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AVAST 2009 User's Guide for the AVAST Autotester

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Contract Scientific Authority:
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Contract Report

DRDC Atlantic CR 2009-112

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Abstract

The AVAST software was developed to predict underwater radiated noise and acoustic target strength of ships and submarines. Over the last several years the AVAST code has undergone significant modifications and upgrades. At this point in the software development cycle, it is necessary for the software to undergo a rigorous series of regression tests to ensure the entire suite of analysis features is still operating properly

A series of benchmark test cases has been developed to validate the AVAST software after any significant modifications are made to the code. To aid in the evaluation of the testing, an autotester was developed to automate the process of running the test models, comparing the new results to the benchmark results, and generating reports.

Additional benchmark test cases will be added as the analysis features of the software are upgraded. It is suggested that the AVAST software should be modified to generate standardized output files in Tecplot format. This approach would eliminate the need for codes to translate the data into the format necessary to plot the results for comparison with the benchmark results.

Résumé

Le logiciel AVAST a été conçu pour prédire le niveau de bruit transmis par rayonnement sous-marin et déterminer l'indice de réflexion acoustique des navires et des sous-marins. Au cours des dernières années, le code du logiciel AVAST a subi des modifications et des mises à niveau importantes. Au moment présent du cycle de développement du logiciel, AVAST doit subir une série d'essais de régression rigoureux pour s'assurer que toutes les caractéristiques d'analyse fonctionnent correctement.

Une série de tests de performance a été mise au point afin de valider le logiciel AVAST une fois que toutes les modifications importantes au code auront été apportées. Pour contribuer à l'évaluation de ces tests, on a conçu un testeur automatique capable d'automatiser le processus d'évaluation des tests modèles, la comparaison de nouveaux résultats et de résultats des tests de performance et la création de rapports.

Des tests de performance supplémentaires seront ajoutés à mesure que les caractéristiques d'analyse du logiciel seront mises à niveau. On a proposé de modifier le logiciel AVAST de manière à créer des fichiers de sortie normalisés en format Tecplot. Cette modification éliminerait la nécessité d'utiliser des codes pour convertir les données vers un format cible aux fins de représentation graphique des résultats et de comparaison avec les résultats des tests de performance.

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Executive summary

Introduction

The AVAST software was developed to predict underwater radiated noise and acoustic target strength of ships and submarines. Over the last several years the AVAST code has undergone significant modifications and upgrades. At this point in the software development cycle, it is necessary for the software to undergo a rigorous series of regression tests to ensure the entire suite of analysis features is still operating properly

Results

To aid in the evaluation of the testing, an autotester was developed to automate the process of running the test models, comparing the new results to the benchmark results, and generating reports.

Significance

A series of benchmark test cases has been developed to validate the AVAST software after any significant modifications are made to the code.

Future Plans

Additional benchmark test cases will be added as the analysis features of the software are upgraded. It is suggested that the AVAST software should be modified to generate standardized output files in Tecplot format. This approach would eliminate the need for codes to translate the data into the format necessary to plot the results for comparison with the benchmark results.

Brennan, D. and Watanabe, R. 2009. AVAST 2009 - User's Guide for the AVAST Autotester. DRDC CR 2009-112. DRDC Atlantic.

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Introduction

Le logiciel AVAST a été conçu pour prédire le niveau de bruit transmis par rayonnement sous-marin et déterminer l'indice de réflexion acoustique des navires et des sous-marins. Au cours des dernières années, le code du logiciel AVAST a subi des modifications et des mises à niveau importantes. Au moment présent du cycle de développement du logiciel, AVAST doit subir une série d'essais de régression rigoureux pour s'assurer que toutes les caractéristiques d'analyse fonctionnent correctement.

Résultats

Pour contribuer à l'évaluation de ces tests, on a conçu un testeur automatique capable d'automatiser le processus d'évaluation des tests modèles, la comparaison de nouveaux résultats et de résultats des tests de performance et la création de rapports.

Portée

Une série de tests de performance a été mise au point afin de valider le logiciel AVAST une fois que toutes les modifications au code auront été apportées.

Recherches futures

Des tests de performance supplémentaires seront ajoutés à mesure que les caractéristiques d'analyse du logiciel seront mises à niveau. On a proposé de modifier le logiciel AVAST de manière à créer des fichiers de sortie normalisés en format Tecplot. Cette modification éliminerait la nécessité d'utiliser des codes pour convertir les données vers un format cible aux fins de représentation graphique des résultats et de comparaison avec les résultats des tests de performance.

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1. Introduction

The AVAST software was developed to predict underwater radiated noise and acoustic target strength of ships and submarines. Over the last several years the AVAST code has undergone significant modifications and upgrades. At this point in the software development cycle, it is necessary for the software to undergo a rigorous series of regression tests to ensure the entire suite of analysis features is still operating properly.

A series of benchmark test cases has been developed to validate the AVAST software after any significant modifications are made to the code. To aid in the evaluation of the testing, an autotester was developed to automate the process of running the test models, comparing the new results to the benchmark results, and generating reports.

The autotester files are discussed in Section 2 and the procedure for running the autotester is outlined in Section 3.

2. AVAST Autotester Files

All AVAST autotester files should be stored in a folder called ***\AVAST***, which is located in the system root folder.

The solver to be tested (*AvastSolver_Console.exe*) should be copied to the folder ***\AVAST\01-Solver***.

The benchmark files for the 14 test cases and the input files for the AVAST solver should be installed in the folder ***\AVAST\02-ValidationData***. Additional information about the test cases and data files is presented in Section 2.1.

The autotester files should be installed in the folder ***\AVAST\03-Autotester***. These files include the batch, macro and executable files that are used to set up a test folder, run the solver using standard input data, compare the test results against the benchmark results, and generate a test report. Additional information about the autotester files is presented in Section 2.2.

2.1 Validation Data Files

The autotester runs AVAST for the 14 benchmark test cases shown in Table 1.

Table 1. *Benchmark Test Cases*

TEST	LOCATION OF FILES*	DESCRIPTION OF TEST
Test #1	\BARGL\	Elastic Radiation analysis of an FE model and an AVAST model with 20 wet natural frequencies, to compute radiation pressures for 36 θ-angles at 105 Hz.
Test #2	\FullCylinderBM7500hzMono\	Monostatic Target Strength analysis of a full geometric model of a rigid cylinder, using a Burton and Millar formulation to compute radiation pressures for 360 θ-angles and 360 φ-angles at 7500 Hz.
Test #3	\Full Cylinder Kirchhoff 7500 Hz Mono\	Monostatic Target Strength analysis of a full geometric model of a rigid cylinder, using a Kirchhoff formulation to compute radiation pressures for 36 θ-angles at 7500 Hz.
Test #4	\FullSphereInterior\	Transducer analysis of the interior of a full geometric model of a sphere to compute radiation pressures for 36 θ-angles
Test #5	\FullSphereMixedRadiationPressureBC\	Radiation analysis of a full geometric model of a sphere, using mixed radiation pressure boundary conditions to compute radiation pressures for 36 θ-angles
Test #6	\HalfSphereRigidXeq2BiStatic\	Bistatic target strength analysis of a half geometric model of a rigid sphere, using the symmetry option for equations in the X-direction to compute radiation pressures for 36 θ-angles at 0.159 Hz.

Test #7	\HalfSphereRigidXeq2Radiation\	Radiation target strength analysis of a half geometric model of a rigid sphere, using the symmetry option for equations in the X-direction to compute radiation pressures for 36 θ-angles.
Test #8	\HalfSphereRigidYeq2BiStatic\	Bistatic target strength analysis of a half geometric model of a rigid sphere, using the symmetry option for equations in the Y-direction to compute radiation pressures for 36 θ-angles at 0.159 Hz..
Test #9	\HalfSphereRigidYeq2Radiation\	Radiation target strength analysis of a half geometric model of a rigid sphere, using the symmetry option for equations in the Y-direction to compute radiation pressures for 36 θ-angles.
Test #10	\HalfSphereRigidZeq2BiStatic\	Bistatic target strength analysis of a half geometric model of a rigid sphere, using the symmetry option for equations in the Z-direction to compute radiation pressures for 36 θ-angles at 0.159 Hz.
Test #11	\HalfSphereRigidZeq2Radiation\	Radiation target strength analysis of a half geometric model of a rigid sphere, using the symmetry option for equations in the Z-direction to compute radiation pressures for 36 θ-angles.
Test #12	\KirchhoffFullCapsule200Hz\	Kirchhoff target strength analysis of a full geometric model of a capsule to compute radiation pressures for 360 θ-angles at 200 Hz
Test #13	\KirchhoffHalfCapsuleYSymm200Hz\	Kirchhoff target strength analysis of a half geometric model of a capsule, using the Y symmetry option to compute radiation pressures for 36 θ-angles at 200 Hz.
Test #14	\QuarterSphereRadiation\	Radiation target strength analysis of a quarter geometric model of a rigid sphere, using the symmetry option to compute radiation pressures for 36 θ-angles.

* Folders should be installed in \AVAST\02-ValidationData\

The standard input files for these tests are stored in the folder ***AVAST**\, and each folder contains the following 9 files (where *filename* is an abbreviation of the folder name):

AVAST.IOF	AVAST input/output control file (input for tests)
AVAST.BEM	AVAST boundary element model data file (input for tests)
filenamepressuresXY.lay	Tecplot layout file for generating XY-plots of pressures
filenamepressures.lay	Tecplot layout file for generating polar-plots of pressures
AVAST-STD.IOF	AVAST input/output control file (benchmark file)
AVAST-STD.BEM	AVAST boundary element model data file (benchmark file)
AVAST-STD.OUT	AVAST output file (benchmark file)
AVAST-STD.LOG	AVAST log file (benchmark file)
press-STD.dat	AVAST output translated to Tecplot format (benchmark file)

The ***BARGL**\ folder also include two extra files for the wet natural frequencies:

filenamewnf.lay	Tecplot layout file for generating plots of wet natural frequencies
wnf-STD.dat	AVAST output translated to Tecplot format (benchmark file)

2.2 Autotester Files

The different types of autotester files and their functions are shown in Table 2.

Table 2. *Functions of Autotester Files*

AUTOTESTER FILES*	TYPE	FUNCTION
Step1-GetInputData	Shortcut	Provides a hyperlink to the file *Step1-GetInputData.exe* (useful if the files are stored on a fileserver instead of a local drive).
Step1-GetInputData.exe	Fortran executable	Copies AVAST solver, validation data and autotester files to a test directory, writes messages to an *Autotest.log* file, and creates the batch file *Step2-RunAtests.bat.*
AVASTAutotester.bat	Batch file	Runs all test cases, with input from the *parallelflag.inp* file.
parallelflag.inp	ASCII file	Turns off the option for parallel processing.
Step2-RunAtests.bat	Batch file	Runs the AVAST solver on all test cases, and writes messages to an *Autotest.log* file.
Step3a-RunAVASTWindiff.bat	Batch file	Compares ASCII files from test cases (*AVAST.IOF, AVAST.BEM, AVAST.OUT* and *AVAST.LOG*) with ASCII benchmark files (*AVAST-STD.IOF, AVAST-STD.BEM, AVAST-STD.OUT* and *AVAST-STD.LOG*), and writes results to *AVASTdiff.out*
Step3b-GenerateAvastTecplotFigures.bat	Batch file	Runs translator programs to convert AVAST.OUT to files in Tecplot format and runs Tecplot macros for polar-rectangular conversion and for exporting plots.
tr.exe*	Fortran executable	Translates *AVAST.OUT* to a Tecplot format file *press.da*t.
filename.mcr	Tecplot macro	Loads the files *press.dat* and *press-STD.dat* in Tecplot and creates XY plots, then transforms polar coordinates to Tecplot's rectangular coordinate system creates polar plots and creates the binary files *pressRad.pl*t and *pressRad-STD.plt*. For the \BARGL\ folder, loads the files *wnf.dat* and *wnf-STD.dat* in Tecplot and creates XY plots
ExportfilenamepressXY.mcr	Tecplot macro	Opens the Tecplot lay files for each test case, loads the files *press.dat* and exports the plots to WMF files.
Exportfilenamepress.mcr	Tecplot macro	Opens the Tecplot lay files for each test case, loads the files *pressRad.plt* and exports the plots to WMF files.
ExportBARGLwnf.mcr	Tecplot macro	Opens the Tecplot lay files for the BARGL test case, loads the files *wnf.dat* and exports the plots to WMF files.
MasterTemplateTestResultsFromAVASTAutotester.doc	Word document containing a macro	Running the macro *InsertAutotesterPlots* inserts the WMF files as pictures, resizes the figures, and saves the document as *TestResultsFromAVASTAutotester.doc*.

3. Procedure for Running the AVAST Autotester

The autotester files, AVAST solver and standard input files for the tests are stored in the folder \AVAST\, which is located in the system root folder. Batch, macro and executable files are used to:

- Download the input files to the folder \testAVASTsolvers\
- Run the AVAST solver on the benchmark test cases
- Compare the ASCII input and output files
- Generate plots for comparing the test results against the benchmark results.
- Insert XY and polar plots into a test report.

The computed pressures in the AVAST output file are converted to Tecplot format, plotted in rectangular and polar coordinates and exported to graphics files. Plots of the test results and benchmark results are then inserted into a Word Document for comparison purposes. A sample autotester report is presented in Appendix A

3.1 Test Procedure

The validation tests should be performed as follows.

1. **Installing the AVAST Solver**

- Copy the most recent version of the AVAST solver to ***AVAST\01-Solver**\.

2. **Installing Input Data for Benchmark Test Cases**

- Copy the input data for the benchmark test cases to ***AVAST\02-ValidationData**\.

3. **Installing the Autotester files**

- Copy theautotester files to ***AVAST\03-Autotester**\.

4. **Setting up a Working Directory**

- In ***AVAST\03-AVASTautotester**\, run the file ***Step1-GetInputData*** (hyperlink) or ***Step1-GetInputData.exe***, which will do the following:
  - Create a working directory ***testAVASTsolvers**\.
  - Copy the AVAST solver from ***AVAST\01-Solver**\ to the working directory.
  - Copy folders containing the input data, benchmark data and Tecplot data files from ***AVAST\02-ValidationData**\ to the working directory.

- Copy the autotester files from ***AVAST\03-Autotester**\ to the working directory.

5. Testing the AVAST Solver

- In ***testAVASTsolvers**\, run the file ***Step2-RunAtests***, which will run the codes on each of the benchmark test cases.

6. Postprocessing of the Test Results

- In ***testAVASTsolvers**\, run the file ***Step3-GenerateAVASTecplotFigures***, which will do the following:
  - Apply translator programs that read AVAST output files and create input data files for Tecplot.
  - Apply a Tecplot macro to create rectangular and polar plots and export them to WMF files.

7. Generating a Report of the Test Results

- In ***testAVASTsolvers**\, enable macros in Word, and open the Word document *MasterTemplateTestResultsFromAVASTAutotester.doc* and run the macro *InsertTecplotFigures*, which will do the following:
  - Insert the WMF files generated by the Tecplot macros as pictures, and resize the figures.
  - Save the document as *TestResultsFromAVASTAutotester.doc*.

4. Recommendations

Additional benchmark test cases will be added as the analysis features of the software are upgraded.

It is suggested that the AVAST software should be modified to generate standardized output files in Tecplot format. This approach would eliminate the need for codes to translate the data into the format necessary to plot the results for comparison with the benchmark results.

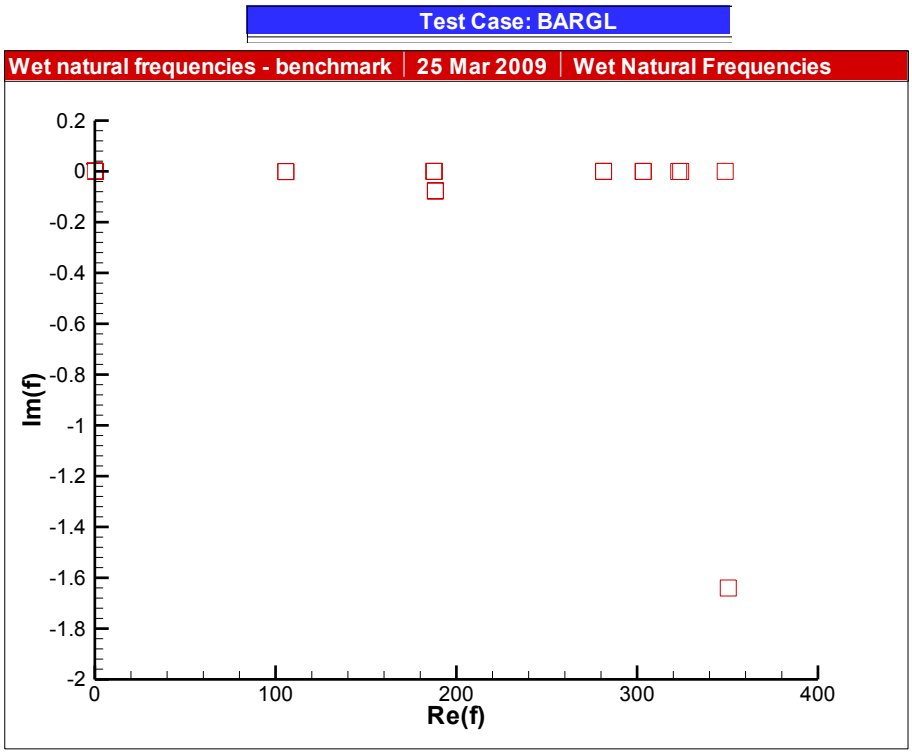
Annexes

ANNEX A: TEST RESULTS FROM THE AVAST AUTOTESTER

Standard Comparison Tests

Test Case	Test Description	Figure No.	Plots of Baseline and Test Results
#1.	BARGL	Fig. 1 Fig. 2 Fig. 3	Wet natural frequencies XY plot of radiated, scattered and total pressure Polar plot of radiated, scattered and total pressure
#2.	Full Cylinder BM 7500 Hz Mono	Fig. 4 Fig. 5	XY plot of radiated, scattered and total pressure Polar plot of radiated, scattered and total pressure
#3.	Full Cylinder Kirchhoff 7500 Hz Mono	Fig. 6 Fig. 7	XY plot of radiated, scattered and total pressure Polar plot of radiated, scattered and total pressure
#4.	Full Sphere Interior	Fig. 8 Fig. 9	XY plot of radiated, scattered and total pressure Polar plot of radiated, scattered and total pressure
#5.	Full Sphere Mixed Radiation Pressure BC	Fig. 10 Fig. 11	XY plot of radiated, scattered and total pressure Polar plot of radiated, scattered and total pressure
#6.	Half Sphere Rigid Xeq2 BiStatic	Fig. 12 Fig. 13	XY plot of radiated, scattered and total pressure Polar plot of radiated, scattered and total pressure
#7.	Half Sphere Rigid Xeq2 Radiation	Fig. 14 Fig. 15	XY plot of radiated, scattered and total pressure Polar plot of radiated, scattered and total pressure
#8.	Half Sphere Rigid Yeq2 BiStatic	Fig. 16 Fig. 17	XY plot of radiated, scattered and total pressure Polar plot of radiated, scattered and total pressure
#9.	Half Sphere Rigid Yeq2 Radiation	Fig. 18 Fig. 19	XY plot of radiated, scattered and total pressure Polar plot of radiated, scattered and total pressure
#10.	Half Sphere Rigid Zeq2 BiStatic	Fig. 20 Fig. 21	XY plot of radiated, scattered and total pressure Polar plot of radiated, scattered and total pressure
#11.	Half Sphere Rigid Zeq2 Radiation	Fig. 22 Fig. 23	XY plot of radiated, scattered and total pressure Polar plot of radiated, scattered and total pressure
#12.	Kirchhoff Full Capsule 200 Hz	Fig. 24 Fig. 25	XY plot of radiated, scattered and total pressure Polar plot of radiated, scattered and total pressure
#13.	Kirchhoff Half Capsule Y Symm 200 Hz	Fig. 26 Fig. 27	XY plot of radiated, scattered and total pressure Polar plot of radiated, scattered and total pressure
#14	Quarter Sphere Radiation	Fig. 28 Fig. 29	XY plot of radiated, scattered and total pressure Polar plot of radiated, scattered and total pressure

1. Test Case #1: BARGL



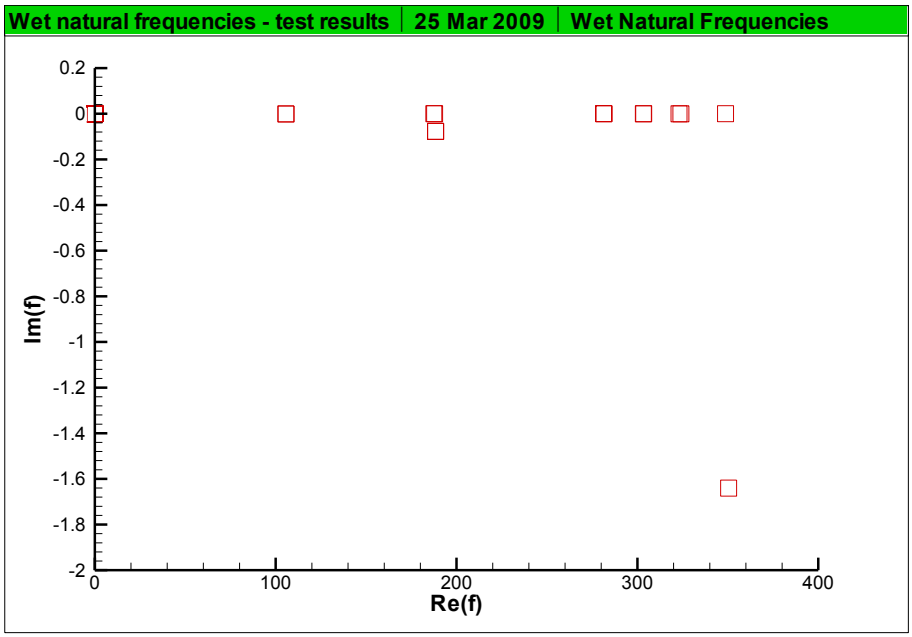


Figure 1. *Wet Natural Frequencies*

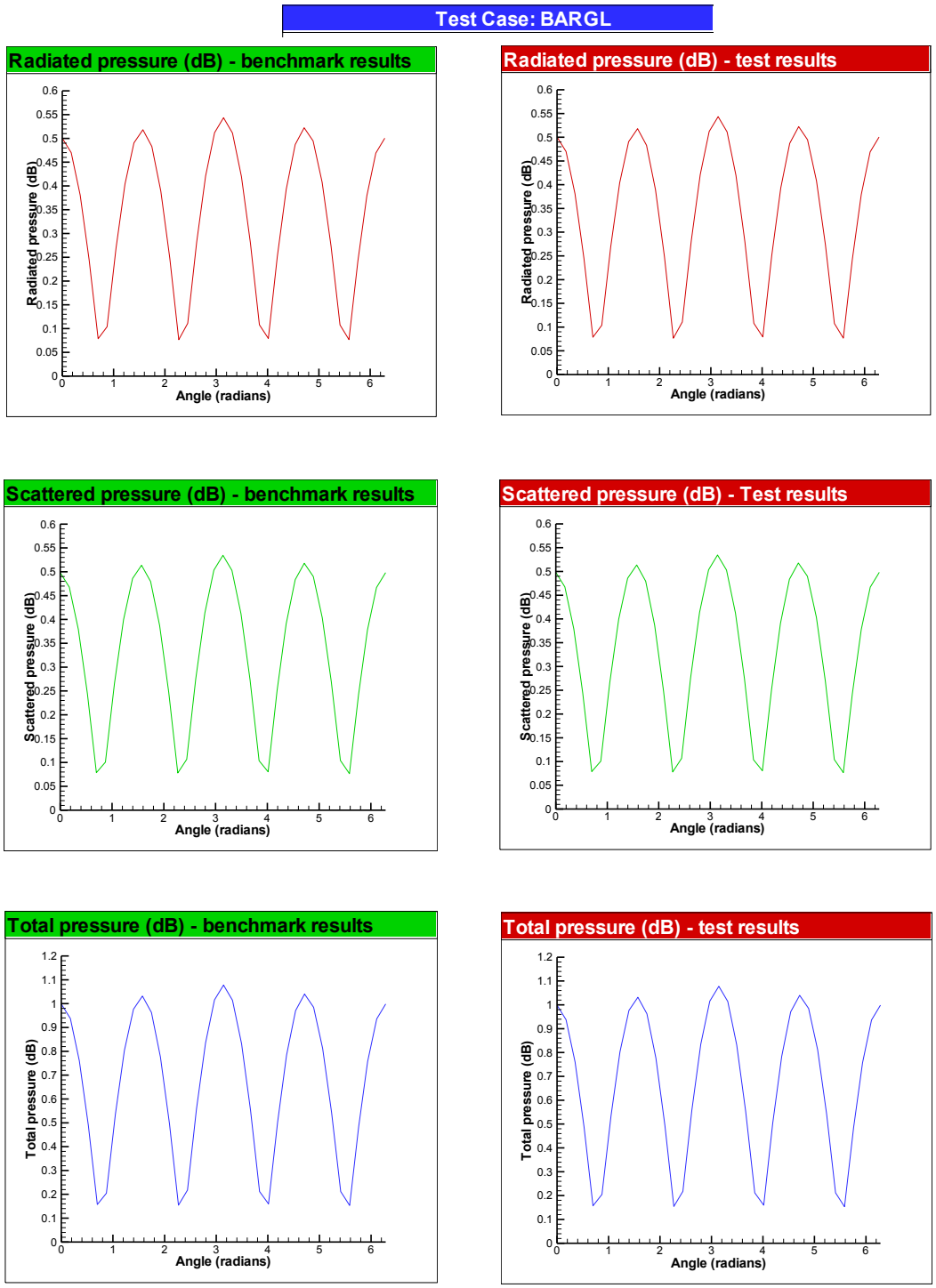


Figure 2. *XY Plot of Radiated, Scattered and Total Pressures*

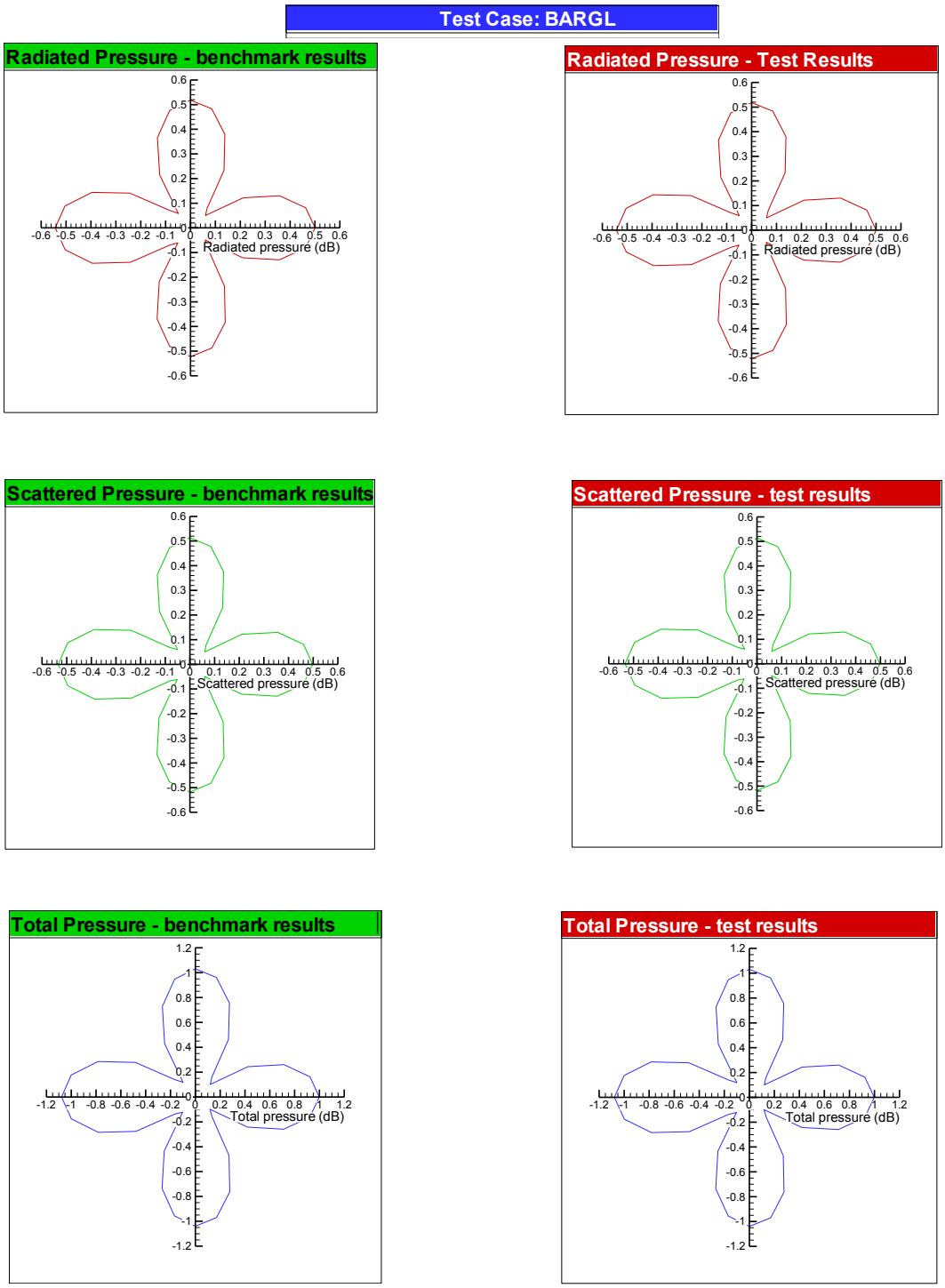


Figure 3. *Polar Plot of Radiated, Scattered and Total Pressures*

2. Test Case #2: Full Cylinder BM 7500 Hz Mono

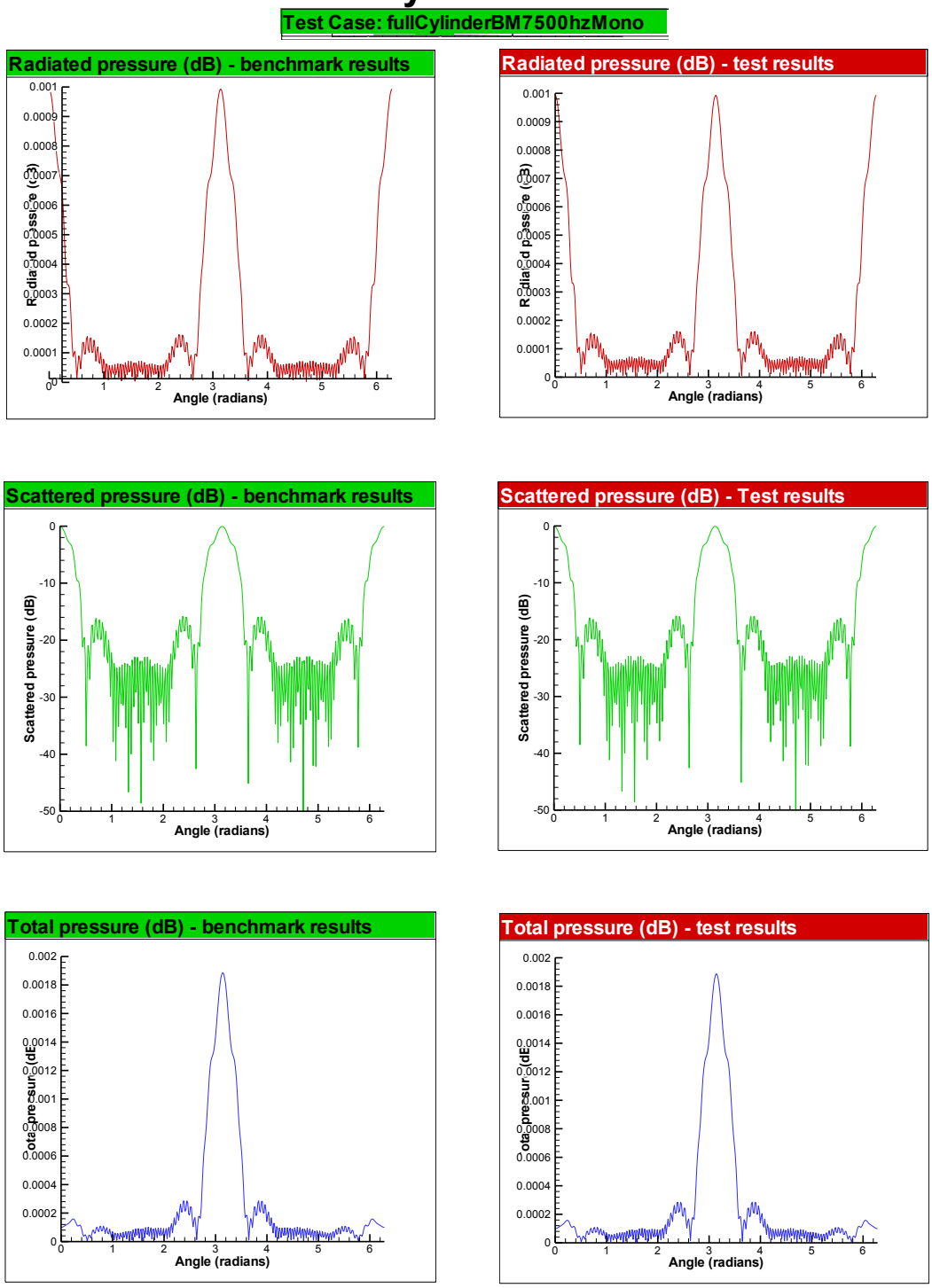


Figure 4. *XY Plot of Radiated, Scattered and Total Pressures*

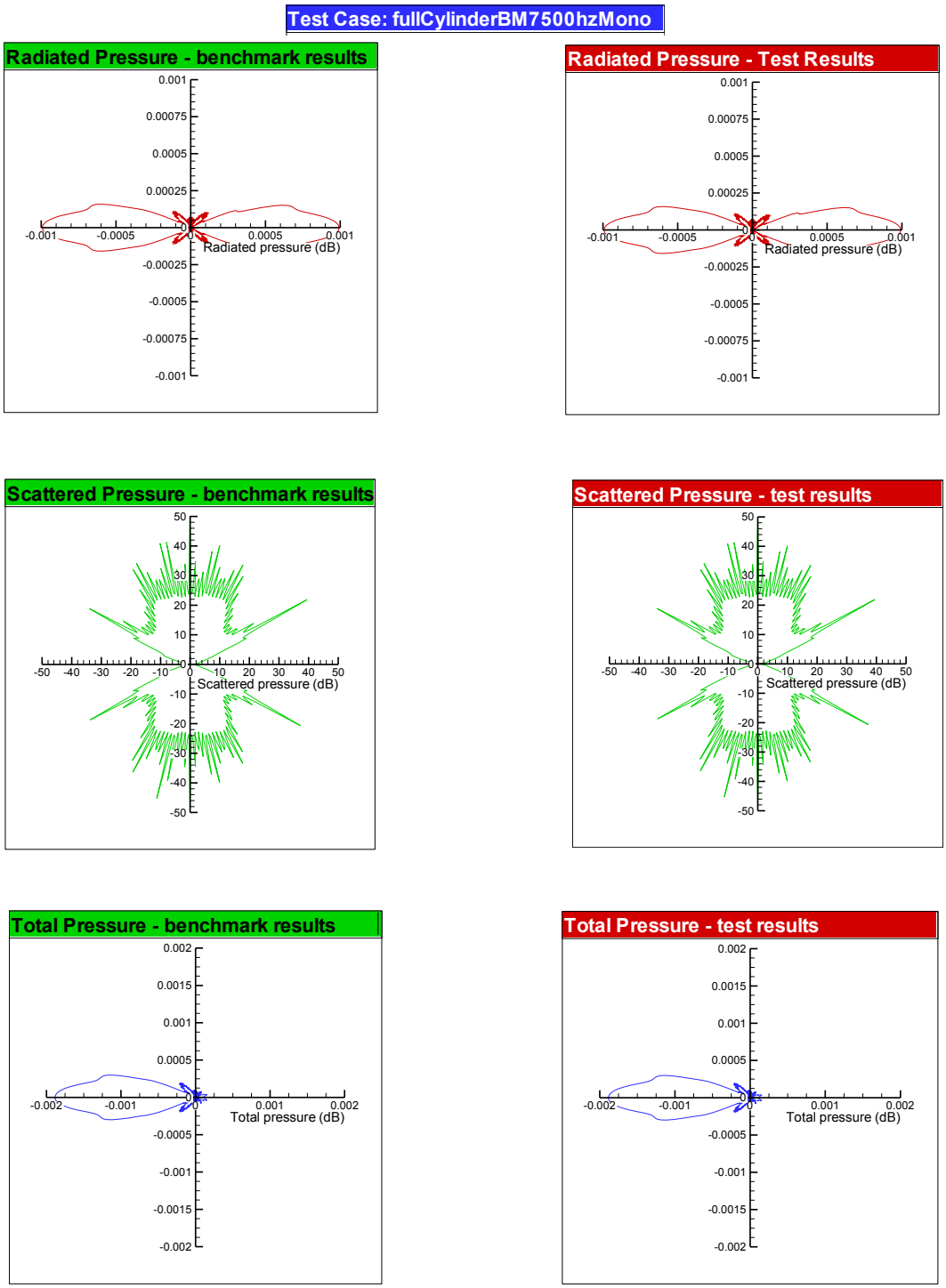


Figure 5. *Polar Plot of Radiated, Scattered and Total Pressures*

3. Test Case #3: Full Cylinder Kirchhoff 7500 Hz Mono

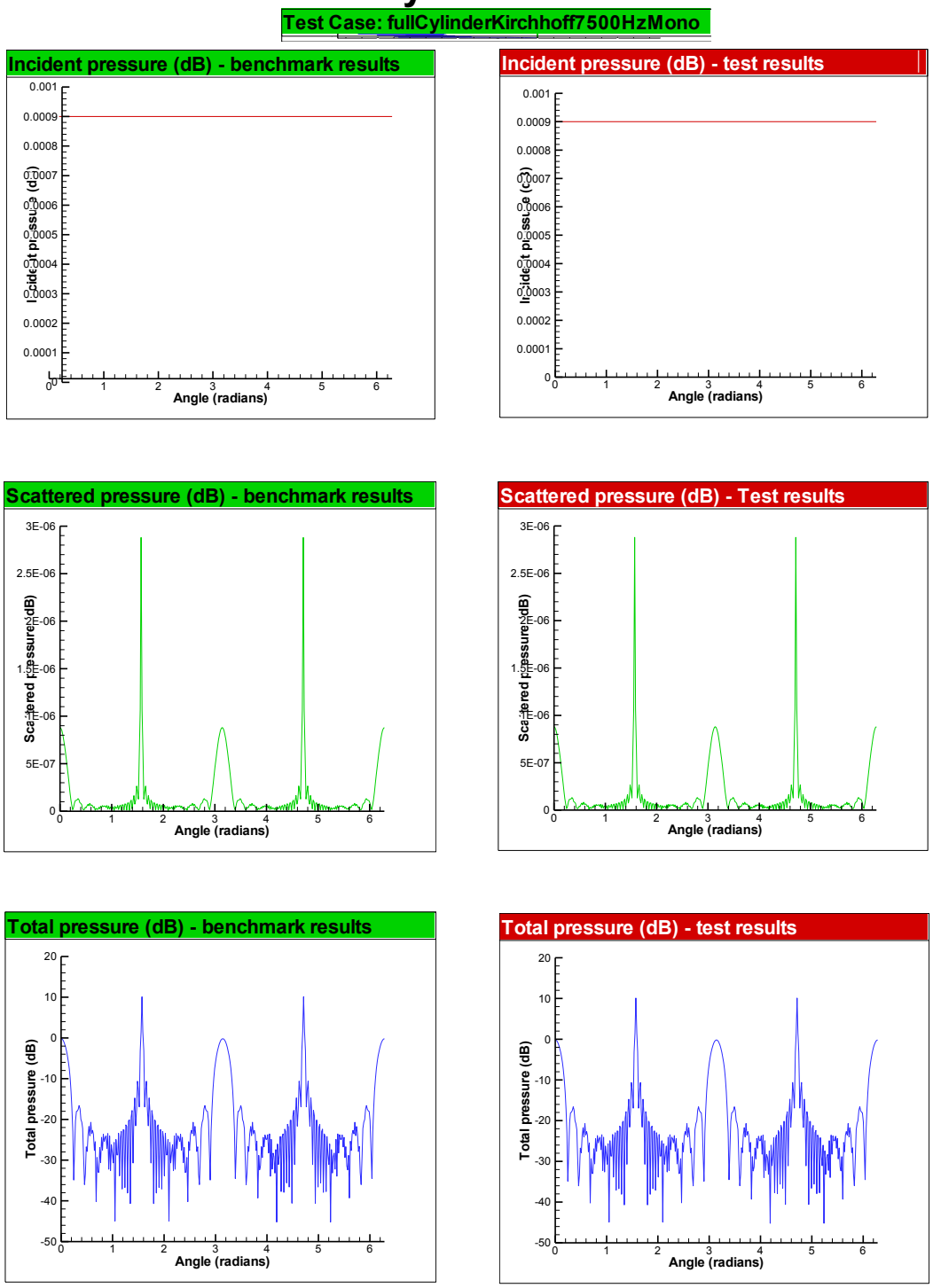


Figure 6. *XY Plot of Radiated, Scattered and Total Pressures*

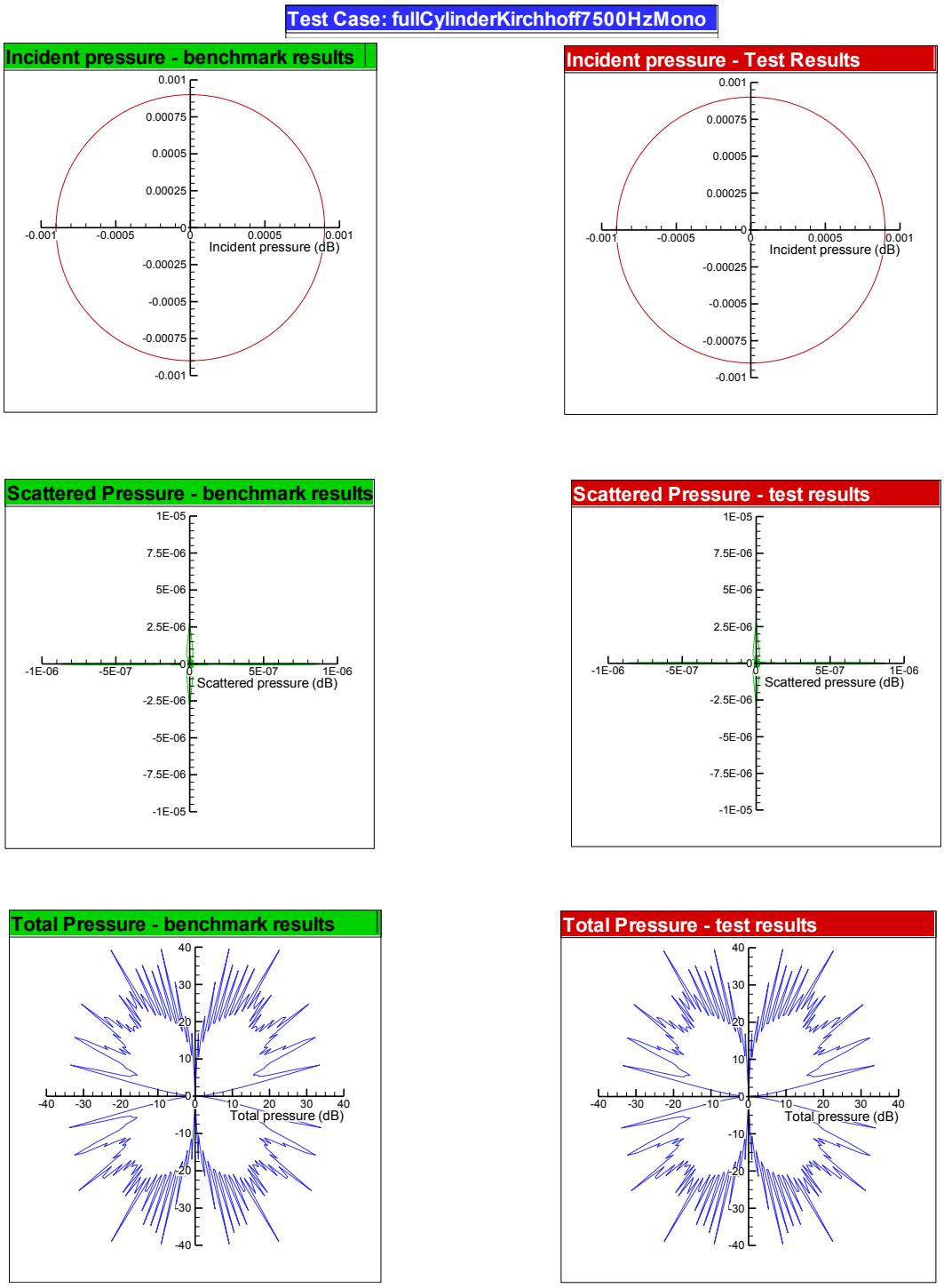


Figure 7. *Polar Plot of Radiated, Scattered and Total Pressures*

4. Test Case #4: Full Sphere Interior

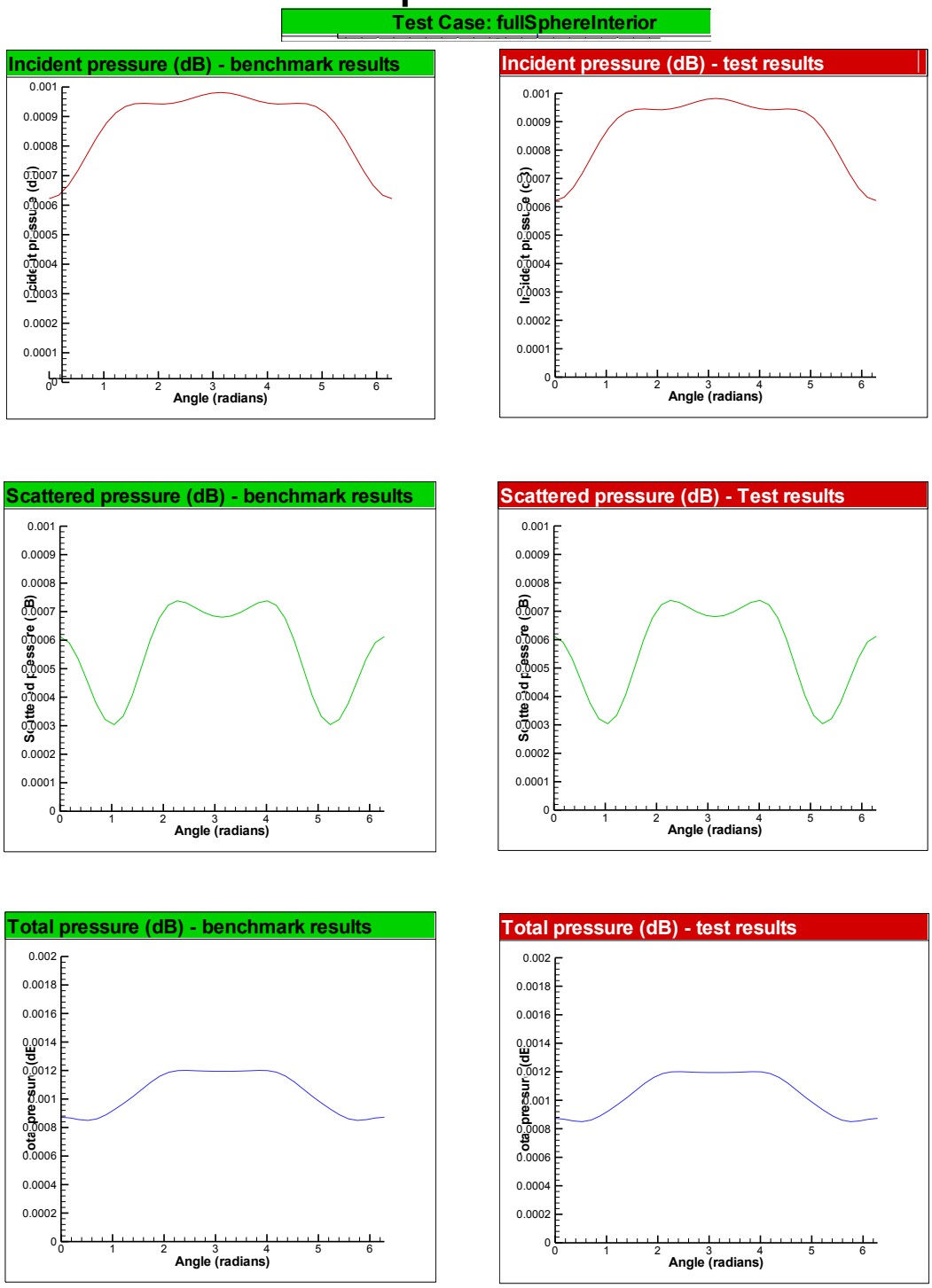


Figure 8. *XY Plot of Radiated, Scattered and Total Pressures*

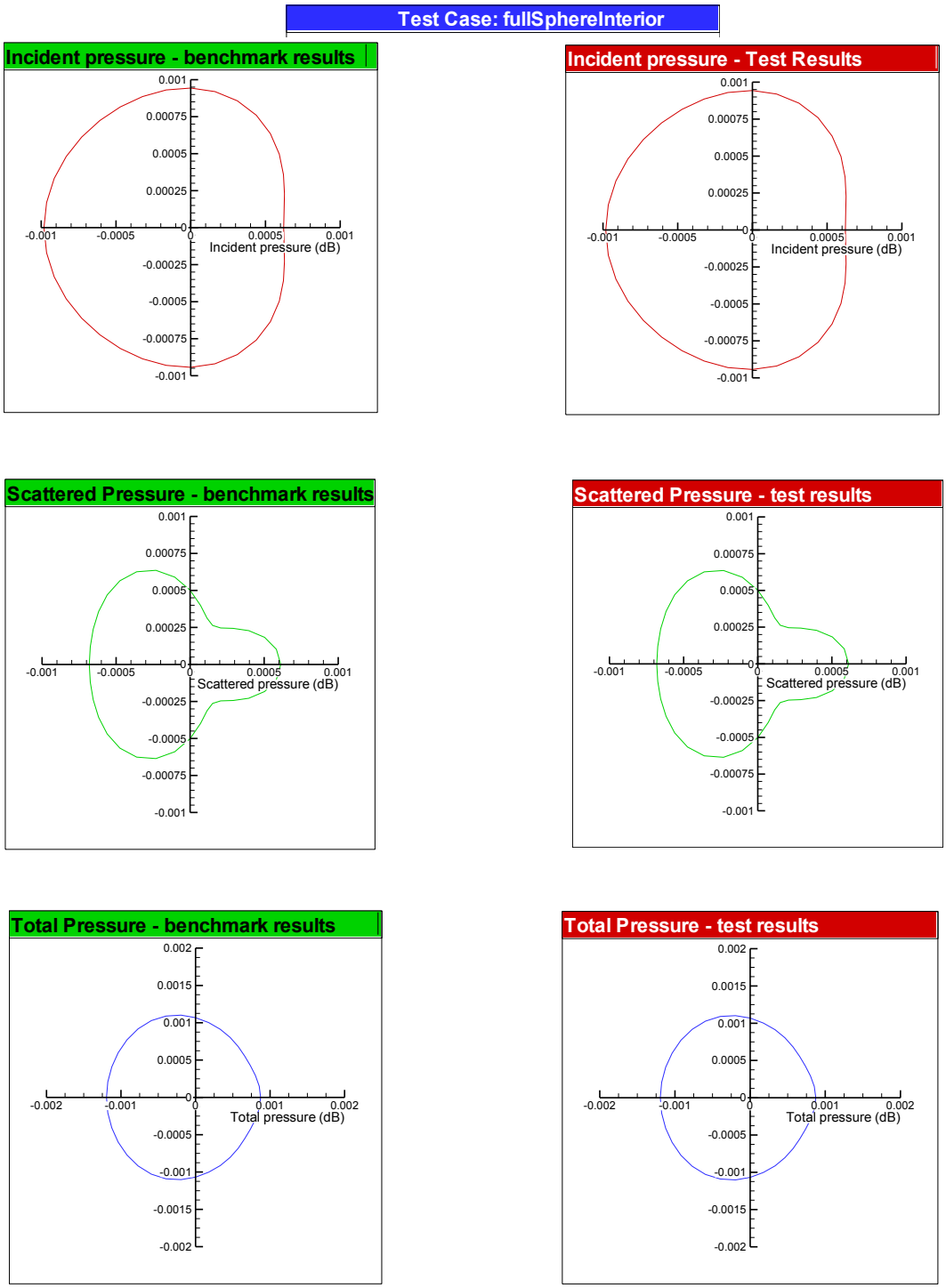


Figure 9. *Polar Plot of Radiated, Scattered and Total Pressures*

5. Test Case #5: Full Sphere Mixed Radiation Pressure BC

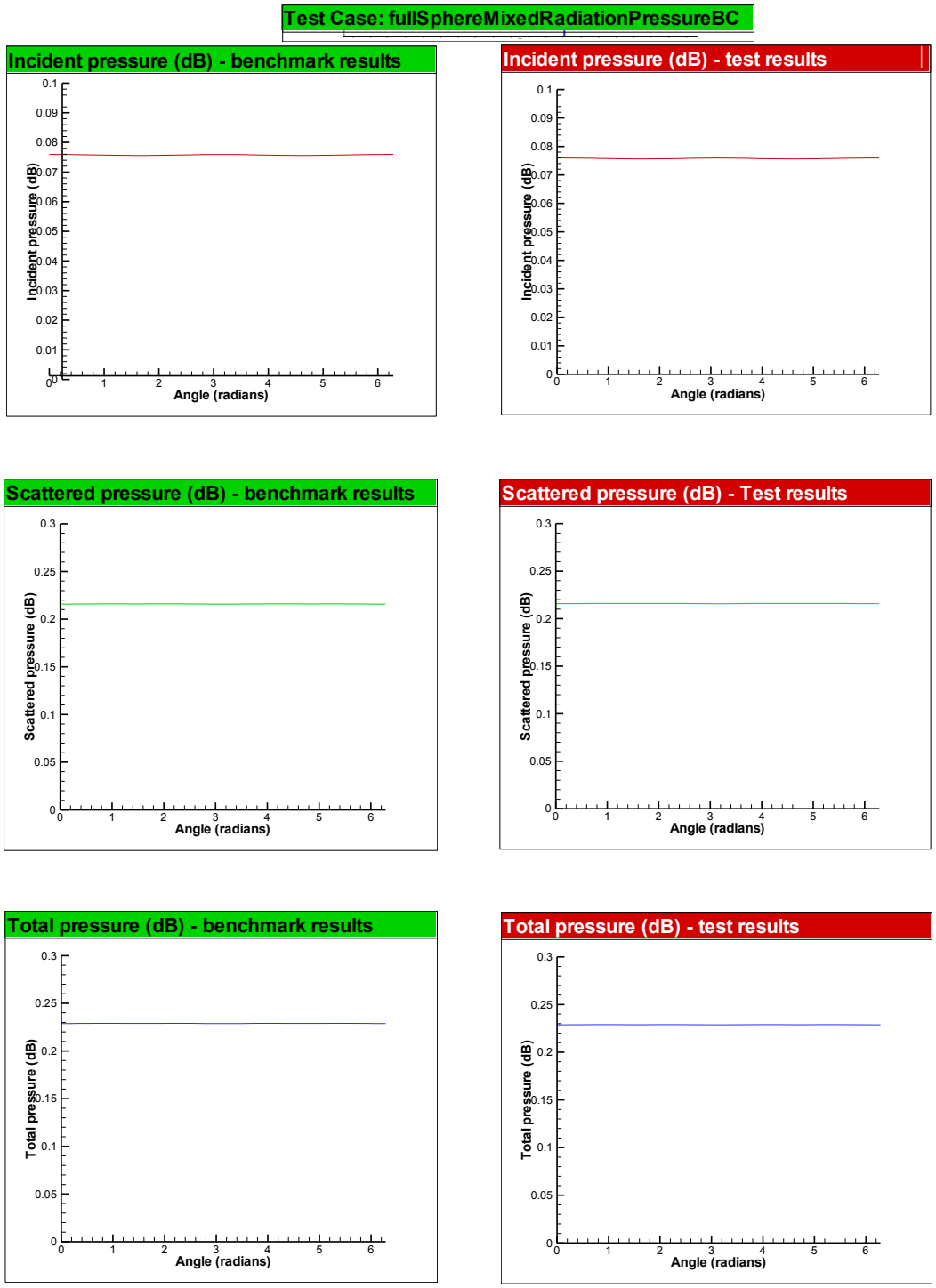


Figure 10. *XY Plot of Radiated, Scattered and Total Pressures*

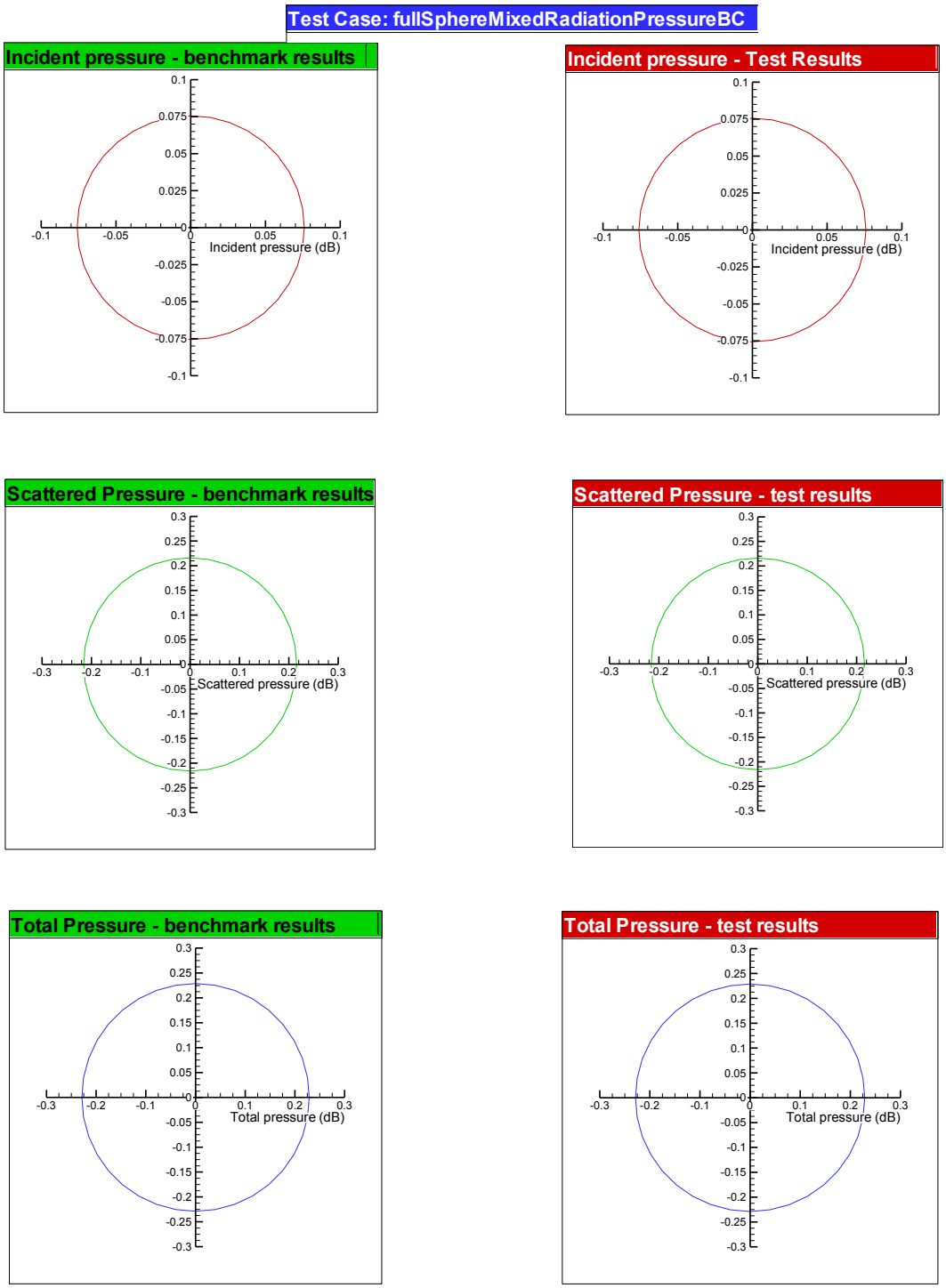


Figure 11. *Polar Plot of Radiated, Scattered and Total Pressures*

6. Test Case #6: Half Sphere Rigid Xeq2 BiStatic

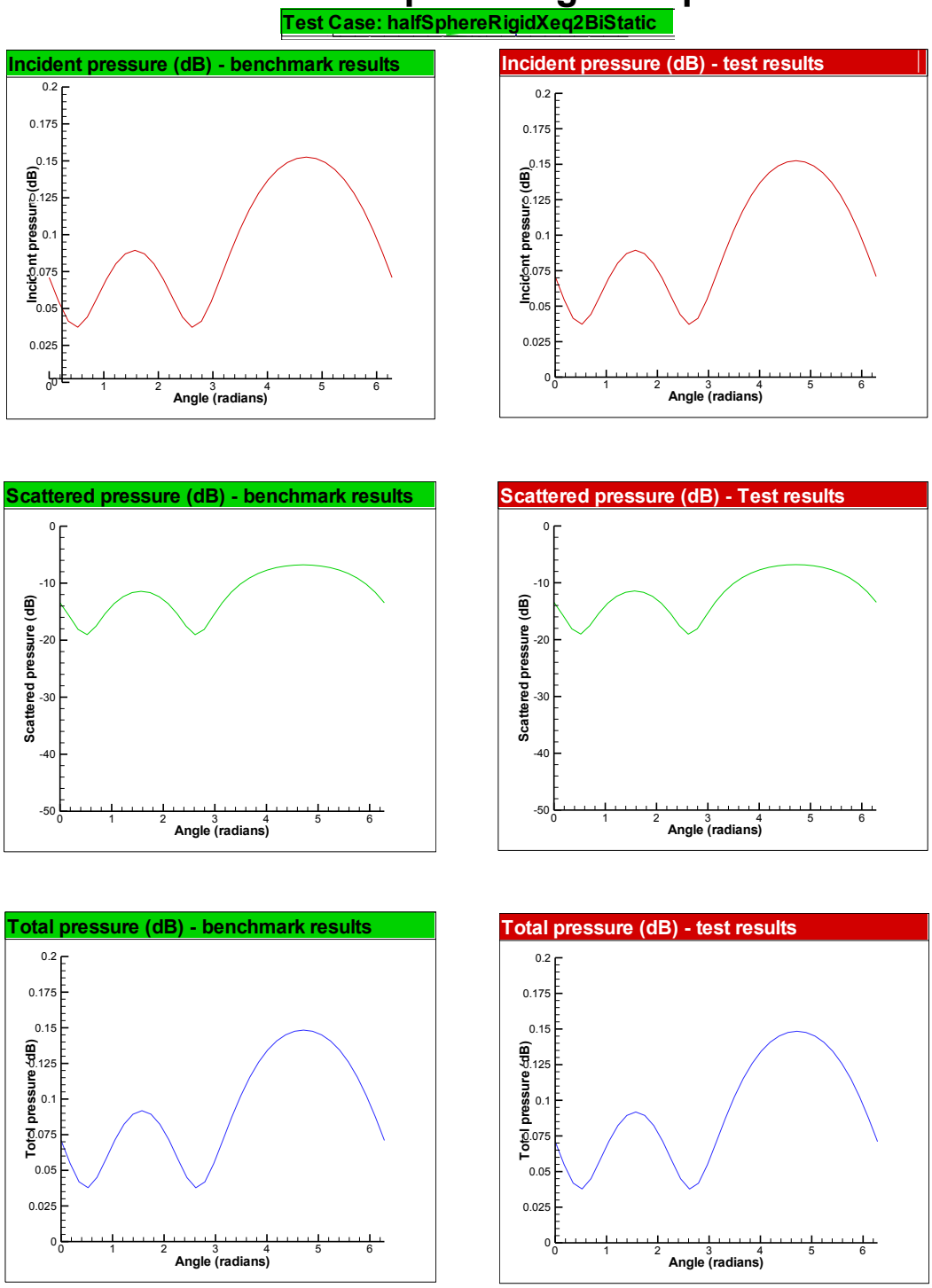


Figure 12. *XY Plot of Radiated, Scattered and Total Pressures*

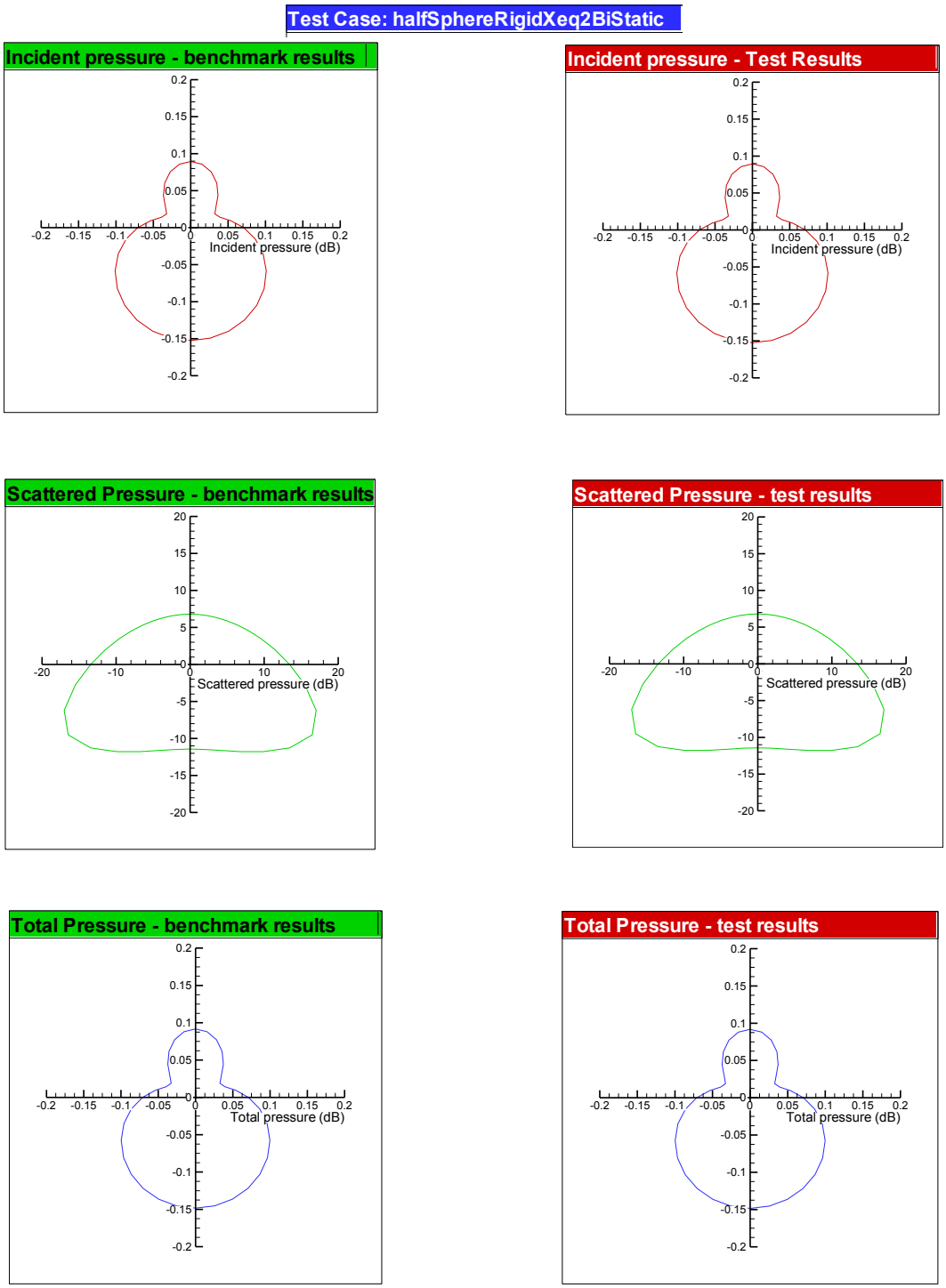


Figure 13. *Polar Plot of Radiated, Scattered and Total Pressures*

7. Test Case #7: Half Sphere Rigid Xeq2 Radiation

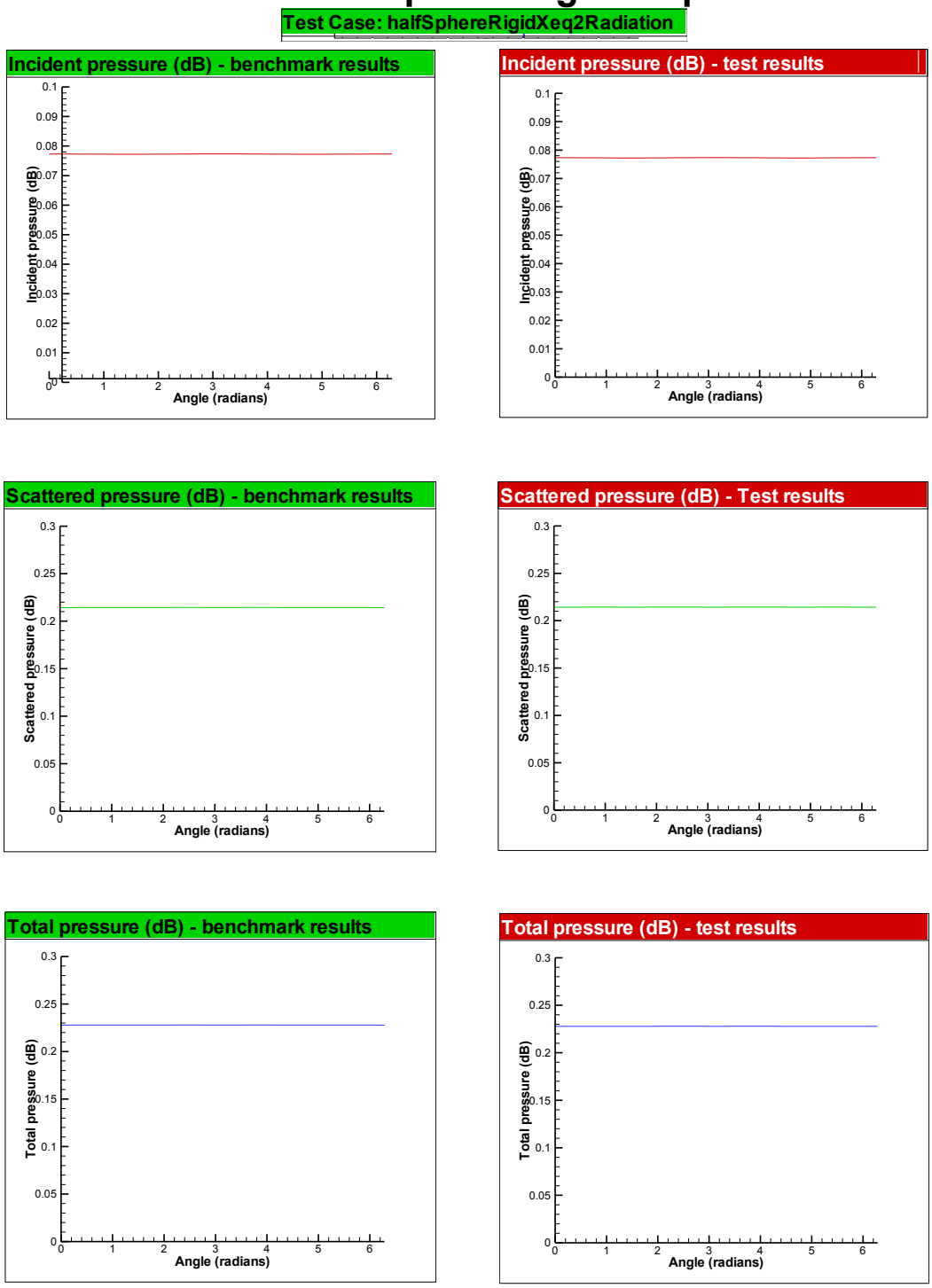


Figure 14. *XY Plot of Radiated, Scattered and Total Pressures*

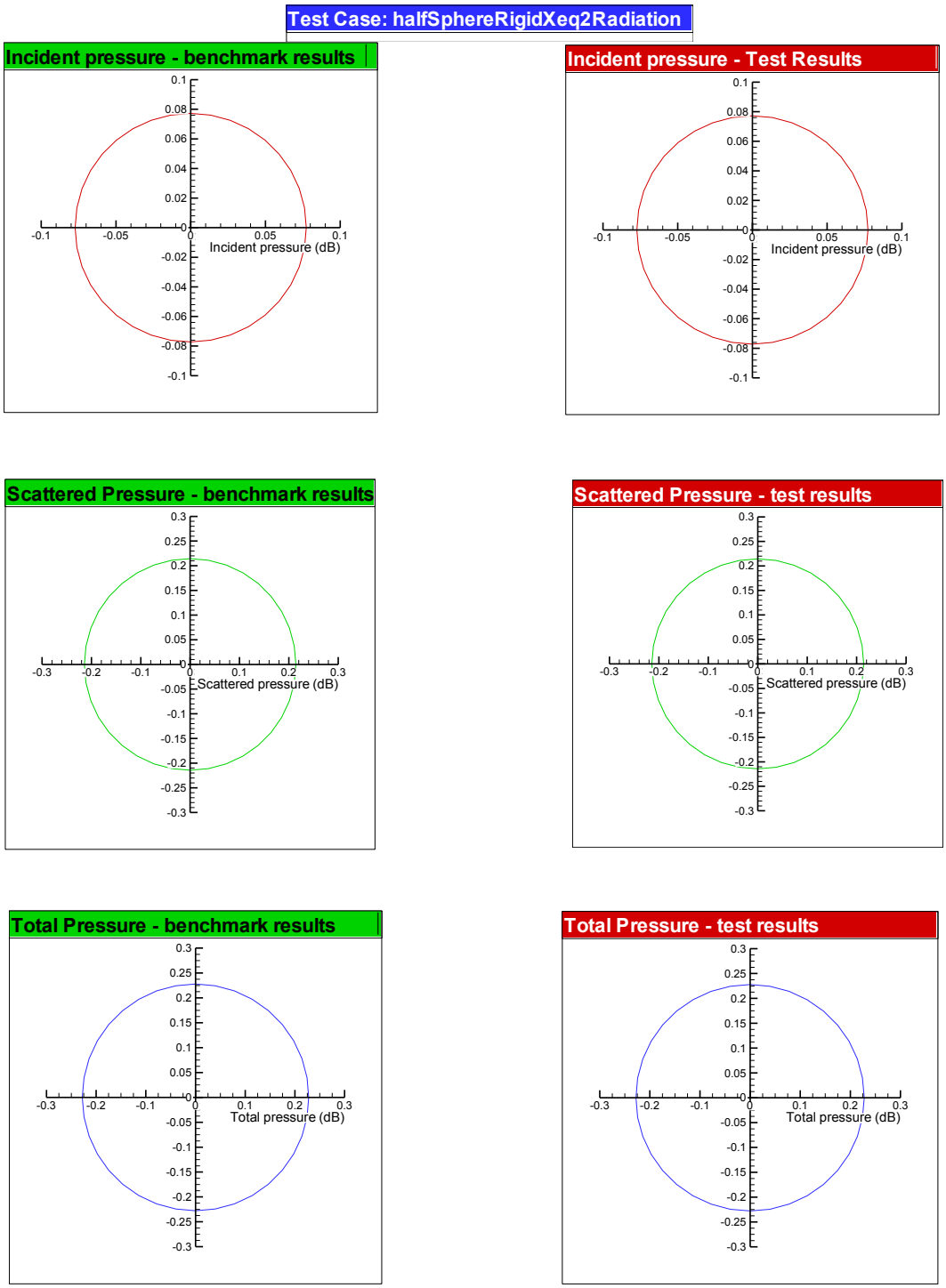


Figure 15. *Polar Plot of Radiated, Scattered and Total Pressures*

8. Test Case #8: Half Sphere Rigid Yeq2 BiStatic

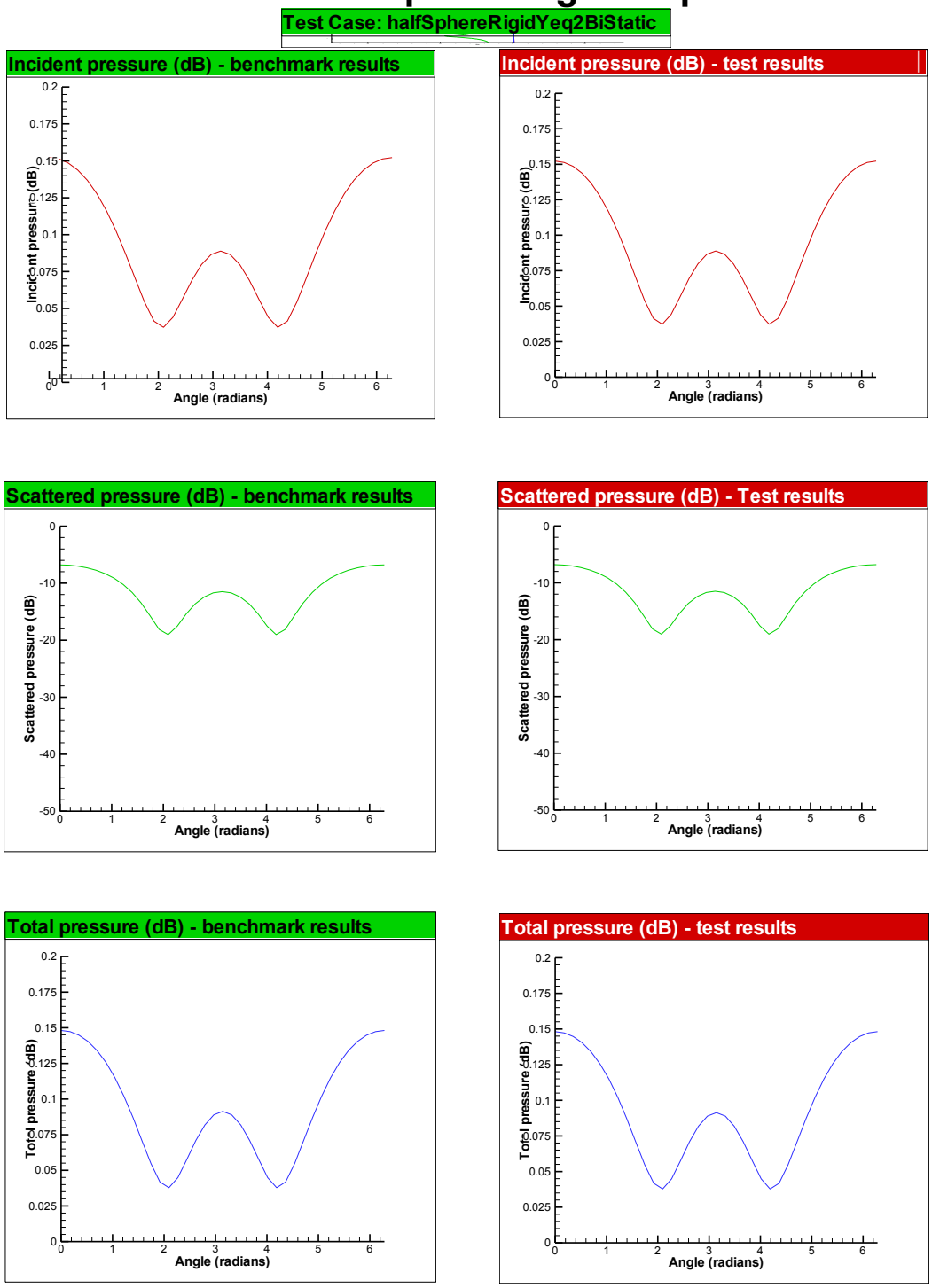


Figure 16. *XY Plot of Radiated, Scattered and Total Pressures*

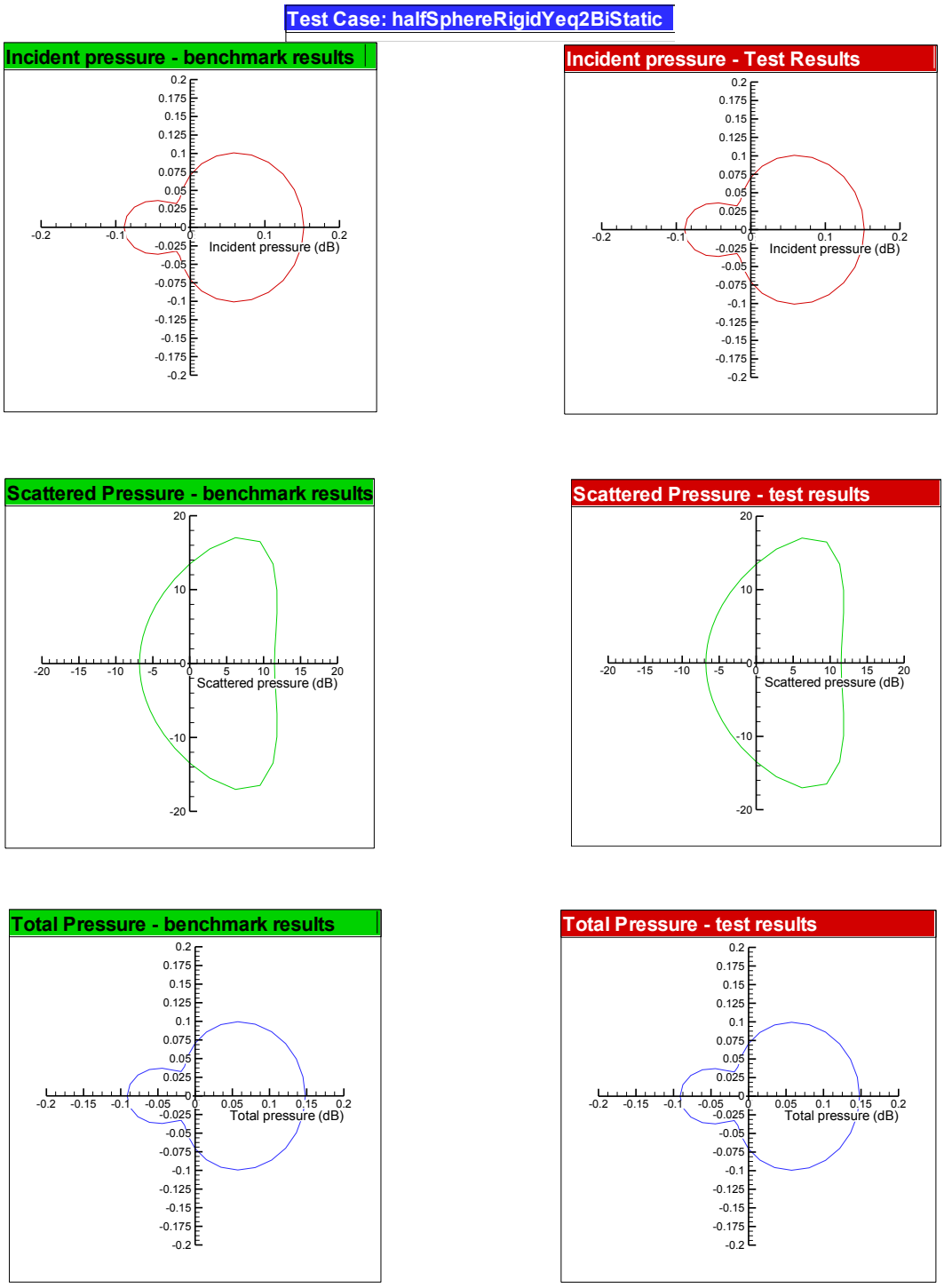


Figure 17. *Polar Plot of Radiated, Scattered and Total Pressures*

9. Test Case #9: Half Sphere Rigid Yeq2 Radiation

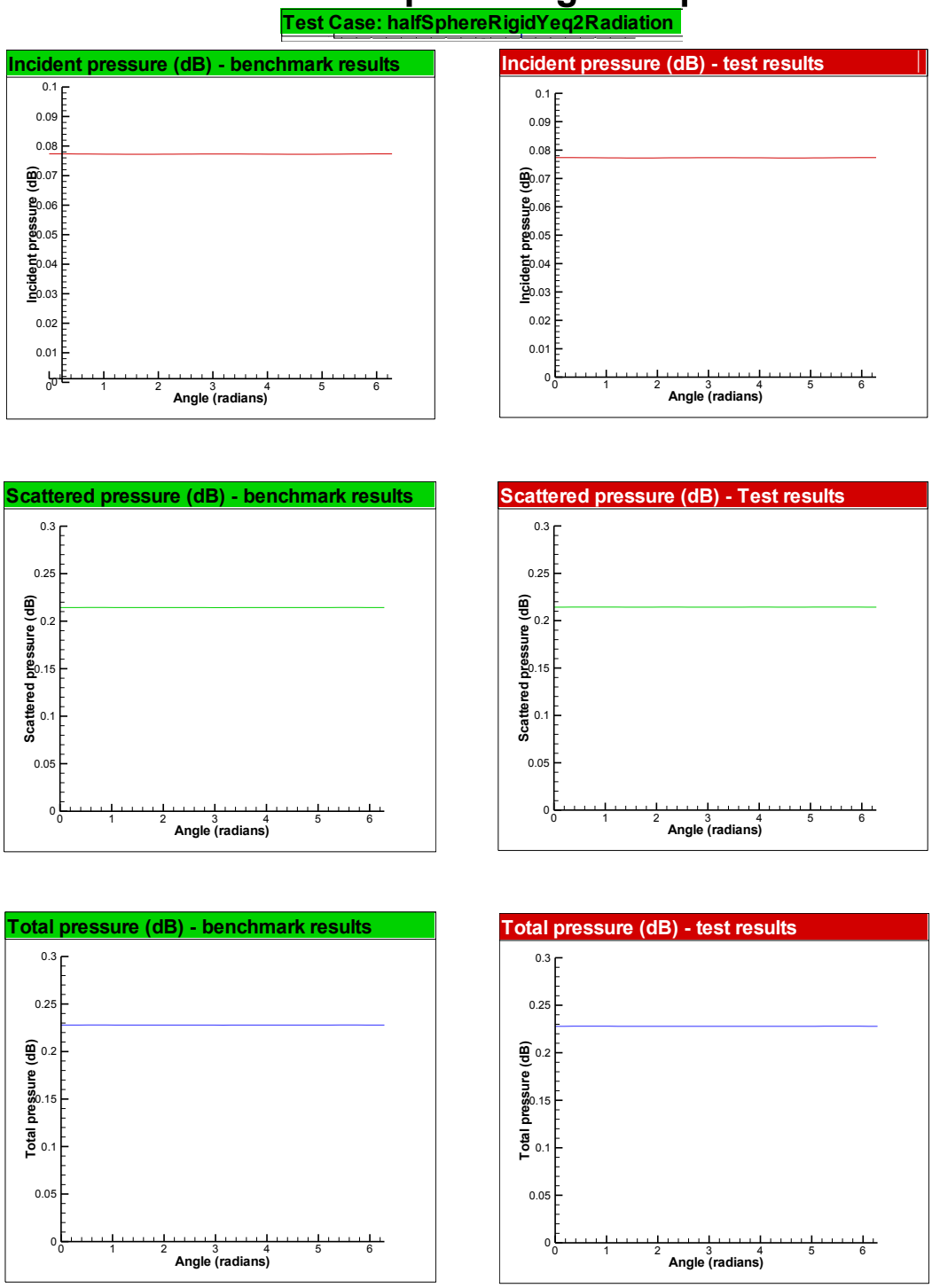


Figure 18. *XY Plot of Radiated, Scattered and Total Pressures*

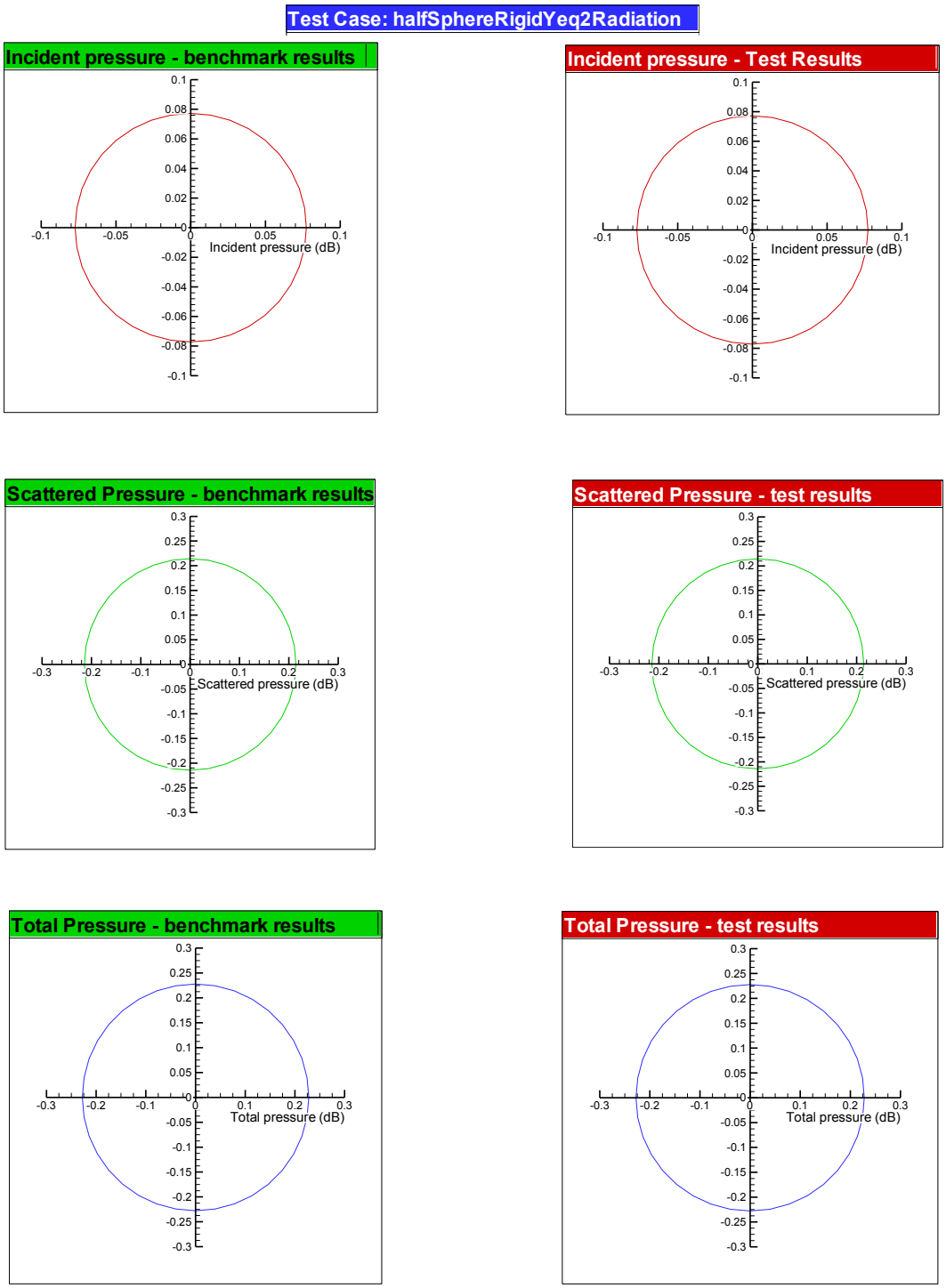


Figure 19. *Polar Plot of Radiated, Scattered and Total Pressures*

10. Test Case #10: Half Sphere Rigid Zeq2 BiStatic

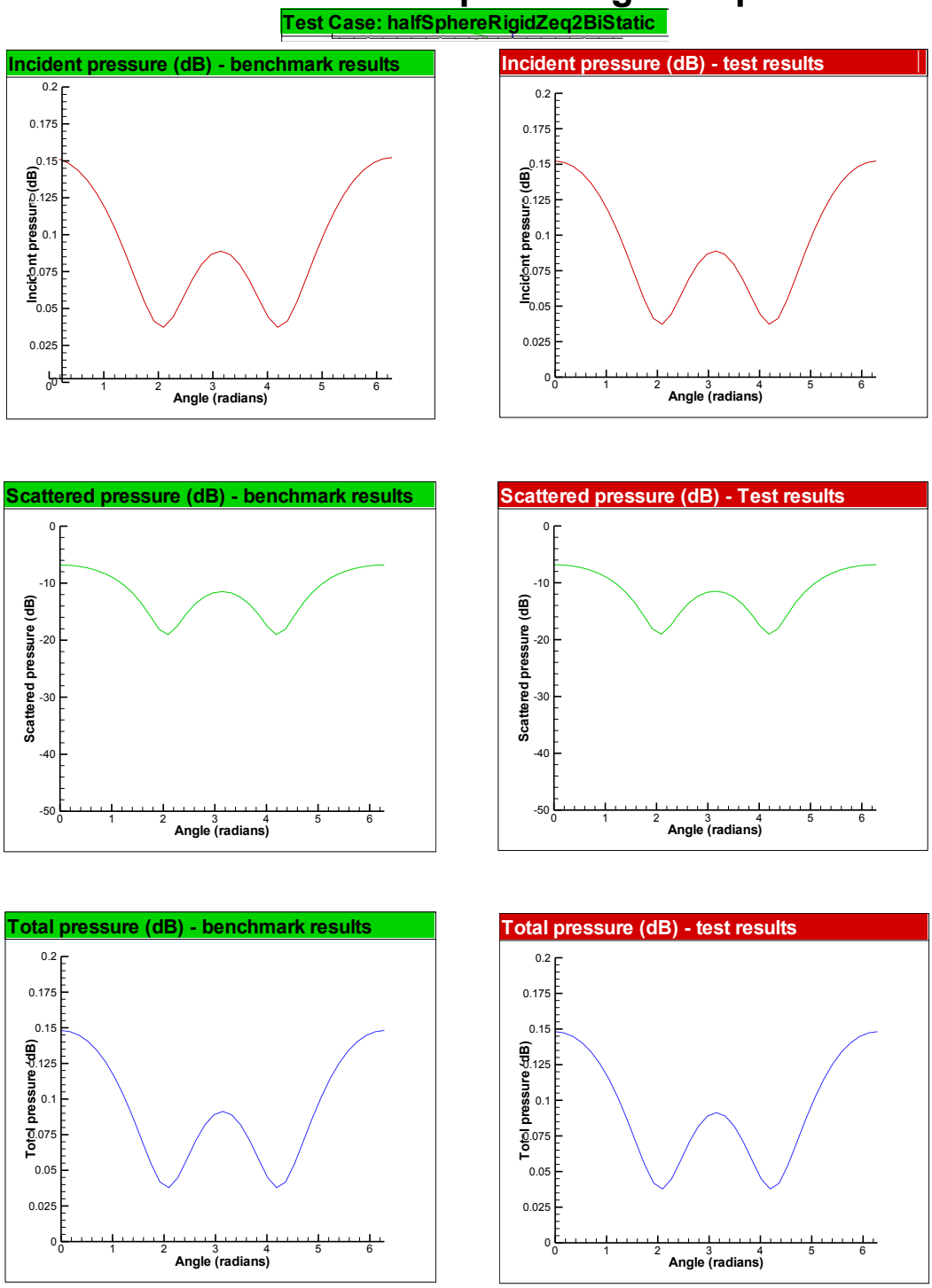


Figure 20. *XY Plot of Radiated, Scattered and Total Pressures*

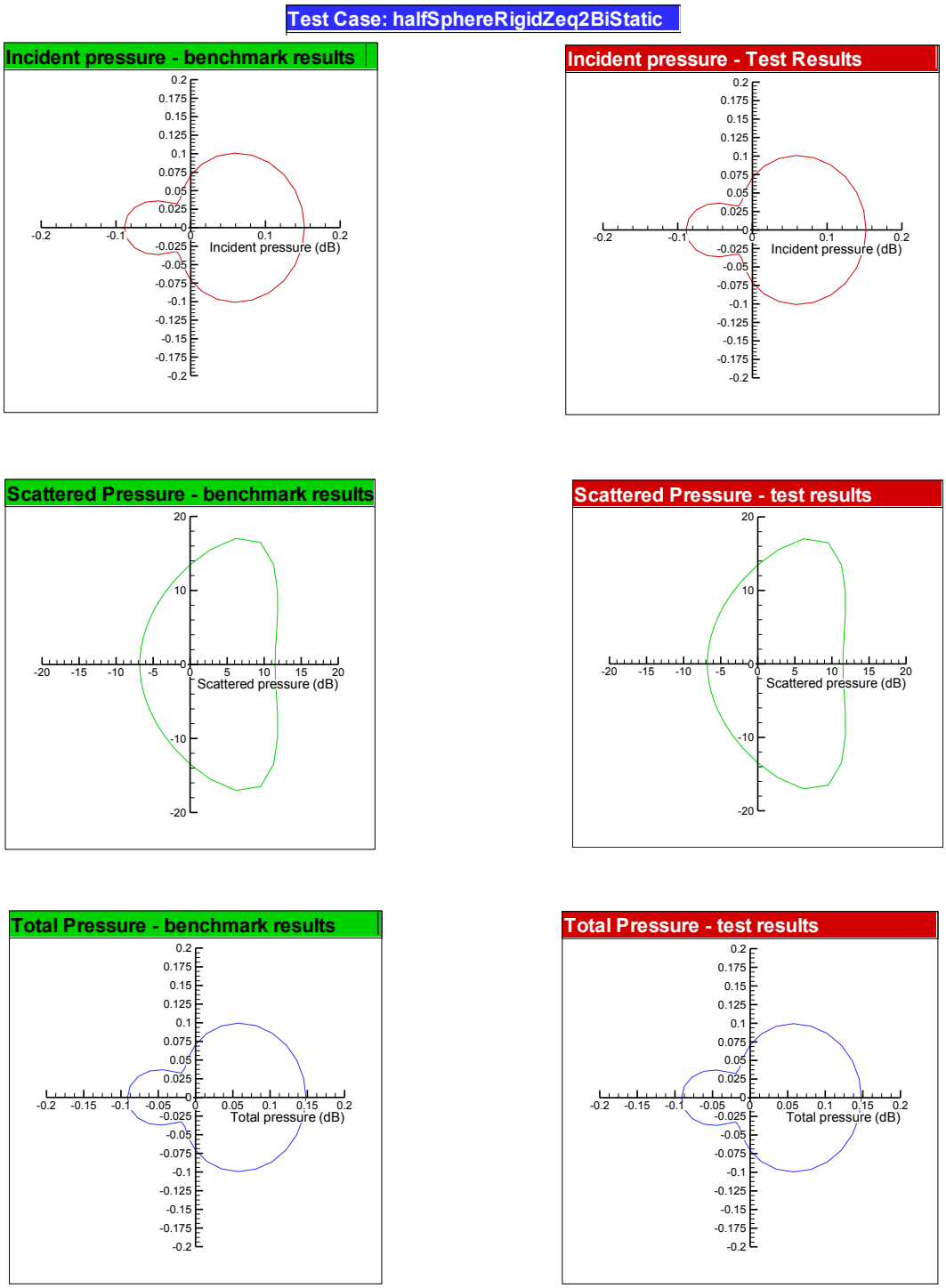


Figure 21. *Polar Plot of Radiated, Scattered and Total Pressures*

11. Test Case #11: Half Sphere Rigid Zeq2 Radiation

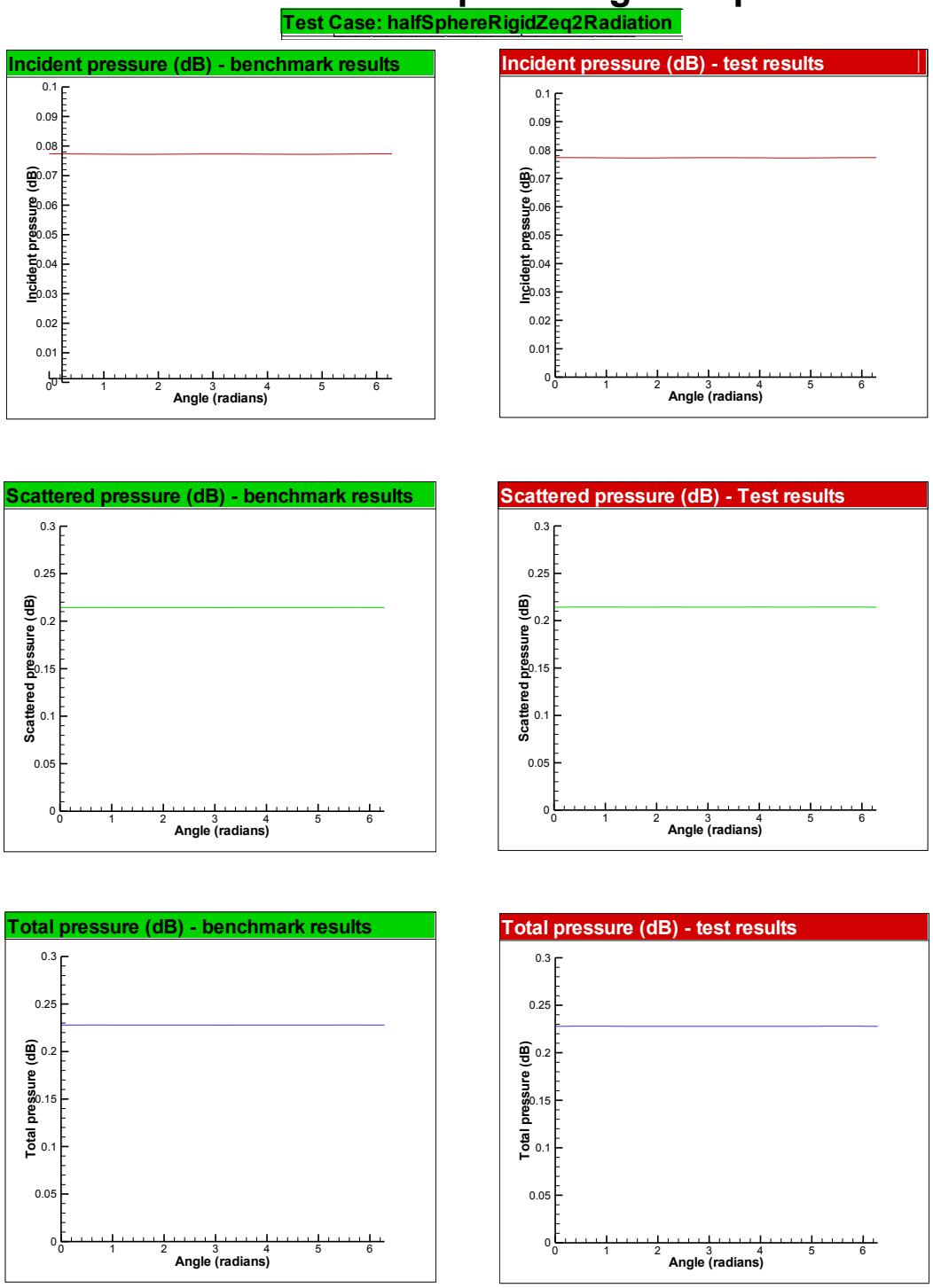


Figure 22. *XY Plot of Radiated, Scattered and Total Pressures*

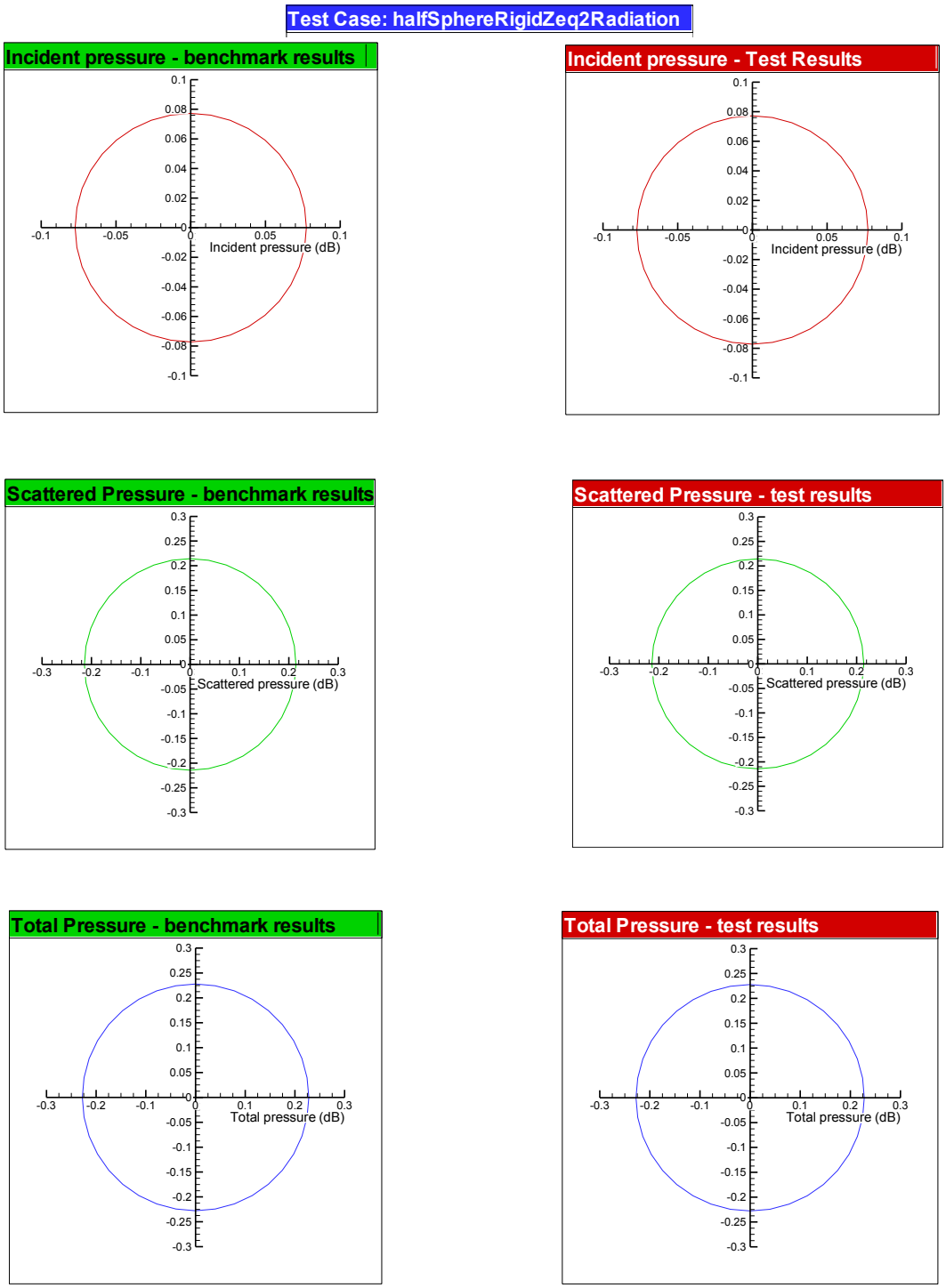


Figure 23. *Polar Plot of Radiated, Scattered and Total Pressures*

12. Test Case #12: Kirchhoff Full Capsule 200Hz

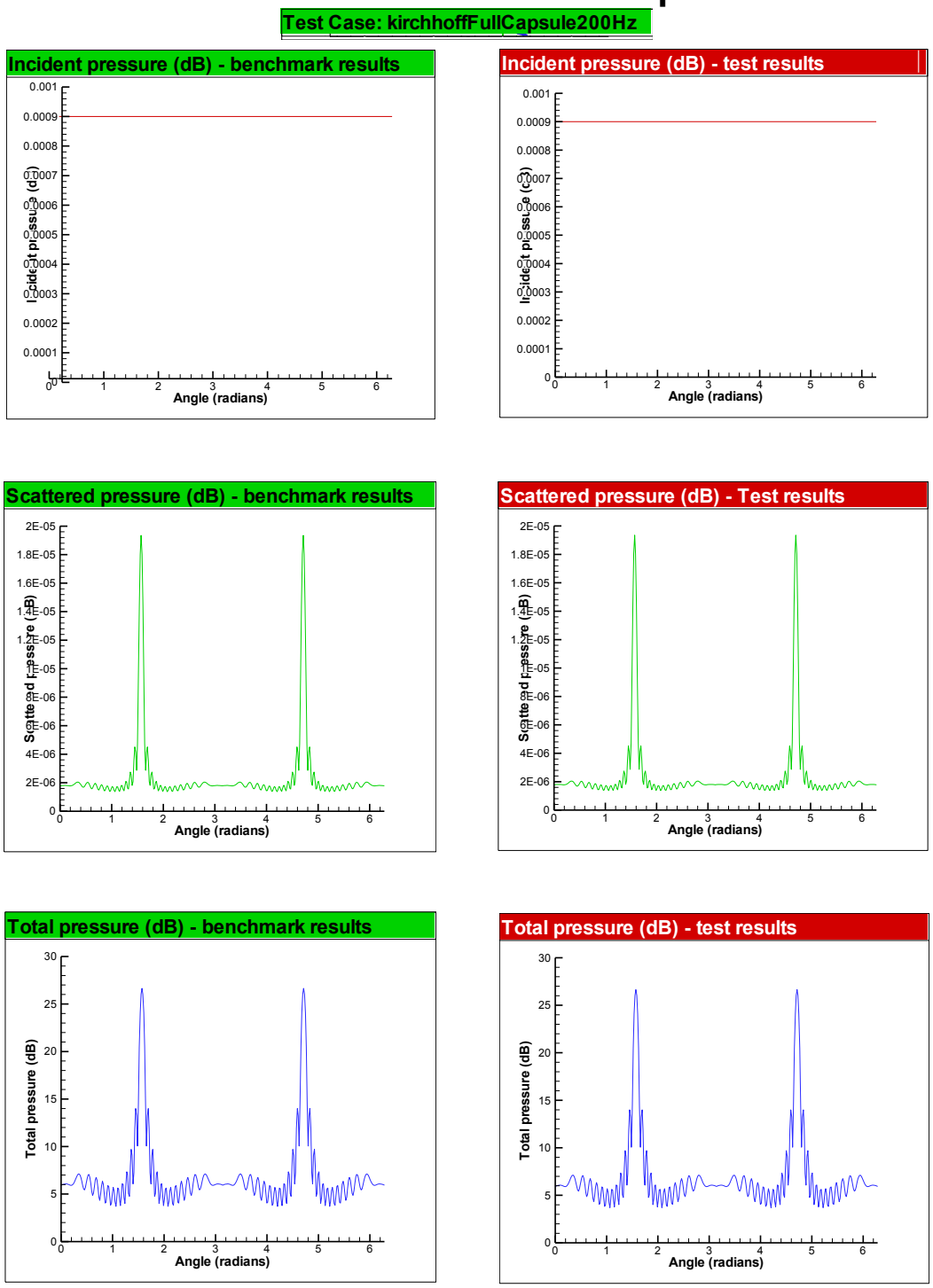


Figure 24. *XY Plot of Radiated, Scattered and Total Pressures*

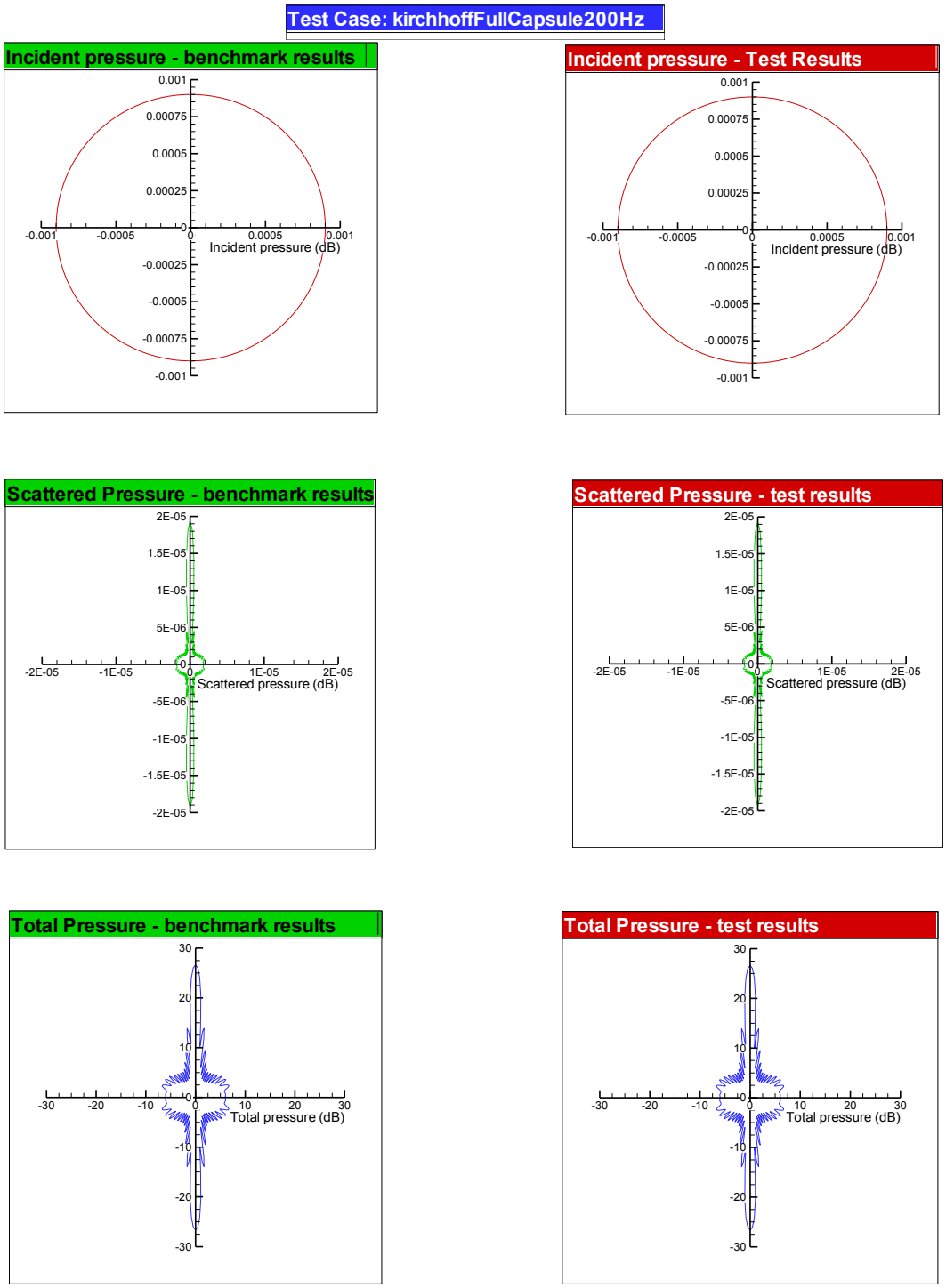


Figure 25. *Polar Plot of Radiated, Scattered and Total Pressures*

13. Test Case #13: Kirchhoff Half Capsule Y Symm 200Hz

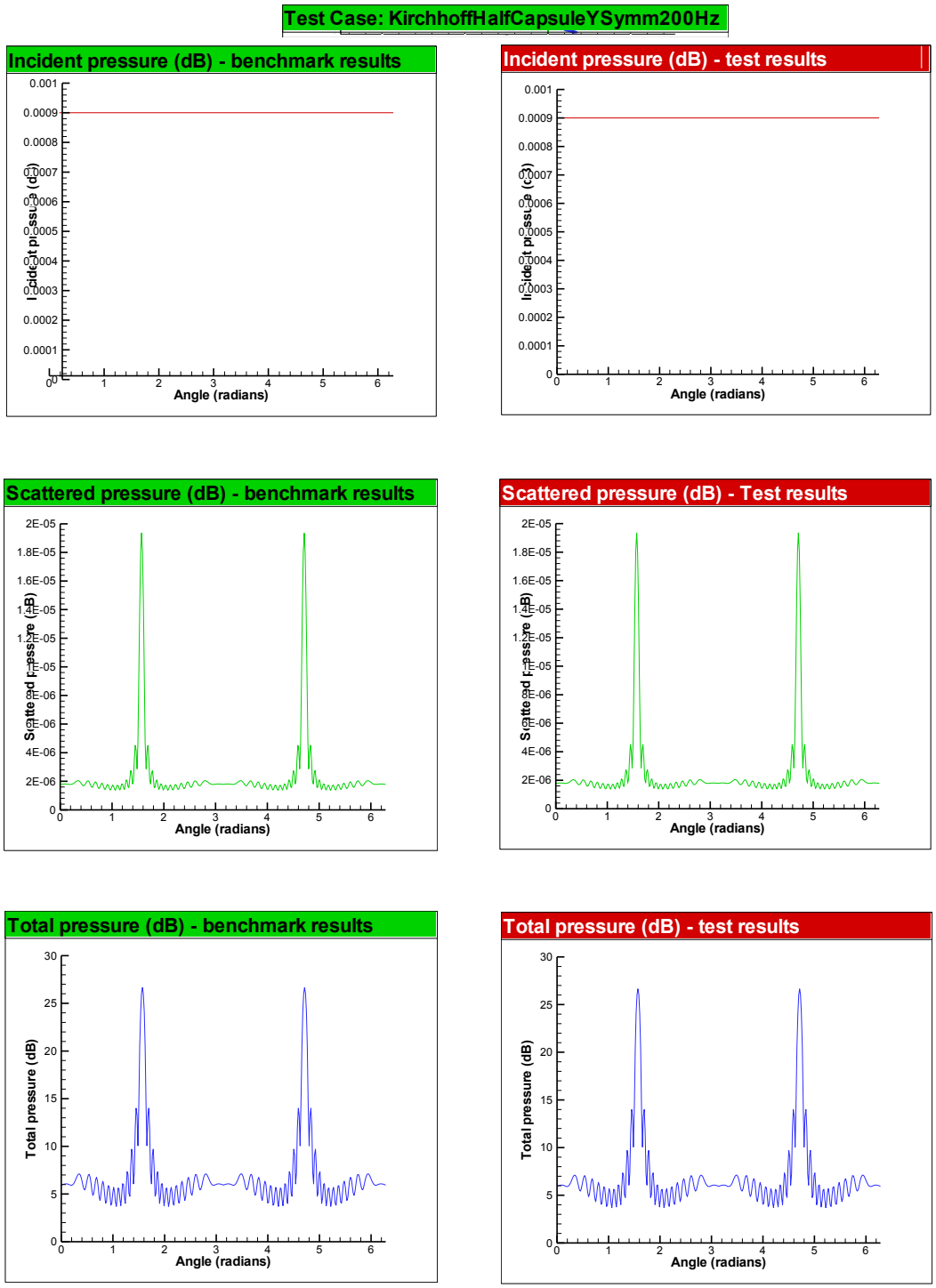


Figure 26. *XY Plot of Radiated, Scattered and Total Pressures*

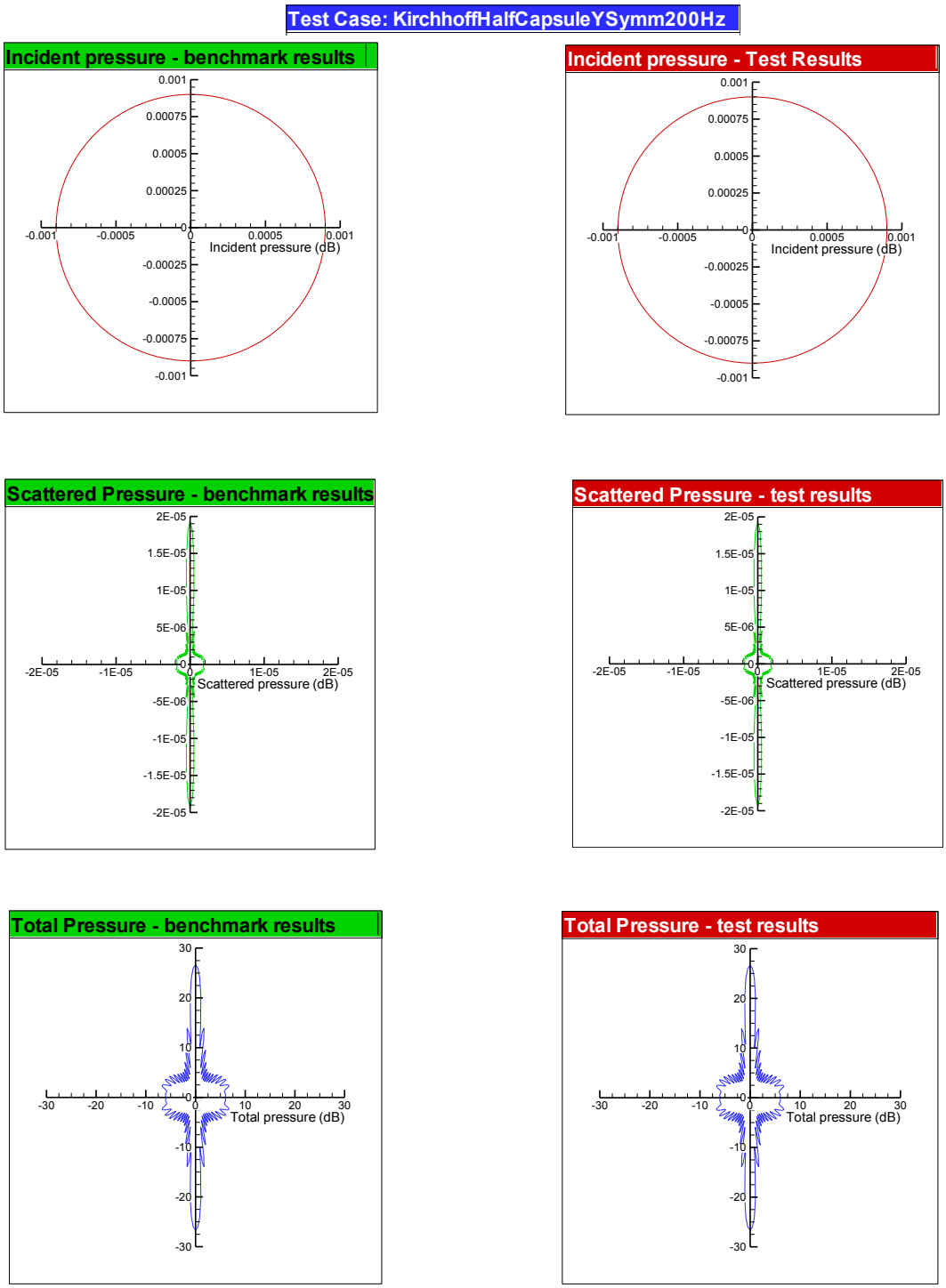


Figure 27. *Polar Plot of Radiated, Scattered and Total Pressures*

14. Test Case #14: Quarter Sphere Radiation

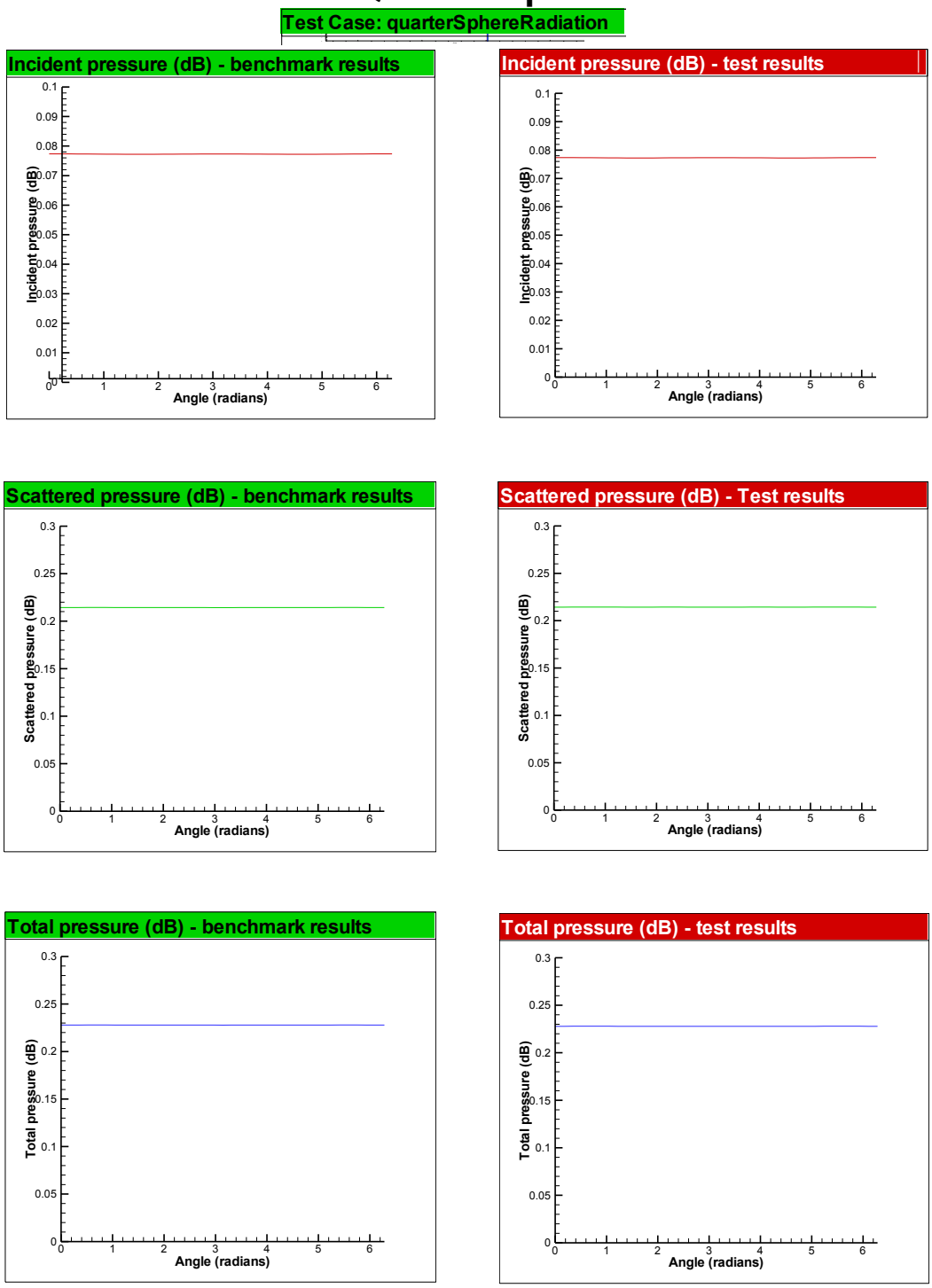


Figure 28. *XY Plot of Radiated, Scattered and Total Pressures*

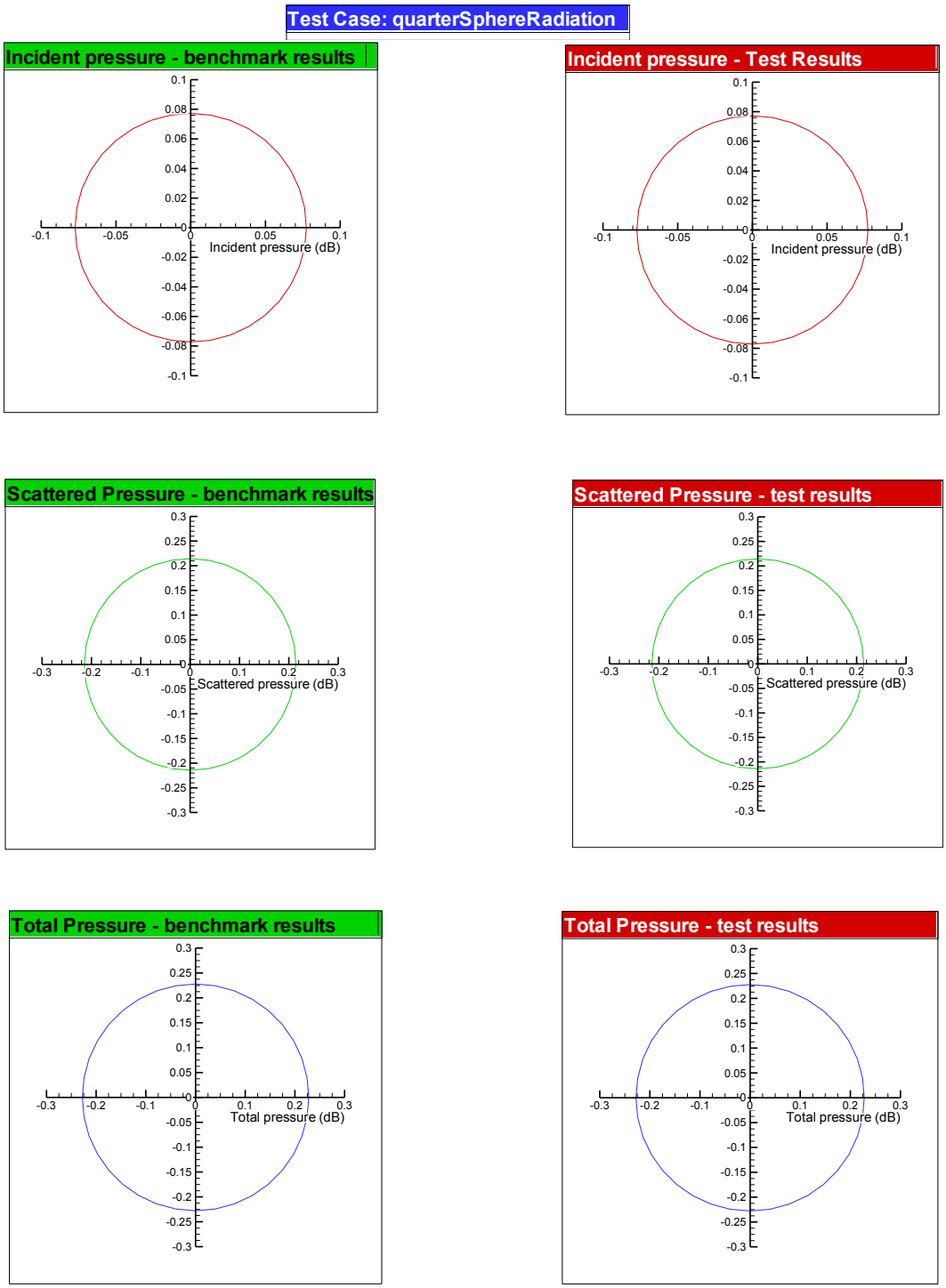


Figure 29. *Polar Plot of Radiated, Scattered and Total Pressures*

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The AVAST software was developed to predict underwater radiated noise and acoustic target strength of ships and submarines. Over the last several years the AVAST code has undergone significant modifications and upgrades. At this point in the software development cycle, it is necessary for the software to undergo a rigorous series of regression tests to ensure the entire suite of analysis features is still operating properly.

A series of benchmark test cases has been developed to validate the AVAST software after any significant modifications are made to the code. To aid in the evaluation of the testing, an autotester was developed to automate the process of running the test models, comparing the new results to the benchmark results, and generating reports.

Additional benchmark test cases will be added as the analysis features of the software are upgraded. It is suggested that the AVAST software should be modified to generate standardized output files in Tecplot format. This approach would eliminate the need for codes to translate the data into the format necessary to plot the results for comparison with the benchmark results.

Le logiciel AVAST a été conçu pour prédire le niveau de bruit transmis par rayonnement sous-marin et déterminer l'indice de réflexion acoustique des navires et des sous-marins. Au cours des dernières années, le code du logiciel AVAST a subi des modifications et des mises à niveau importantes. Au moment présent du cycle de développement du logiciel, AVAST doit subir une série d'essais de régression rigoureux pour s'assurer que toutes les caractéristiques d'analyse fonctionnent correctement.

Une série de tests de performance a été mise au point afin de valider le logiciel AVAST une fois que toutes les modifications importantes au code auront été apportées. Pour contribuer à l'évaluation de ces tests, on a conçu un testeur automatique capable d'automatiser le processus d'évaluation des tests modèles, la comparaison de nouveaux résultats et de résultats des tests de performance et la création de rapports.

Des tests de performance supplémentaires seront ajoutés à mesure que les caractéristiques d'analyse du logiciel seront mises à niveau. On a proposé de modifier le logiciel AVAST de manière à créer des fichiers de sortie normalisés en format Tecplot. Cette modification éliminerait la nécessité d'utiliser des codes pour convertir les données vers un format cible aux fins de représentation graphique des résultats et de comparaison avec les résultats des tests de performance.

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AVAST; Acoustic Radiation; Target Strength; Benchmark; Test cases

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