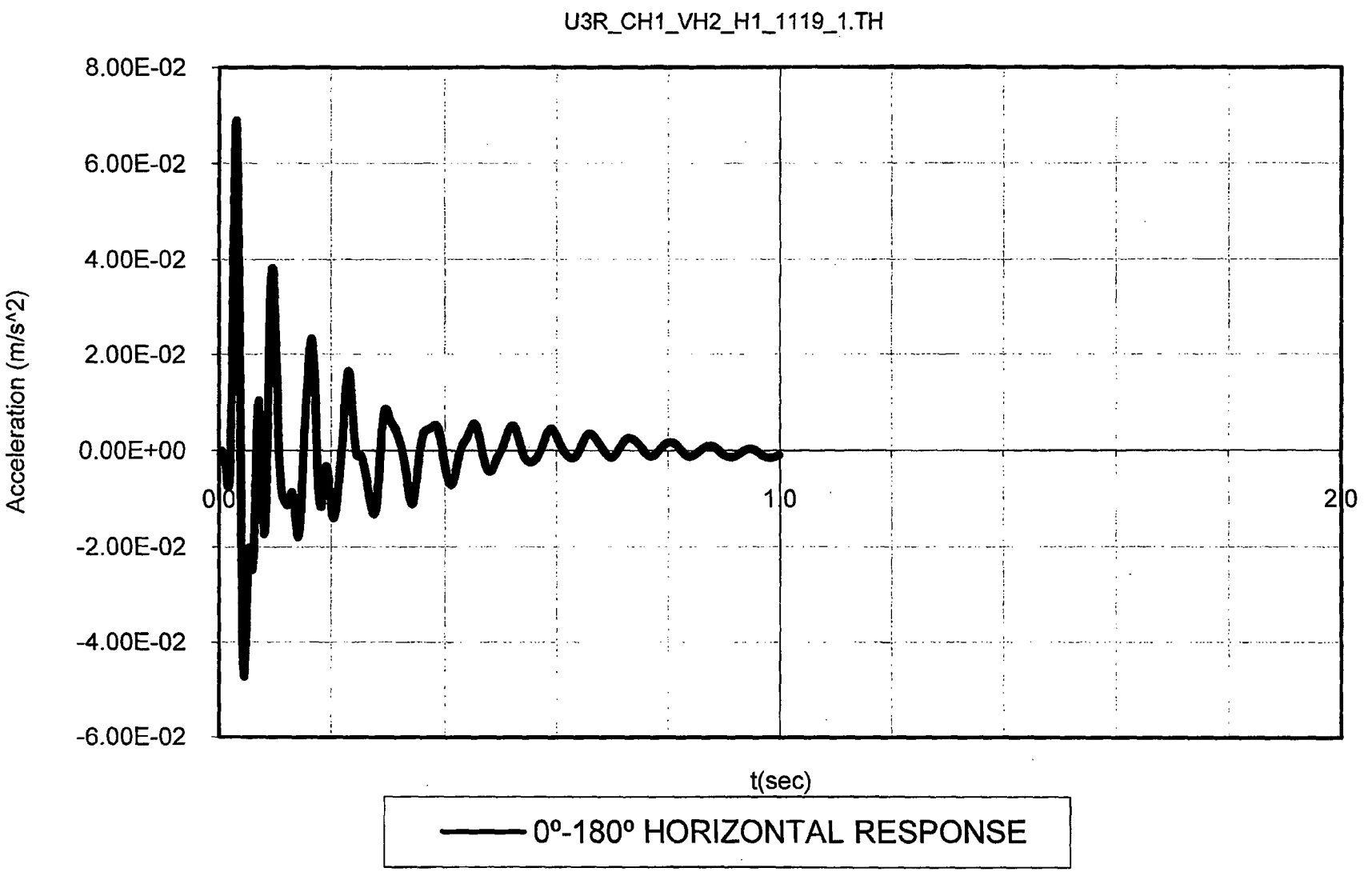

U3R_CH1_VH2_H1_1089_1.TH
6.00E-01
5.00E-01
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
-4.00E-01
Acceleration (m/s^2)
0
10
20
t(sec)
VERTICAL RESPONSE

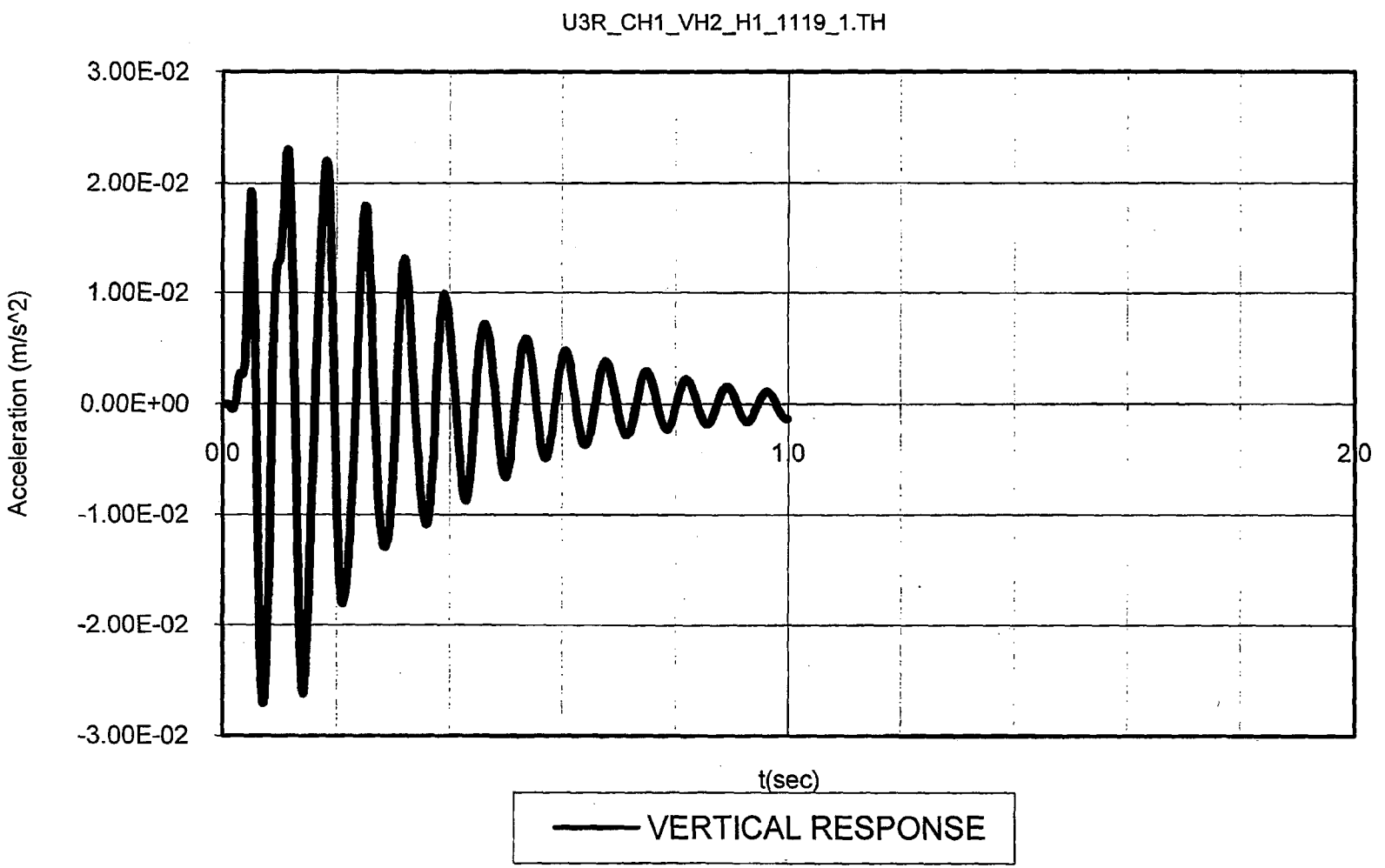

U3R_CH1_VH2_H1_1089_1.TH
4.00E-03
3.00E-03
2.00E-03
1.00E-03
0.00E+00
-1.00E-03
-2.00E-03
-3.00E-03
-4.00E-03
Acceleration (m/s^2)
0.0
10
20
t(sec)
90°-270° HORIZONTAL RESPONSE

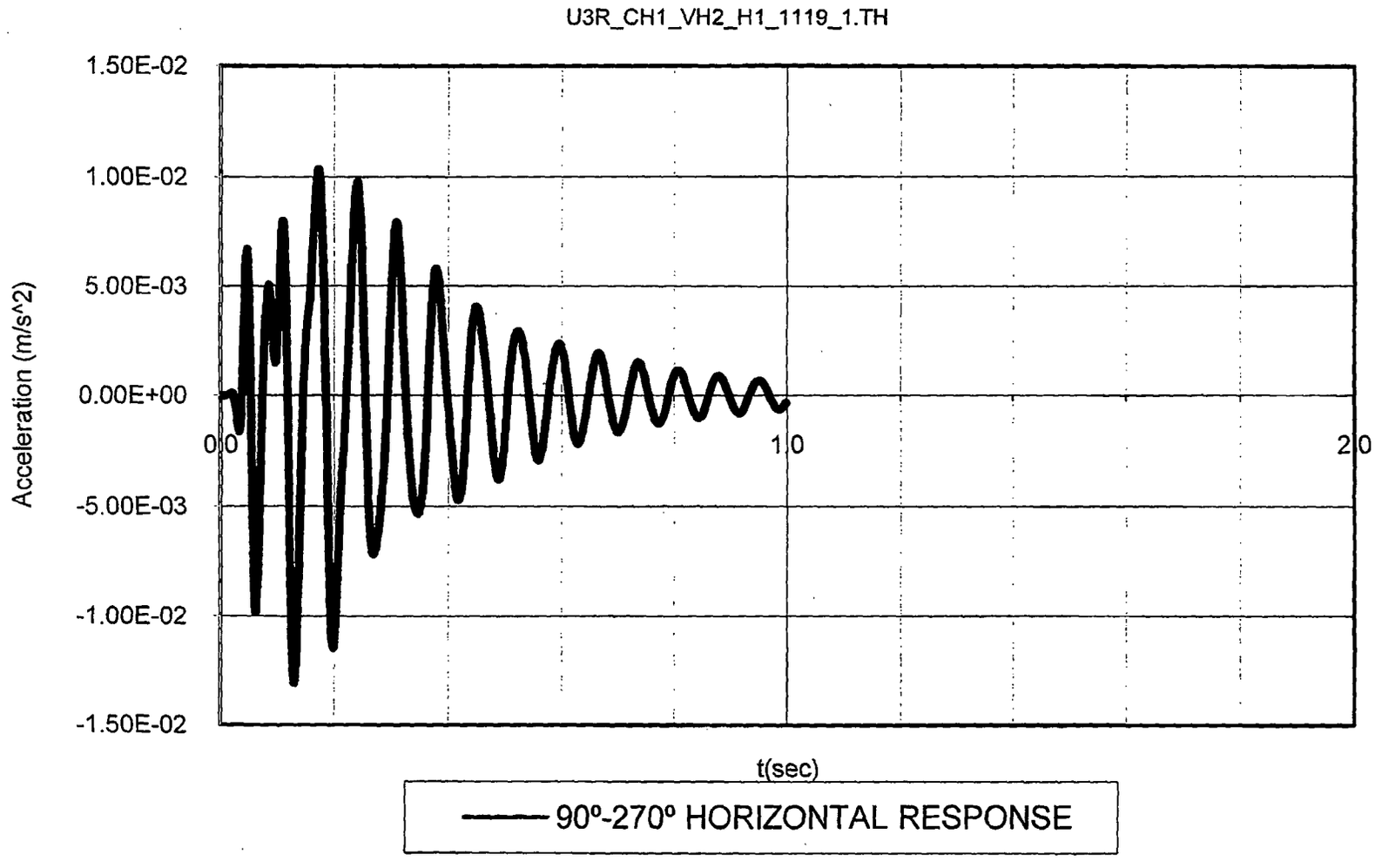

U3R_CH1_VH2_H1_1109_1.TH
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
-1.50E-01
-2.00E-01
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
0º-180º HORIZONTAL RESPONSE

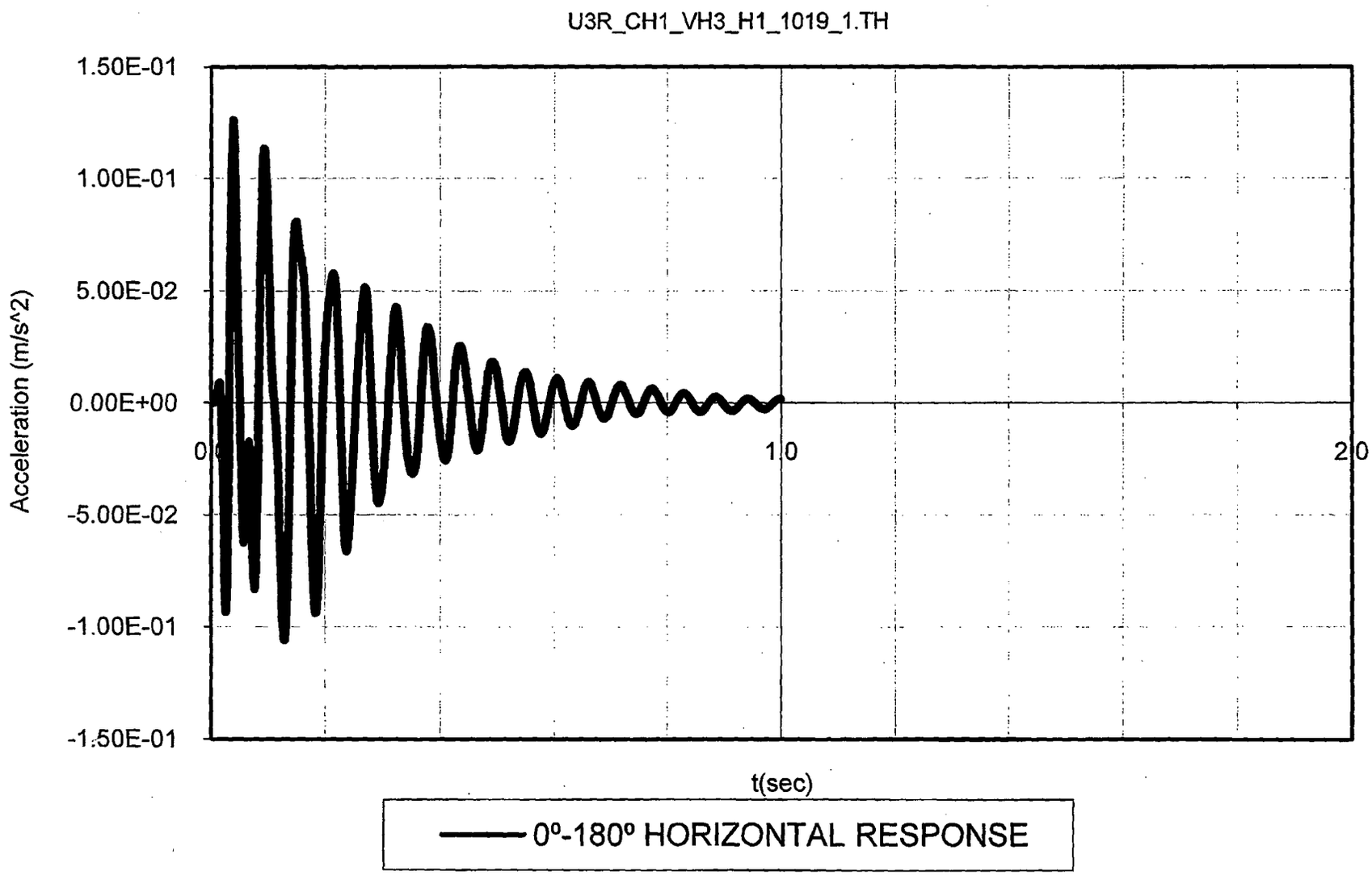

U3R_CH1_VH2_H1_1109_1.TH
2.50E-02
2.00E-02
1.50E-02
1.00E-02
5.00E-03
0.00E+00
-5.00E-03
-1.00E-02
-1.50E-02
-2.00E-02
-2.50E-02
-3.00E-02
Acceleration (m/s^2)
0.0
10
20
t(sec)
VERTICAL RESPONSE

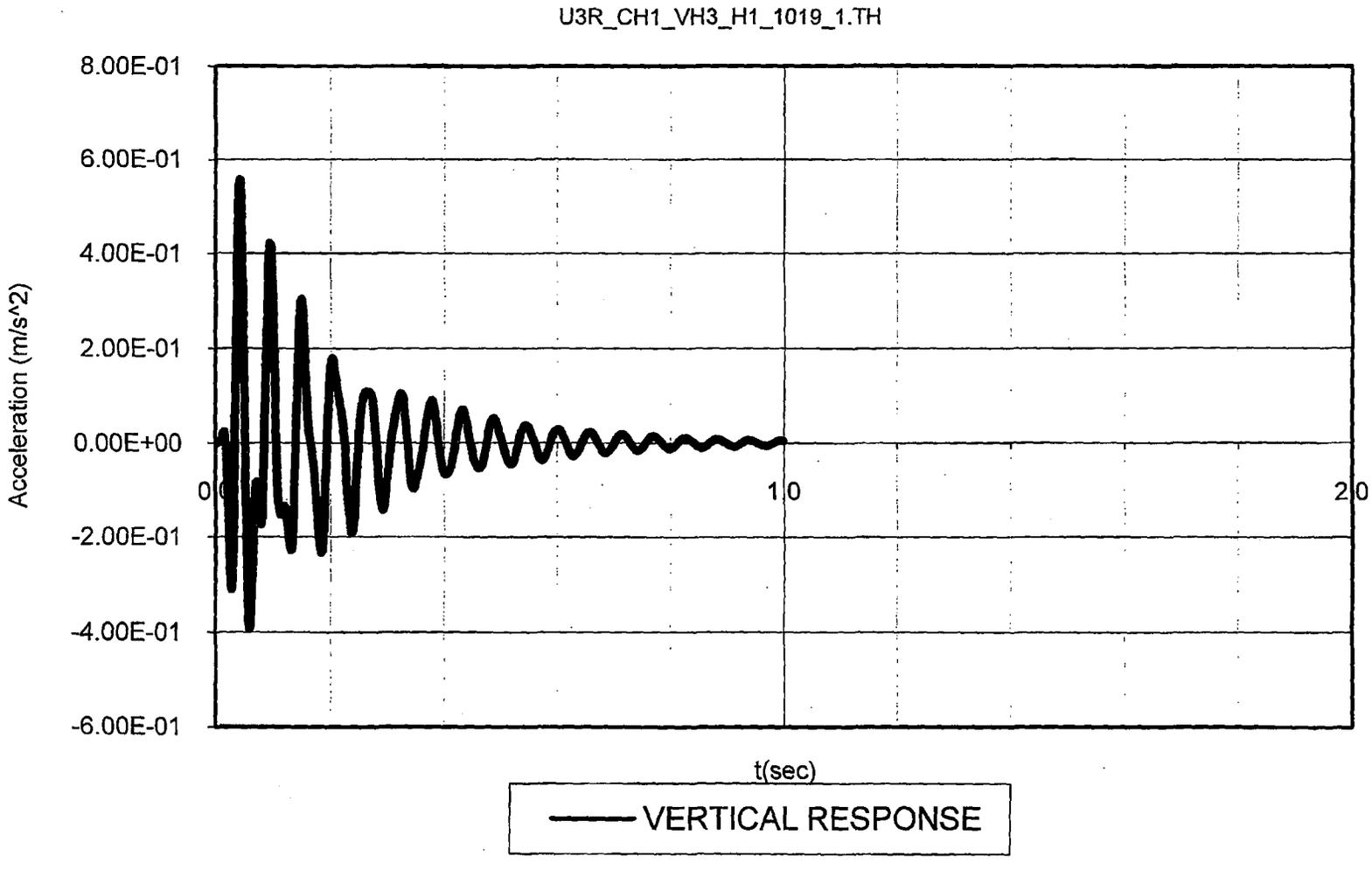

U3R_CH1_VH2_H1_1109_1.TH
3.00E-02
2.00E-02
1.00E-02
0.00E+00
-1.00E-02
-2.00E-02
-3.00E-02
Acceleration (m/s^2)
0.0
10
20
t(sec)
90°-270° HORIZONTAL RESPONSE

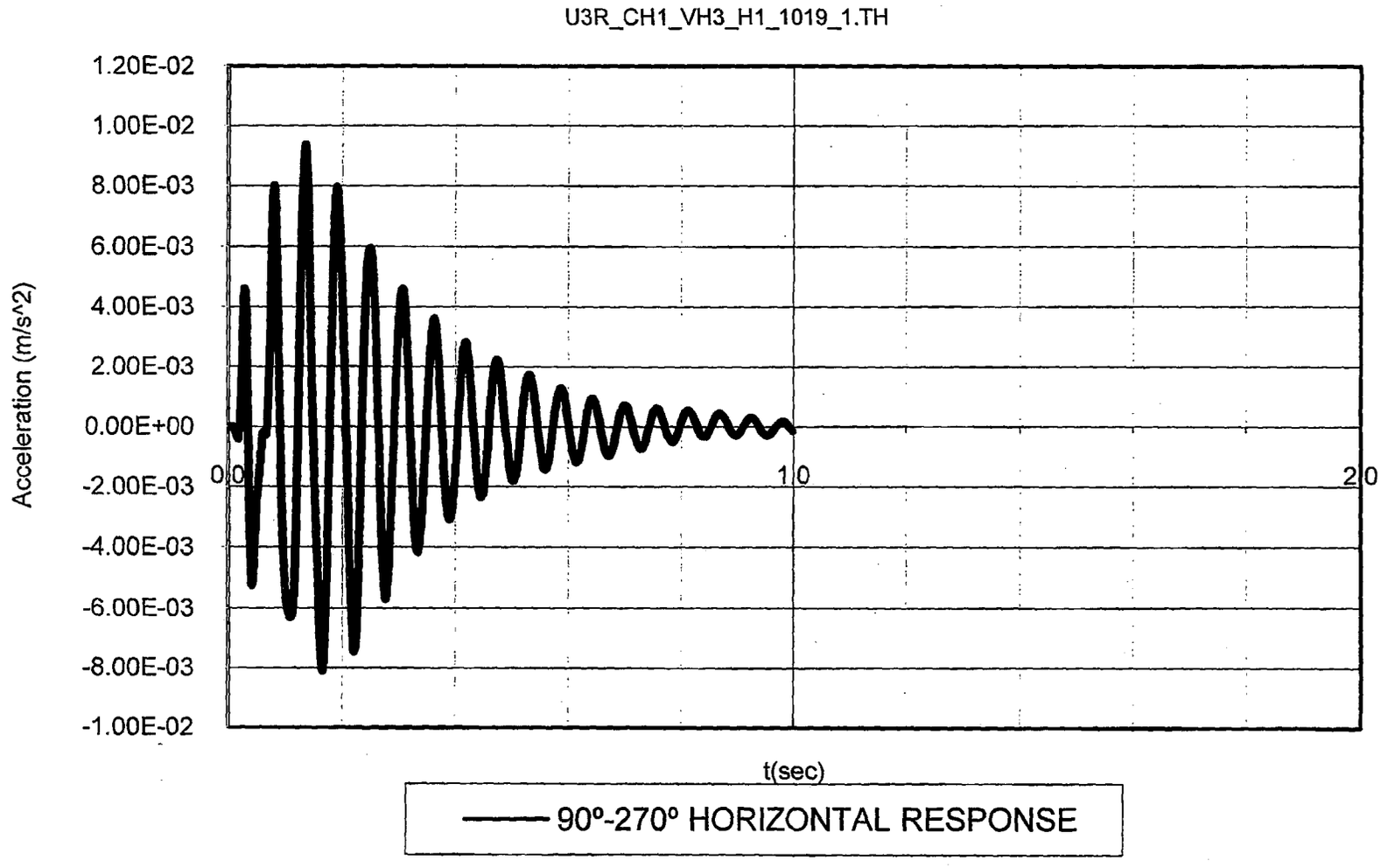

U3R_CH1_VH2_H1_1119_1.TH
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
-2.00E-02
-4.00E-02
-6.00E-02
Acceleration (m/s^2)
0.0
10
20
t(sec)
0º-180º HORIZONTAL RESPONSE

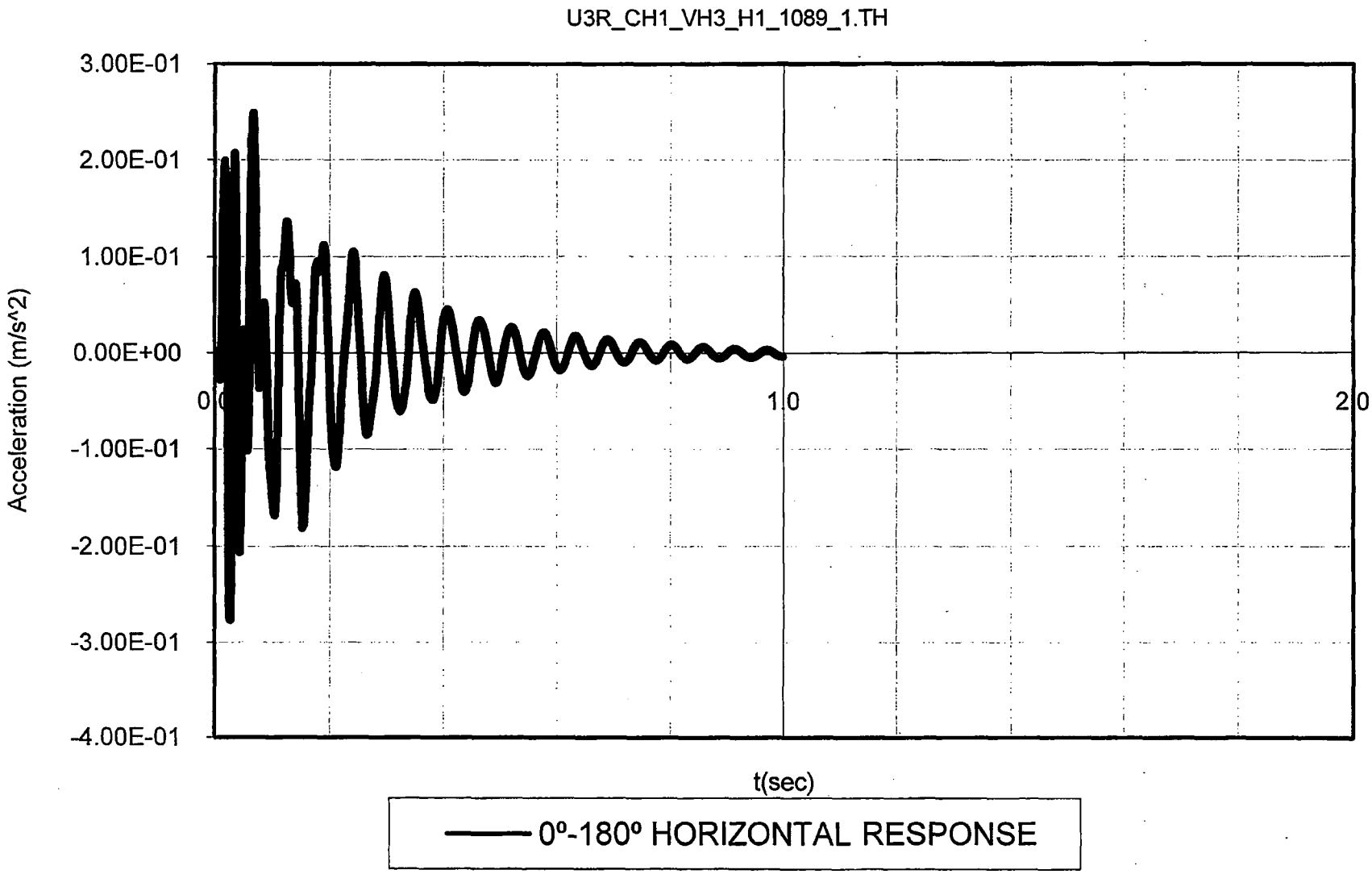

U3R_CH1_VH2_H1_1119_1.TH
3.00E-02
2.00E-02
1.00E-02
0.00E+00
-1.00E-02
-2.00E-02
-3.00E-02
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
VERTICAL RESPONSE

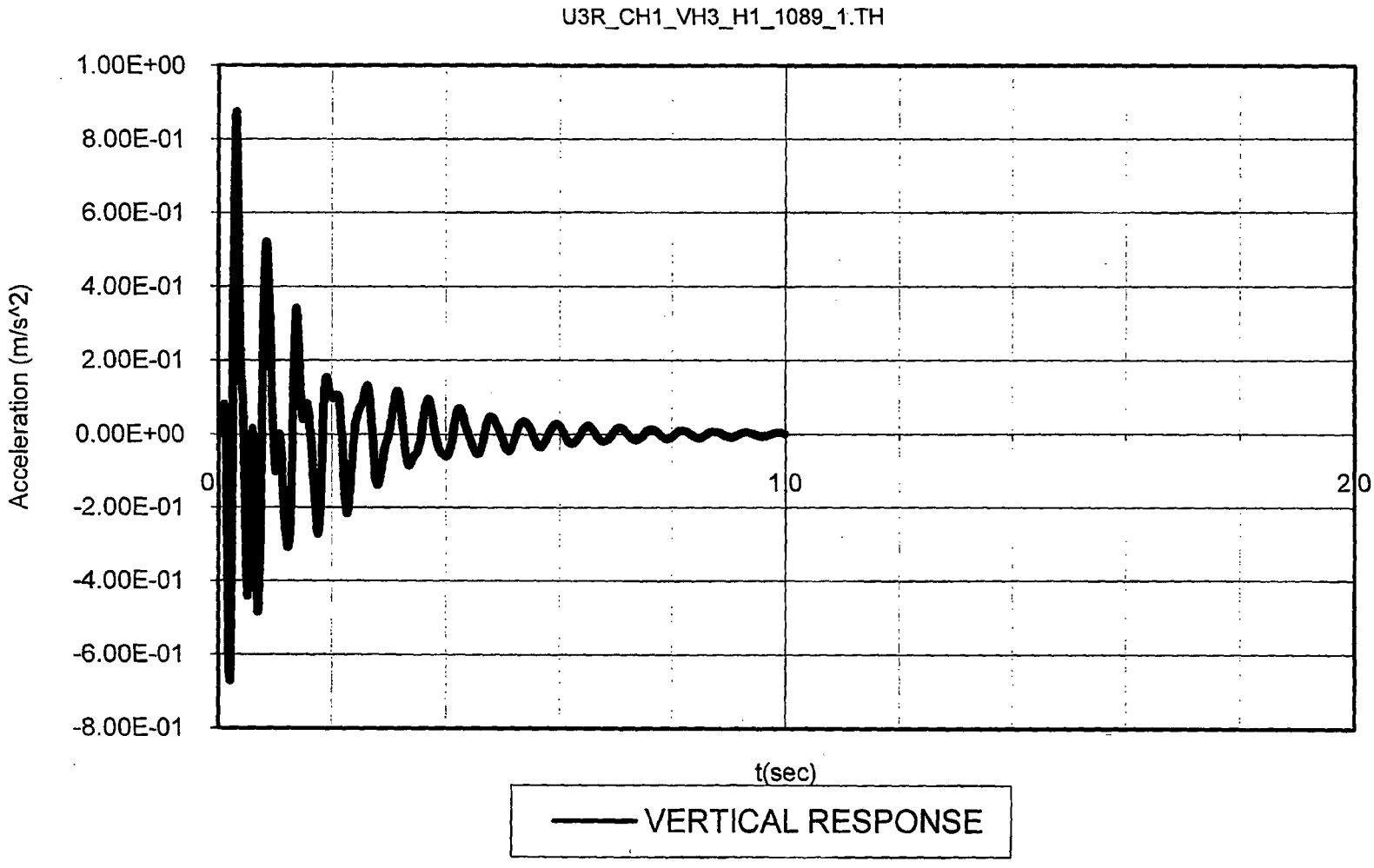

U3R_CH1_VH2_H1_1119_1.TH
1.50E-02
1.00E-02
5.00E-03
0.00E+00
-5.00E-03
-1.00E-02
-1.50E-02
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
90º-270º HORIZONTAL RESPONSE

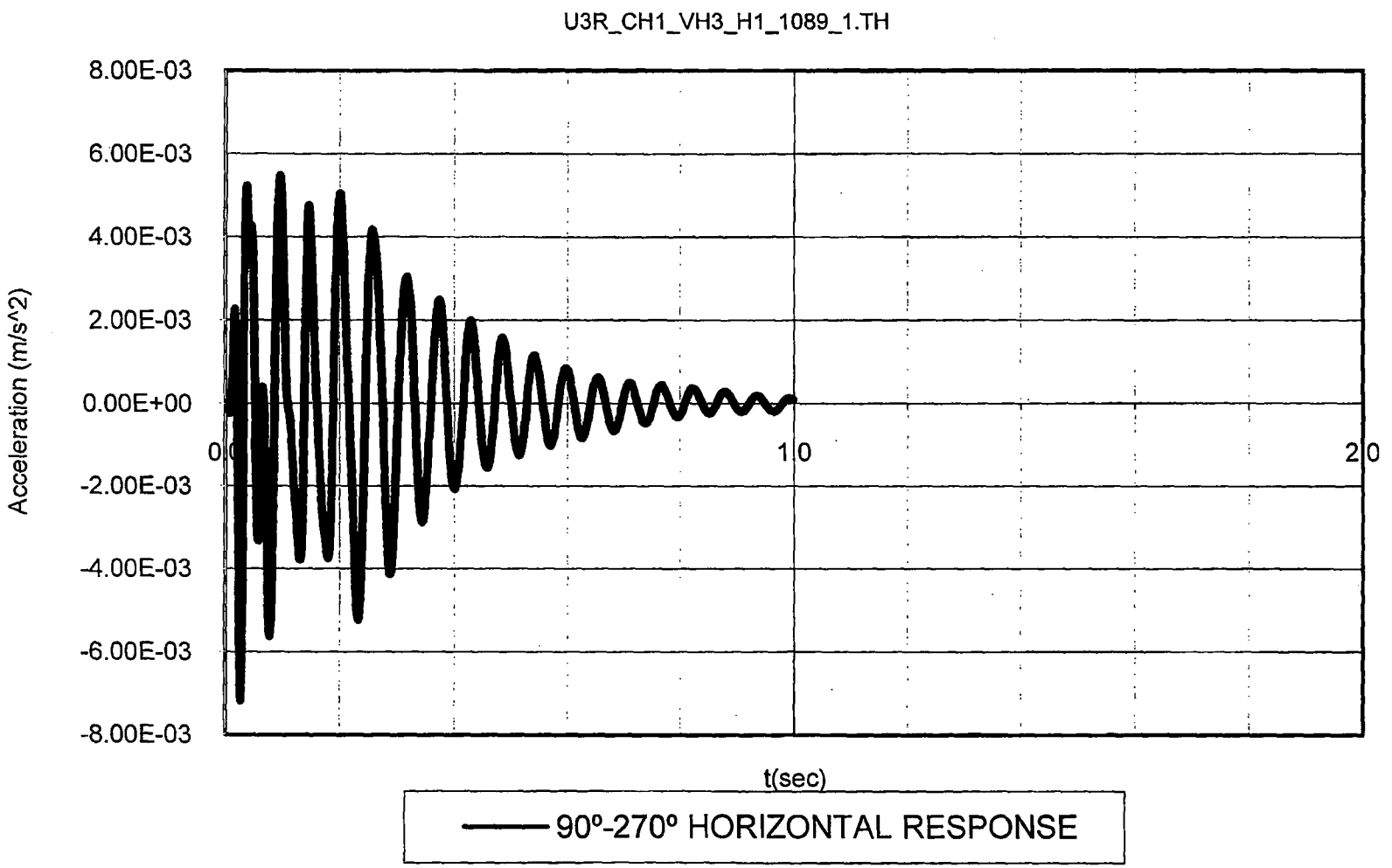

U3R_CH1_VH3_H1_1019_1.TH
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
-1.50E-01
Acceleration (m/s^2)
0
10
20
t(sec)
0°-180° HORIZONTAL RESPONSE

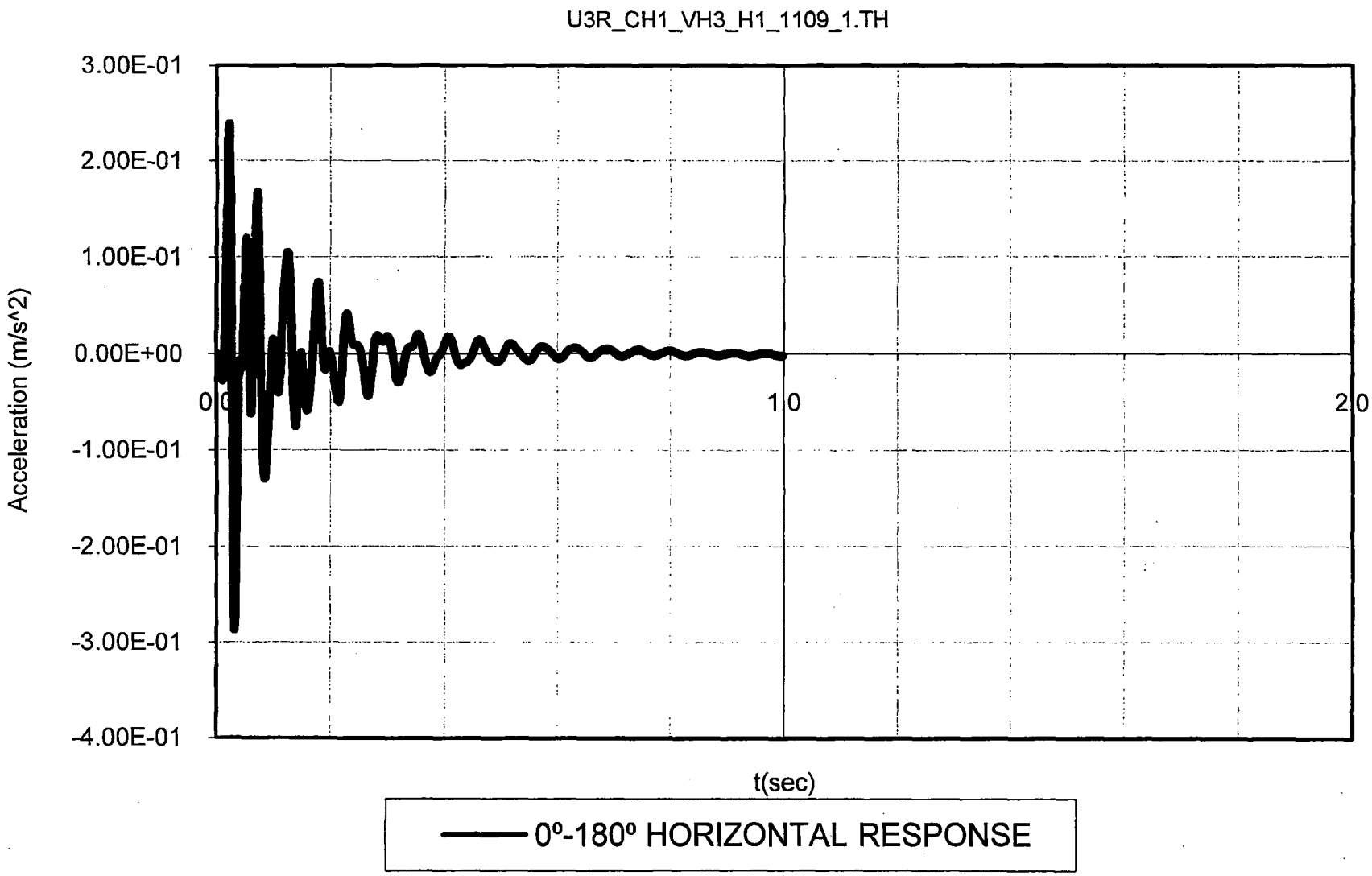

U3R_CH1_VH3_H1_1019_1.TH
8.00E-01
6.00E-01
4.00E-01
2.00E-01
0.00E+00
-2.00E-01
-4.00E-01
-6.00E-01
Acceleration (m/s^2)
0
10
20
t(sec)
VERTICAL RESPONSE

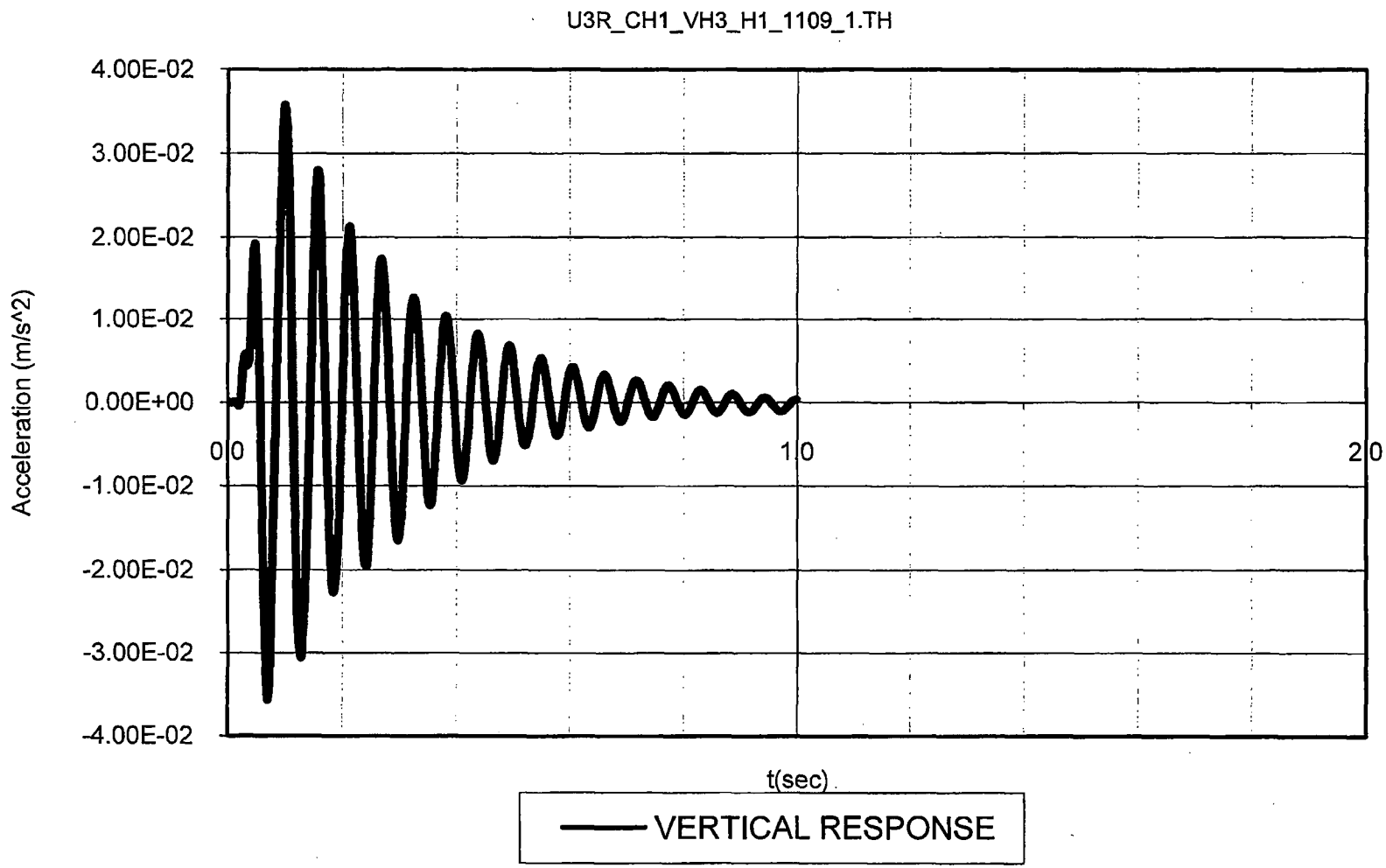

U3R_CH1_VH3_H1_1019_1.TH
1.20E-02
1.00E-02
8.00E-03
6.00E-03
4.00E-03
2.00E-03
0.00E+00
-2.00E-03
-4.00E-03
-6.00E-03
-8.00E-03
-1.00E-02
Acceleration (m/s^2)
0.0
10
20
t(sec)
90°-270° HORIZONTAL RESPONSE

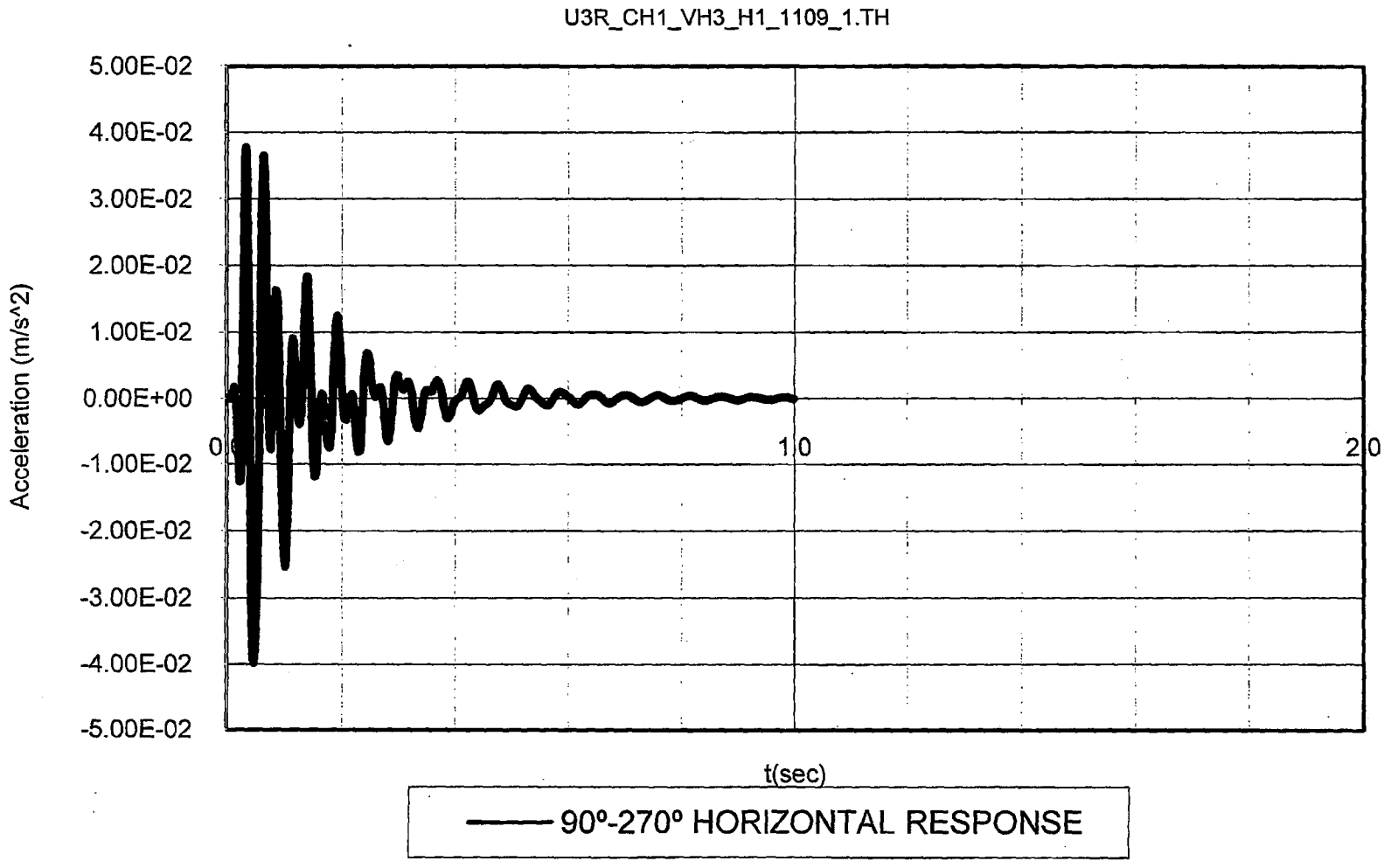

U3R_CH1_VH3_H1_1089_1.TH
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
-4.00E-01
Acceleration (m/s^2)
0
10
20
t(sec)
0º-180º HORIZONTAL RESPONSE

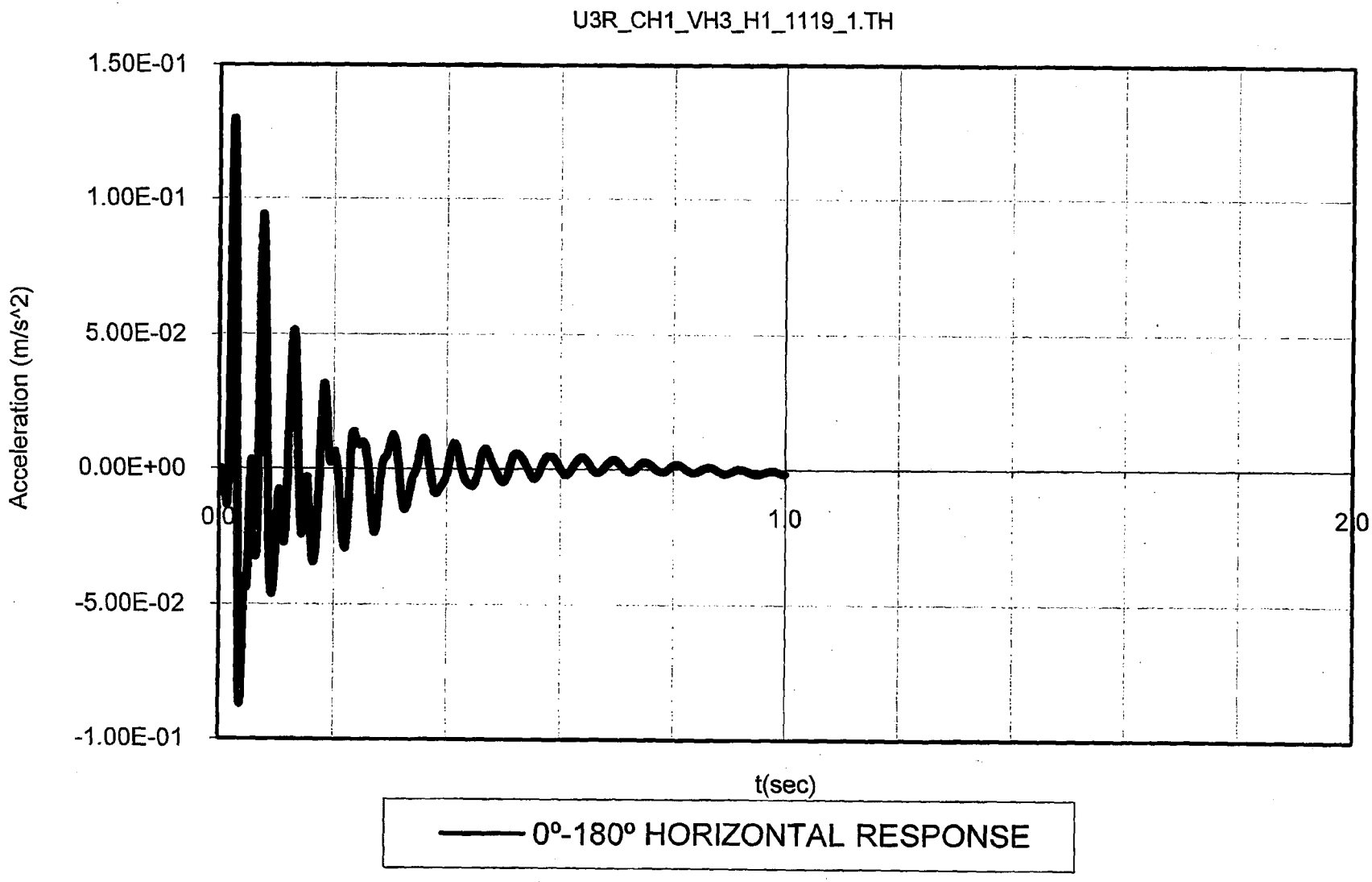

U3R_CH1_VH3_H1_1089_1.TH
1.00E+00
8.00E-01
6.00E-01
4.00E-01
2.00E-01
0.00E+00
-2.00E-01
-4.00E-01
-6.00E-01
-8.00E-01
Acceleration (m/s^2)
0
10
20
t(sec)
VERTICAL RESPONSE

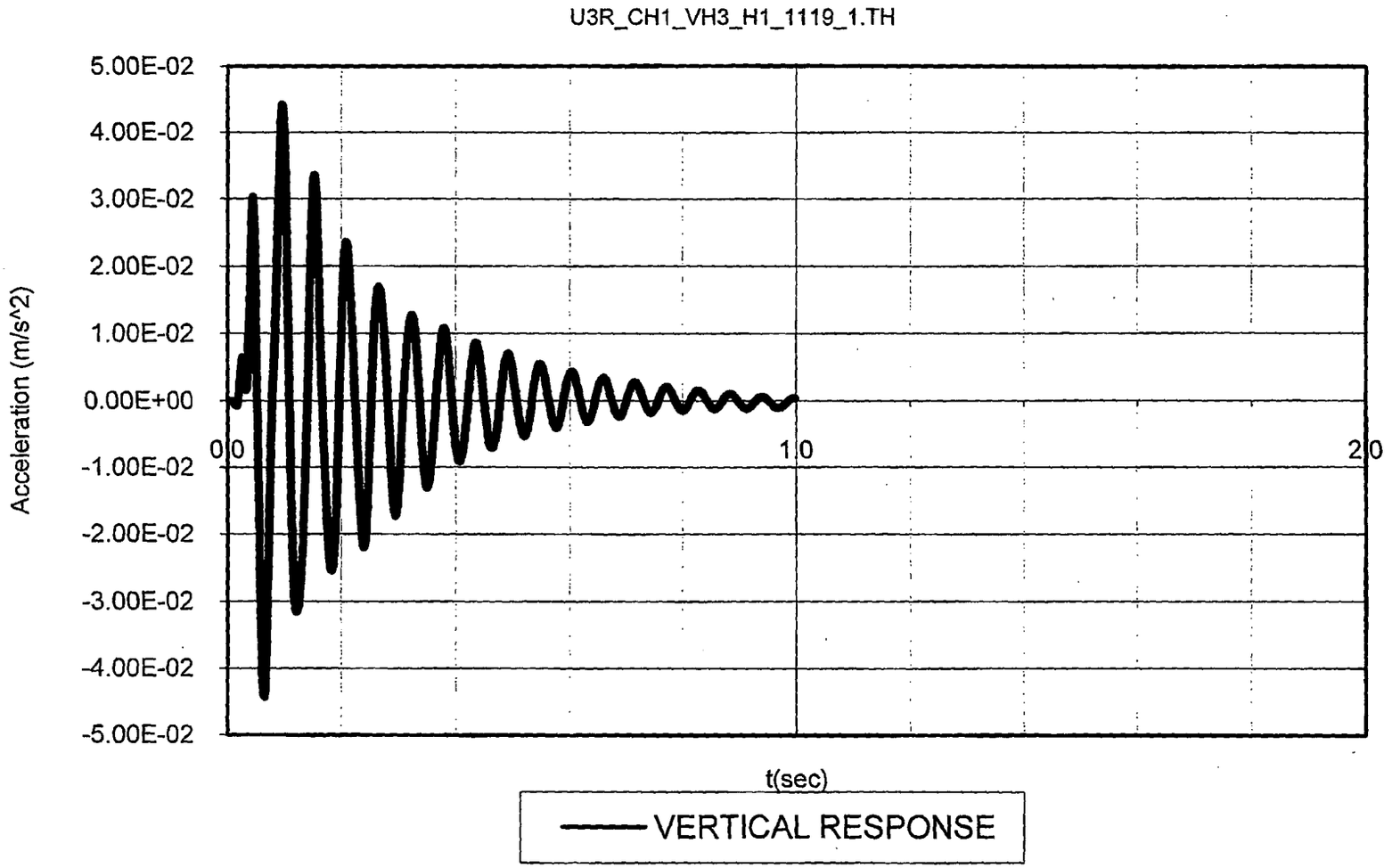

U3R_CH1_VH3_H1_1089_1.TH
8.00E-03
6.00E-03
4.00E-03
2.00E-03
0.00E+00
-2.00E-03
-4.00E-03
-6.00E-03
-8.00E-03
Acceleration (m/s^2)
0.0
10
20
t(sec)
90º-270º HORIZONTAL RESPONSE

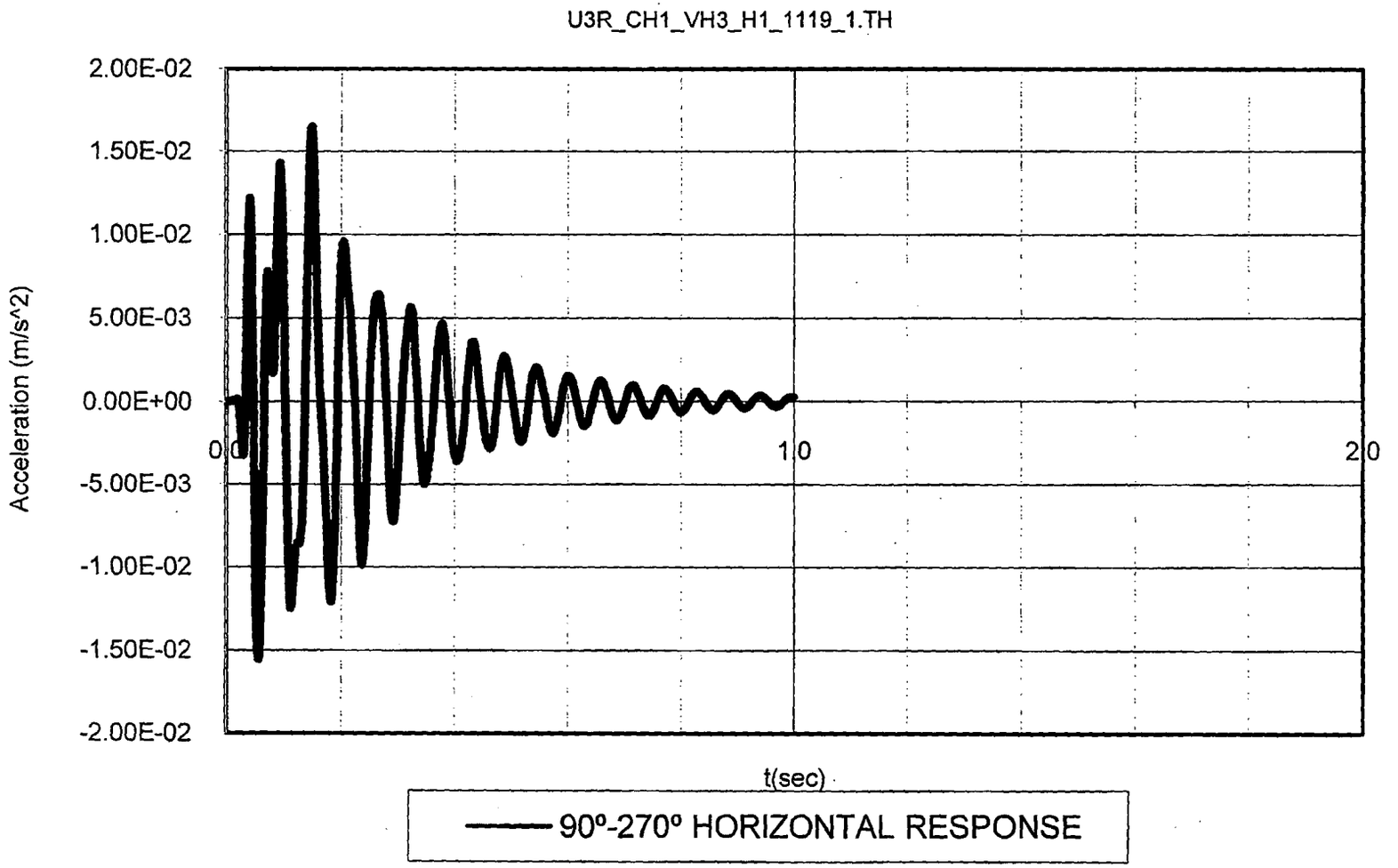

U3R_CH1_VH3_H1_1109_1.TH
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
-4.00E-01
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
0º-180º HORIZONTAL RESPONSE

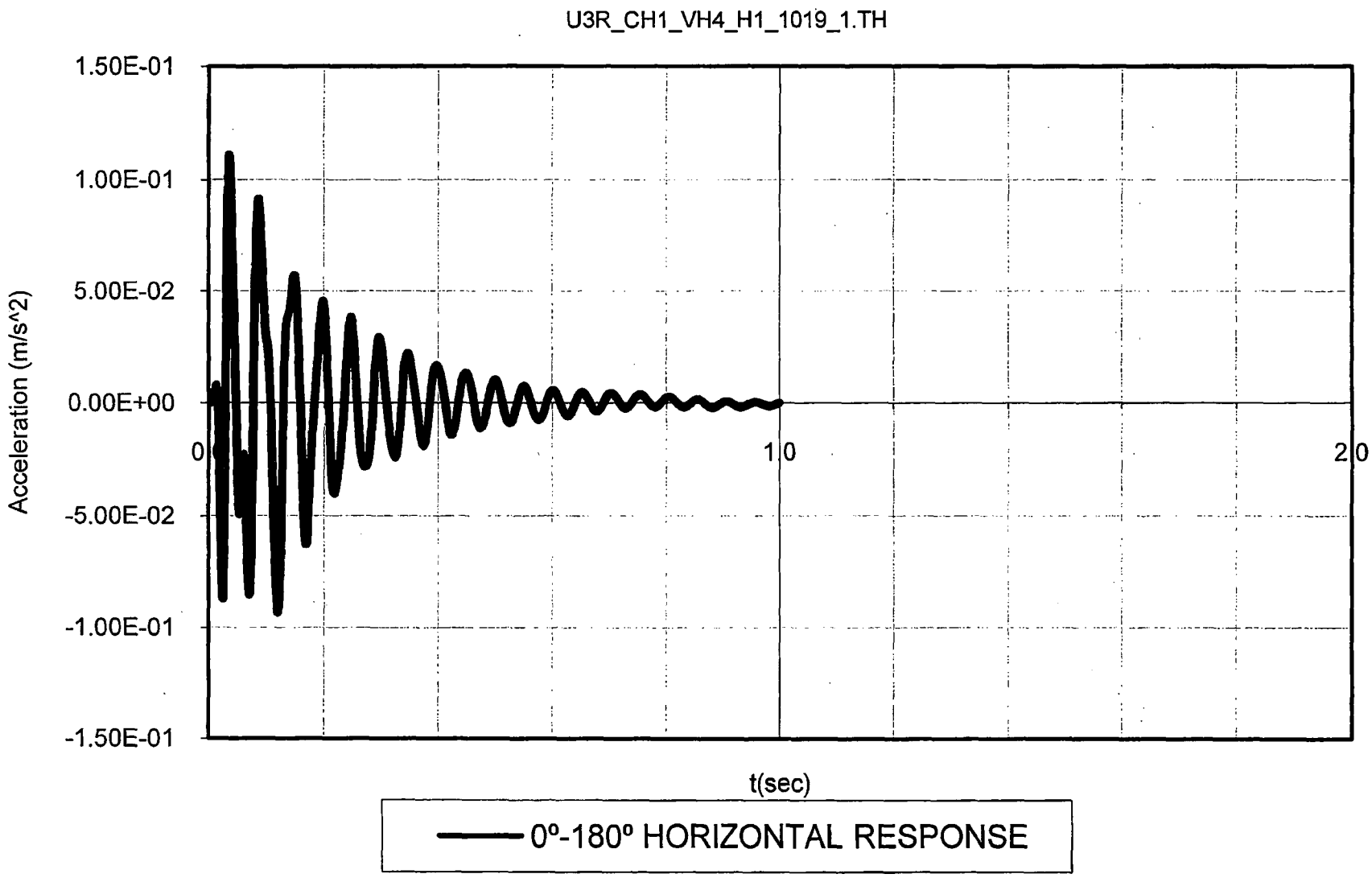

U3R_CH1_VH3_H1_1109_1.TH
4.00E-02
3.00E-02
2.00E-02
1.00E-02
0.00E+00
-1.00E-02
-2.00E-02
-3.00E-02
-4.00E-02
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
VERTICAL RESPONSE

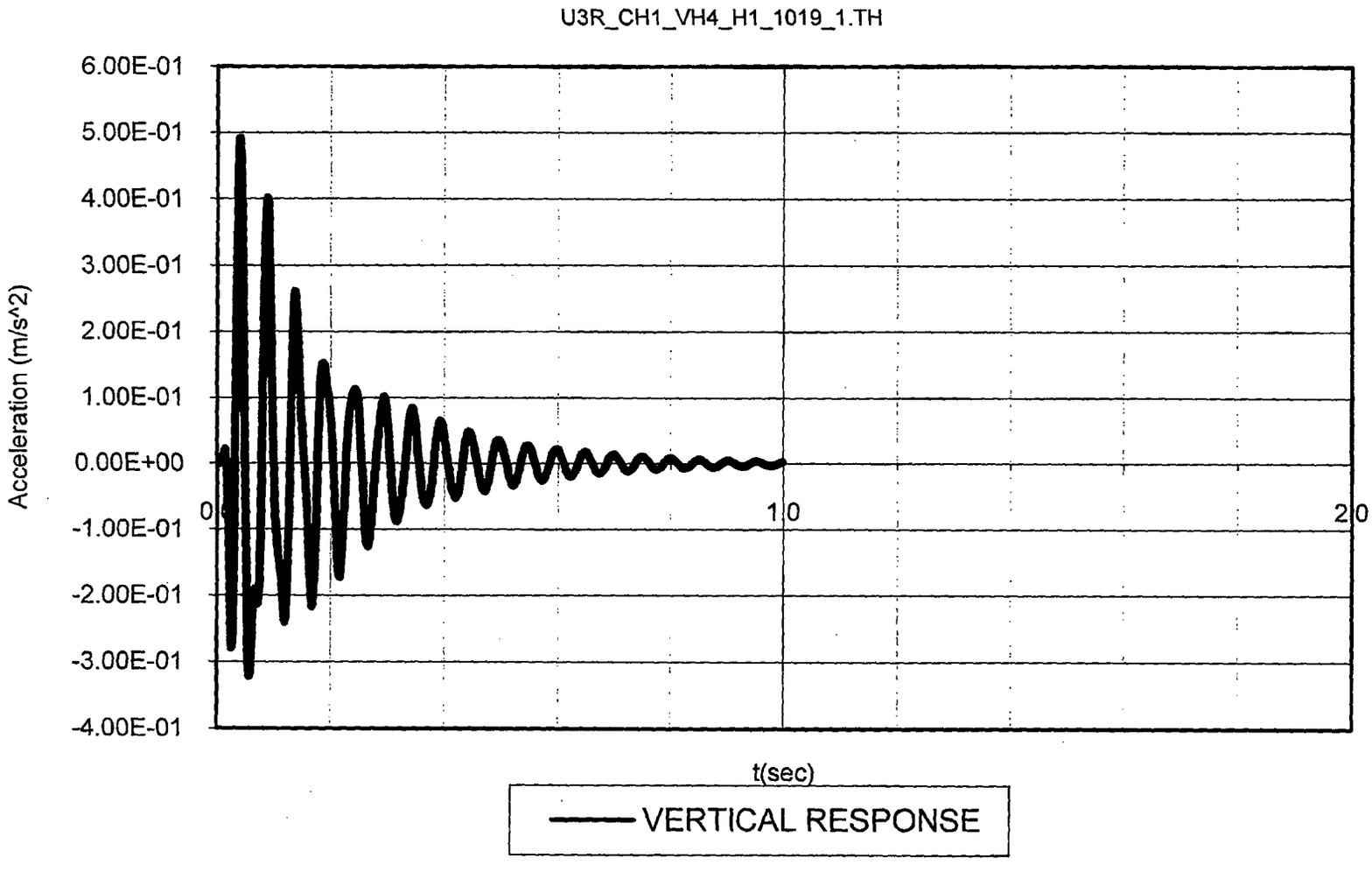

U3R_CH1_VH3_H1_1109_1.TH
5.00E-02
4.00E-02
3.00E-02
2.00E-02
1.00E-02
0.00E+00
-1.00E-02
-2.00E-02
-3.00E-02
-4.00E-02
-5.00E-02
Acceleration (m/s^2)
0
10
20
t(sec)
90°-270° HORIZONTAL RESPONSE

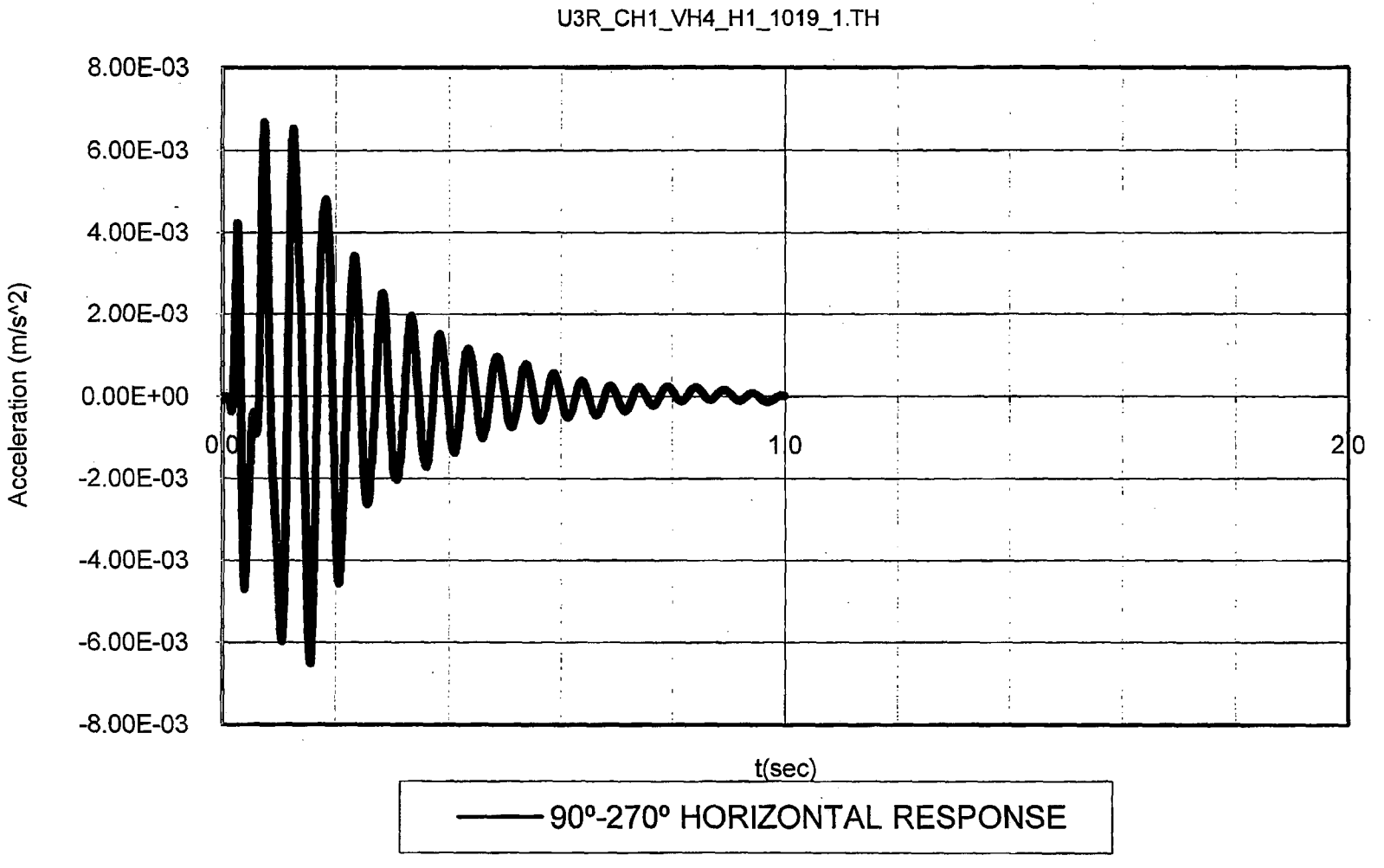

U3R_CH1_VH3_H1_1119_1.TH
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
0°-180° HORIZONTAL RESPONSE

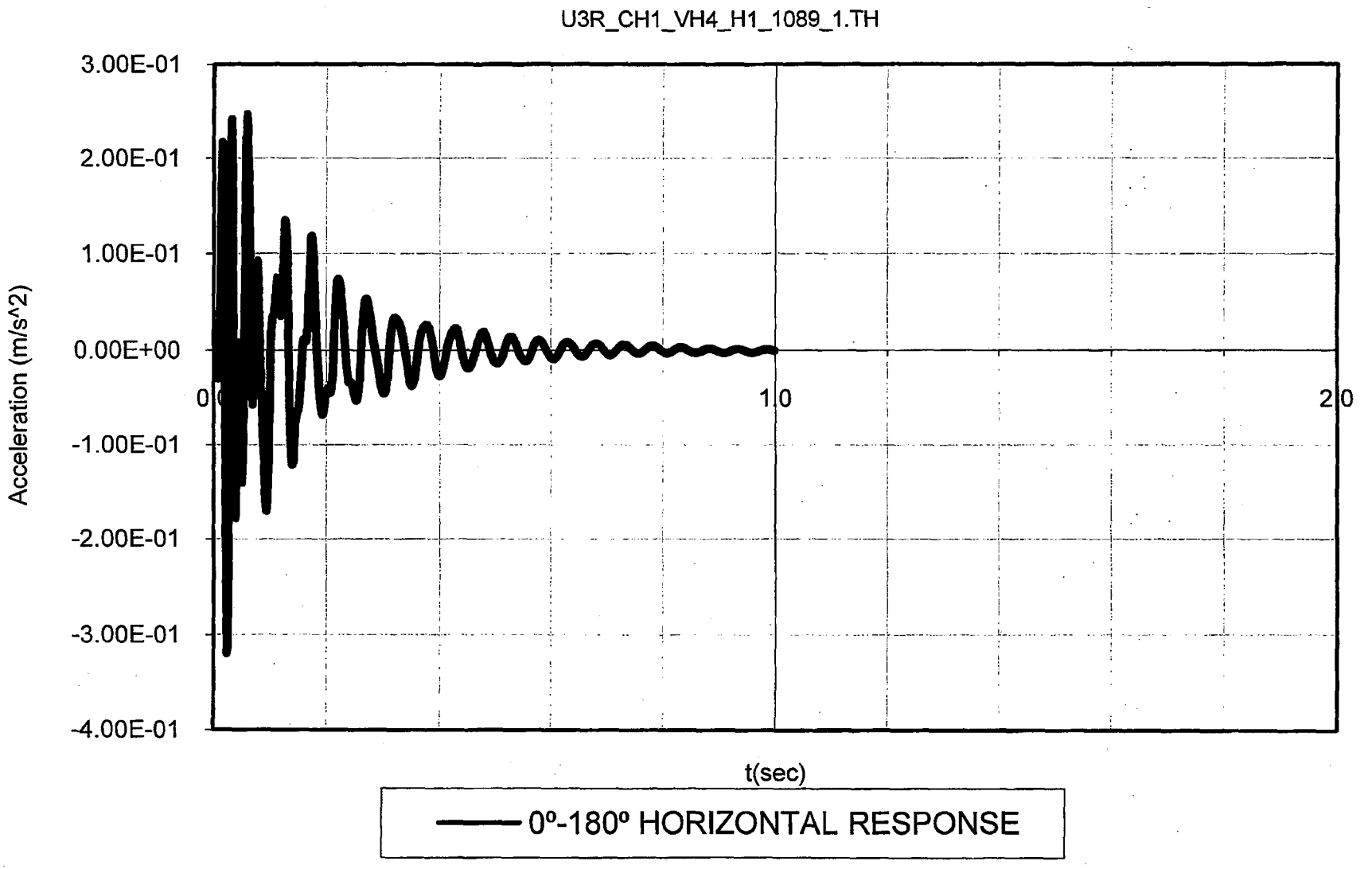

U3R_CH1_VH3_H1_1119_1.TH
5.00E-02
4.00E-02
3.00E-02
2.00E-02
1.00E-02
0.00E+00
-1.00E-02
-2.00E-02
-3.00E-02
-4.00E-02
-5.00E-02
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
VERTICAL RESPONSE

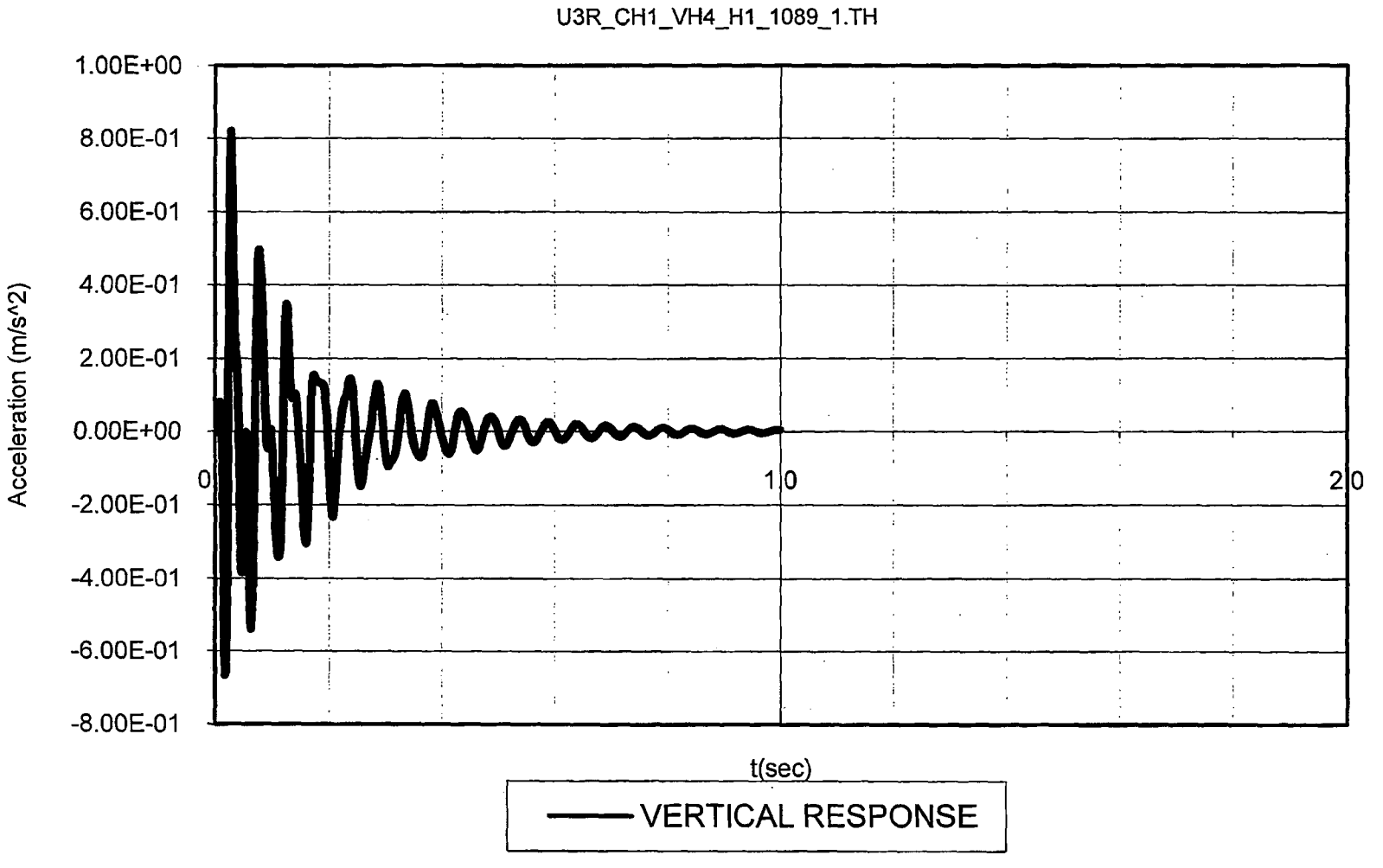

U3R_CH1_VH3_H1_1119_1.TH
2.00E-02
1.50E-02
1.00E-02
5.00E-03
0.00E+00
-5.00E-03
-1.00E-02
-1.50E-02
-2.00E-02
Acceleration (m/s^2)
0.0
10
20
t(sec)
90º-270º HORIZONTAL RESPONSE

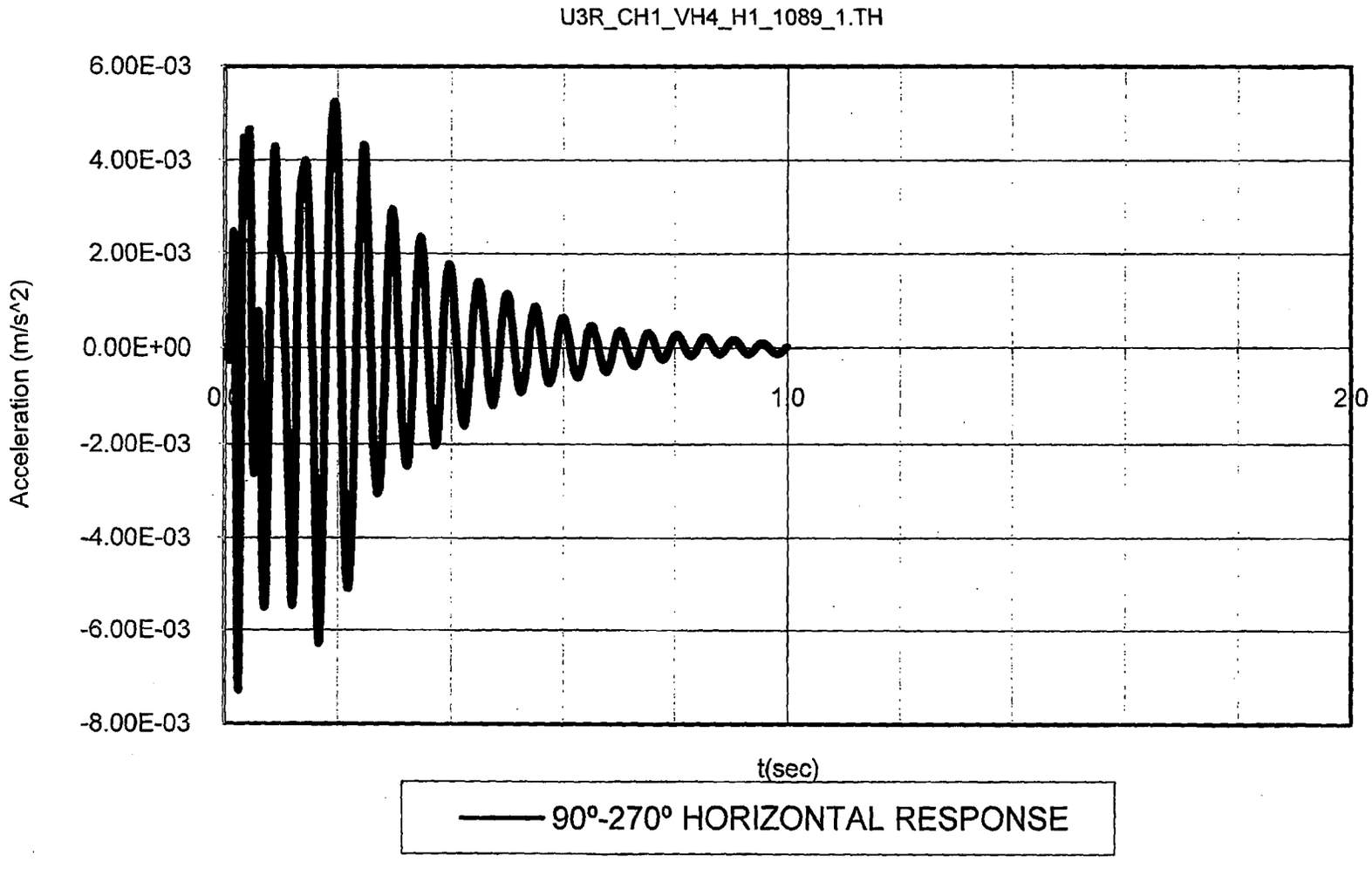

U3R_CH1_VH4_H1_1019_1.TH
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
-1.50E-01
Acceleration (m/s^2)
0
10
20
t(sec)
0º-180º HORIZONTAL RESPONSE

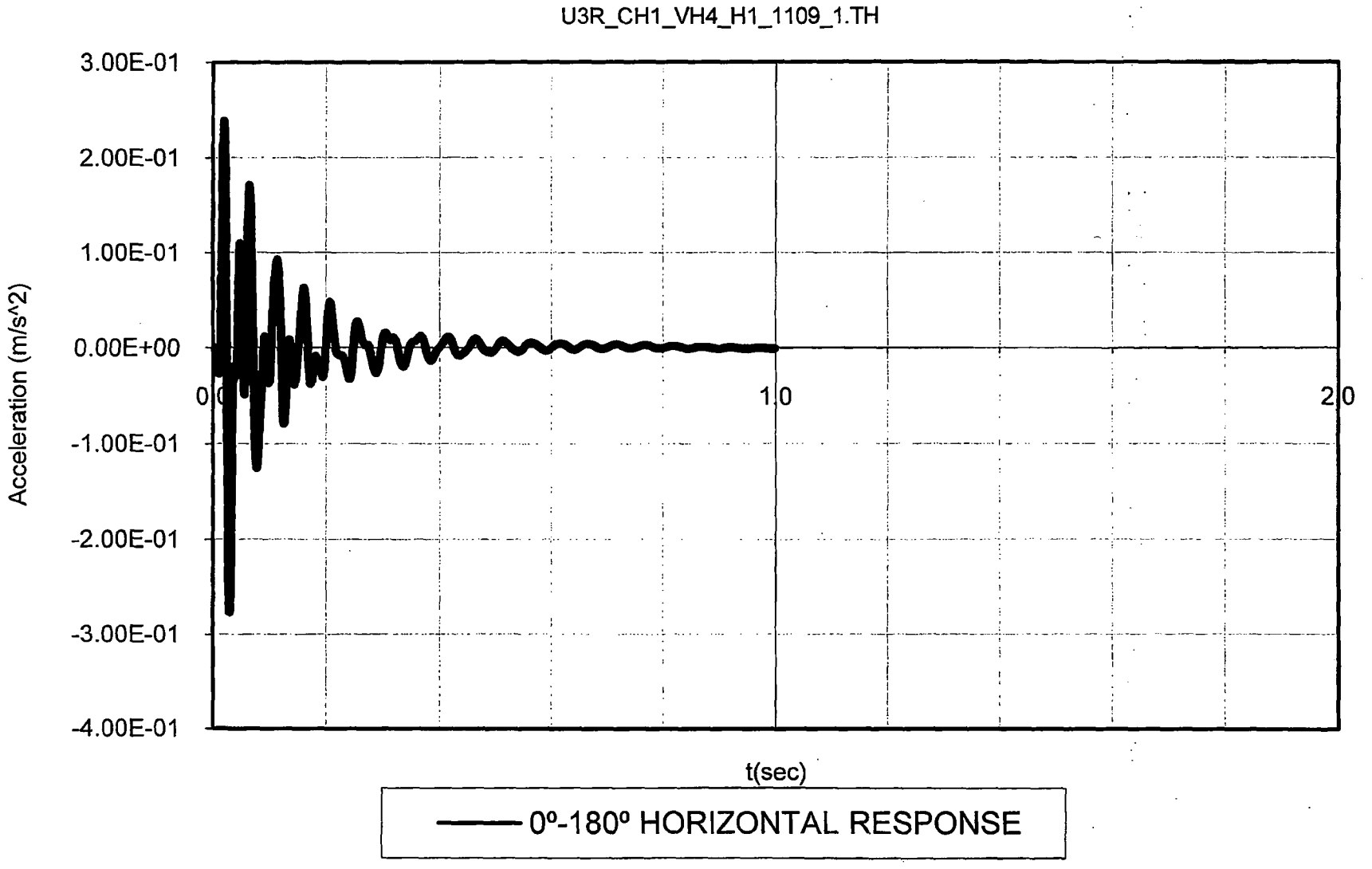

U3R_CH1_VH4_H1_1019_1.TH
6.00E-01
5.00E-01
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
-4.00E-01
Acceleration (m/s^2)
0
10
20
t(sec)
VERTICAL RESPONSE

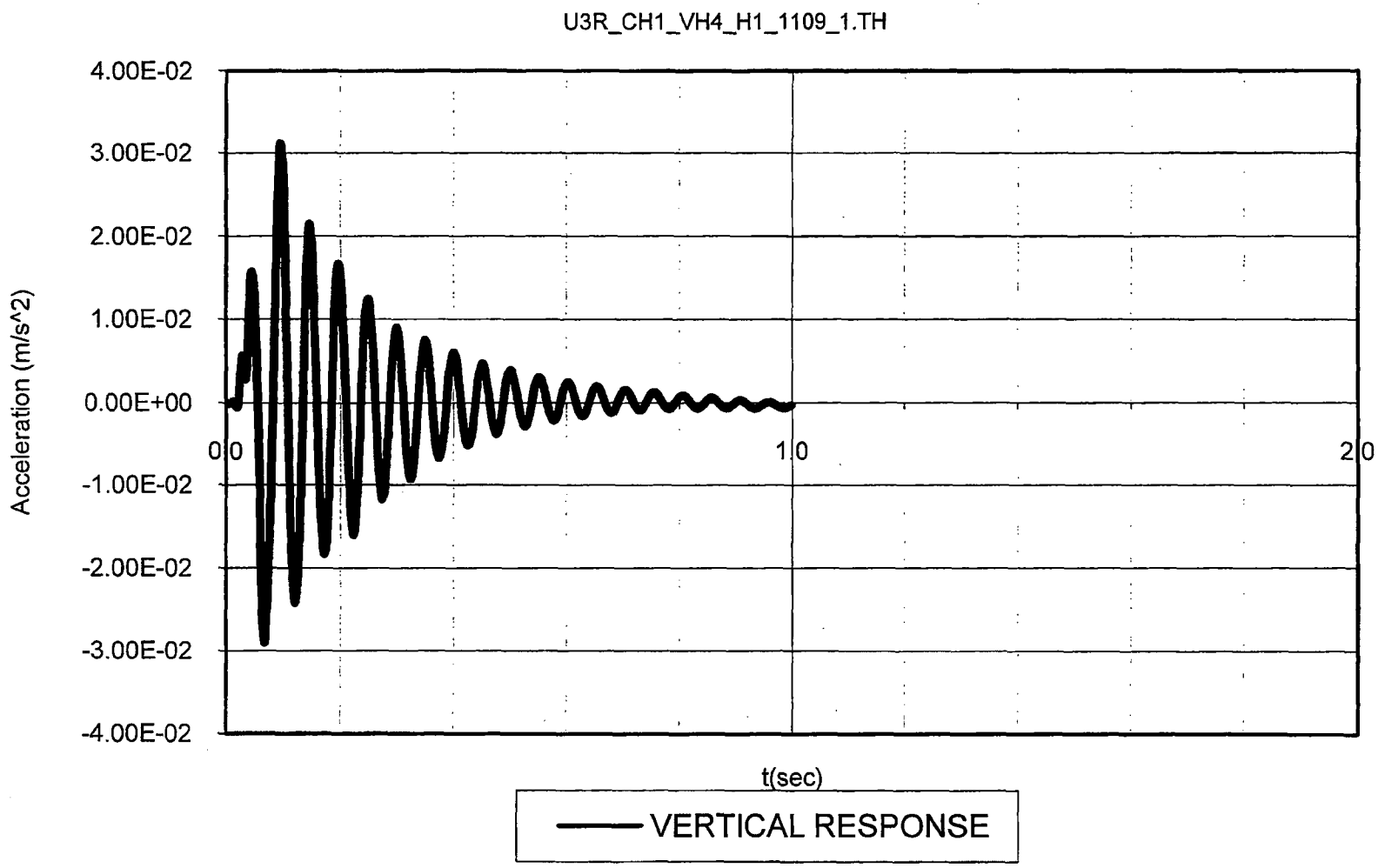

U3R_CH1_VH4_H1_1019_1.TH
8.00E-03
6.00E-03
4.00E-03
2.00E-03
0.00E+00
-2.00E-03
-4.00E-03
-6.00E-03
-8.00E-03
Acceleration (m/s^2)
0.0
10
20
t(sec)
90º-270º HORIZONTAL RESPONSE

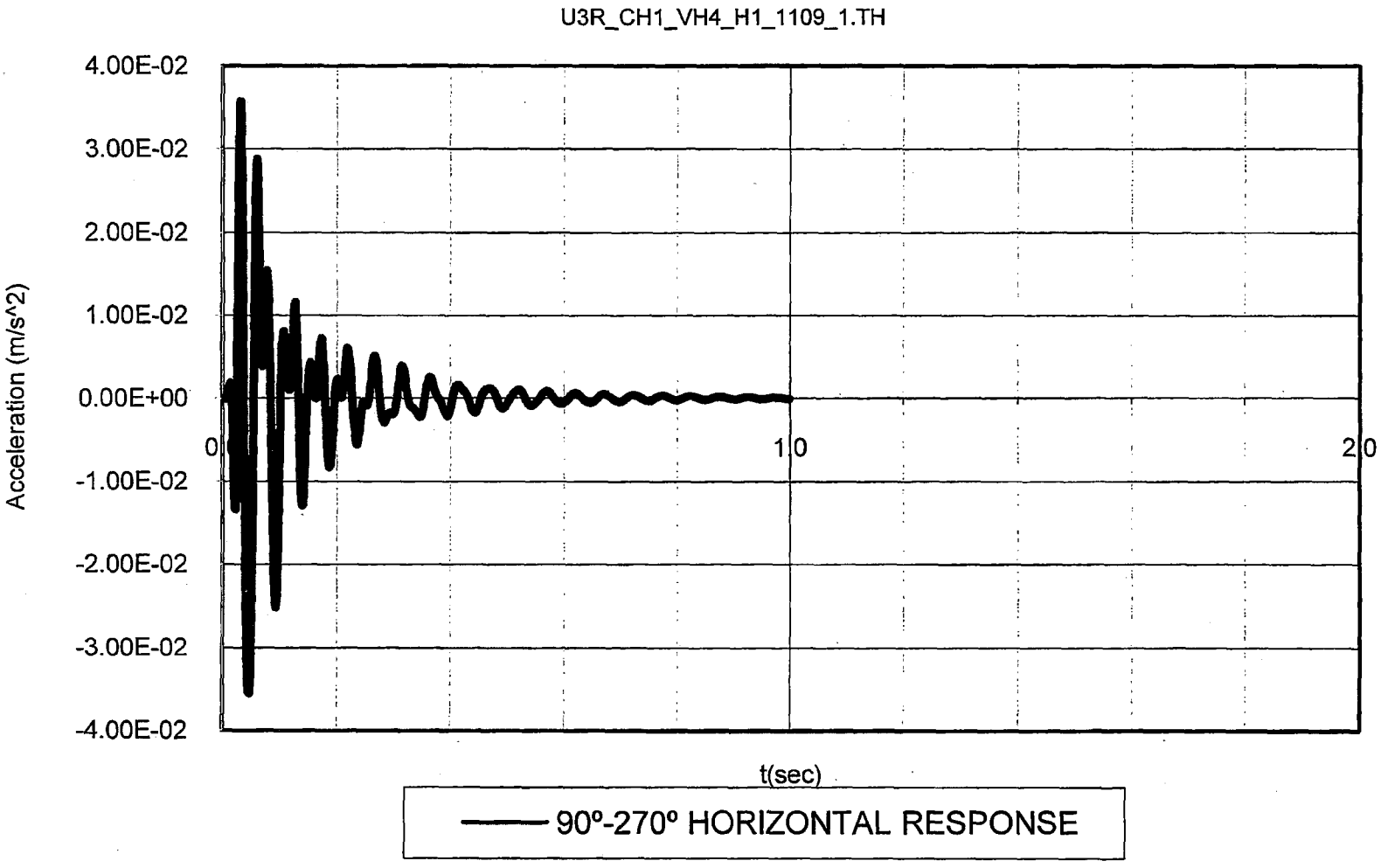

U3R_CH1_VH4_H1_1089_1.TH
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
-4.00E-01
Acceleration (m/s^2)
0
10
20
t(sec)
0º-180º HORIZONTAL RESPONSE

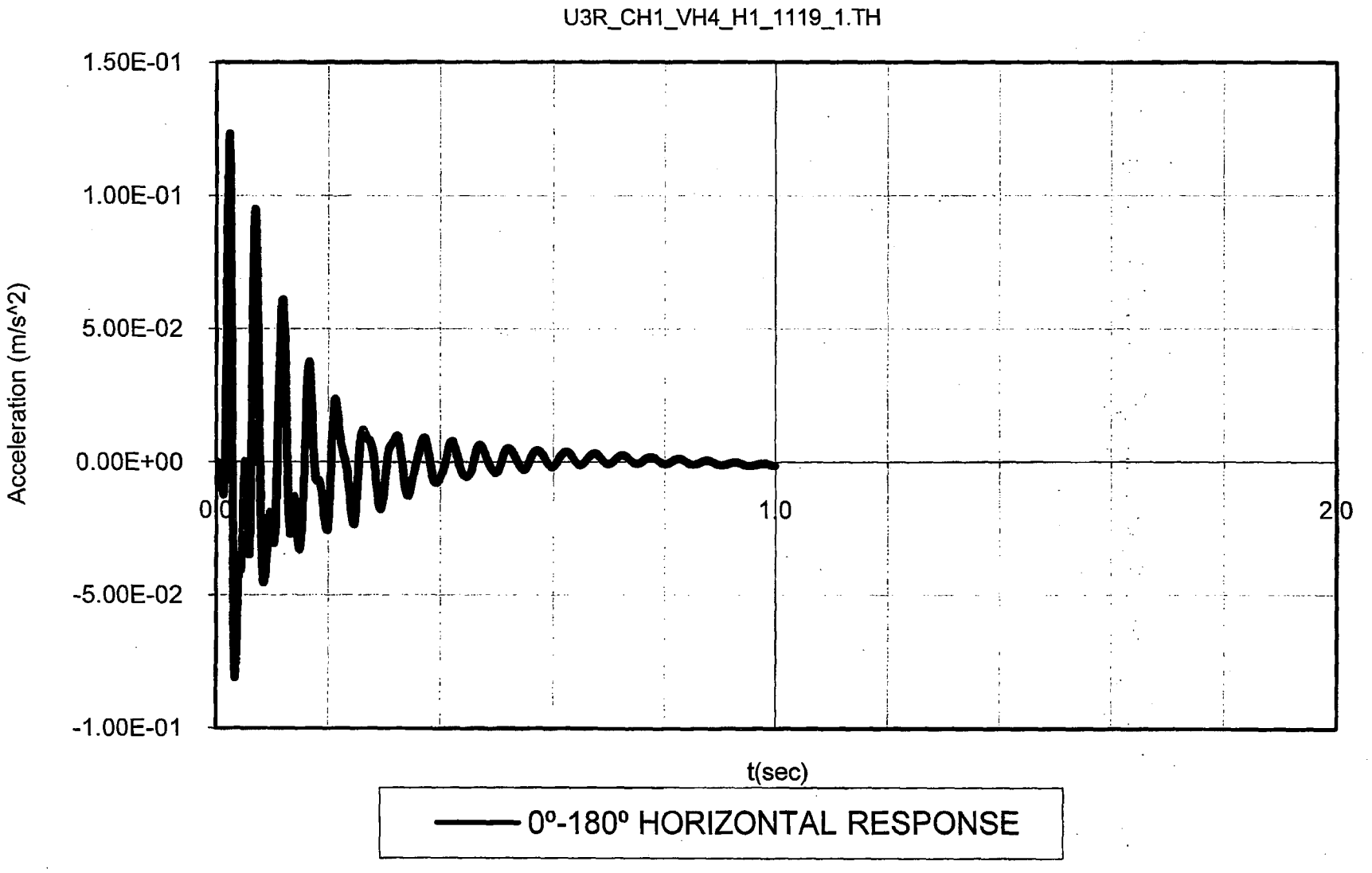

U3R_CH1_VH4_H1_1089_1.TH
1.00E+00
8.00E-01
6.00E-01
4.00E-01
2.00E-01
0.00E+00
-2.00E-01
-4.00E-01
-6.00E-01
-8.00E-01
Acceleration (m/s^2)
0
10
20
t(sec)
VERTICAL RESPONSE

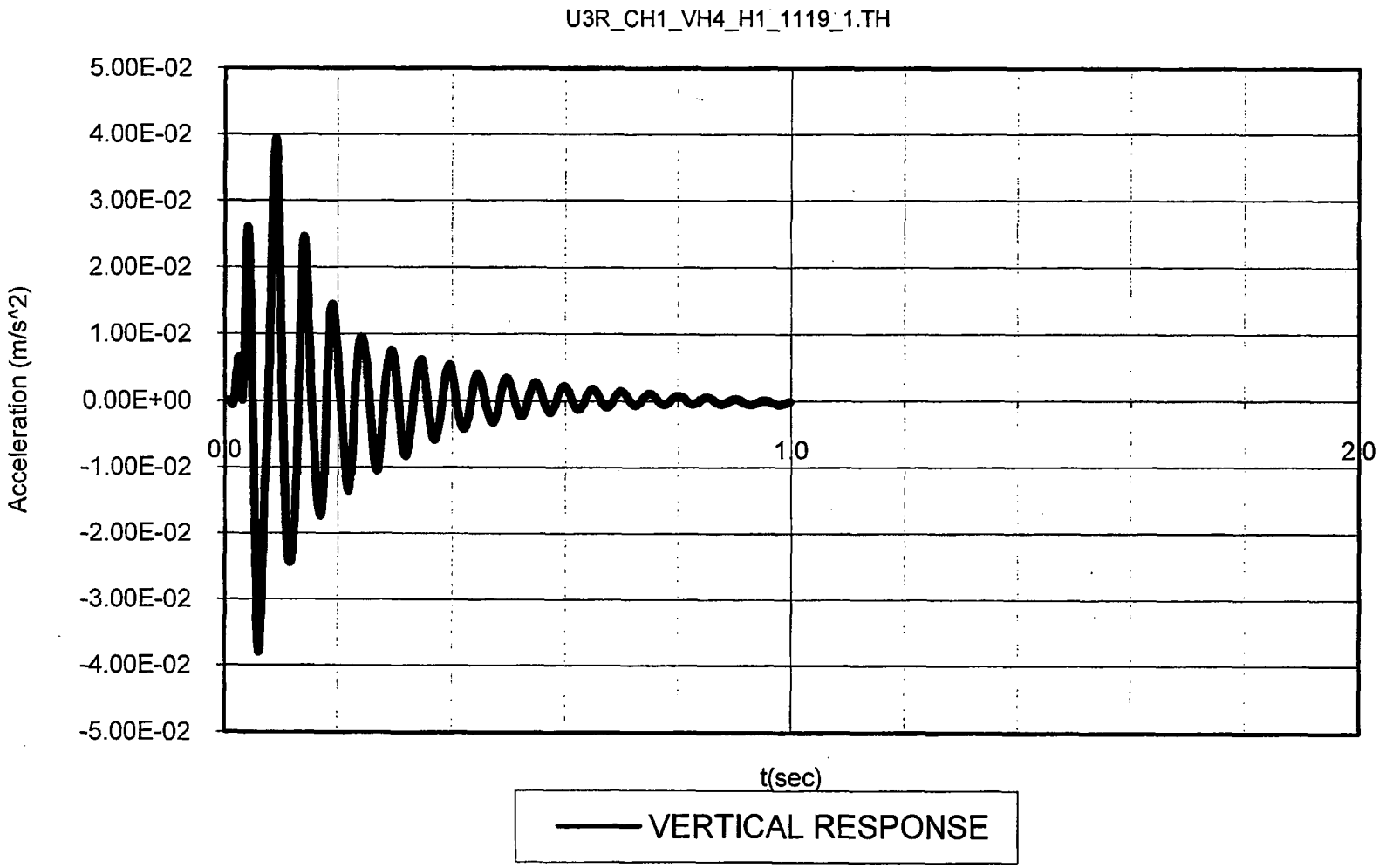

U3R_CH1_VH4_H1_1089_1.TH
6.00E-03
4.00E-03
2.00E-03
0.00E+00
-2.00E-03
-4.00E-03
-6.00E-03
-8.00E-03
Acceleration (m/s^2)
0
10
20
t(sec)
90º-270º HORIZONTAL RESPONSE

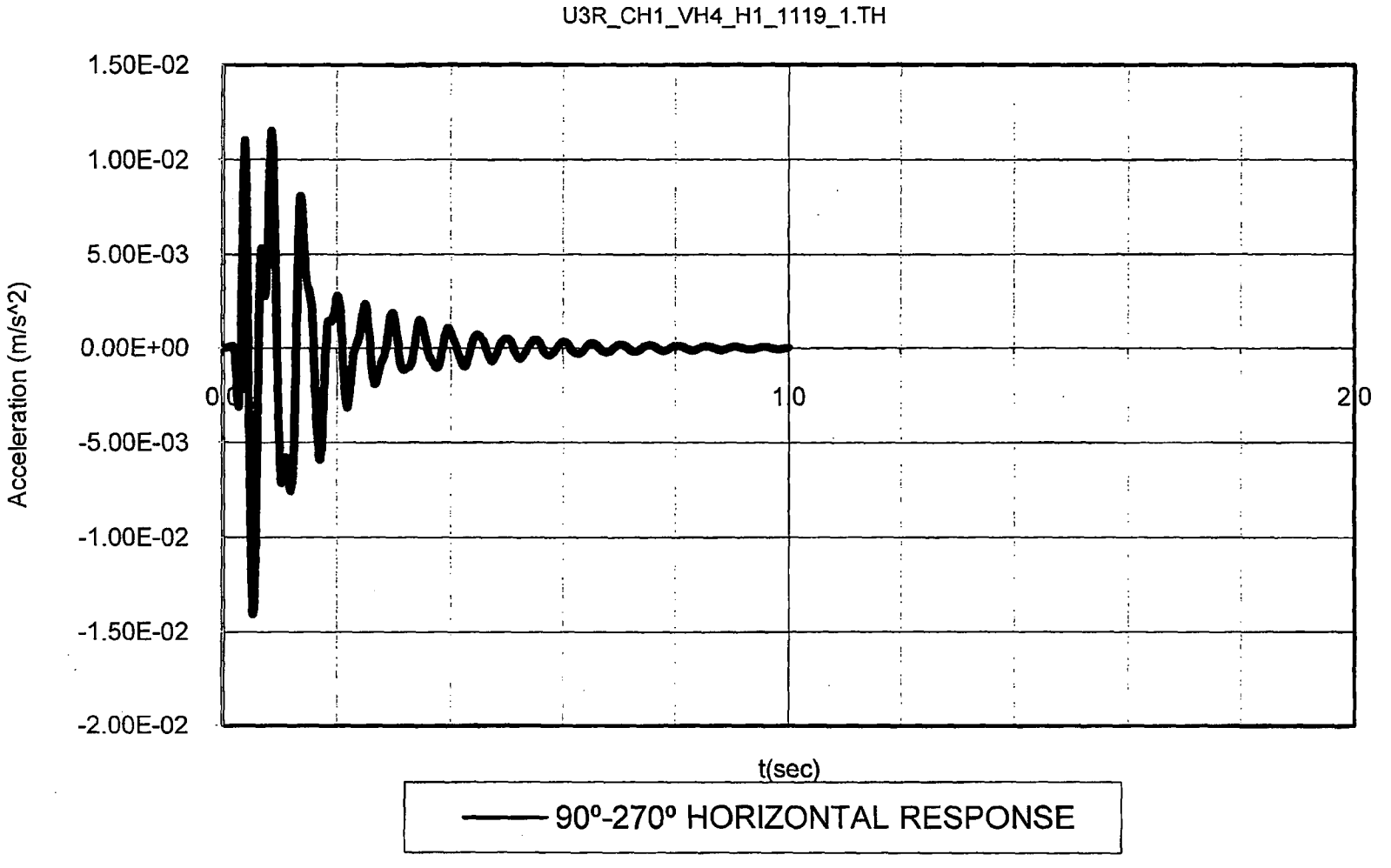

U3R_CH1_VH4_H1_1109_1.TH
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
-4.00E-01
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
0º-180º HORIZONTAL RESPONSE

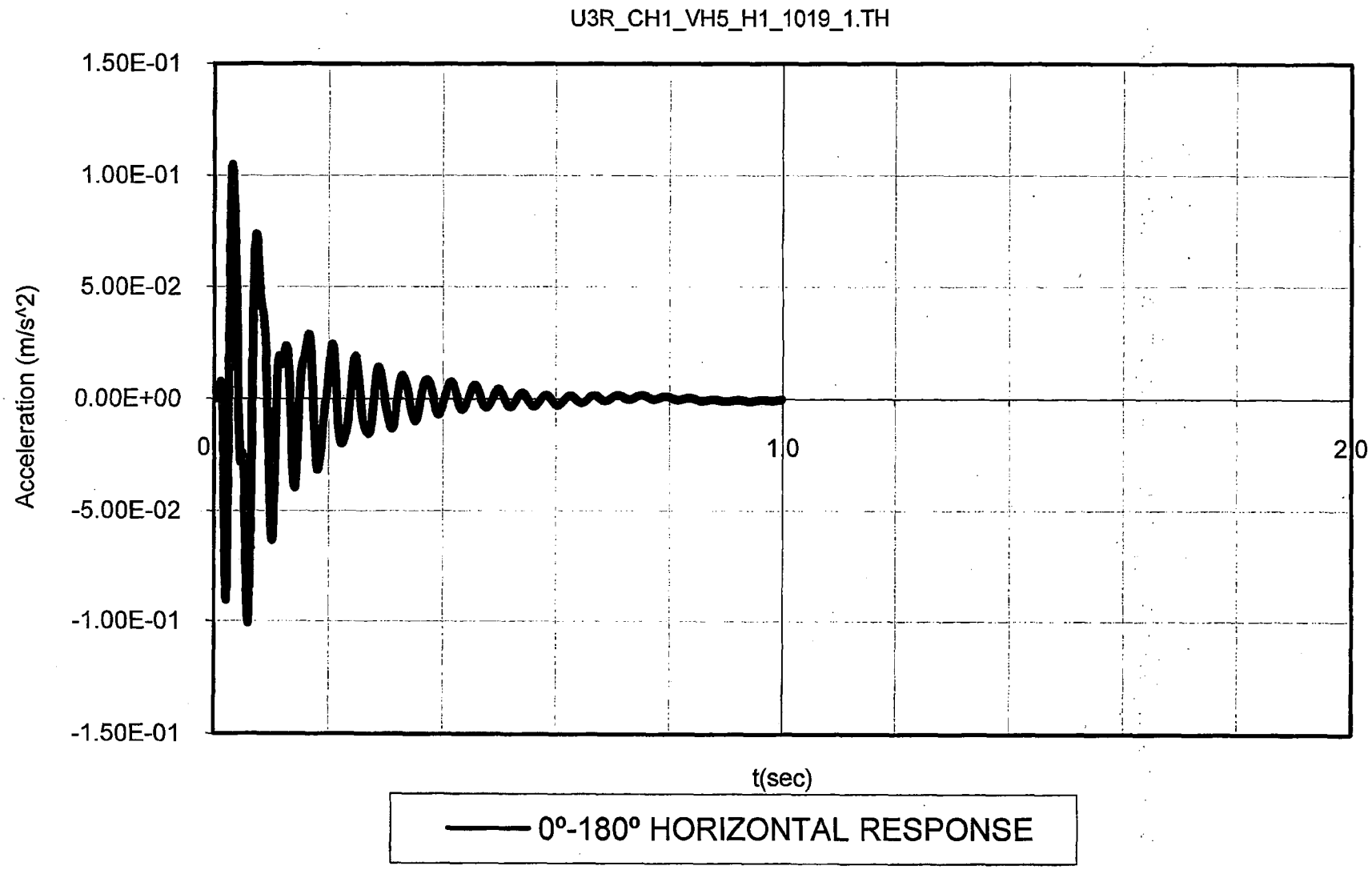

U3R_CH1_VH4_H1_1109_1.TH
4.00E-02
3.00E-02
2.00E-02
1.00E-02
0.00E+00
-1.00E-02
-2.00E-02
-3.00E-02
-4.00E-02
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
VERTICAL RESPONSE

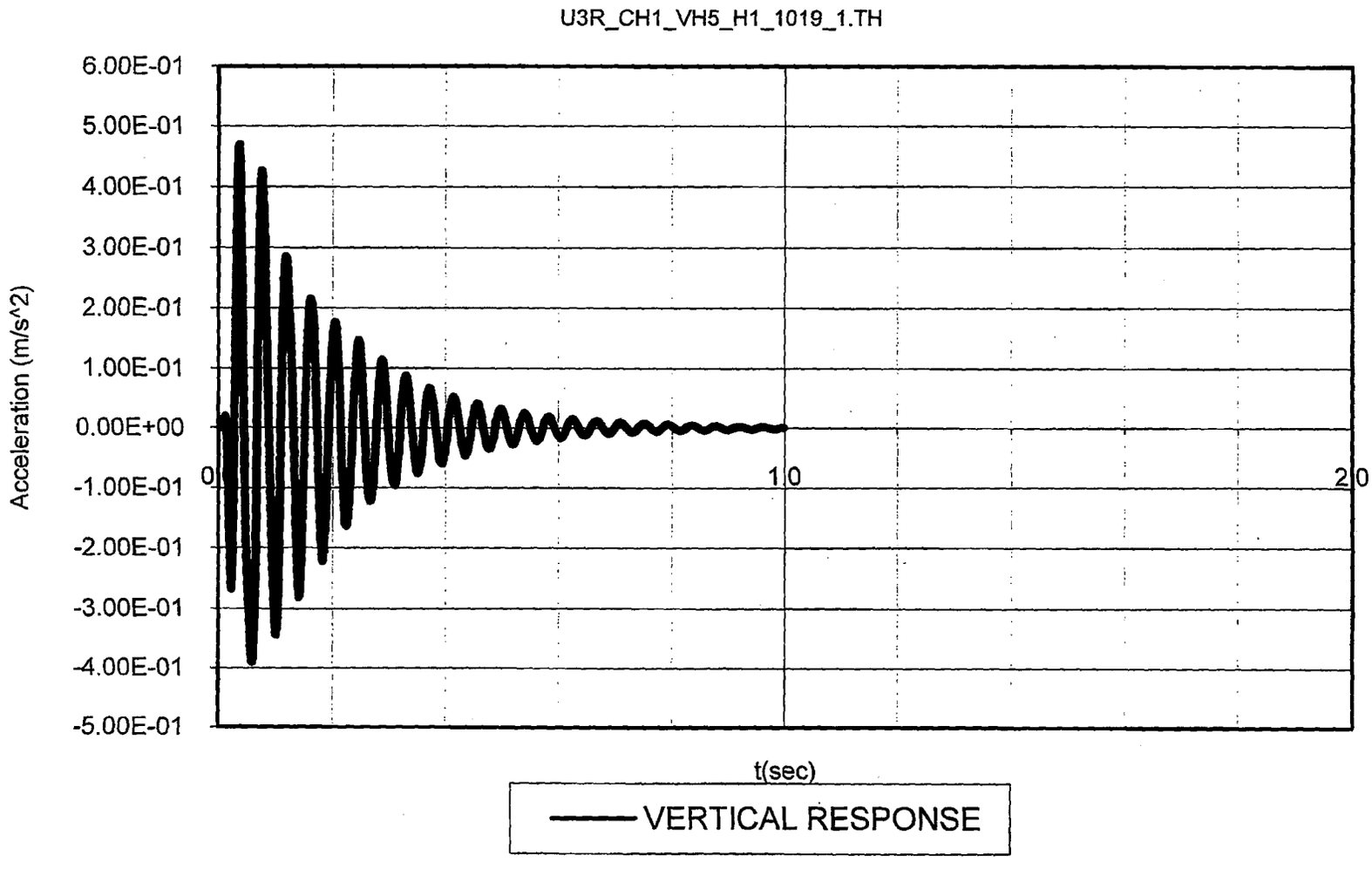

U3R_CH1_VH4_H1_1109_1.TH
4.00E-02
3.00E-02
2.00E-02
1.00E-02
0.00E+00
-1.00E-02
-2.00E-02
-3.00E-02
-4.00E-02
Acceleration (m/s^2)
0
10
20
t(sec)
90°-270° HORIZONTAL RESPONSE

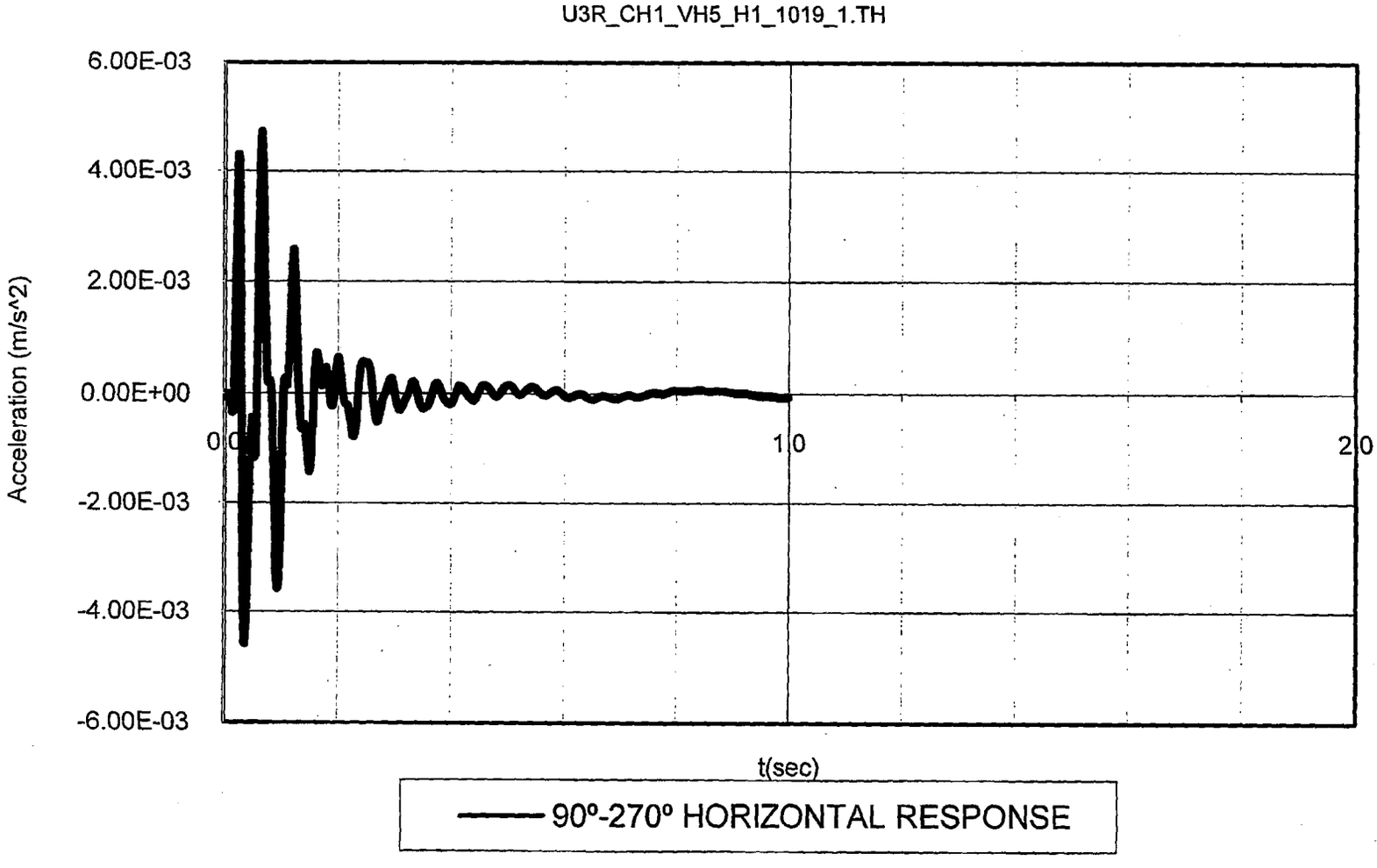

U3R_CH1_VH4_H1_1119_1.TH
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
0°-180° HORIZONTAL RESPONSE

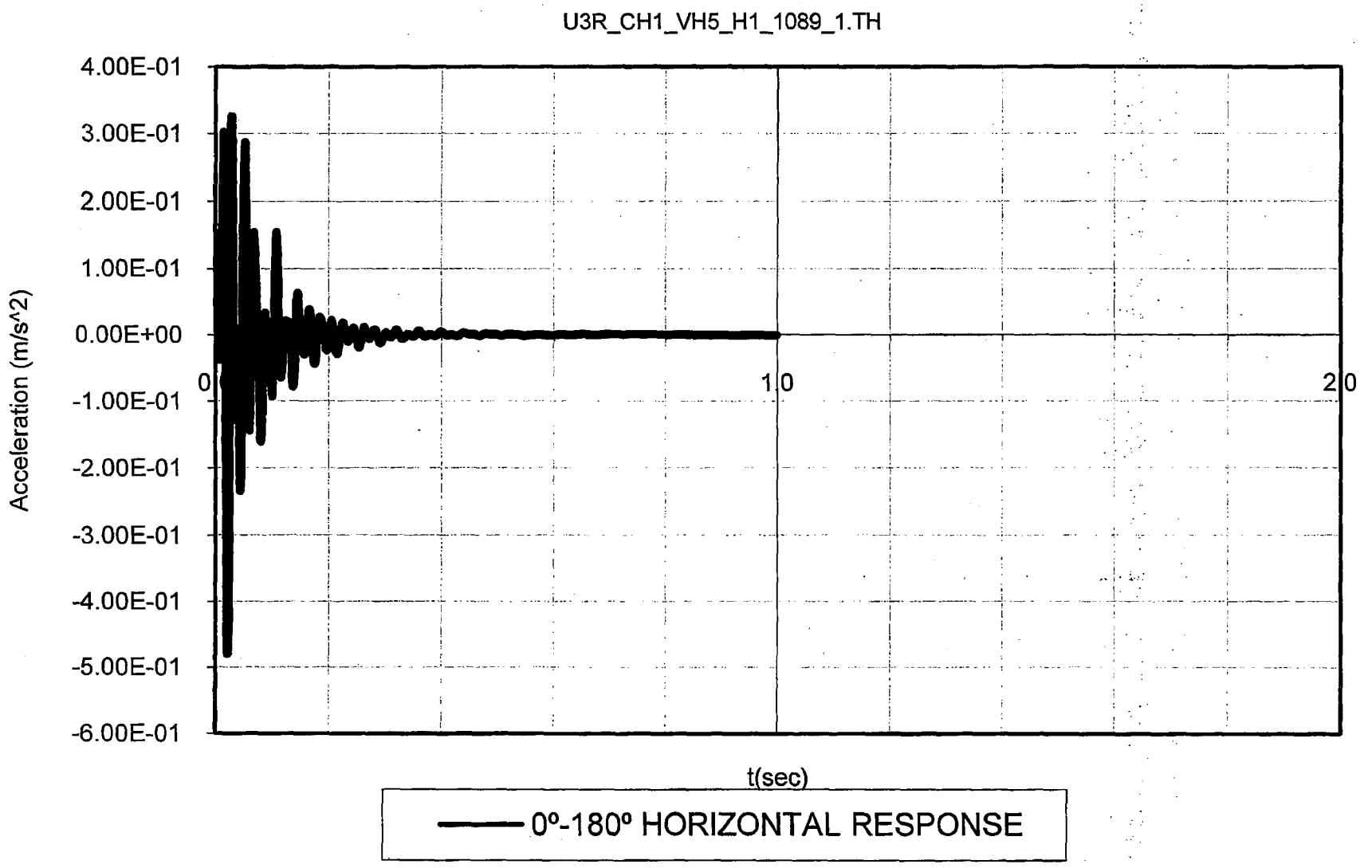

U3R_CH1_VH4_H1_1119_1.TH
5.00E-02
4.00E-02
3.00E-02
2.00E-02
1.00E-02
0.00E+00
-1.00E-02
-2.00E-02
-3.00E-02
-4.00E-02
-5.00E-02
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
VERTICAL RESPONSE

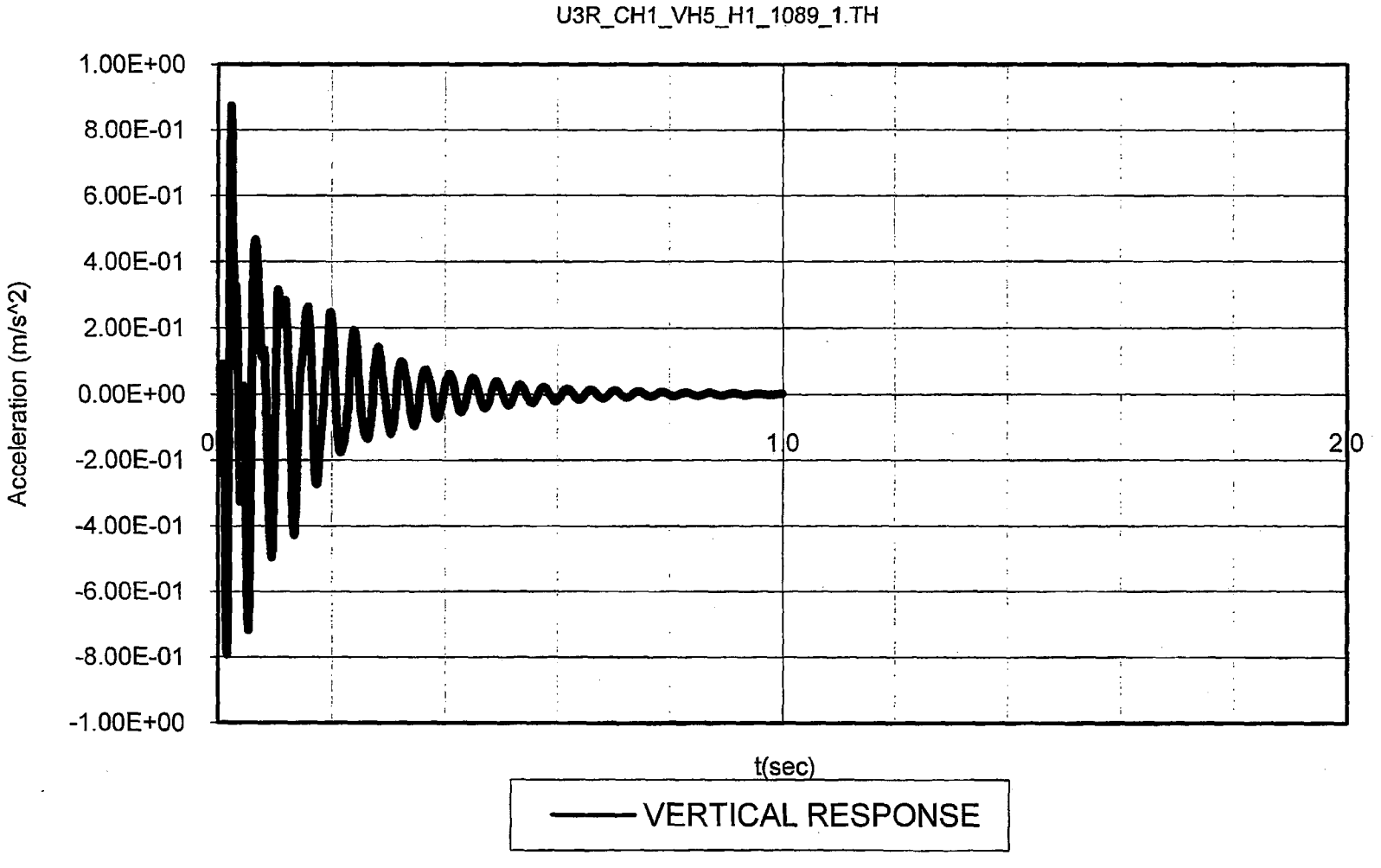

U3R_CH1_VH4_H1_1119_1.TH
1.50E-02
1.00E-02
5.00E-03
0.00E+00
-5.00E-03
-1.00E-02
-1.50E-02
-2.00E-02
Acceleration (m/s^2)
0
10
20
t(sec)
90º-270º HORIZONTAL RESPONSE

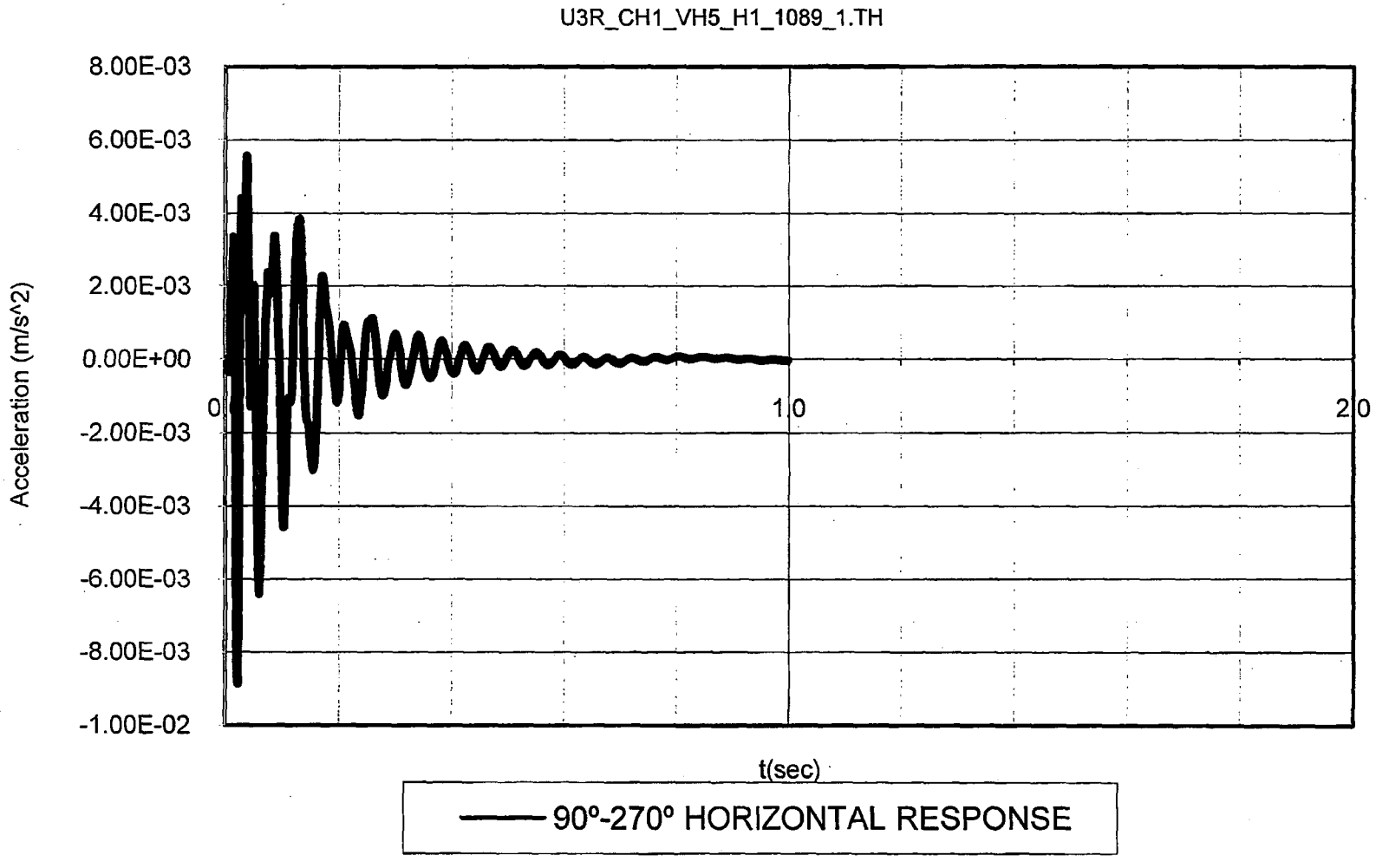

U3R_CH1_VH5_H1_1019_1.TH
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
-1.50E-01
Acceleration (m/s^2)
0
10
20
t(sec)
0º-180º HORIZONTAL RESPONSE

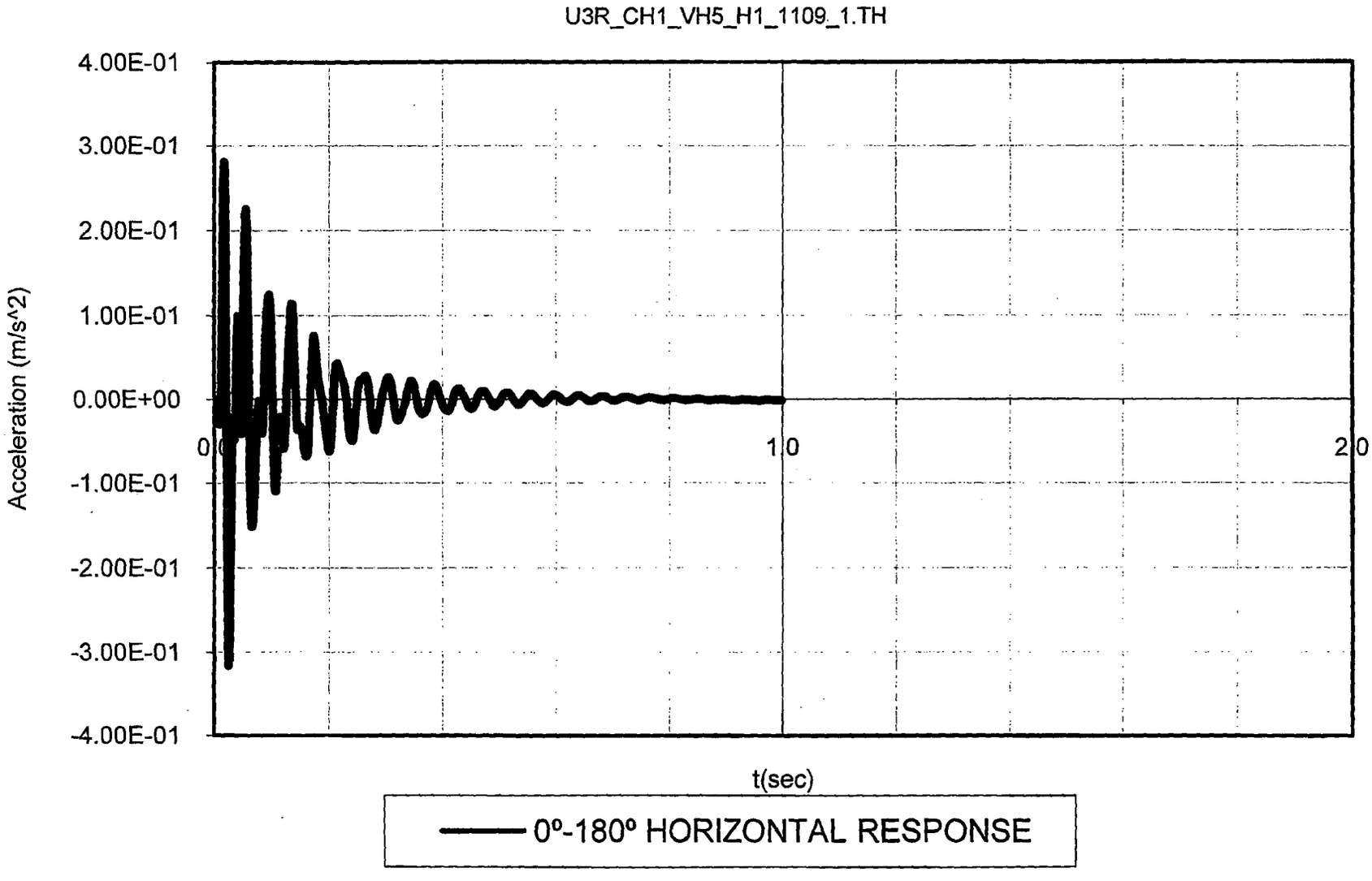

U3R_CH1_VH5_H1_1019_1.TH
6.00E-01
5.00E-01
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
-4.00E-01
-5.00E-01
Acceleration (m/s^2)
0
10
20
t(sec)
VERTICAL RESPONSE

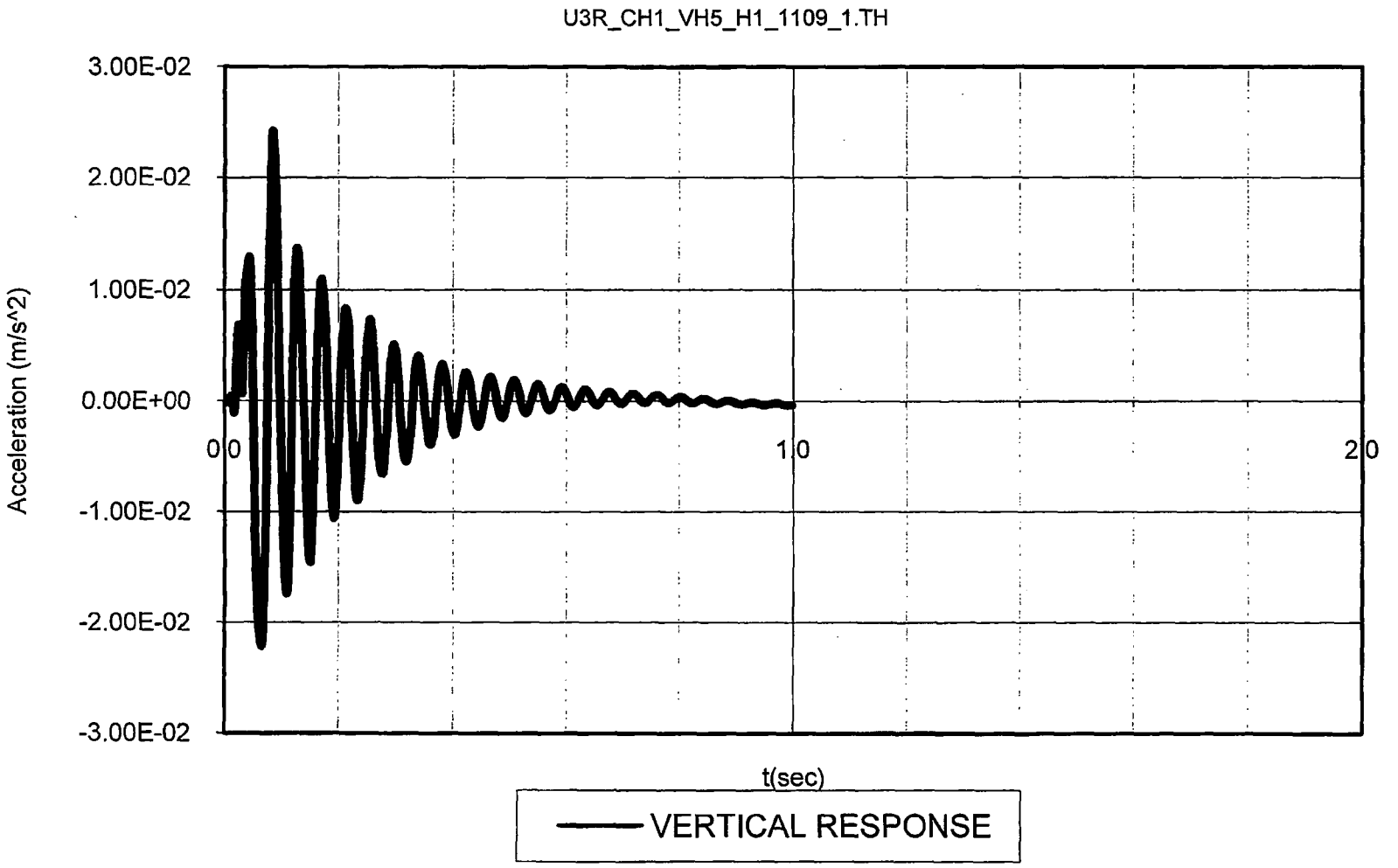

U3R_CH1_VH5_H1_1019_1.TH
6.00E-03
4.00E-03
2.00E-03
0.00E+00
-2.00E-03
-4.00E-03
-6.00E-03
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
90°-270° HORIZONTAL RESPONSE

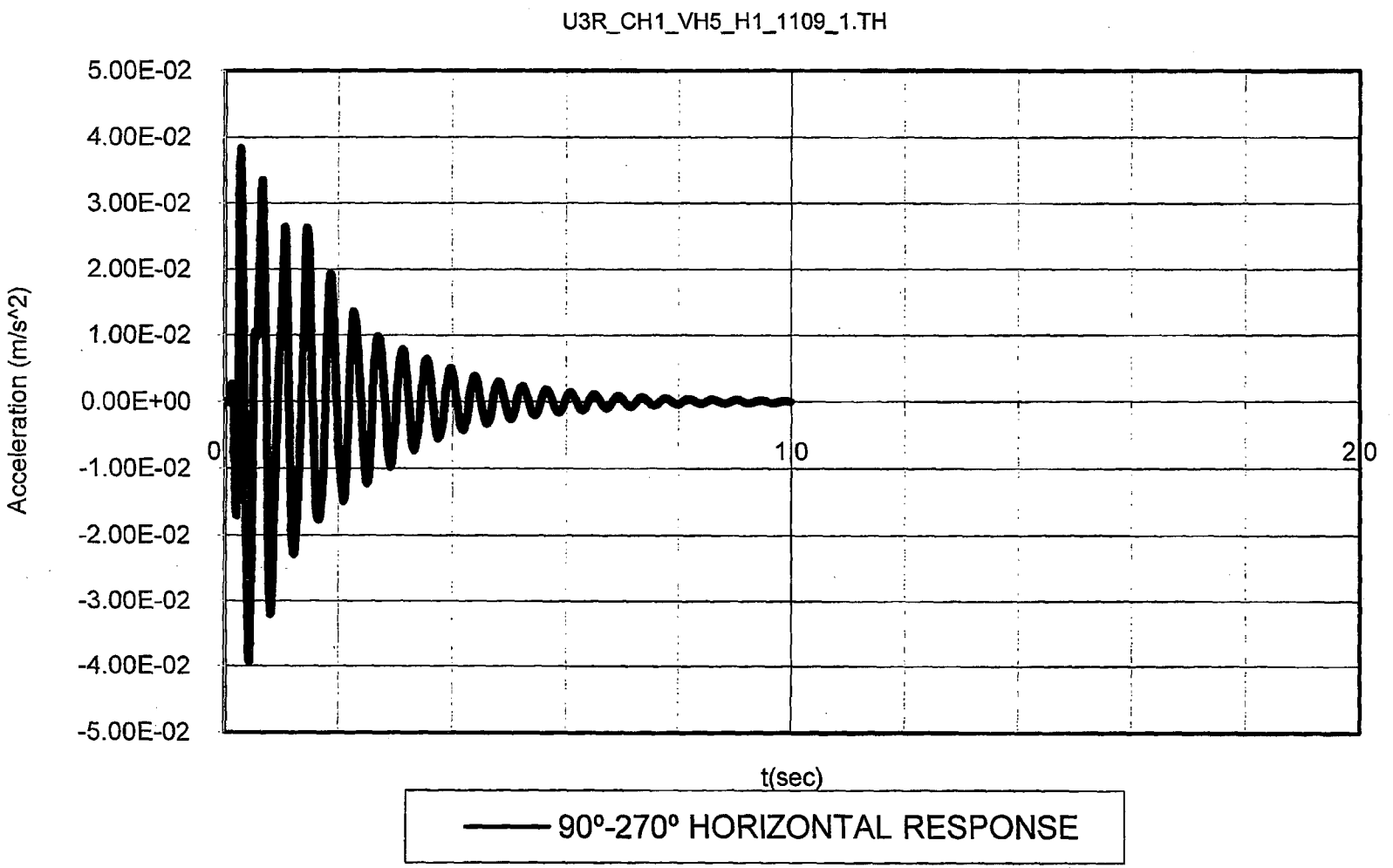

U3R_CH1_VH5_H1_1089_1.TH
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
-4.00E-01
-5.00E-01
-6.00E-01
Acceleration (m/s^2)
0
10
20
t(sec)
0º-180º HORIZONTAL RESPONSE

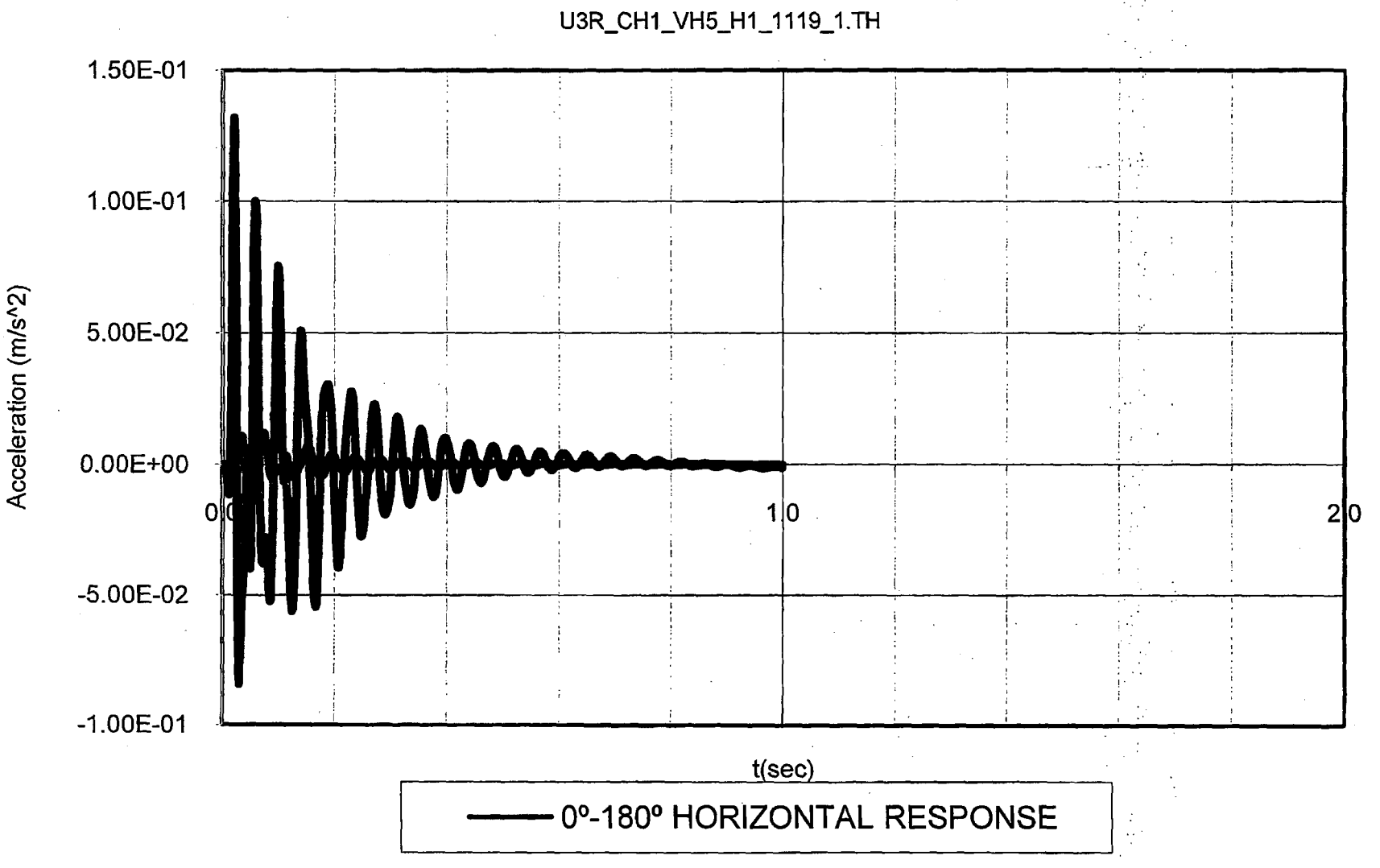

U3R_CH1_VH5_H1_1089_1.TH
1.00E+00
8.00E-01
6.00E-01
4.00E-01
2.00E-01
0.00E+00
-2.00E-01
-4.00E-01
-6.00E-01
-8.00E-01
-1.00E+00
Acceleration (m/s^2)
0
10
20
t(sec)
VERTICAL RESPONSE

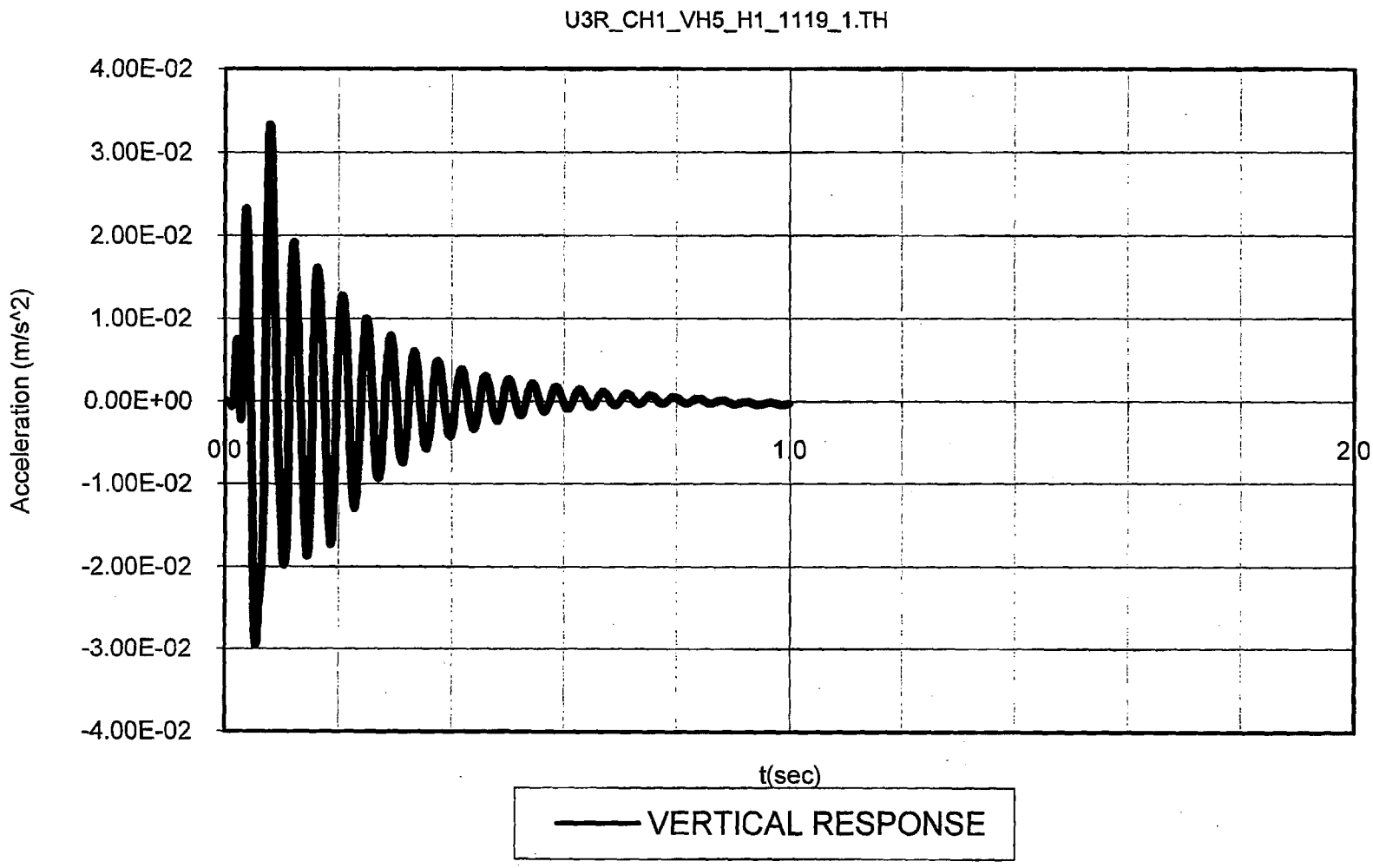

U3R_CH1_VH5_H1_1089_1.TH
8.00E-03
6.00E-03
4.00E-03
2.00E-03
0.00E+00
-2.00E-03
-4.00E-03
-6.00E-03
-8.00E-03
-1.00E-02
Acceleration (m/s^2)
0
10
20
t(sec)
90°-270° HORIZONTAL RESPONSE

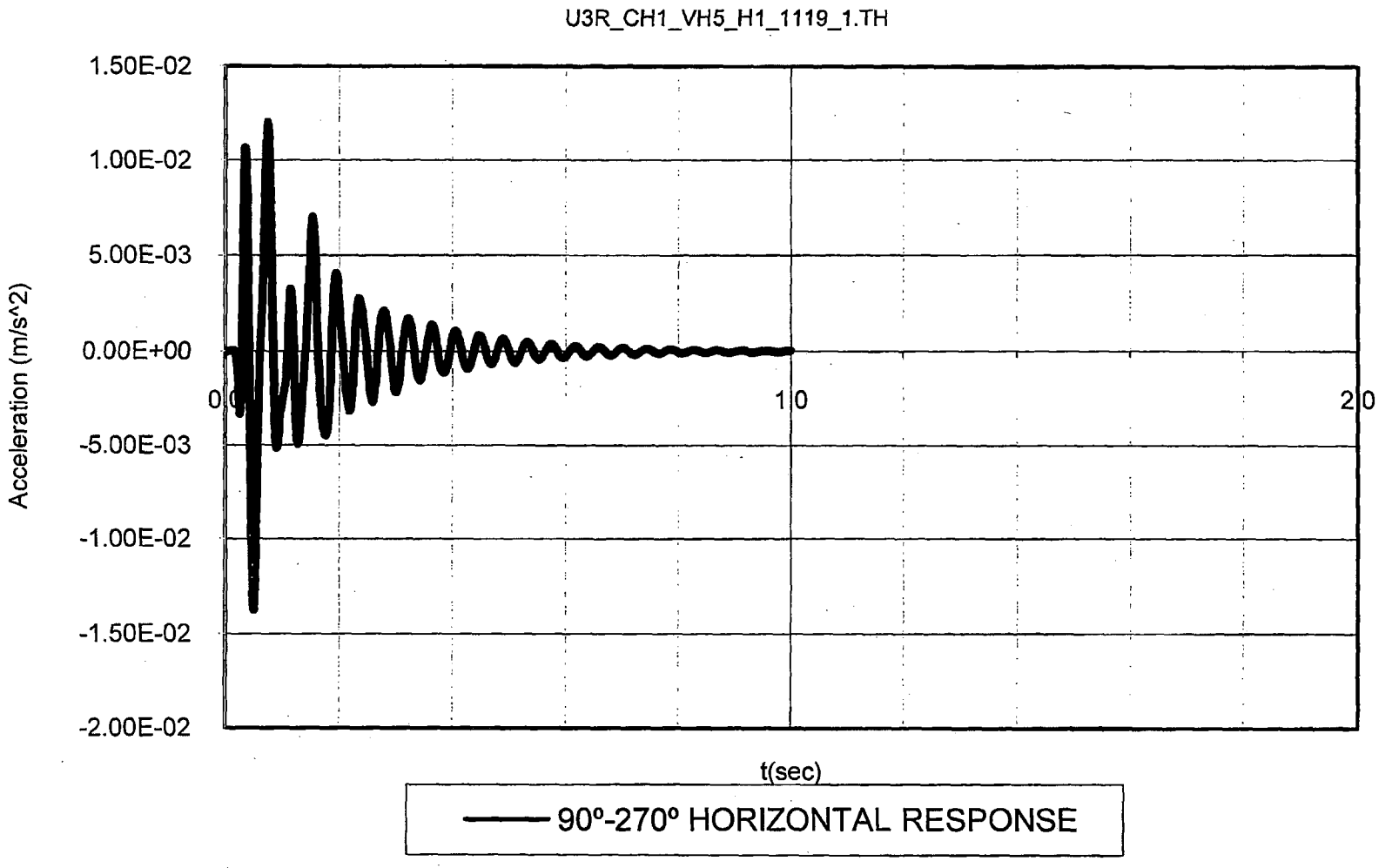

U3R_CH1_VH5_H1_1109_1.TH
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
-4.00E-01
Acceleration (m/s^2)
0
10
20
t(sec)
0º-180º HORIZONTAL RESPONSE

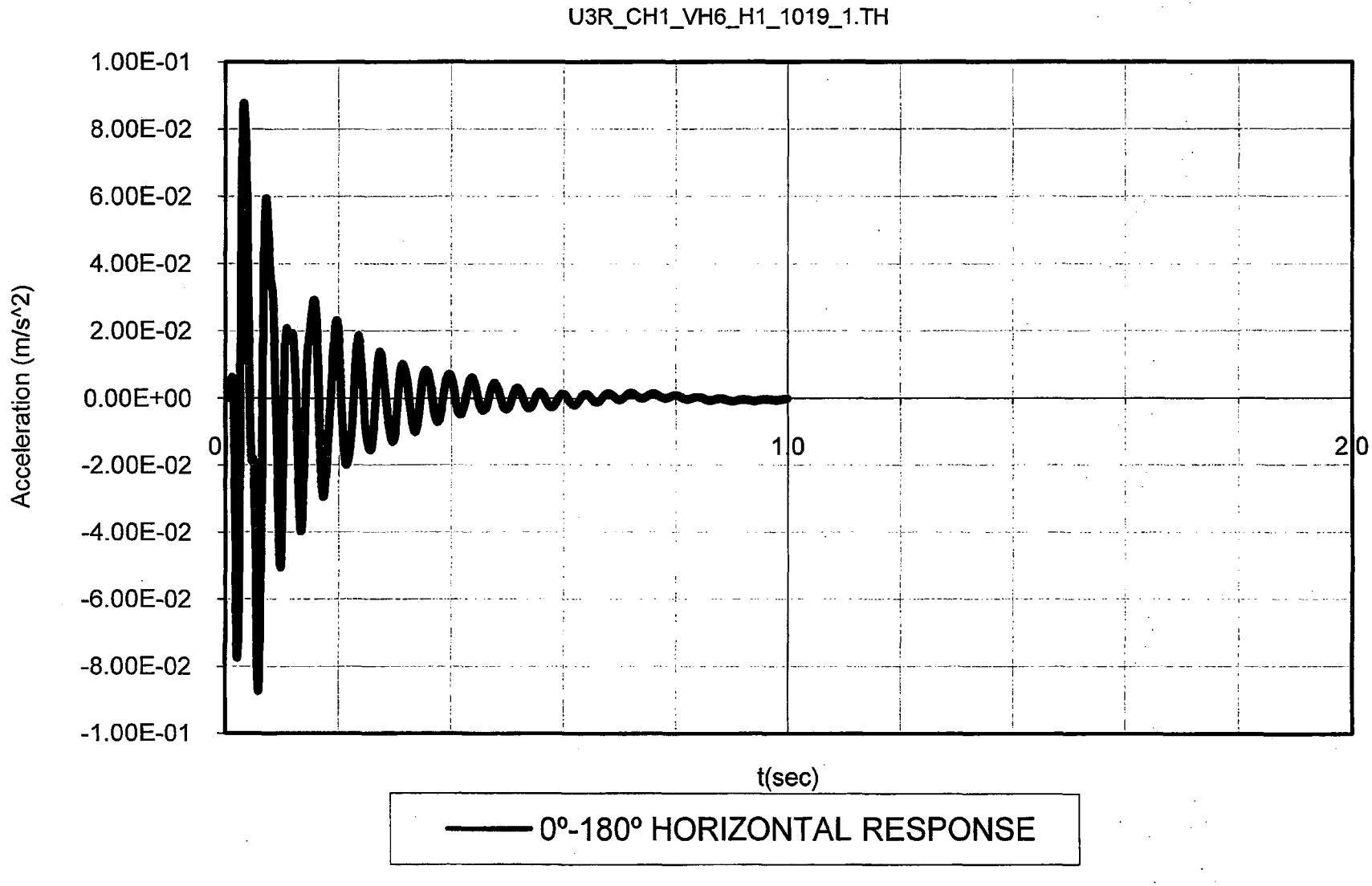

U3R_CH1_VH5_H1_1109_1.TH
3.00E-02
2.00E-02
1.00E-02
0.00E+00
-1.00E-02
-2.00E-02
-3.00E-02
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
VERTICAL RESPONSE

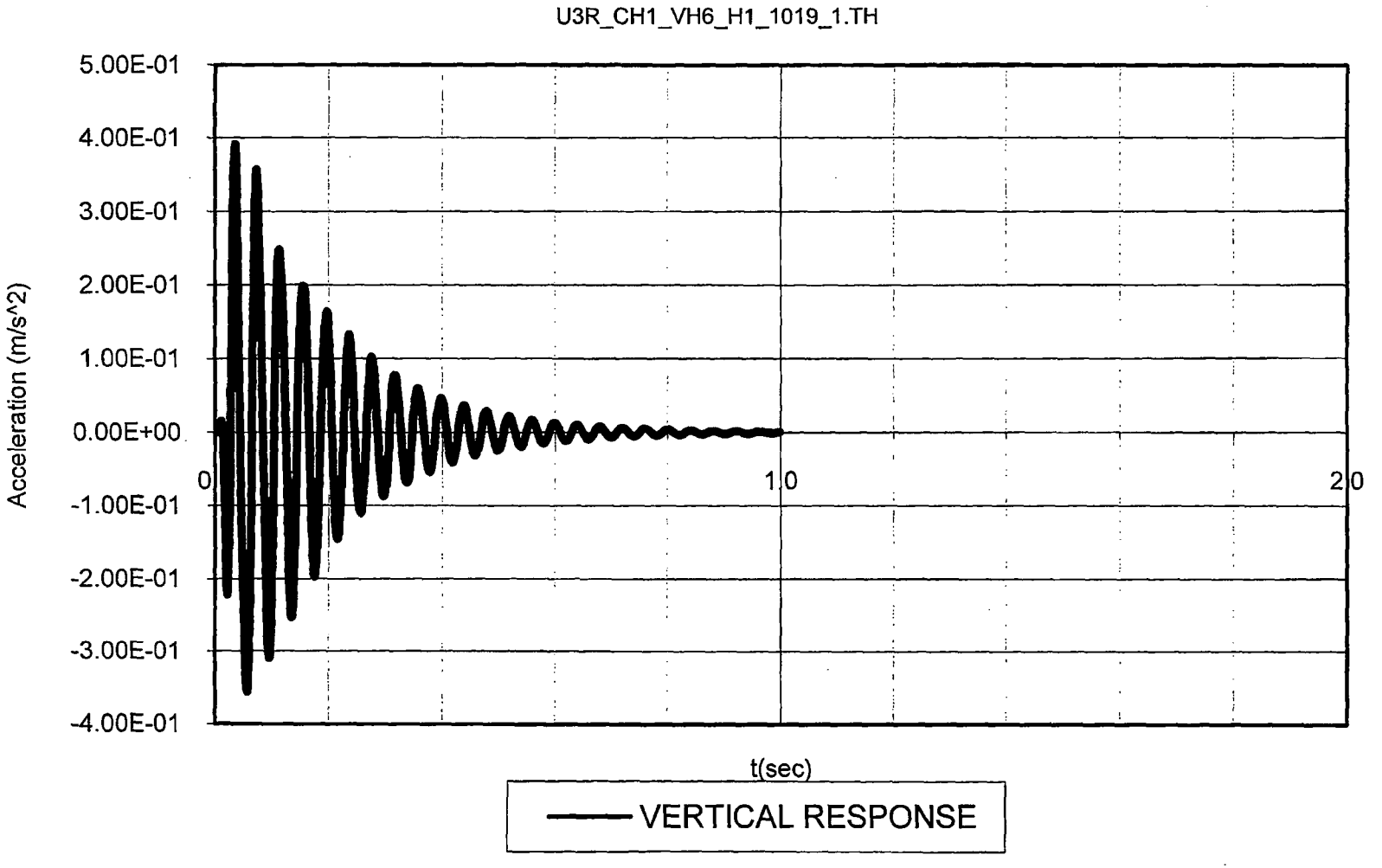

U3R_CH1_VH5_H1_1109_1.TH
5.00E-02
4.00E-02
3.00E-02
2.00E-02
1.00E-02
0.00E+00
-1.00E-02
-2.00E-02
-3.00E-02
-4.00E-02
-5.00E-02
Acceleration (m/s^2)
0
10
20
t(sec)
90°-270° HORIZONTAL RESPONSE

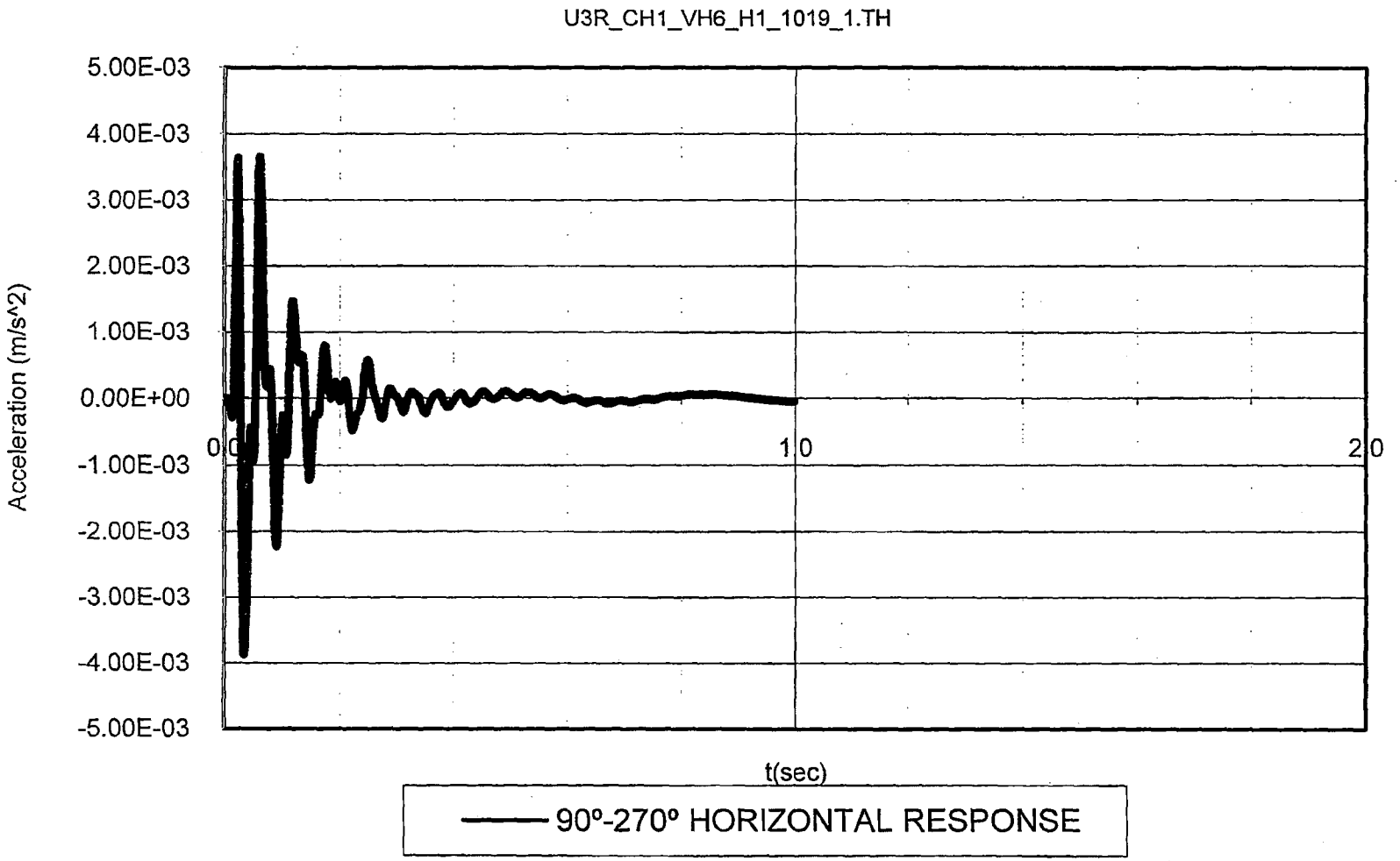

U3R_CH1_VH5_H1_1119_1.TH
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
Acceleration (m/s^2)
0
10
20
t(sec)
0º-180º HORIZONTAL RESPONSE

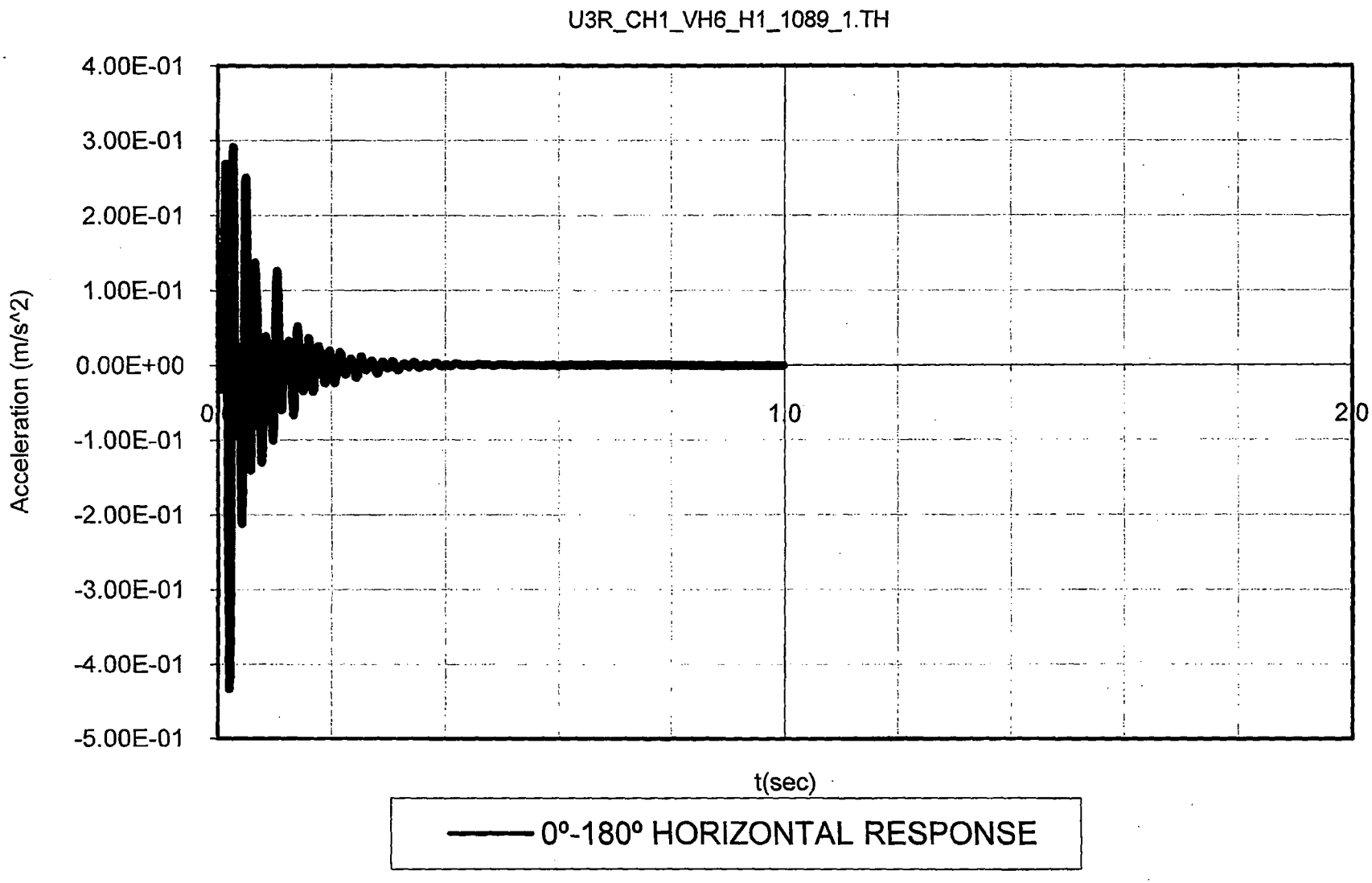

U3R_CH1_VH5_H1_1119_1.TH
4.00E-02
3.00E-02
2.00E-02
1.00E-02
0.00E+00
-1.00E-02
-2.00E-02
-3.00E-02
-4.00E-02
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
VERTICAL RESPONSE

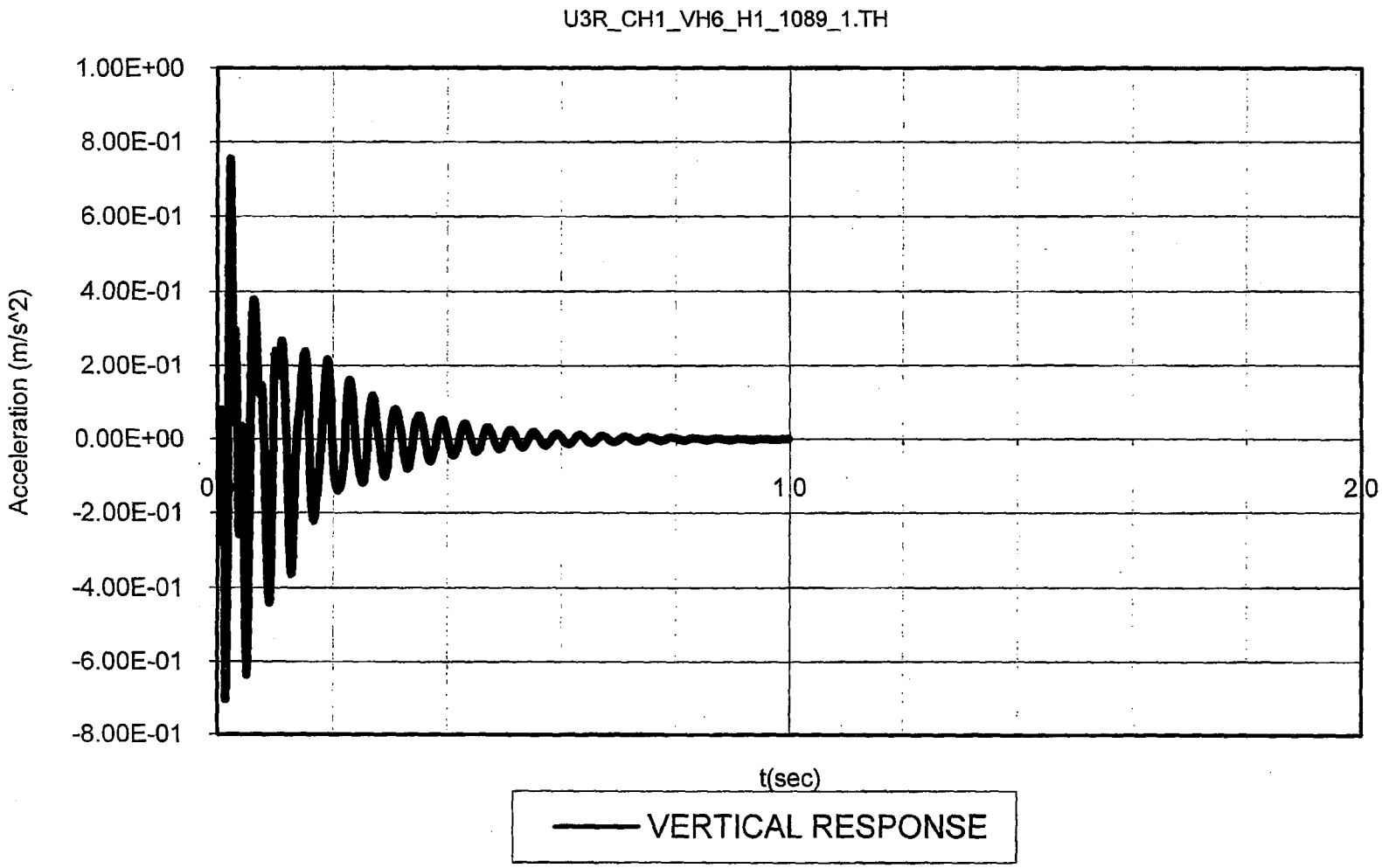

U3R_CH1_VH5_H1_1119_1.TH
1.50E-02
1.00E-02
5.00E-03
0.00E+00
-5.00E-03
-1.00E-02
-1.50E-02
-2.00E-02
Acceleration (m/s^2)
0
10
20
t(sec)
90º-270º HORIZONTAL RESPONSE

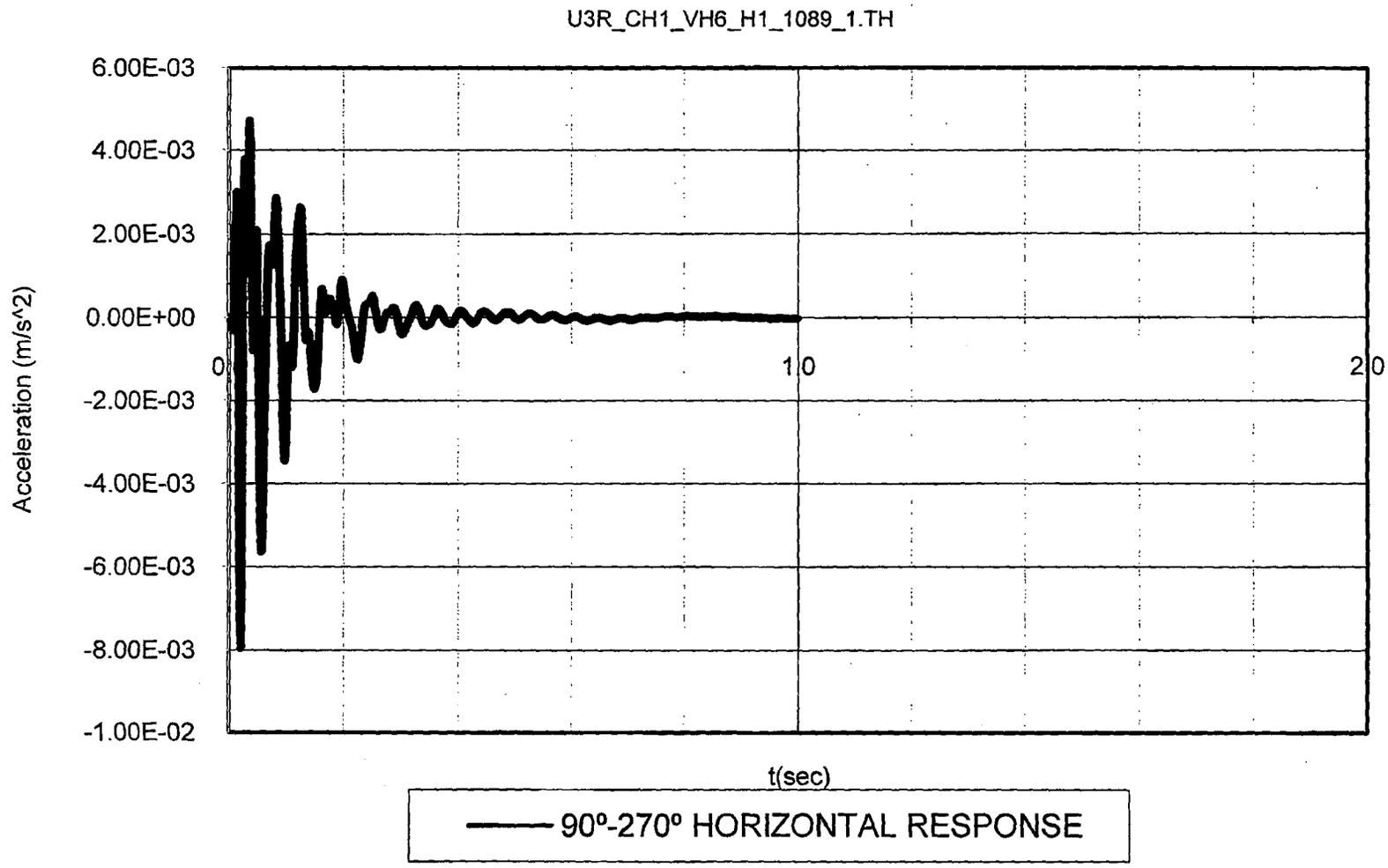

U3R_CH1_VH6_H1_1019_1.TH
1.00E-01
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
-2.00E-02
-4.00E-02
-6.00E-02
-8.00E-02
-1.00E-01
Acceleration (m/s^2)
0
10
20
t(sec)
0º-180º HORIZONTAL RESPONSE

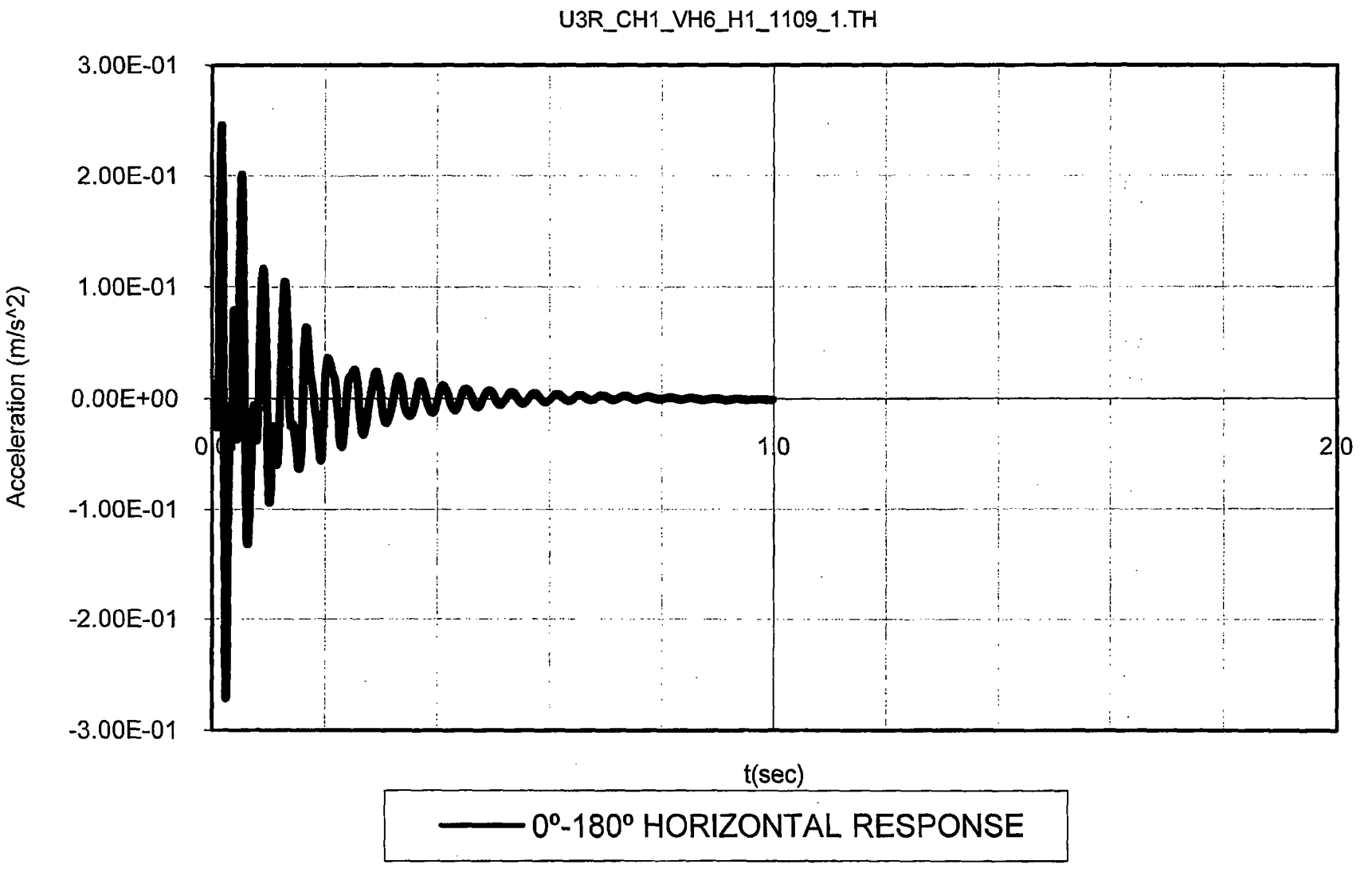

U3R_CH1_VH6_H1_1019_1.TH
5.00E-01
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
-4.00E-01
Acceleration (m/s^2)
0
10
20
t(sec)
VERTICAL RESPONSE

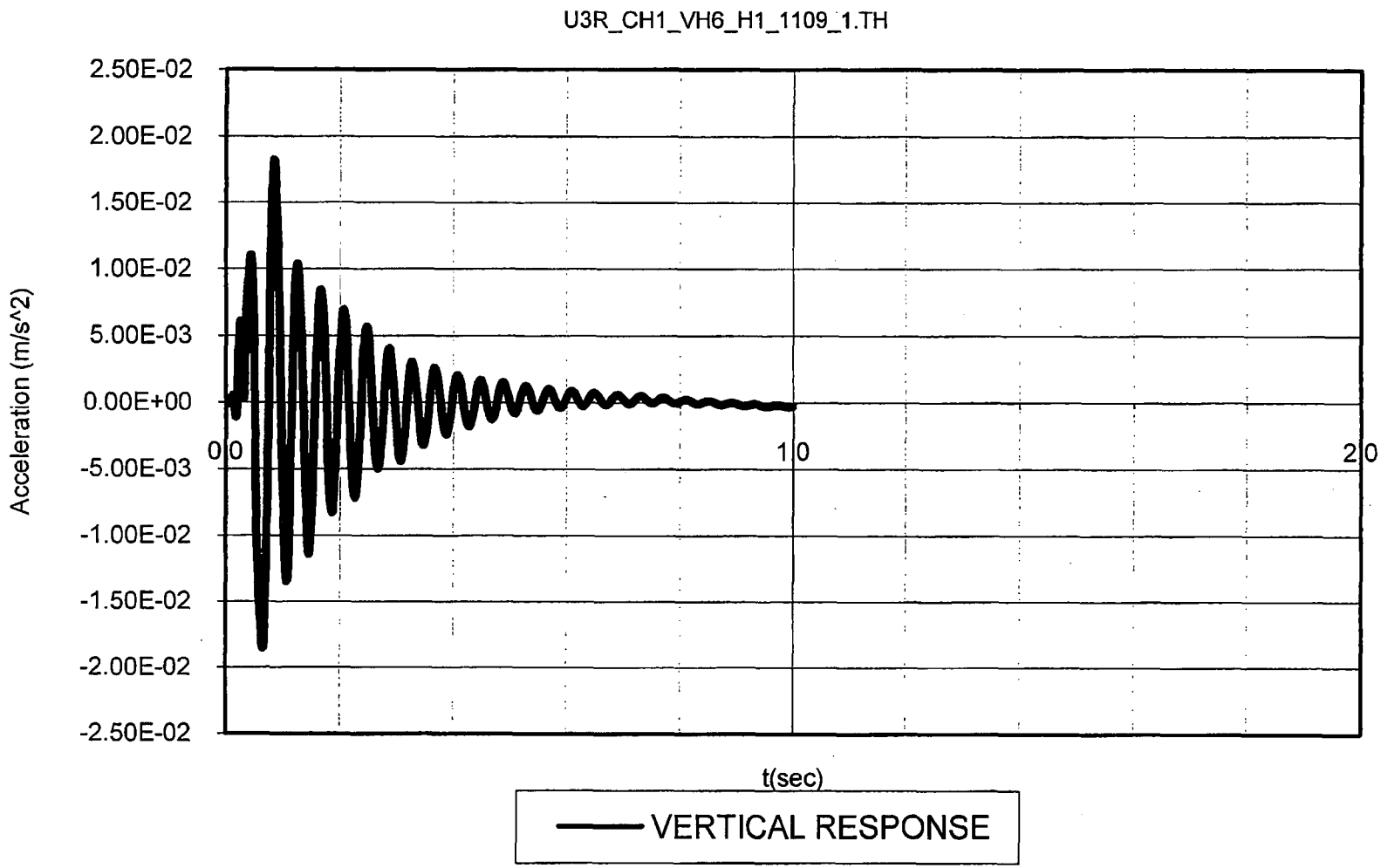

U3R_CH1_VH6_H1_1019_1.TH
5.00E-03
4.00E-03
3.00E-03
2.00E-03
1.00E-03
0.00E+00
-1.00E-03
-2.00E-03
-3.00E-03
-4.00E-03
-5.00E-03
Acceleration (m/s^2)
0.0
10
20
t(sec)
90º-270º HORIZONTAL RESPONSE

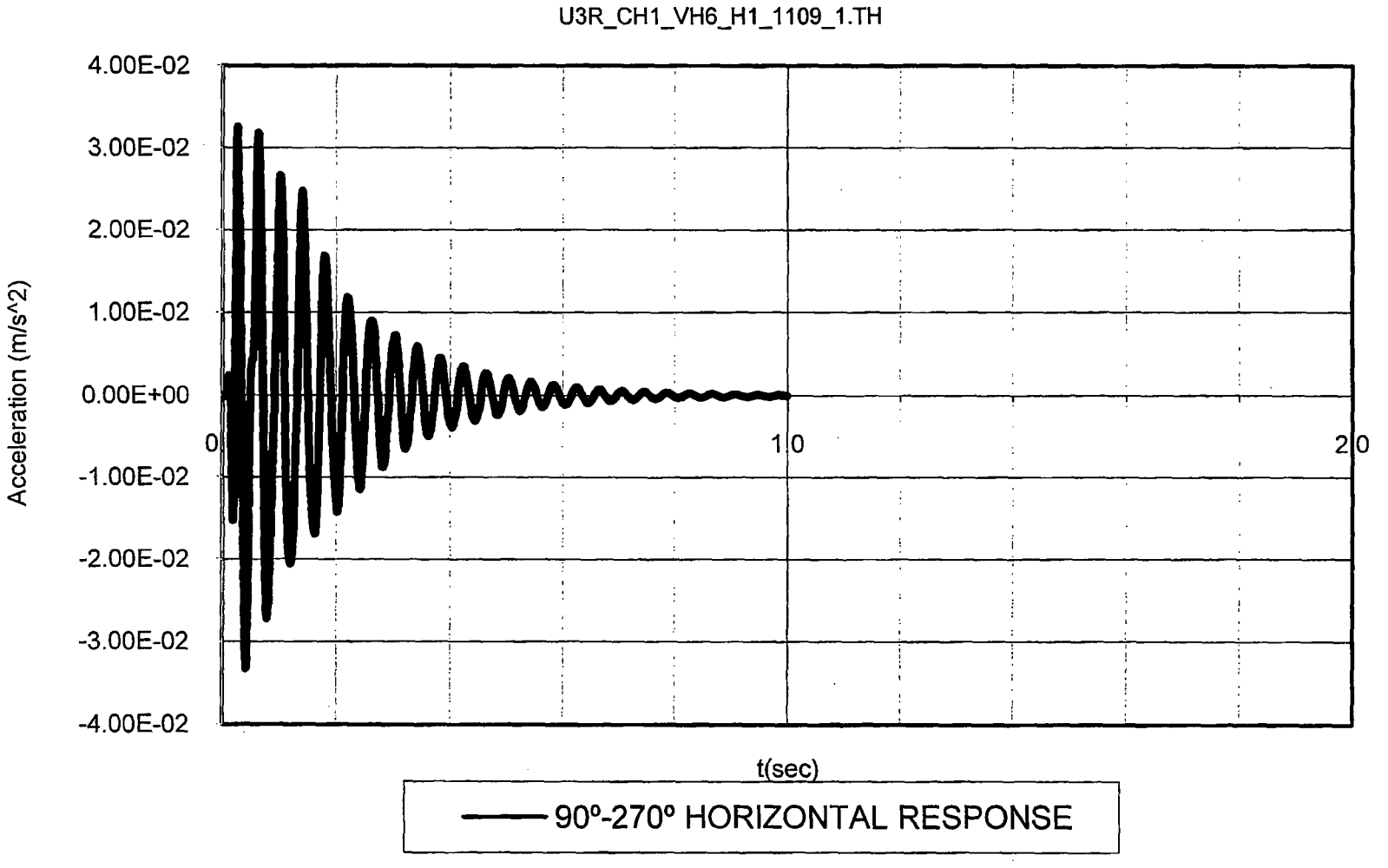

U3R_CH1_VH6_H1_1089_1.TH
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
-4.00E-01
-5.00E-01
Acceleration (m/s^2)
0
10
20
t(sec)
0°-180° HORIZONTAL RESPONSE

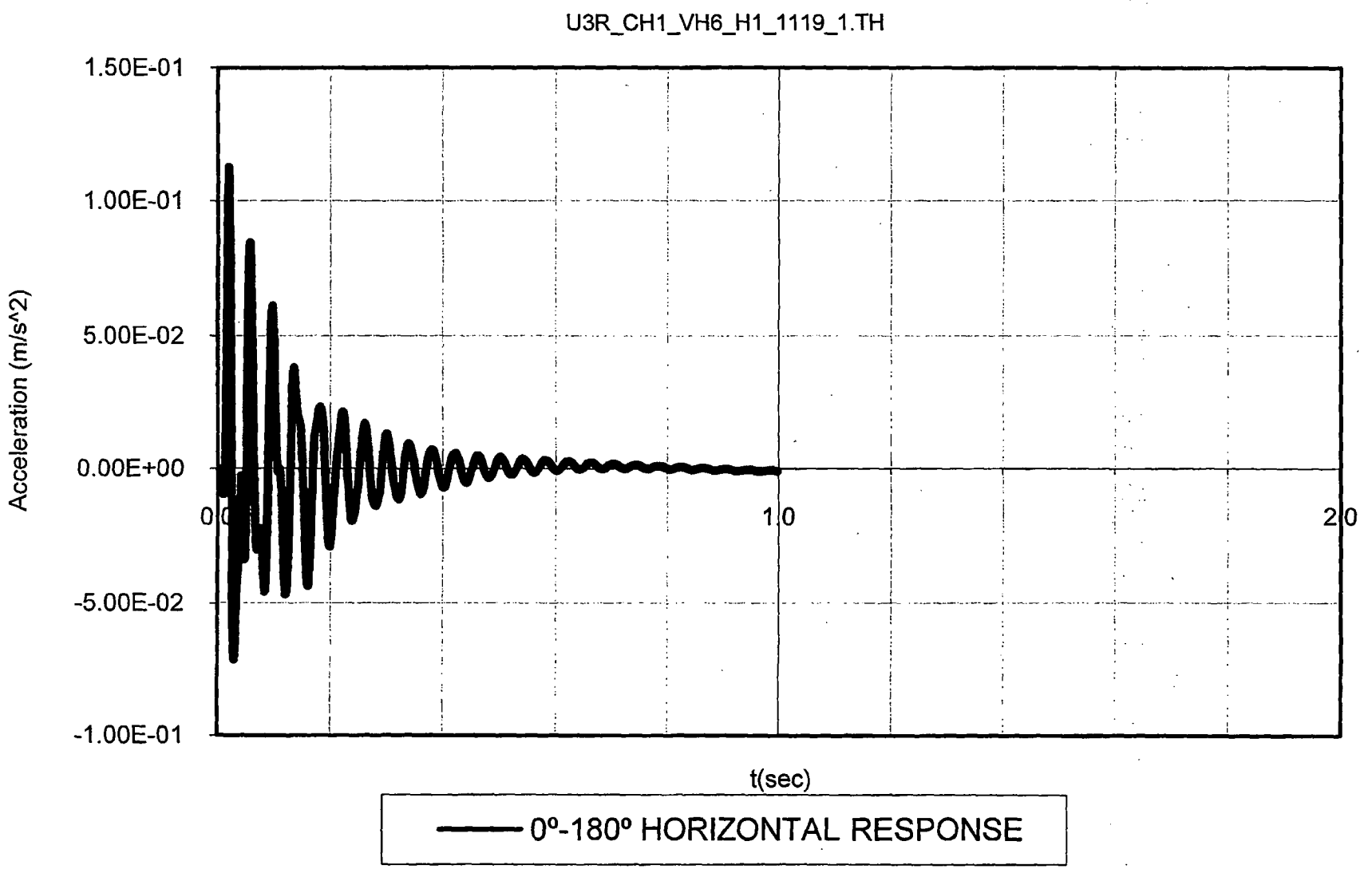

U3R_CH1_VH6_H1_1089_1.TH
1.00E+00
8.00E-01
6.00E-01
4.00E-01
2.00E-01
0.00E+00
-2.00E-01
-4.00E-01
-6.00E-01
-8.00E-01
Acceleration (m/s^2)
0
10
20
t(sec)
VERTICAL RESPONSE

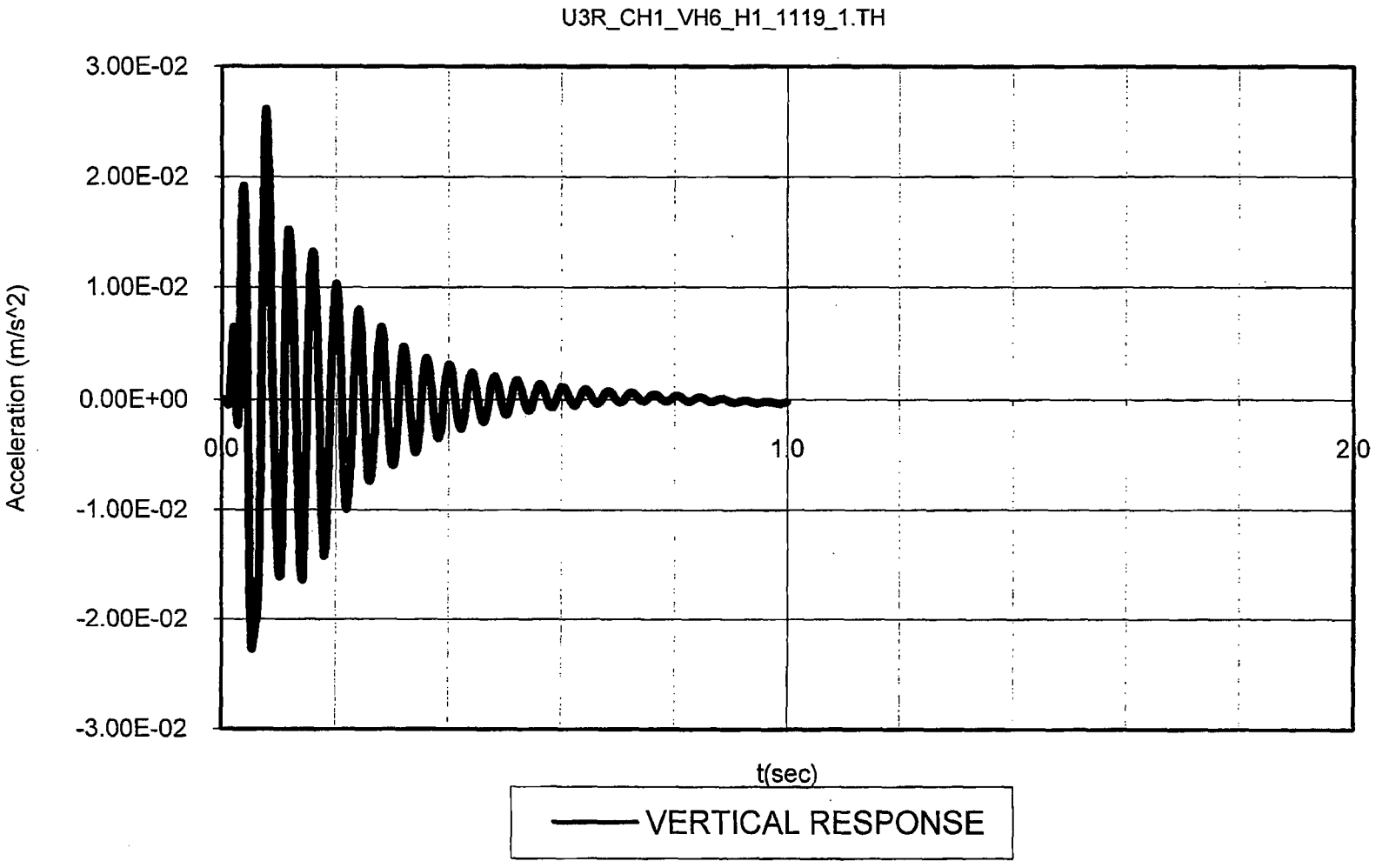

U3R_CH1_VH6_H1_1089_1.TH
6.00E-03
4.00E-03
2.00E-03
0.00E+00
-2.00E-03
-4.00E-03
-6.00E-03
-8.00E-03
-1.00E-02
Acceleration (m/s^2)
0
10
20
t(sec)
90º-270º HORIZONTAL RESPONSE

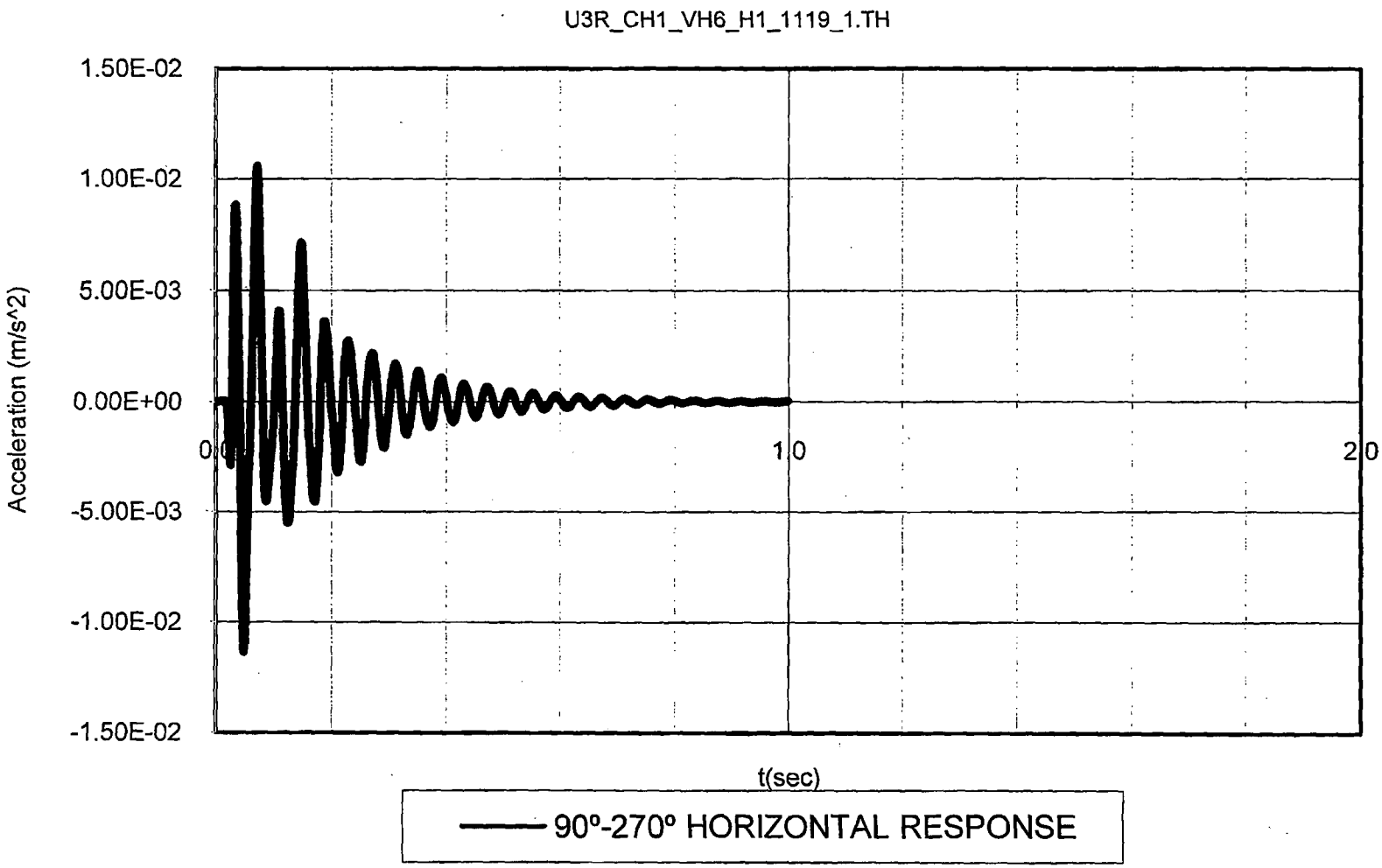

U3R_CH1_VH6_H1_1109_1.TH
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
Acceleration (m/s^2)
0
1.0
2.0
t(sec)
0º-180º HORIZONTAL RESPONSE

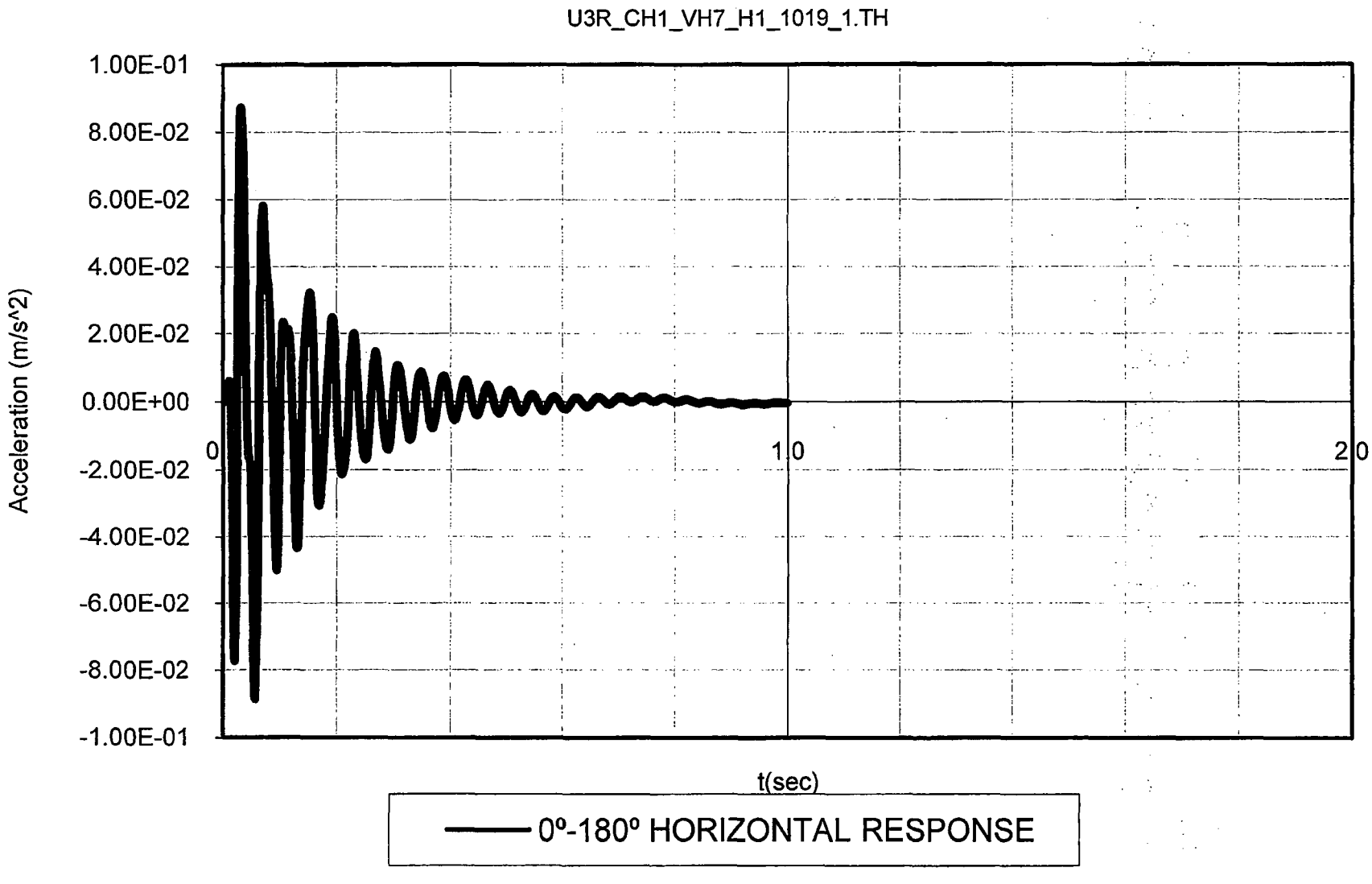

U3R_CH1_VH6_H1_1109_1.TH
2.50E-02
2.00E-02
1.50E-02
1.00E-02
5.00E-03
0.00E+00
-5.00E-03
-1.00E-02
-1.50E-02
-2.00E-02
-2.50E-02
Acceleration (m/s^2)
0.0
10
20
t(sec)
VERTICAL RESPONSE

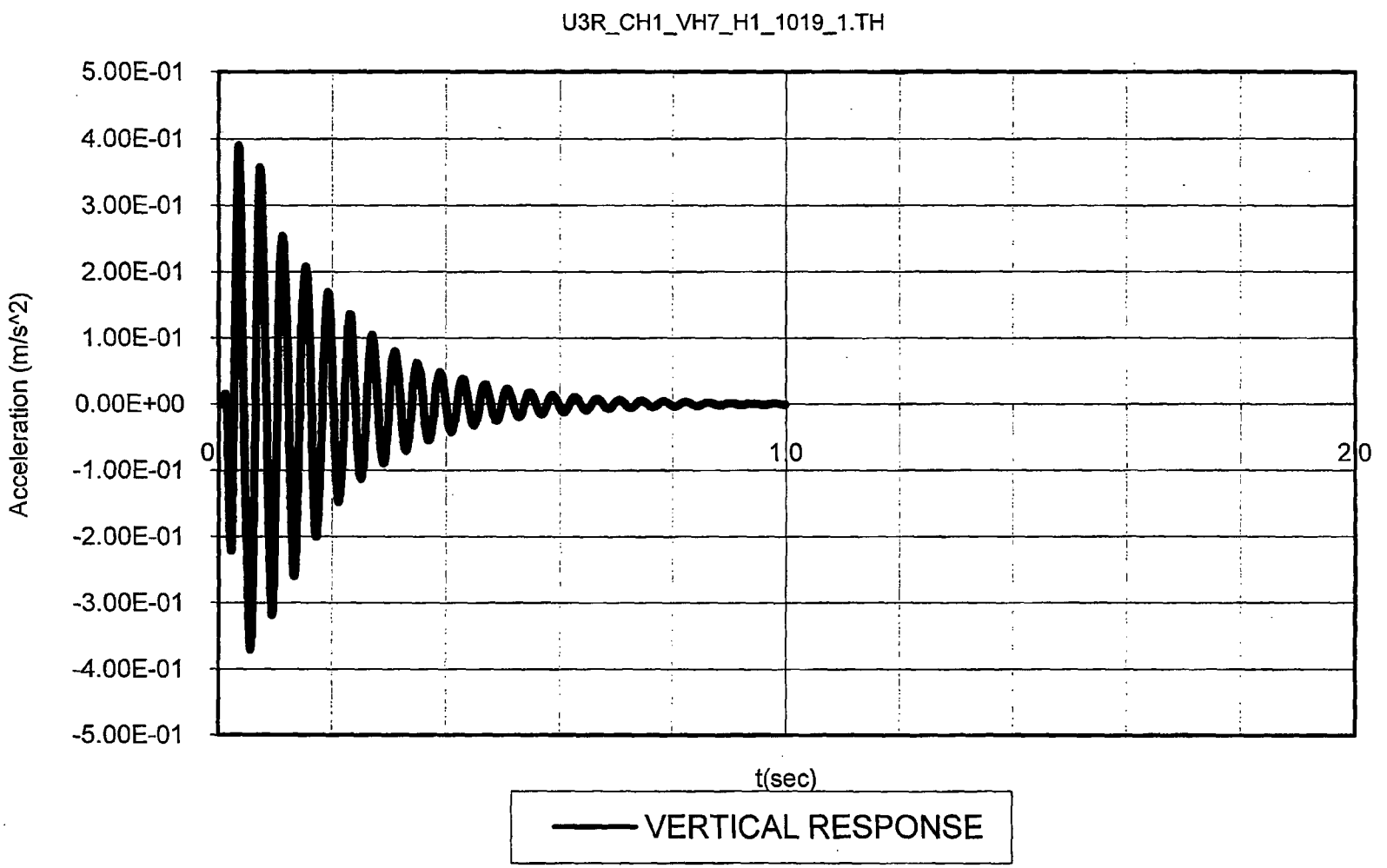

U3R_CH1_VH6_H1_1109_1.TH
4.00E-02
3.00E-02
2.00E-02
1.00E-02
0.00E+00
-1.00E-02
-2.00E-02
-3.00E-02
-4.00E-02
Acceleration (m/s^2)
0
10
20
t(sec)
90º-270º HORIZONTAL RESPONSE

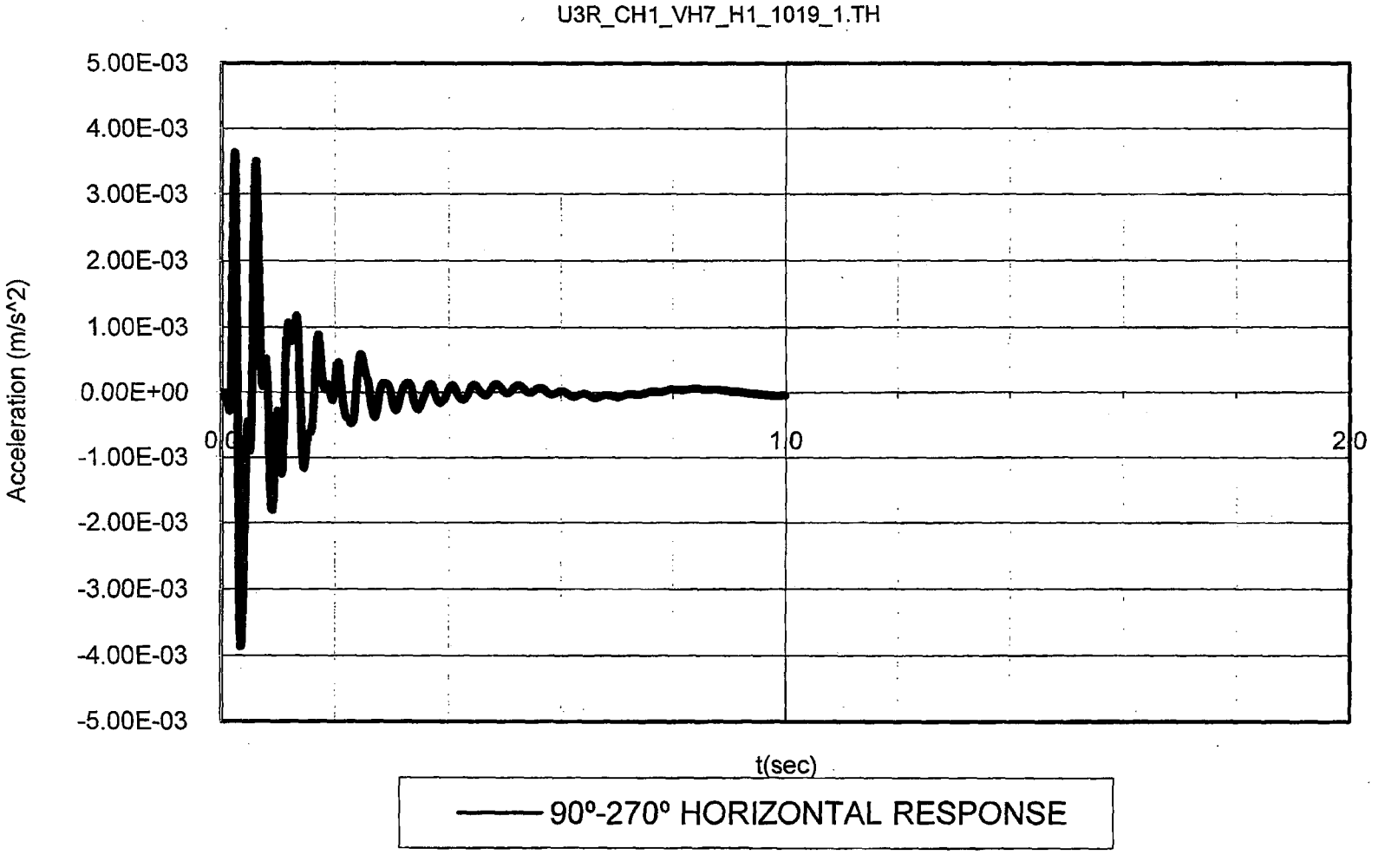

U3R_CH1_VH6_H1_1119_1.TH
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
0º-180º HORIZONTAL RESPONSE

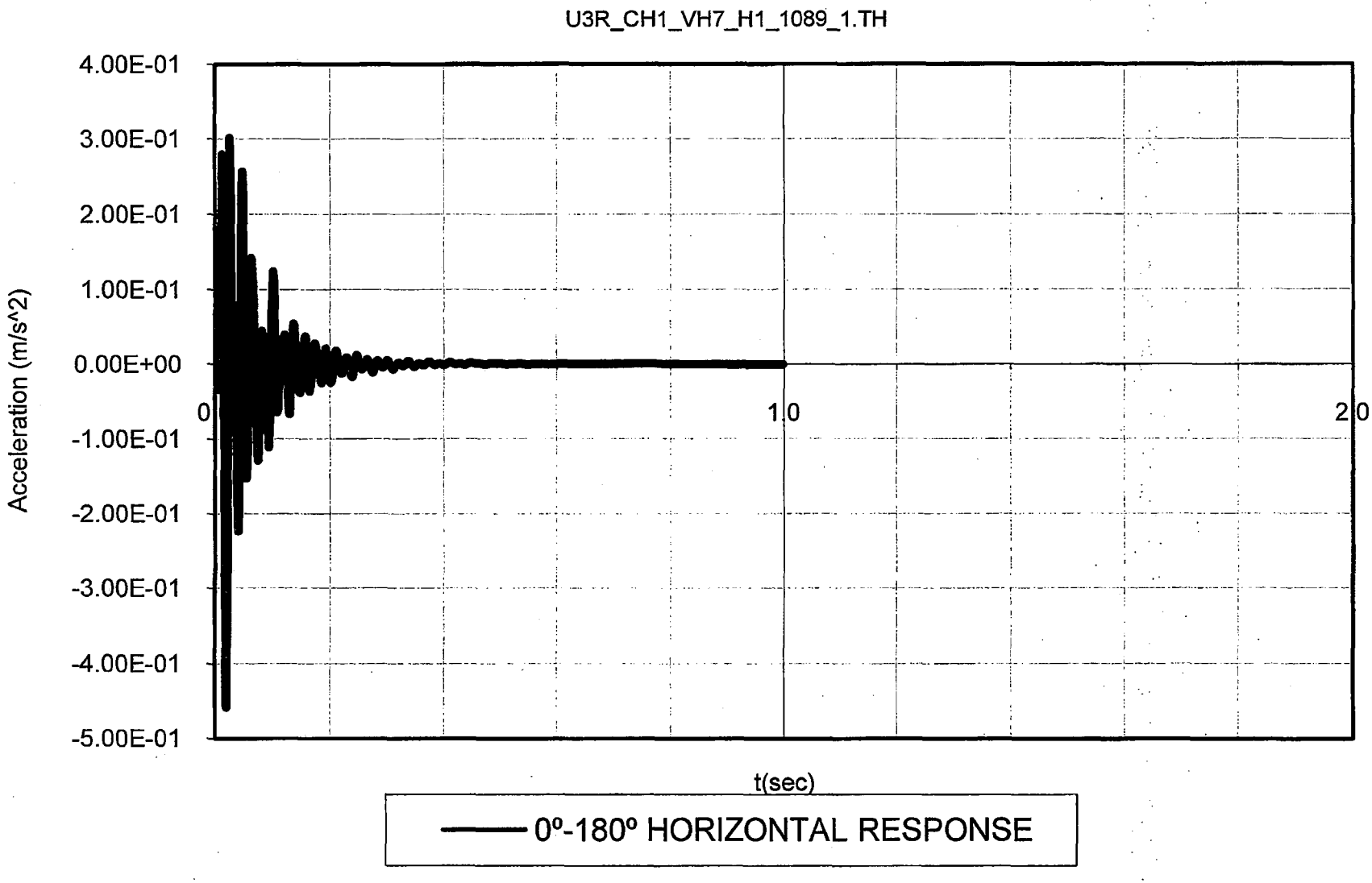

U3R_CH1_VH6_H1_1119_1.TH
3.00E-02
2.00E-02
1.00E-02
0.00E+00
-1.00E-02
-2.00E-02
-3.00E-02
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
VERTICAL RESPONSE

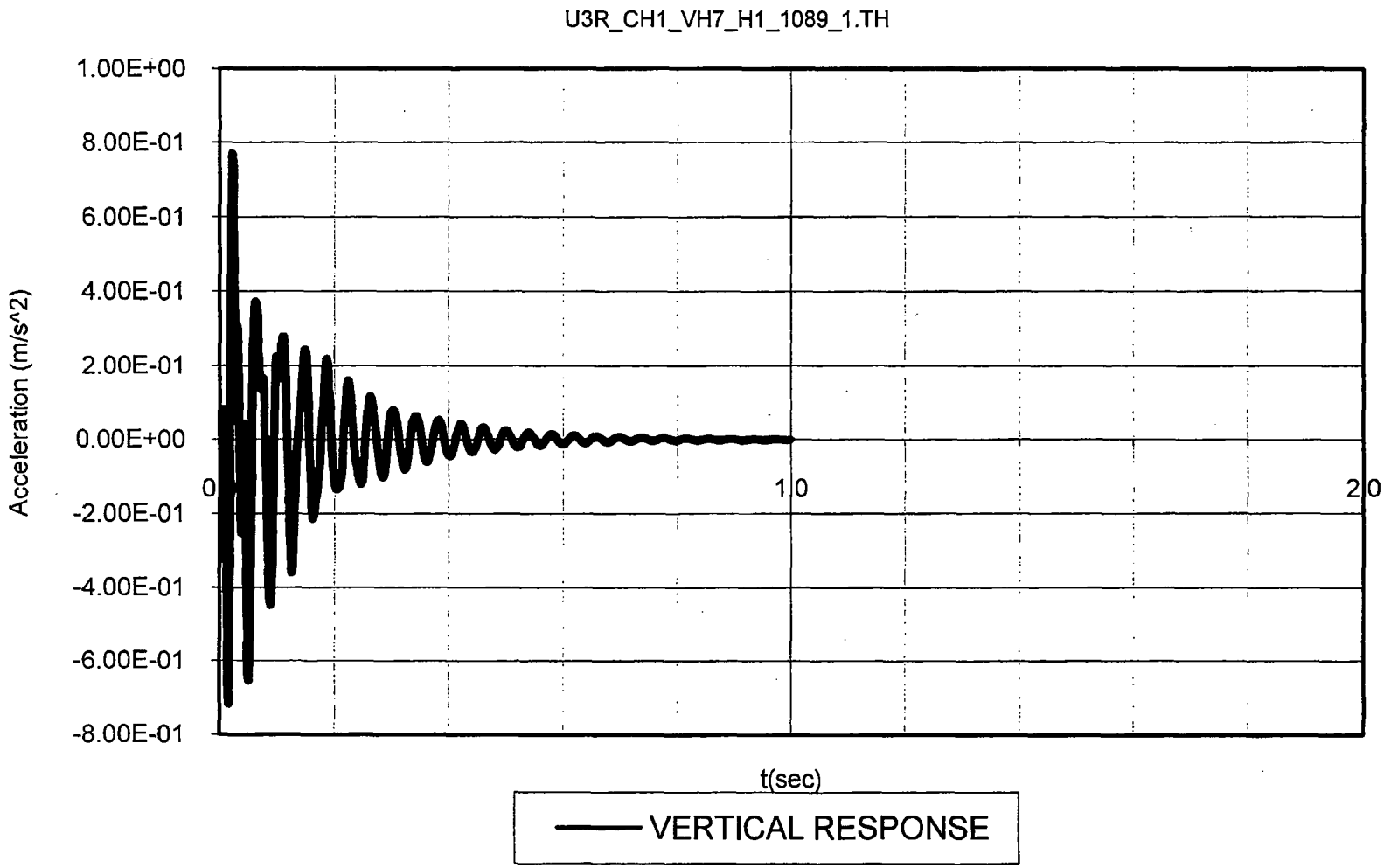

U3R_CH1_VH6_H1_1119_1.TH
1.50E-02
1.00E-02
5.00E-03
0.00E+00
-5.00E-03
-1.00E-02
-1.50E-02
Acceleration (m/s^2)
0.0
10
20
t(sec)
90º-270º HORIZONTAL RESPONSE

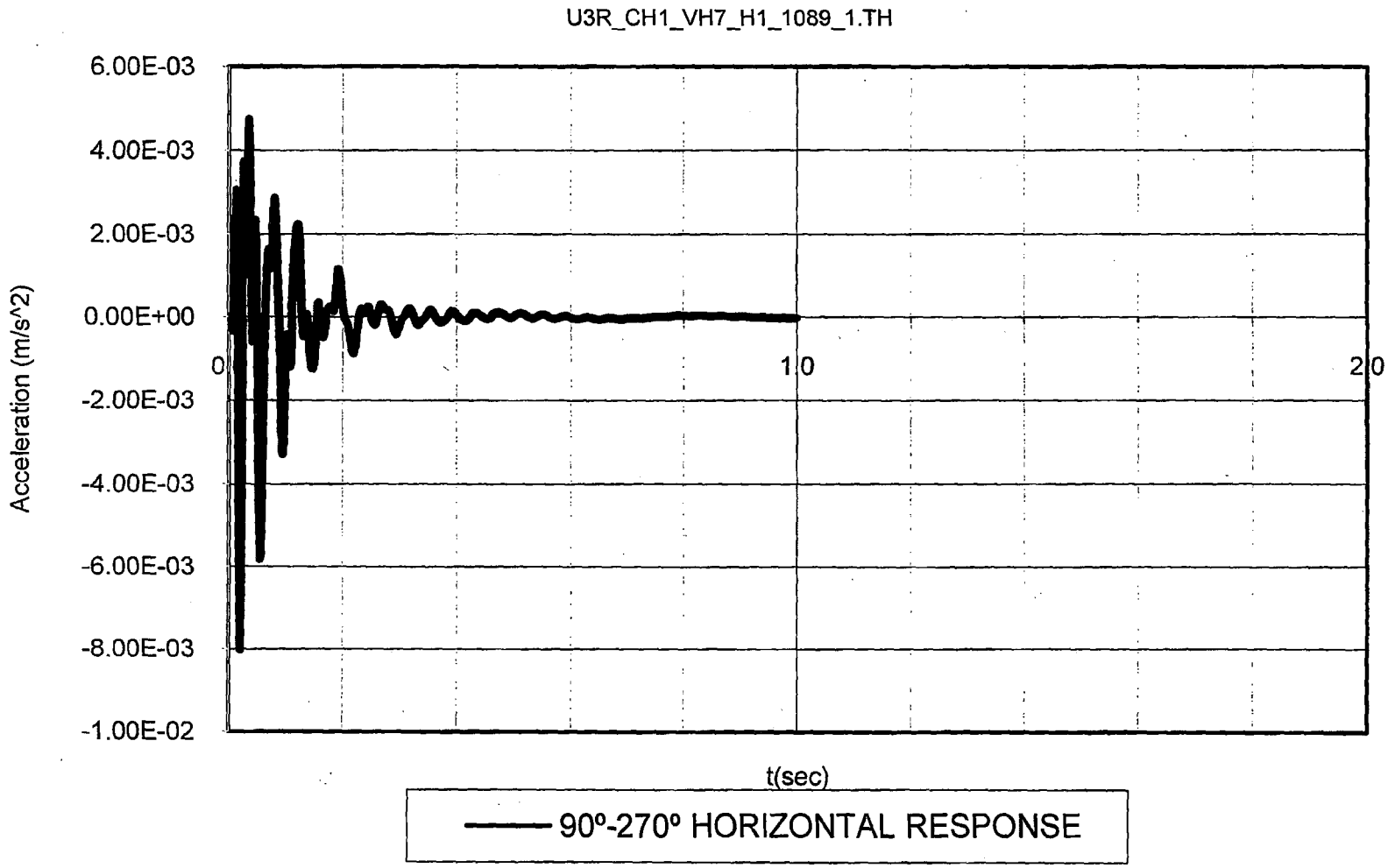

U3R_CH1_VH7_H1_1019_1.TH
1.00E-01
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
-2.00E-02
-4.00E-02
-6.00E-02
-8.00E-02
-1.00E-01
Acceleration (m/s^2)
0
10
20
t(sec)
0º-180º HORIZONTAL RESPONSE

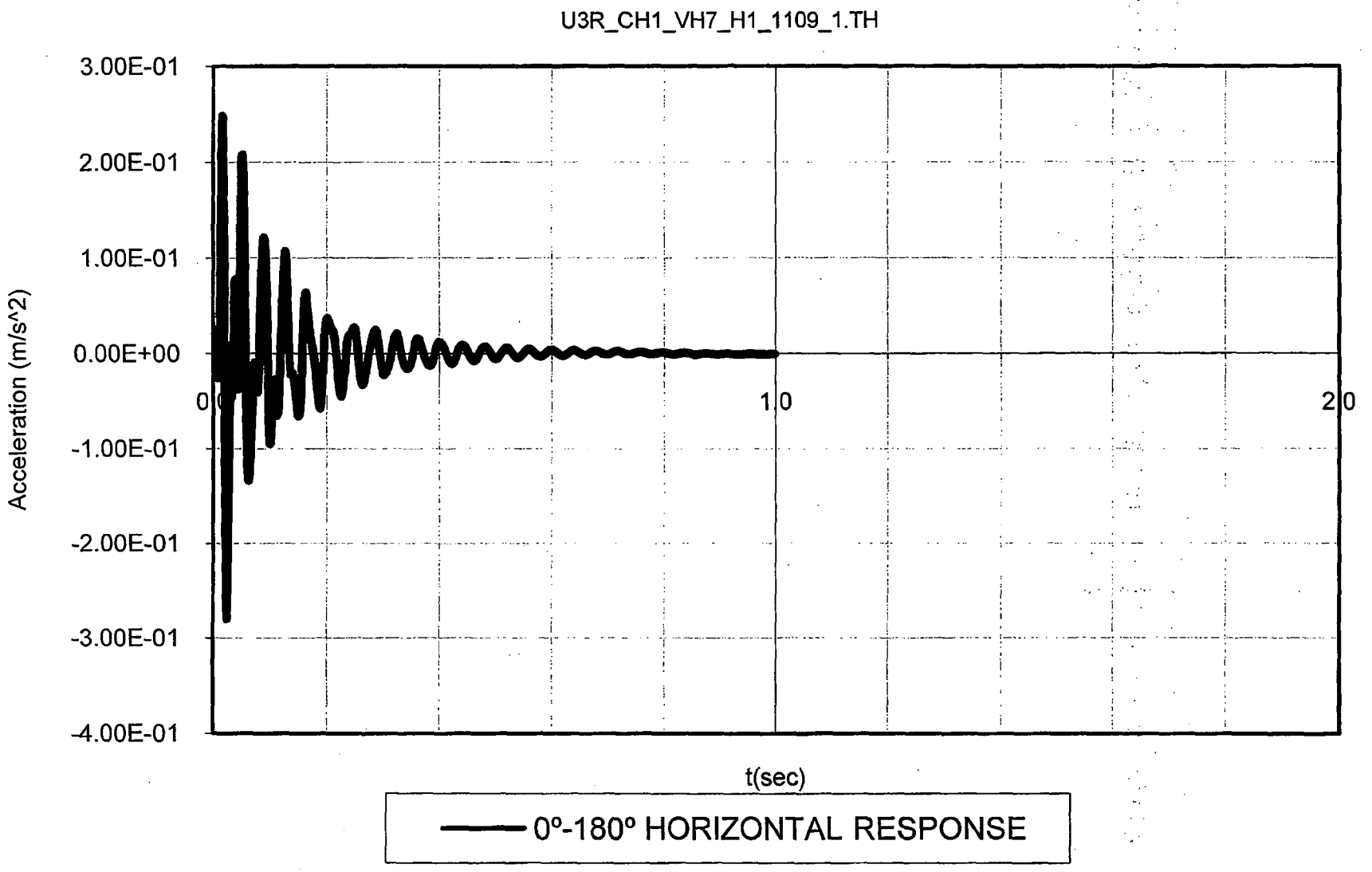

U3R_CH1_VH7_H1_1019_1.TH
5.00E-01
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
-4.00E-01
-5.00E-01
Acceleration (m/s^2)
0
10
20
t(sec)
VERTICAL RESPONSE

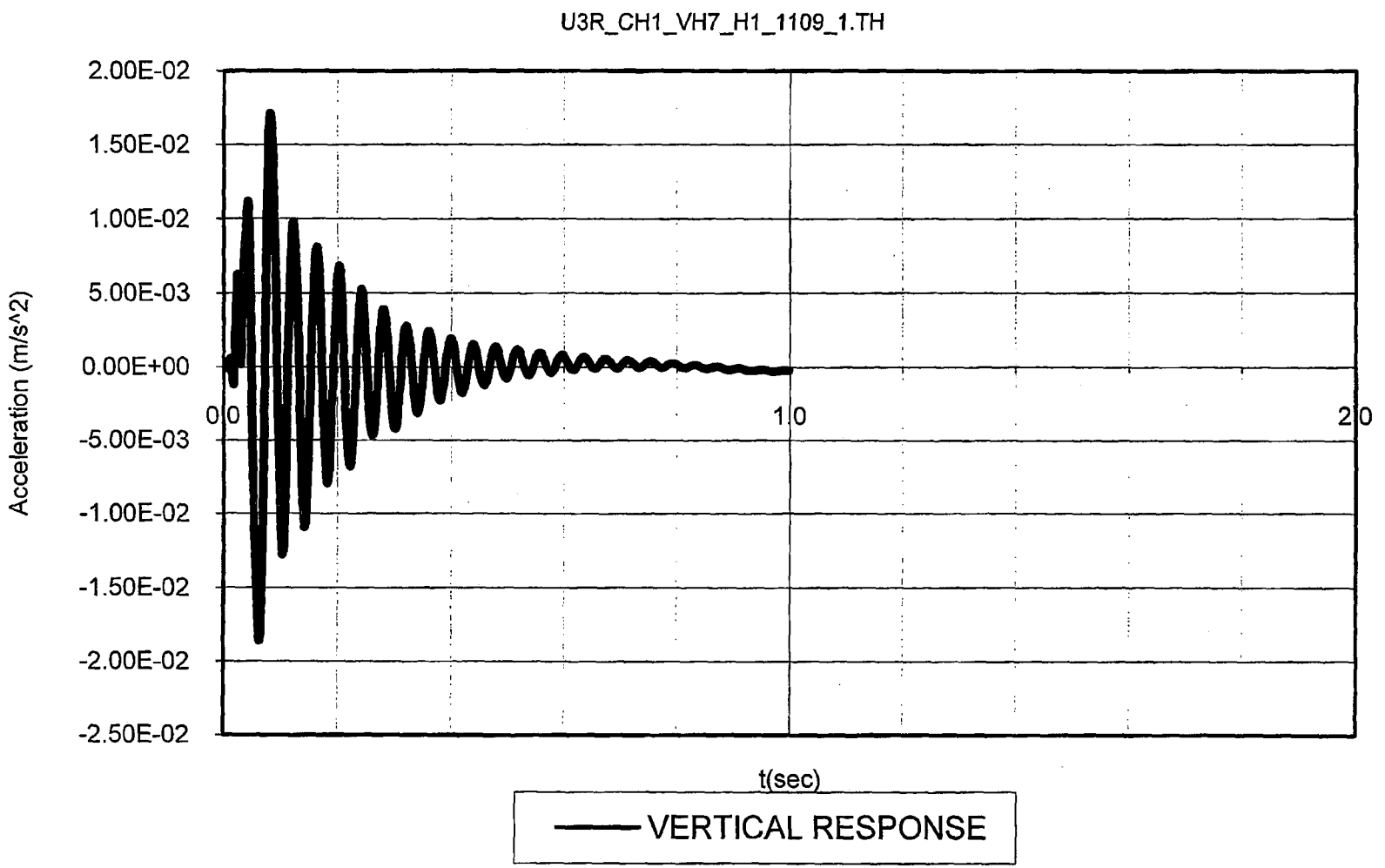

U3R_CH1_VH7_H1_1019_1.TH
5.00E-03
4.00E-03
3.00E-03
2.00E-03
1.00E-03
0.00E+00
-1.00E-03
-2.00E-03
-3.00E-03
-4.00E-03
-5.00E-03
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
90°-270° HORIZONTAL RESPONSE

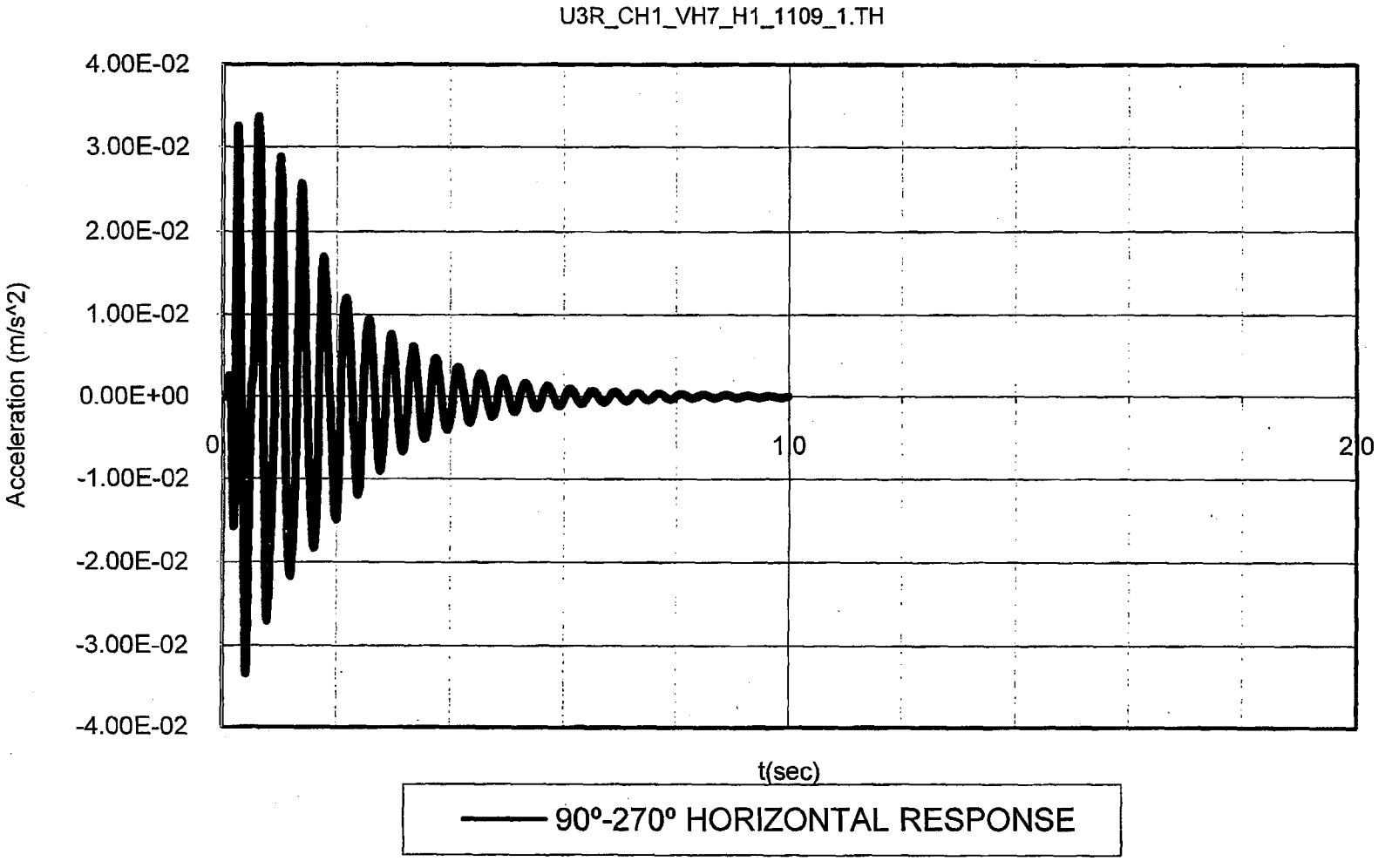

U3R_CH1_VH7_H1_1089_1.TH
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
-4.00E-01
-5.00E-01
Acceleration (m/s^2)
0
10
20
t(sec)
0º-180º HORIZONTAL RESPONSE

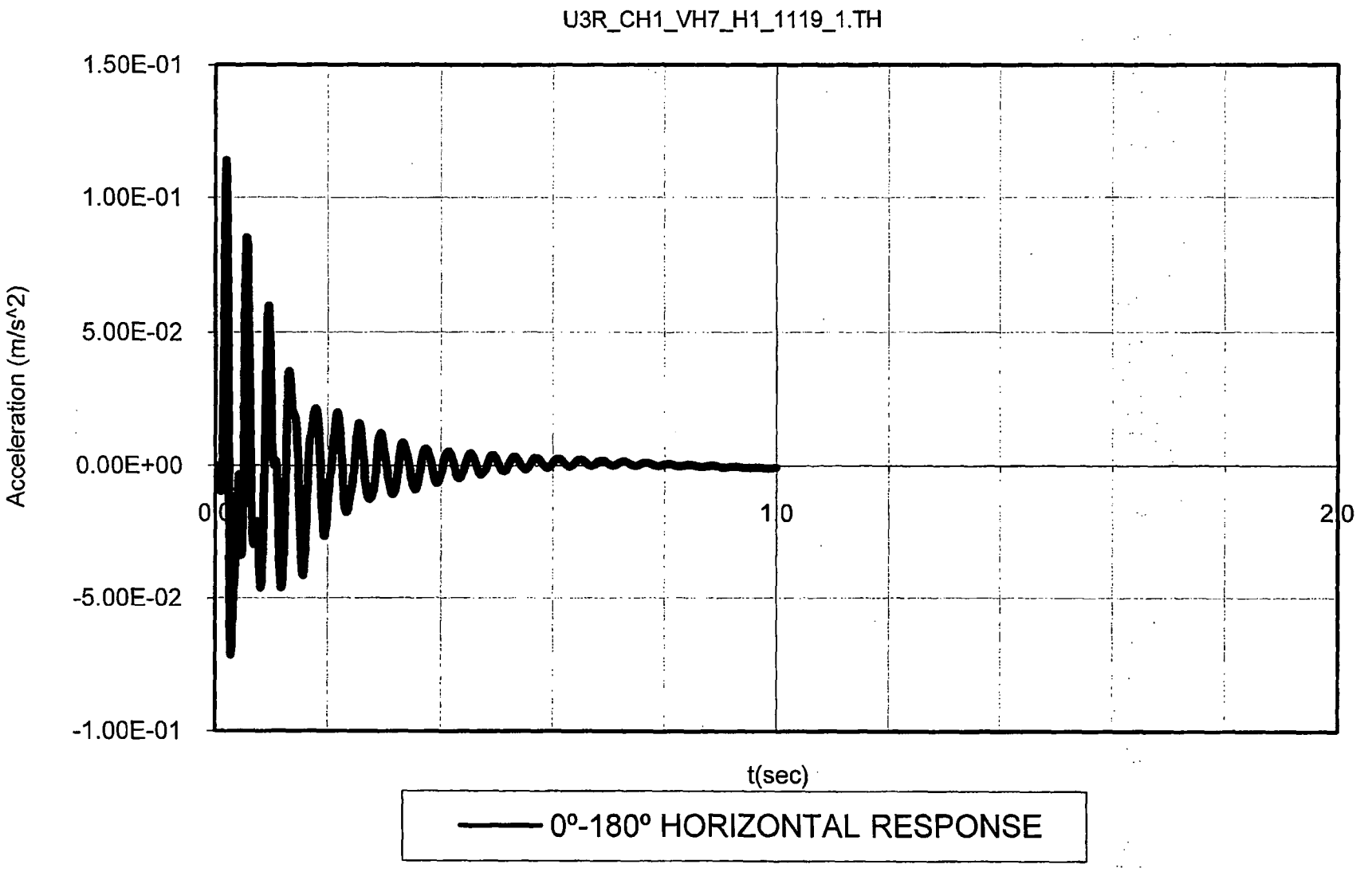

U3R_CH1_VH7_H1_1089_1.TH
1.00E+00
8.00E-01
6.00E-01
4.00E-01
2.00E-01
0.00E+00
-2.00E-01
-4.00E-01
-6.00E-01
-8.00E-01
Acceleration (m/s^2)
0
10
20
t(sec)
VERTICAL RESPONSE

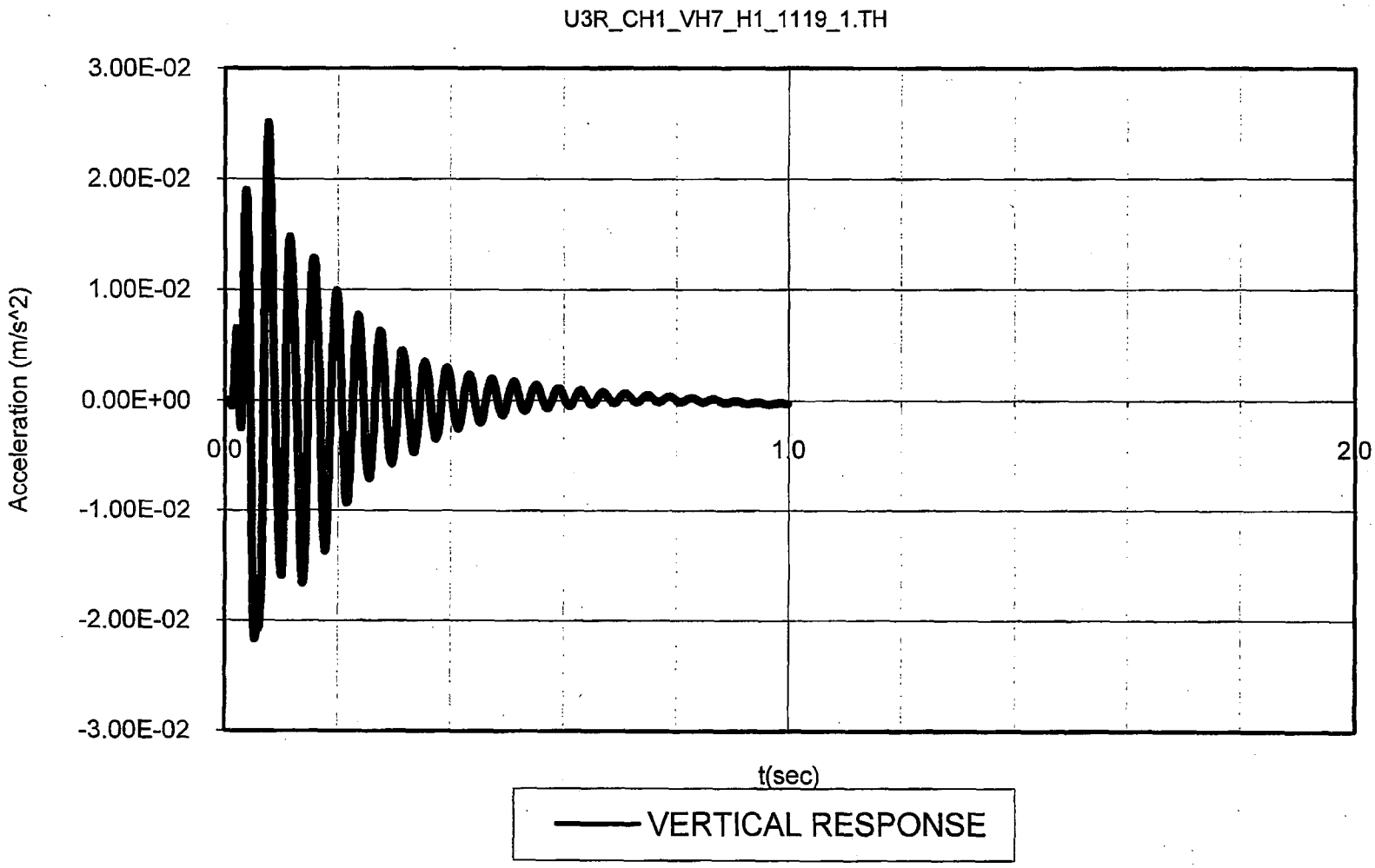

U3R_CH1_VH7_H1_1089_1.TH
6.00E-03
4.00E-03
2.00E-03
0.00E+00
-2.00E-03
-4.00E-03
-6.00E-03
-8.00E-03
-1.00E-02
Acceleration (m/s^2)
0
10
20
t(sec)
90º-270º HORIZONTAL RESPONSE

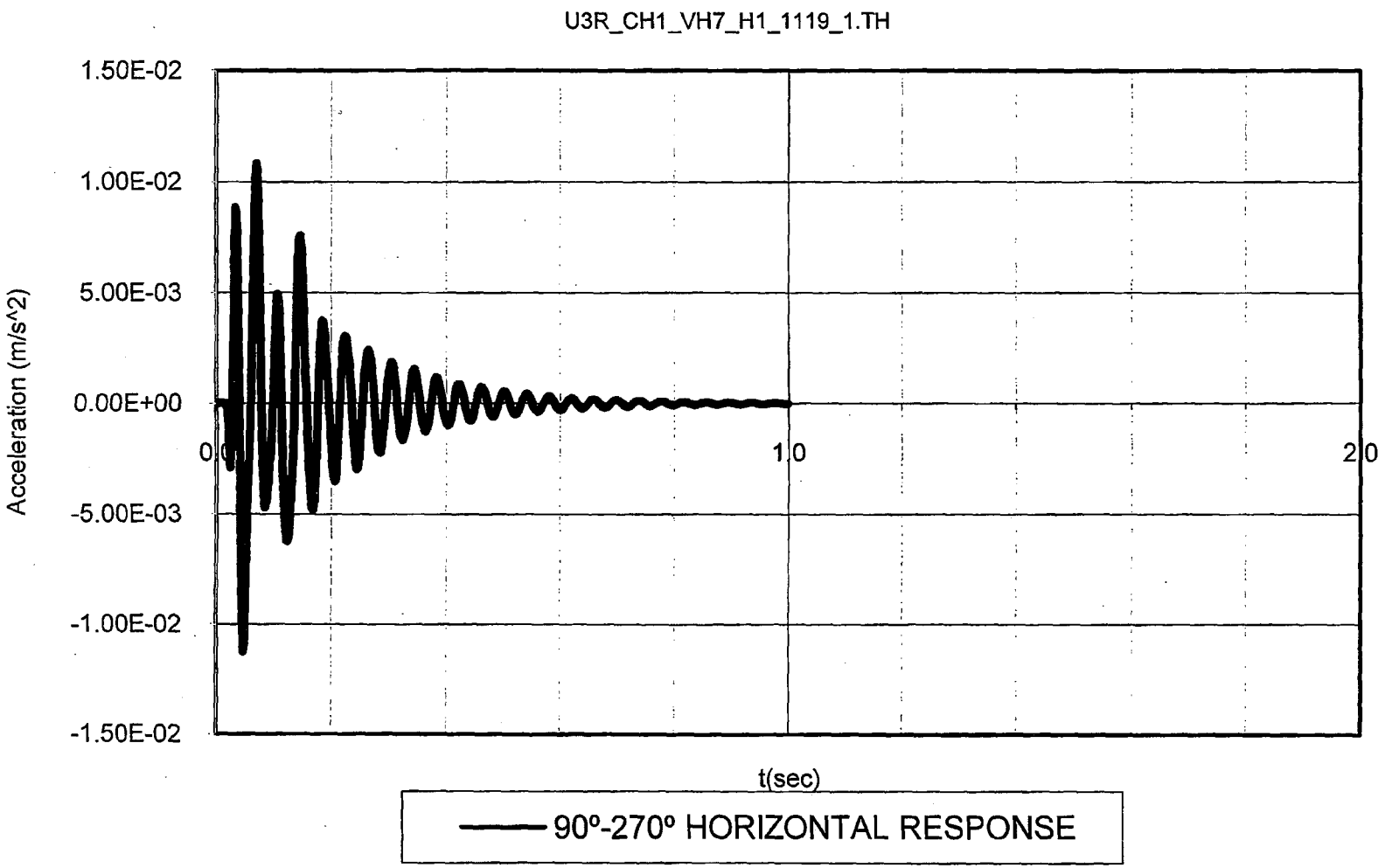

U3R_CH1_VH7_H1_1109_1.TH
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
-4.00E-01
Acceleration (m/s^2)
0
10
20
t(sec)
0º-180º HORIZONTAL RESPONSE

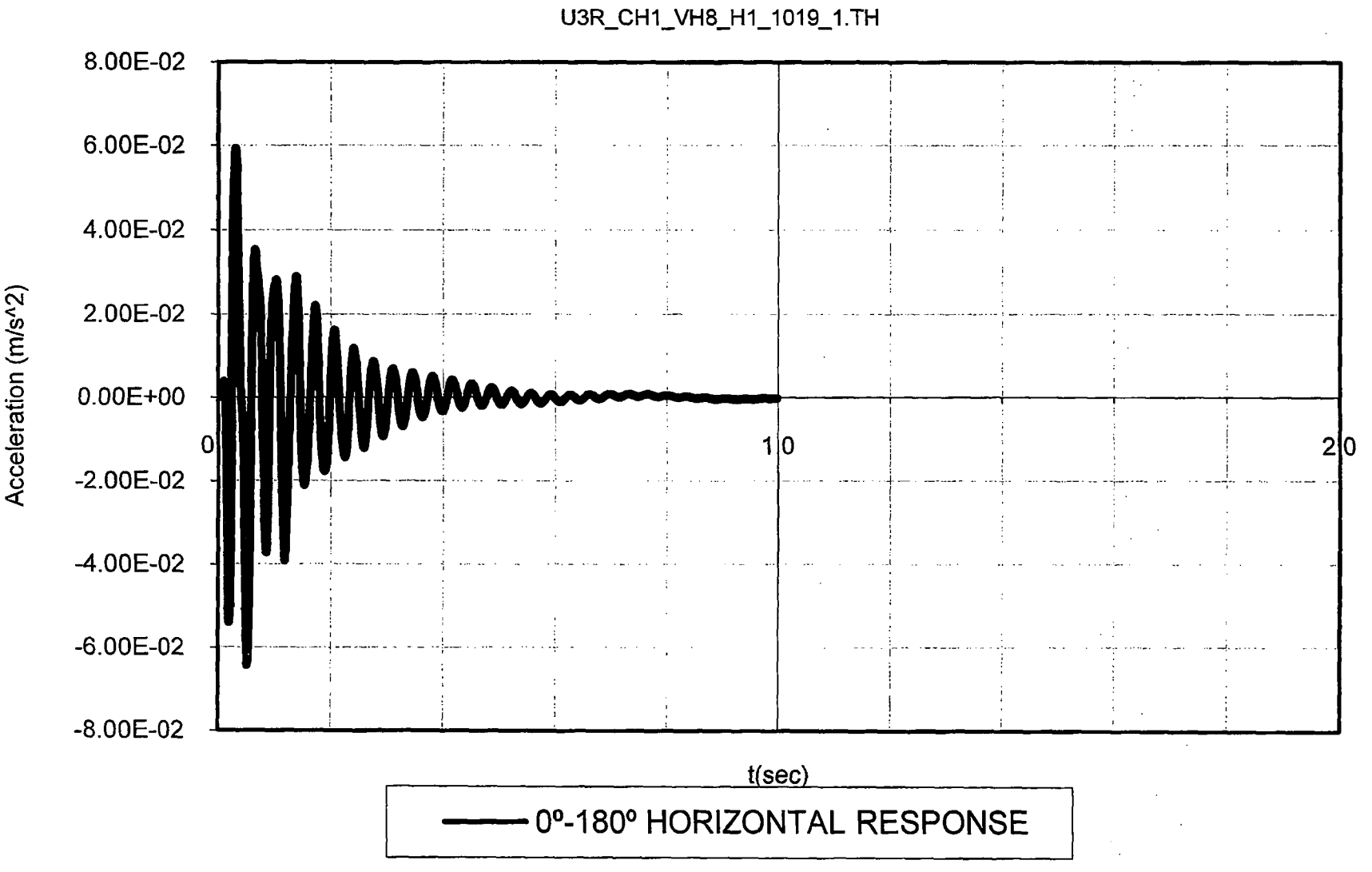

U3R_CH1_VH7_H1_1109_1.TH
2.00E-02
1.50E-02
1.00E-02
5.00E-03
0.00E+00
-5.00E-03
-1.00E-02
-1.50E-02
-2.00E-02
-2.50E-02
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
VERTICAL RESPONSE

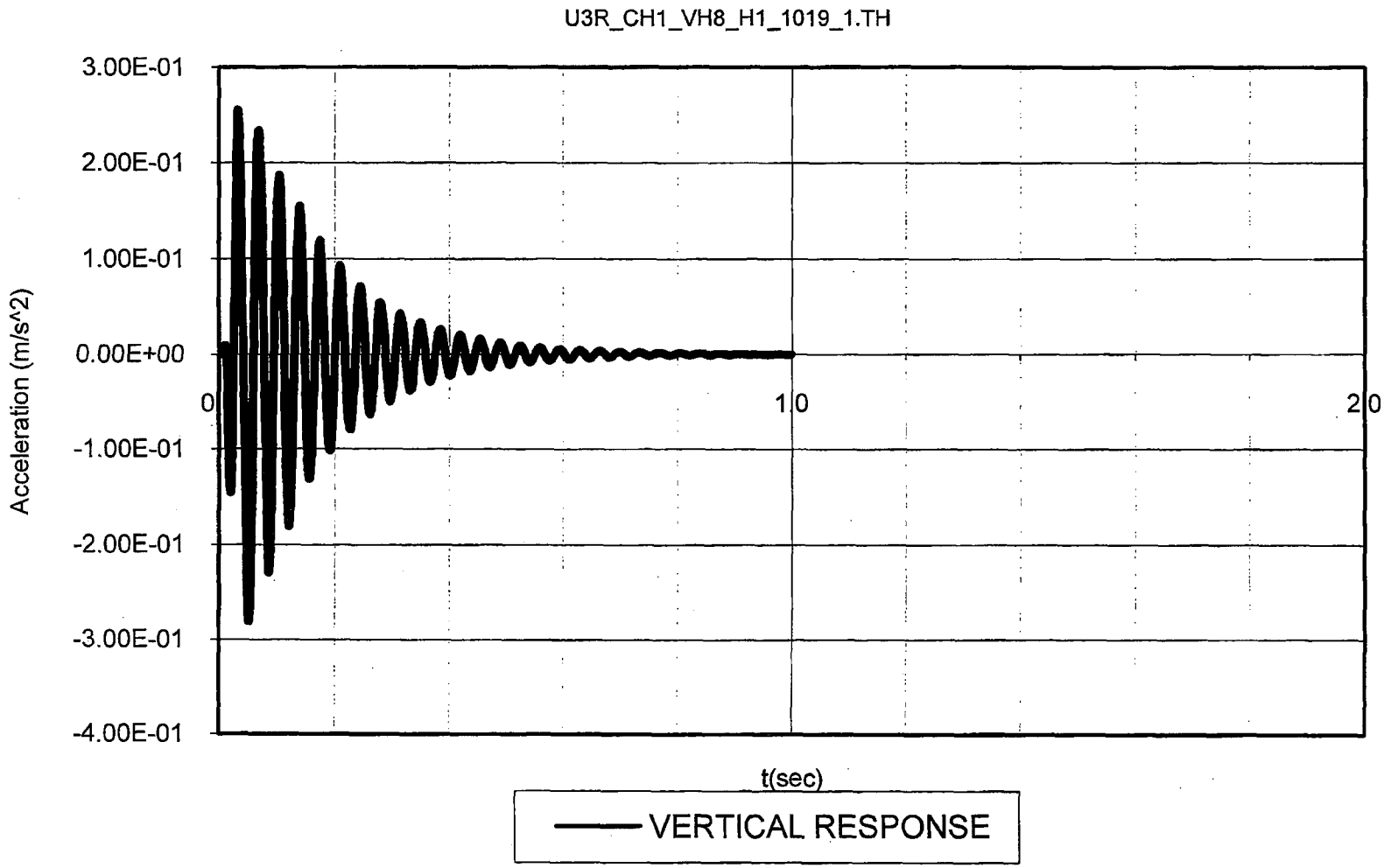

U3R_CH1_VH7_H1_1109_1.TH
4.00E-02
3.00E-02
2.00E-02
1.00E-02
0.00E+00
-1.00E-02
-2.00E-02
-3.00E-02
-4.00E-02
Acceleration (m/s^2)
0
10
20
t(sec)
90°-270° HORIZONTAL RESPONSE

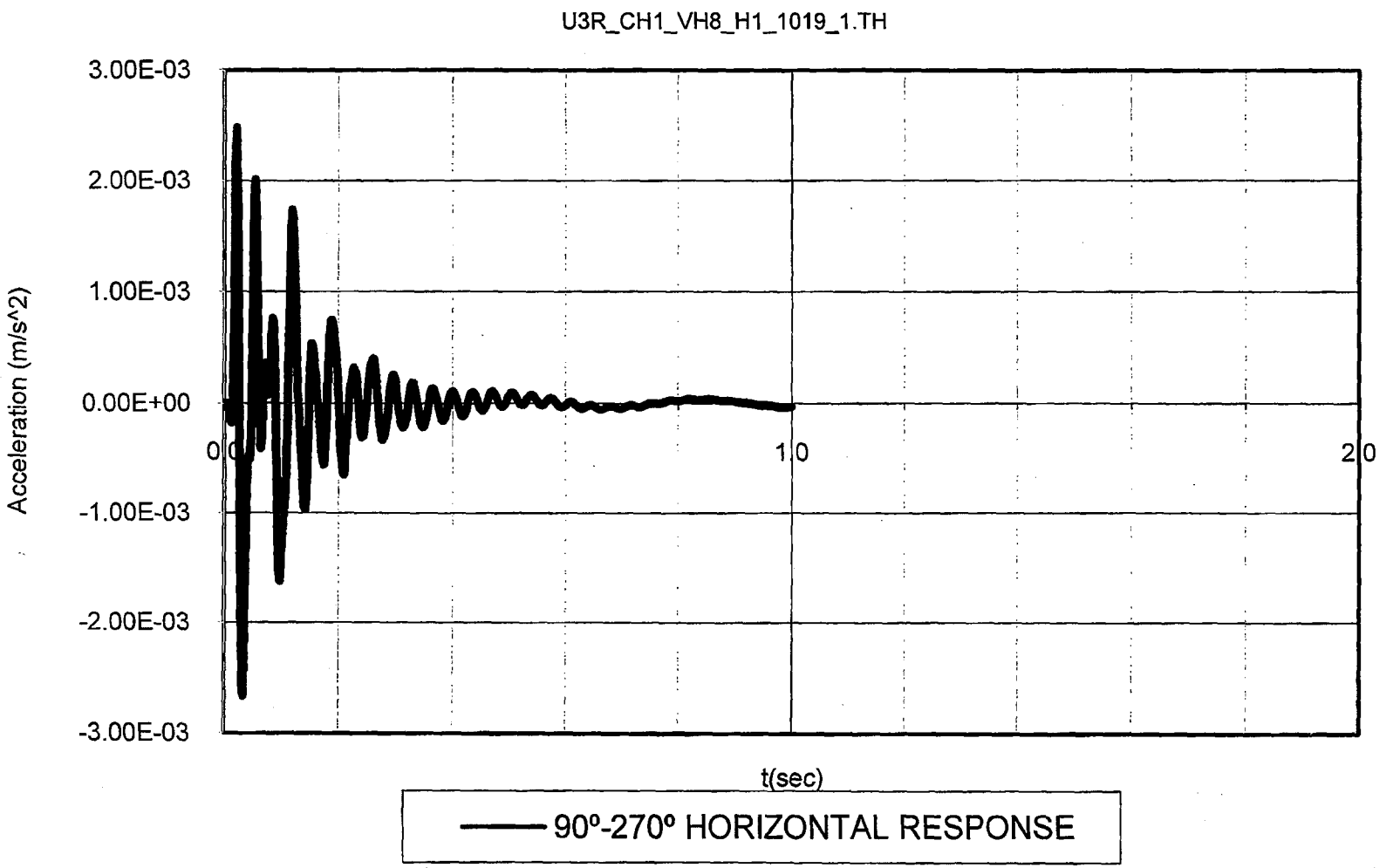

U3R_CH1_VH7_H1_1119_1.TH
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
Acceleration (m/s^2)
0
10
20
t(sec)
0º-180º HORIZONTAL RESPONSE

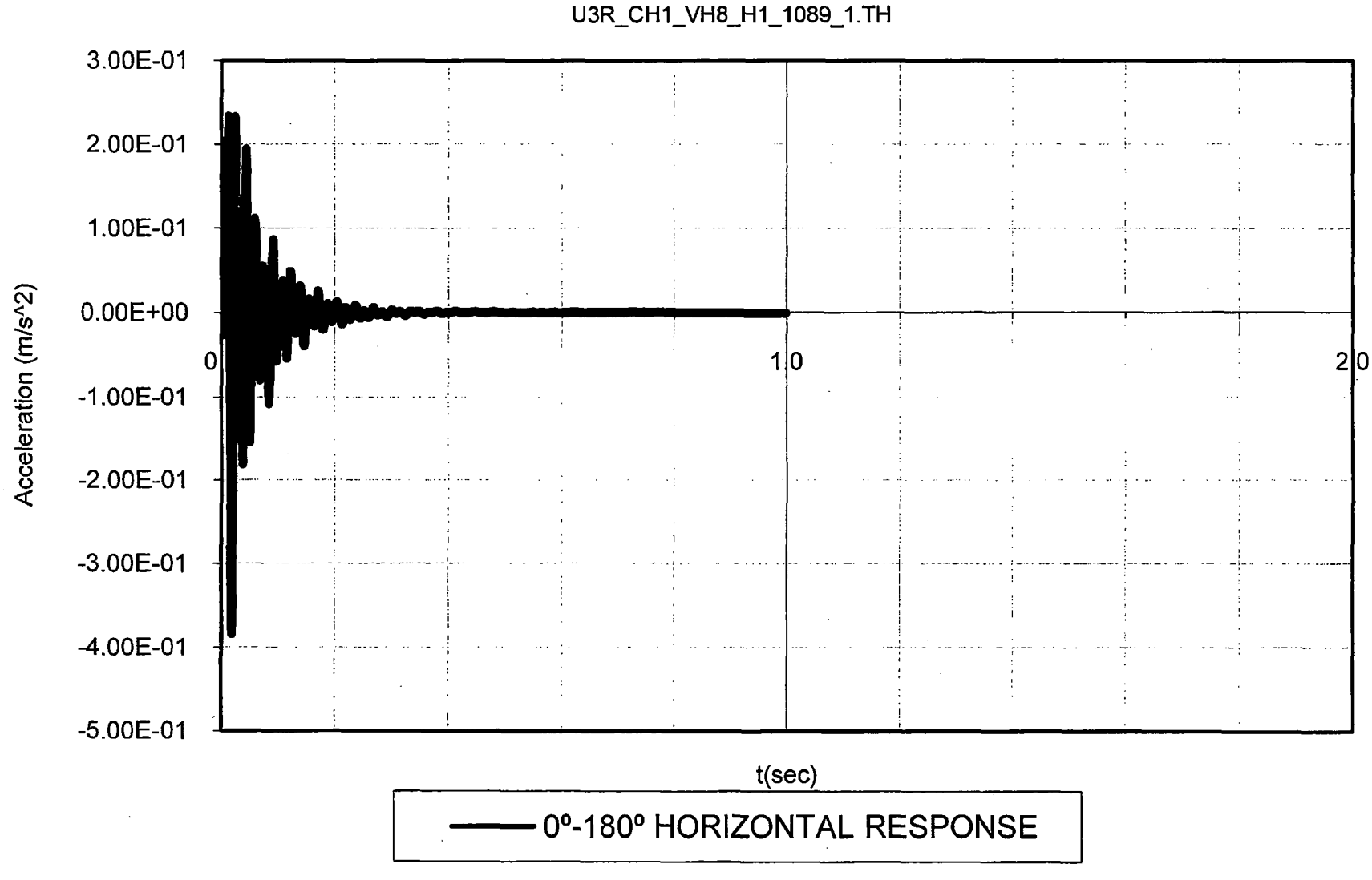

U3R_CH1_VH7_H1_1119_1.TH
3.00E-02
2.00E-02
1.00E-02
0.00E+00
-1.00E-02
-2.00E-02
-3.00E-02
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
VERTICAL RESPONSE

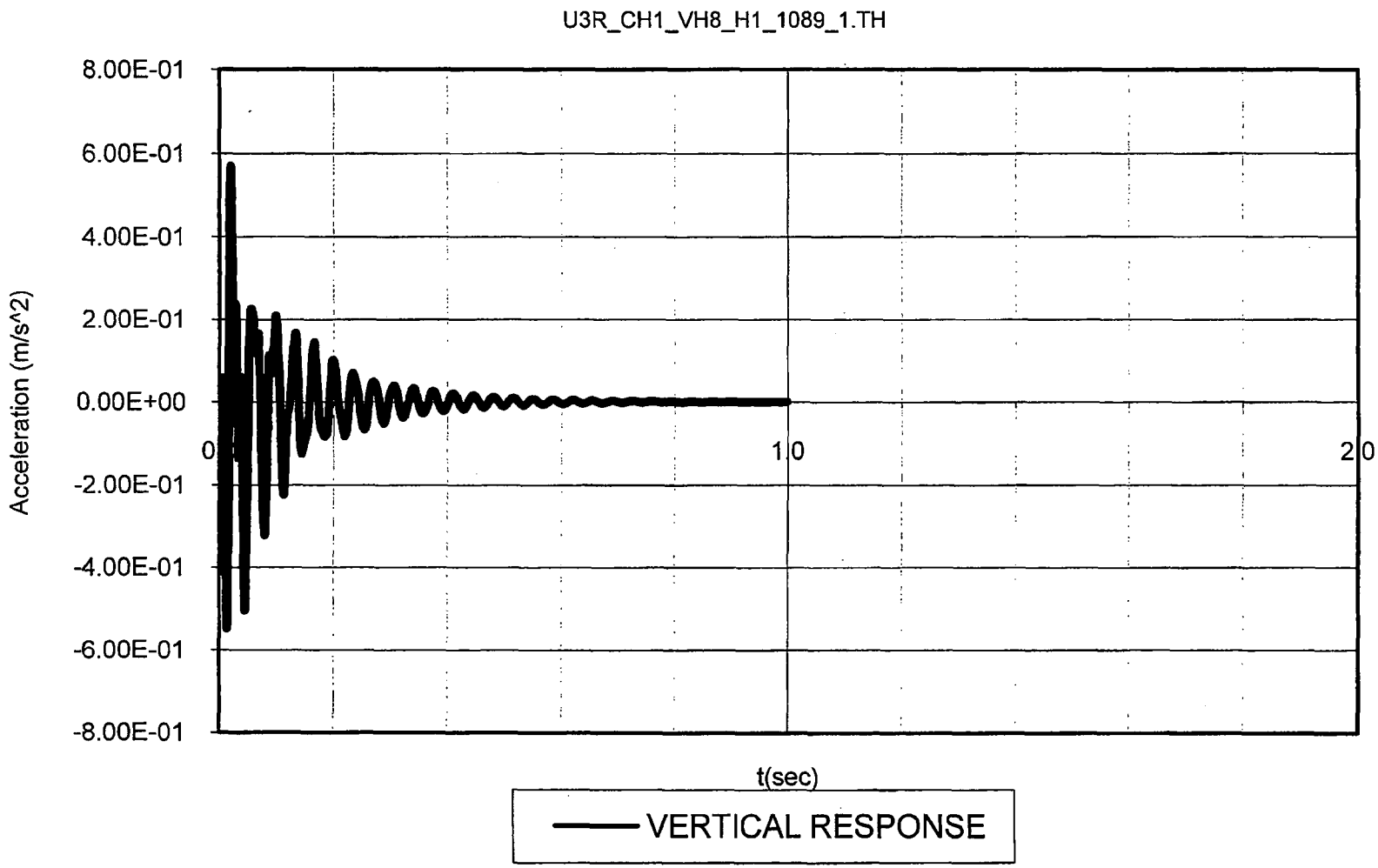

U3R_CH1_VH7_H1_1119_1.TH
1.50E-02
1.00E-02
5.00E-03
0.00E+00
-5.00E-03
-1.00E-02
-1.50E-02
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
90º-270º HORIZONTAL RESPONSE

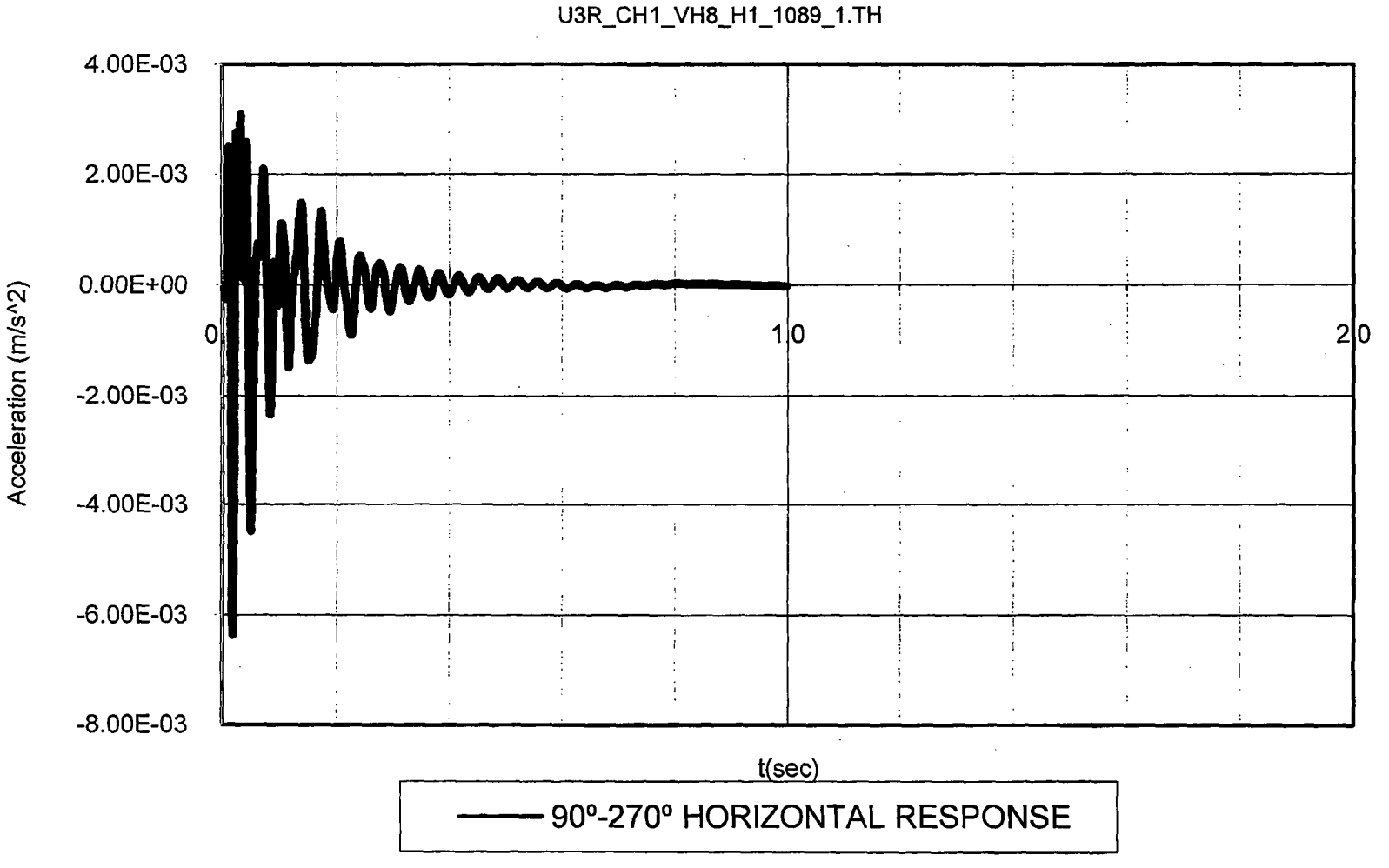

U3R_CH1_VH8_H1_1019_1.TH
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
-2.00E-02
-4.00E-02
-6.00E-02
-8.00E-02
Acceleration (m/s^2)
0
10
20
t(sec)
0º-180º HORIZONTAL RESPONSE

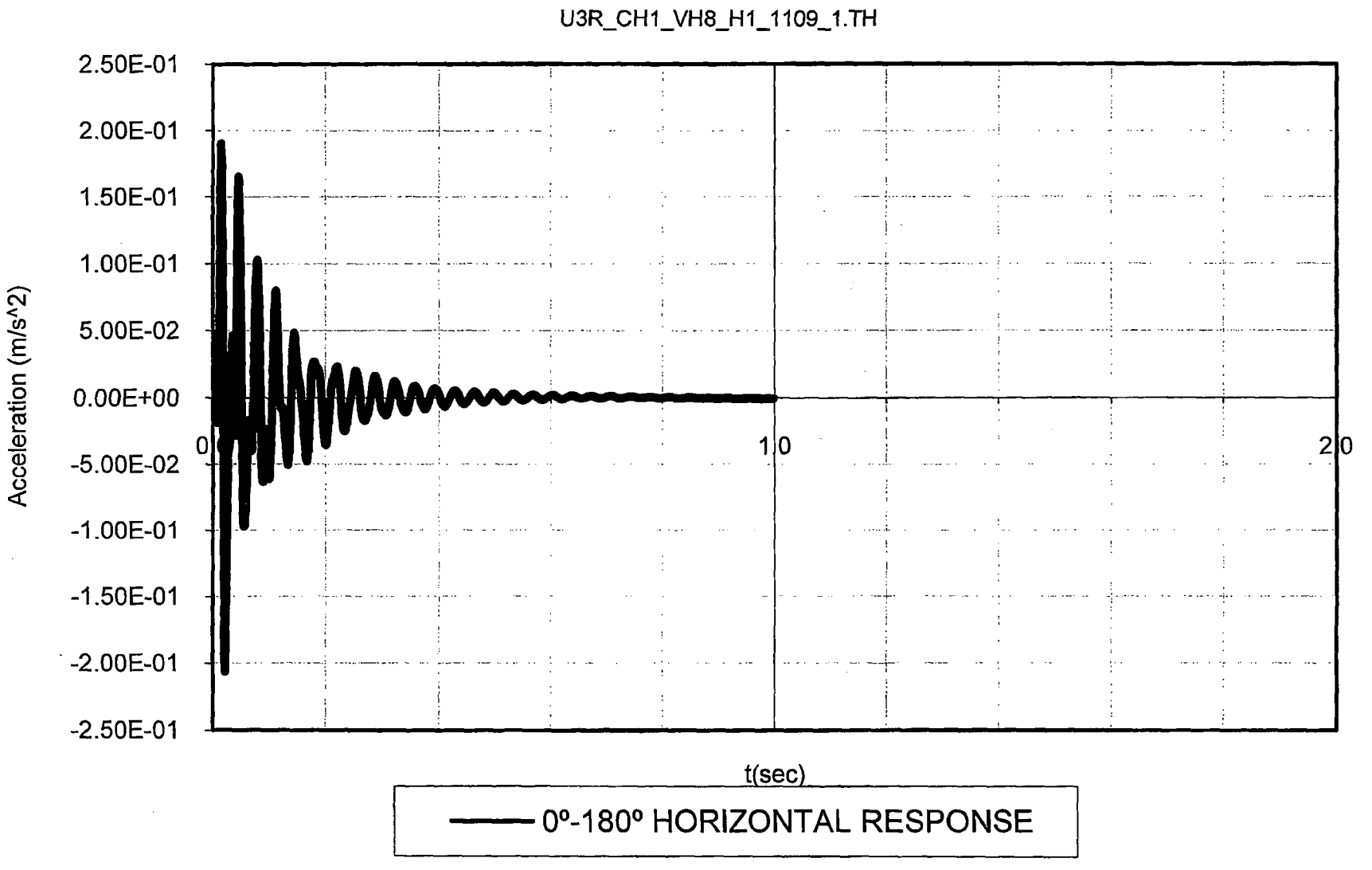

U3R_CH1_VH8_H1_1019_1.TH
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
-4.00E-01
Acceleration (m/s^2)
0
10
20
t(sec)
VERTICAL RESPONSE

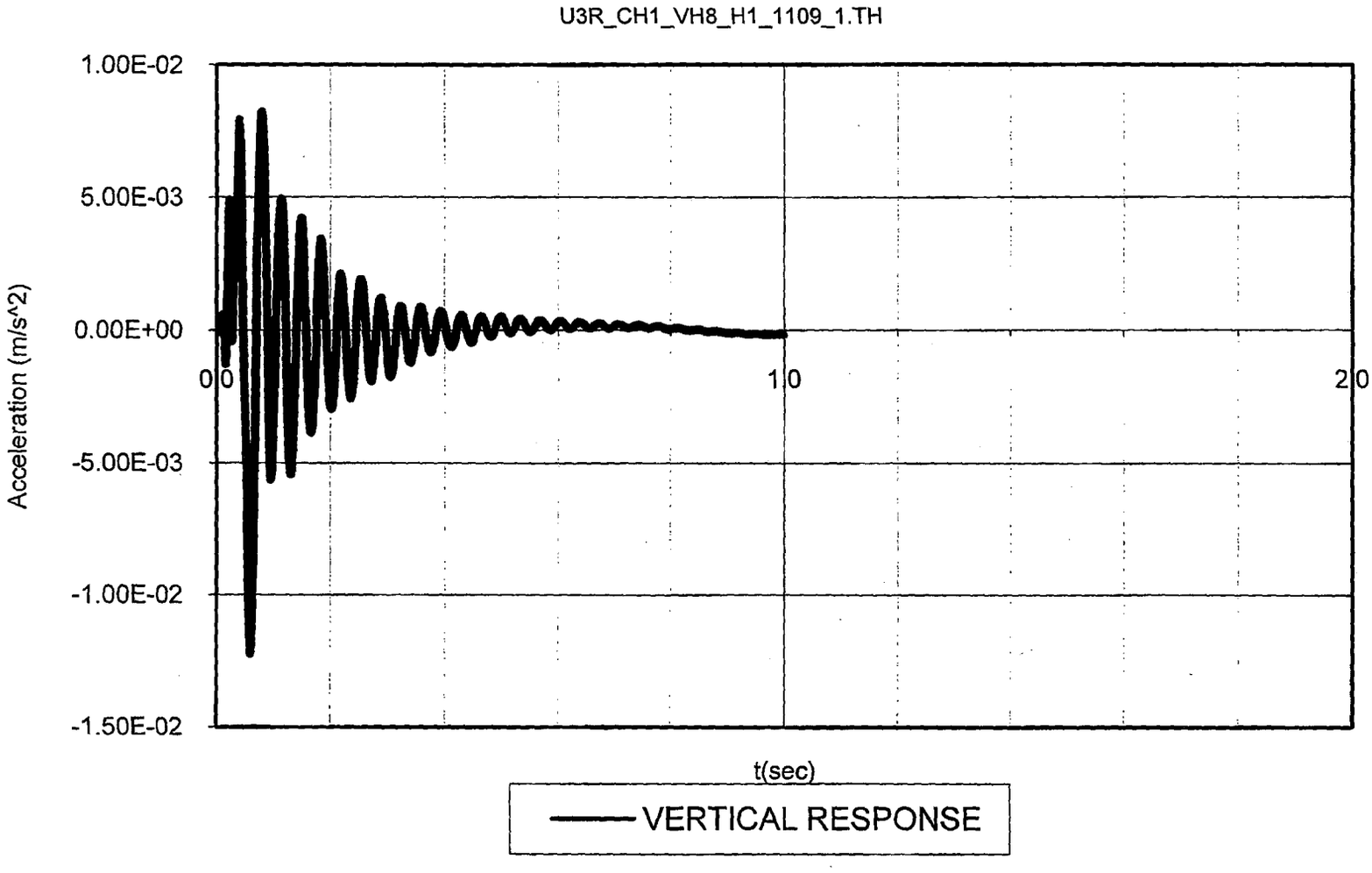

U3R_CH1_VH8_H1_1019_1.TH
3.00E-03
2.00E-03
1.00E-03
0.00E+00
-1.00E-03
-2.00E-03
-3.00E-03
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
90º-270º HORIZONTAL RESPONSE

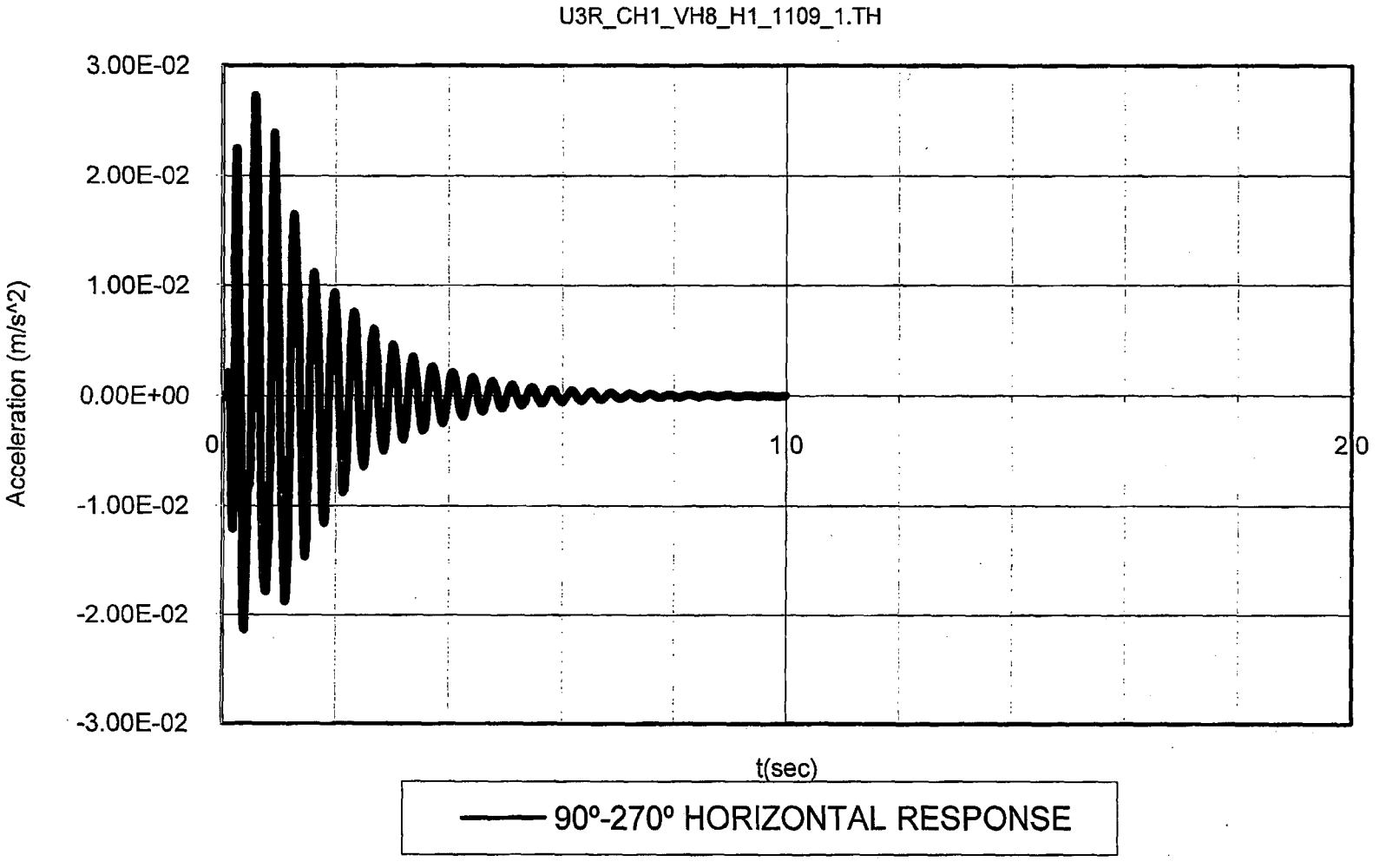

U3R_CH1_VH8_H1_1089_1.TH
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
-4.00E-01
-5.00E-01
Acceleration (m/s^2)
0
10
20
t(sec)
0°-180° HORIZONTAL RESPONSE

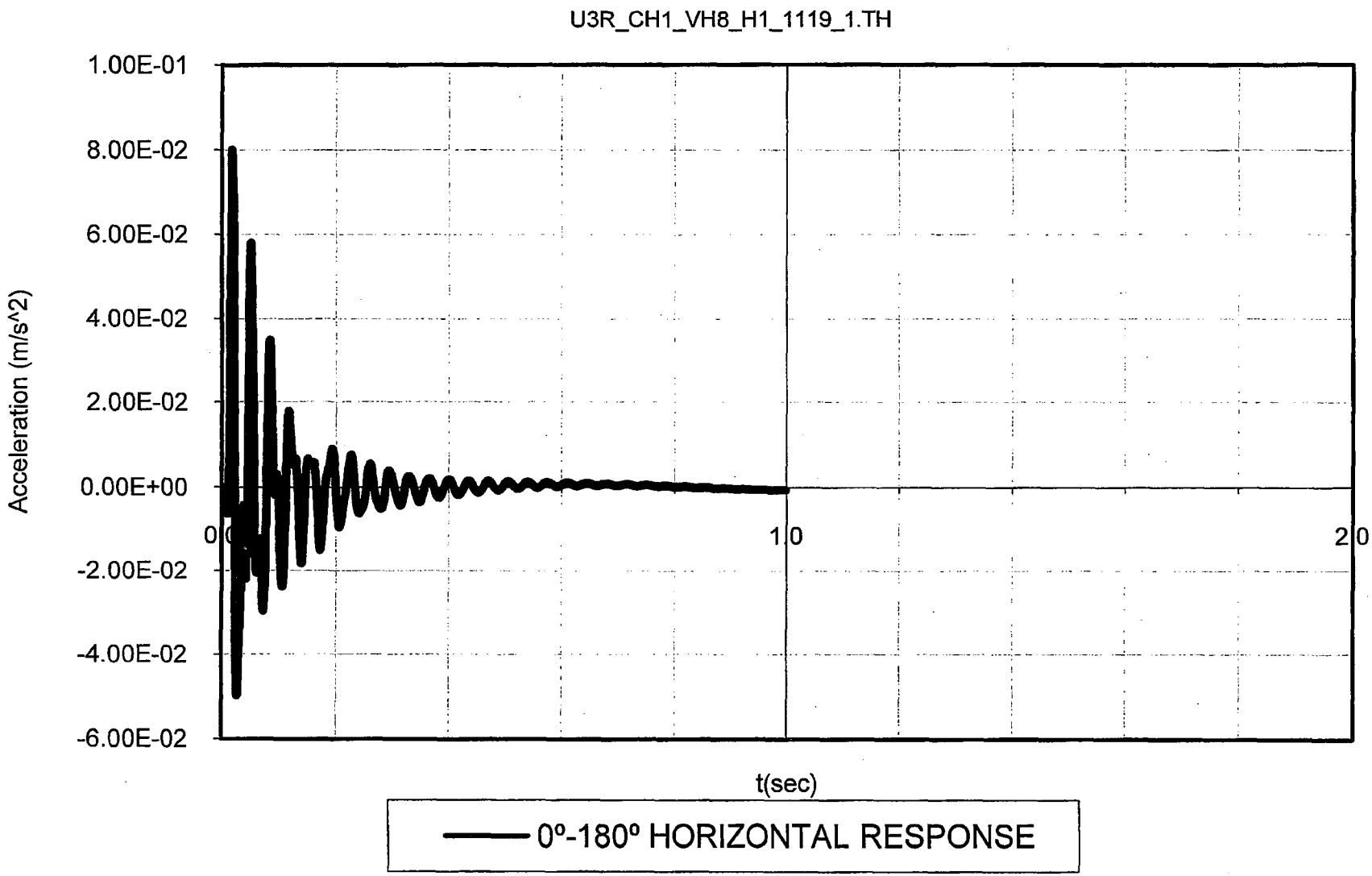

U3R_CH1_VH8_H1_1089_1.TH
8.00E-01
6.00E-01
4.00E-01
2.00E-01
0.00E+00
-2.00E-01
-4.00E-01
-6.00E-01
-8.00E-01
Acceleration (m/s^2)
0
1.0
2.0
t(sec)
VERTICAL RESPONSE

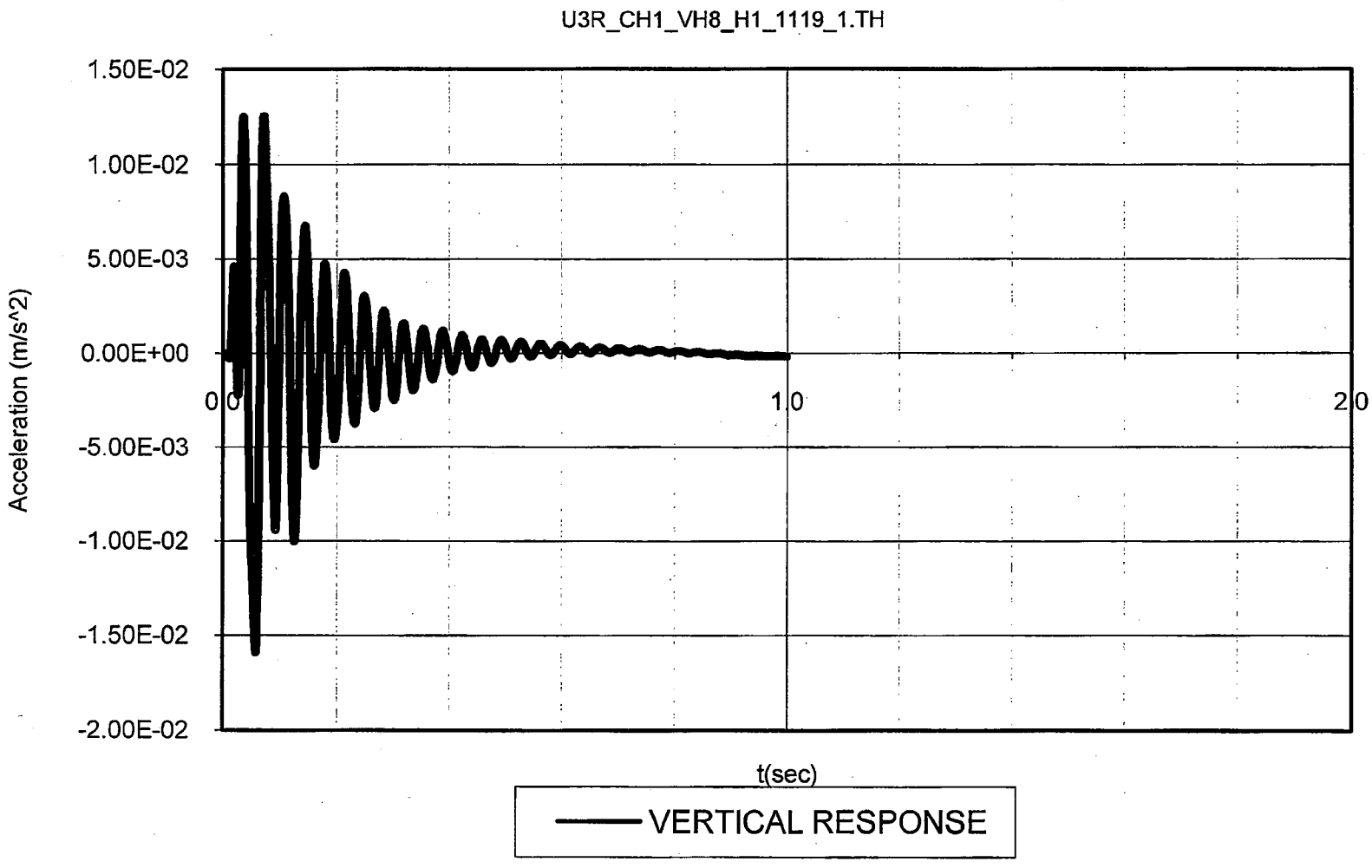

U3R_CH1_VH8_H1_1089_1.TH
4.00E-03
2.00E-03
0.00E+00
-2.00E-03
-4.00E-03
-6.00E-03
-8.00E-03
Acceleration (m/s^2)
0
10
20
t(sec)
90°-270° HORIZONTAL RESPONSE

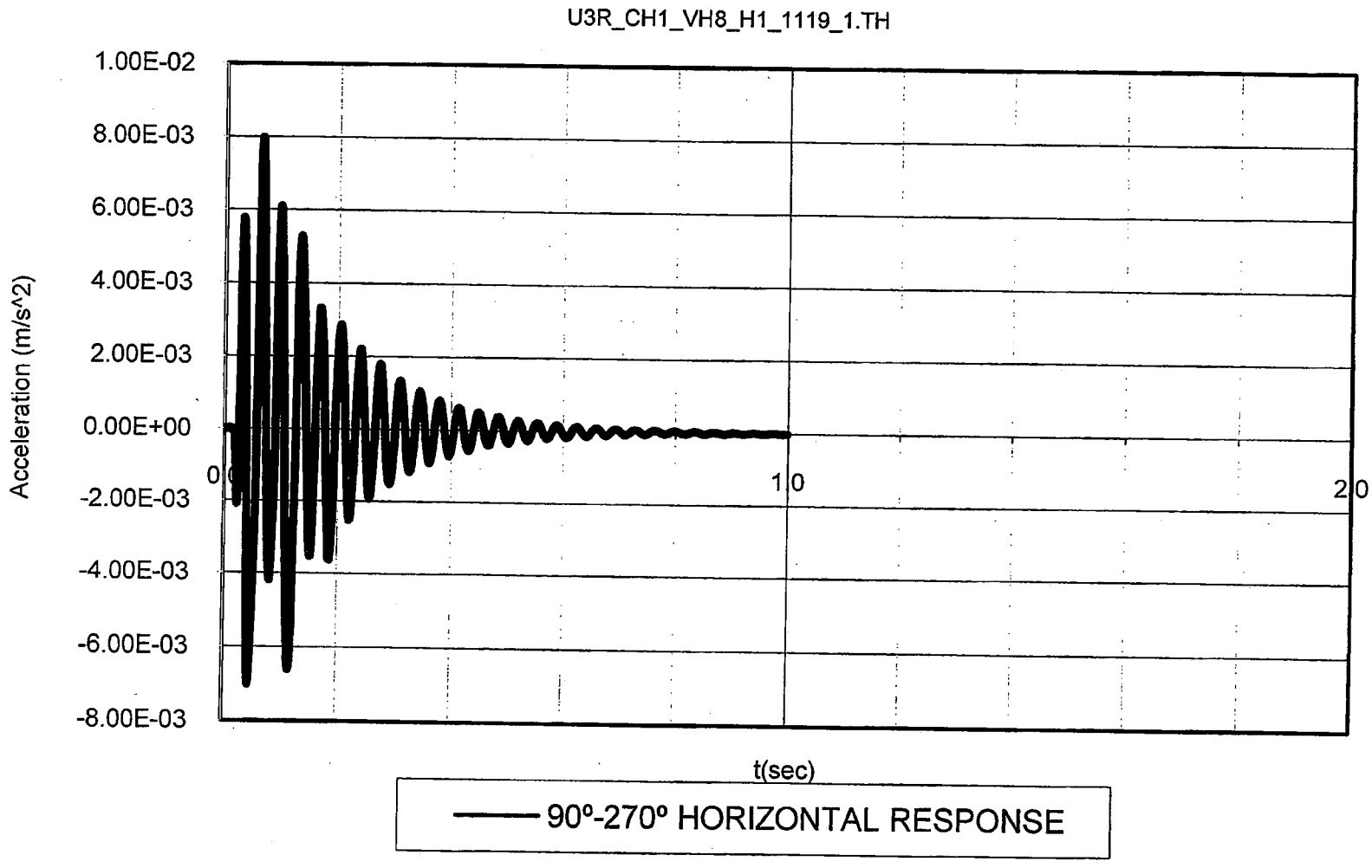

U3R_CH1_VH8_H1_1109_1.TH
2.50E-01
2.00E-01
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
-1.50E-01
-2.00E-01
-2.50E-01
Acceleration (m/s^2)
0
10
20
t(sec)
0º-180º HORIZONTAL RESPONSE


U3R_CH1_VH8_H1_1109_1.TH
1.00E-02
5.00E-03
0.00E+00
-5.00E-03
-1.00E-02
-1.50E-02
Acceleration (m/s^2)
0.0
10
20
t(sec)
VERTICAL RESPONSE


U3R_CH1_VH8_H1_1109_1.TH
3.00E-02
2.00E-02
1.00E-02
0.00E+00
-1.00E-02
-2.00E-02
-3.00E-02
Acceleration (m/s^2)
0
10
20
t(sec)
90º-270º HORIZONTAL RESPONSE


U3R_CH1_VH8_H1_1119_1.TH
1.00E-01
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
-2.00E-02
-4.00E-02
-6.00E-02
Acceleration (m/s^2)
0
10
20
t(sec)
0º-180º HORIZONTAL RESPONSE


U3R_CH1_VH8_H1_1119_1.TH
1.50E-02
1.00E-02
5.00E-03
0.00E+00
-5.00E-03
-1.00E-02
-1.50E-02
-2.00E-02
Acceleration (m/s^2)
0.0
1.0
2.0
t(sec)
VERTICAL RESPONSE


U3R_CH1_VH8_H1_1119_1.TH
1.00E-02
8.00E-03
6.00E-03
4.00E-03
2.00E-03
0.00E+00
-2.00E-03
-4.00E-03
-6.00E-03
-8.00E-03
Acceleration (m/s^2)
0
10
20
t(sec)
90°-270° HORIZONTAL RESPONSE