

SOFTWARE RELEASE NOTICE

1. SRN Number: GHGC-SRN-194		
2. Project Title: Geophysical Investigations in the Yucca Mountain Region		Project No. 20-1402-861
3. SRN Title: Inverse Modeling Software for Resistivity, Induced Polarization and Transient Electromagnetic Sounding, Version 6		
4. Originator/Requestor: David A. Farrell		Date: 5/09/99
5. Summary of Actions <input checked="" type="checkbox"/> Release of new software <input type="checkbox"/> Release of modified software: <input type="checkbox"/> Enhancements made <input type="checkbox"/> Corrections made <input type="checkbox"/> Change of access software <input type="checkbox"/> Software Retirement		
6. Persons Authorized Access		
Name	Read Only/Read-Write	Addition/Change/Delete
David A. Farrell	RO	A
Charles Connor	RO	A
Peter La Femina	RO	A
7. Element Manager Approval: English Percy <i>D.R. Venn for ECP</i>		Date: 07/09/99
8. Remarks: Acquired software: Not to be modified.		

SOFTWARE SUMMARY FORM

01. Summary Date: 7/09/99	02. Summary prepared by (Name and phone) David A. Farrell (210) 522-5208		03. Summary Action: NEW
04. Software Date: 8/07/98	05. Short Title: Inverse Modeling Software for Resistivity, Induced Polarization and Transient Electromagnetic Sounding		
06. Software Title: EINVRT Version 6.0 Modules: ZONGE, READZONGE, T47INPUT, READ, SLUMBER, RAMPRES3, EINVRT6			07. Internal Software ID: NONE
08. Software Type: <input type="checkbox"/> Automated Data System <input checked="" type="checkbox"/> Computer Program <input type="checkbox"/> Subroutine/Module	09. Processing Mode: <input checked="" type="checkbox"/> Interactive <input type="checkbox"/> Batch <input type="checkbox"/> Combination	10. Application Area a. General: <input checked="" type="checkbox"/> Scientific/Engineering <input type="checkbox"/> Auxiliary Analyses <input type="checkbox"/> Total System PA <input type="checkbox"/> Subsystem PA <input type="checkbox"/> Other b. Specific:	
11. Submitting Organization and Address: CNWRA/SwRI 6220 Culebra Road San Antonio, TX 78228		12. Technical Contact(s) and Phone: David A. Farrell Stewart Sandberg CNWRA/SwRI Geophysical Solutions 6220 Culebra Road 1308 Narcisco Court NE San Antonio, TX 78228 Albuquerque, NM 87112 (210) 522-5208 (505) 299-6878	
13. Software Application: Modeling of Resistivity, Induced Polarization and Transient Electromagnetic Data.			
14. Computer Platform PC	15. Computer Operating System: Windows 95&98 Windows NT 4.0, DOS 6.X	16. Programming Language(s): Basic, FORTRAN	17. Number of Source Program Statements: NOT KNOWN
18. Computer Memory Requirements: 16 MB	19. Tape Drives: NONE	20. Disk Units: PC Hard Drive	21. Graphics: Available only on DOS 6.X and Windows 95&98 System
22. Other Operational Requirements: All graphic calls must be turned off when used under Windows NT 4.0 due to device conflicts.			
23. Software Availability: <input checked="" type="checkbox"/> Available <input type="checkbox"/> Limited <input type="checkbox"/> In-House ONLY		24. Documentation Availability: <input checked="" type="checkbox"/> Available <input type="checkbox"/> Preliminary <input type="checkbox"/> In-House ONLY	
25. Software Developer: Geophysical Solutions (Stewart Sandberg) Date: 7/09/99			

David A. Farrell 7/9/99

D.A.F.

TO: Bruce Mabrito
FROM: David A. Farrell
SUBJECT: Installation test for acquired transient electromagnetic, resistivity and induced polarization software suite (ZONGE, READZONGE, T47INPUT, READ, SLUMBER, RAMPRES3 and EINVRT6)
DATE: July 8, 1999.

Version 6.0 of the inverse modeling software suite for resistivity, induced polarization, and transient electromagnetic soundings written by Dr. Stewart K. Sandberg that includes the computer codes ZONGE, READZONGE, T47INPUT, READ, SLUMBER, RAMPRES3 and EINVRT6 was acquired by the Center for Nuclear Waste Regulatory Analyses. Because (i) executable versions of the software were acquired (apart from T47INPUT and SLUMBER for which Basic source codes were provided), and (ii) versions of the codes have been widely used for academic, consulting and other organizations such as the New Jersey Geologic Survey, only an installation verification is warranted. A comprehensive summary of the various codes that comprise the suite can be found on pages 8-11 of the software user's manual entitled "Manual for Computer Programs: ZONGE, READZONGE, T47INPUT, READ, SLUMBER, RAMPRES3 and EINVRT6" dated August 7, 1998.

The suite of codes were designed to run under Windows 3.1, Windows 95, and DOS 6.0 and higher operating systems. The programs may also be executed in the Windows NT 4.0 environment. However, in this environment (Windows NT 4.0), all graphics options must be switched off due to device driver conflicts between the software and the operating system.

A copy of the software suite was installed on the PC workstation MEDUSA running Windows NT 4.0 and located in RM 212 of Bldg. 189. The following documents the software installation tests performed. Because the software's primary usage is for forward and inverse modeling, only the codes which perform these tasks were considered in the installation verification.

Forward Modeling

The program ZONGE was used to perform the forward modeling. This code generates an apparent resistivity response of a layered earth model based on a central loop, time-domain electromagnetic sounding. The layered earth model and the expected response were supplied by Dr. Sandberg. An independent check of the code's performance may be obtained by comparing the generated response to data provided by Asten (1987) who examined the response of the model using an alternate code. The forward model and the expected response generated in this verification exercise are summarized in Appendix 1. Responses obtained by Sandberg, and Asten (1987) are summarized in Appendix 2. Comparison of the results shows that simulation reproduced results that approximated the results of Asten (1987) and Sandberg.

Inverse Modeling

The program EINVRT6 was used to perform the inverse modeling. The code uses the observed data and an initial guess at the model to invert for the real model. For this exercise, the simulated data from the forward model were used as the observed data and an initial guess was supplied. Initially, the forward model was used as the guess Appendix 3. For this case the inversion reproduced the forward model Appendix 4. Subsequent inversion attempts used crude estimates of the forward model Appendix 5. For these cases, the inversion converged to a solution which approximated the known forward model Appendix 6.

On the basis of the limited number of tests described above, the installation appears to have been successful.

David A. Farrell

7/9/99

* THE FIRST 10 PAGES OF THE USER'S MANUAL ARE ATTACHED TO THIS DOCUMENT.
A COPY OF THE USER'S MANUAL MAY BE OBTAINED FROM DAVID FARRELL, RM 212
Bldg 189. TEL: (214) 522-5208. EMAIL: dfarrell@swri.edu.

Appendix 1

TABLE 1

guess.out	guess.plt					
7	1	0	20	0	0	0
0.0040	0.010	1				
2.	3.	1.	4.	5.	6.	
167.60	39.22	66.60	0.13			
119.90	119.10	94.53				
0 0 0 0 0 0						
7.16000	0.319574E-03	250.	0.288E+03	300.	1000.	
5.66700	0.436712E-03	250.	0.288E+03	300.	1000.	
4.46000	0.598420E-03	250.	0.288E+03	300.	1000.	
3.57000	0.817349E-03	250.	0.288E+03	300.	1000.	
2.82000	0.121965E-02	250.	0.288E+03	300.	1000.	
2.21000	0.212024E-02	250.	0.288E+03	300.	1000.	
1.77200	0.390656E-02	250.	0.288E+03	300.	1000.	
1.40000	0.818210E-02	250.	0.288E+03	300.	1000.	
1.08700	0.178357E-01	250.	0.288E+03	300.	1000.	
0.87600	0.328750E-01	250.	0.288E+03	300.	1000.	
0.71200	0.558722E-01	250.	0.288E+03	300.	1000.	
0.56300	0.956178E-01	250.	0.288E+03	300.	1000.	
0.44300	0.152407E+00	250.	0.288E+03	300.	1000.	
0.35500	0.221766E+00	250.	0.288E+03	300.	1000.	
0.28000	0.315567E+00	250.	0.288E+03	300.	1000.	
0.22000	0.435107E+00	250.	0.288E+03	300.	1000.	
0.17700	0.568373E+00	250.	0.288E+03	300.	1000.	
0.14000	0.747266E+00	250.	0.288E+03	300.	1000.	
0.10900	0.992805E+00	250.	0.288E+03	300.	1000.	
0.08900	0.124710E+01	250.	0.288E+03	300.	1000.	



VOLTAGE
RESPONSE

- Compare the voltage response to Aster and Sandberg Appendix 2. Note that the units used by Sandberg and Aster are (nV).
- See pages 30-34 of user's manual for an ~~example~~ explanation of the data shown.

Appendix 2

TABLE 2

Comparison of Forward Modeling Results - *EINVRT6* and *RAMPRES3* versus Asten, M.W. (Geophysics, vol. 52 (1987), no. 3, p. 284; and Aug. 13, 1990, pers. comm.)

SANDBERG ASTEN

FIG. 7(e) 25 Hz base frequency

CASE SIMULATED

sample time (s) ¹	voltage(nV) (einvrt6)	voltage(nV) (Asten)	diff (pct)	app. res. (rampres3)	app. res. (Asten)	diff (pct)
0.000089	1247.099	1256	-0.71	164.75	164.94	-0.12
0.000109	992.8054	992.6	0.02	156.57	156.62	-0.03
0.000140	747.2659	746.9	0.05	145.48	145.64	-0.11
0.000177	568.3728	567.9	0.08	134.88	135.02	-0.10
0.000220	435.107	434.8	0.07	125.64	125.75	-0.09
0.000280	315.5667	315.3	0.08	116.84	116.92	-0.07
0.000355	221.7659	221.4	0.17	110.29	110.42	-0.12
0.000443	152.4069	152.1	0.20	106.77	106.99	-0.21
0.000563	95.61776	95.22	0.42	106.24	106.56	-0.30
0.000712	55.87217	55.99	-0.21	110.48	110.37	0.10
0.000876	32.87504	32.96	-0.26	117.7	117.48	0.19
0.001087	17.83571	17.9	-0.36	129.73	129.46	0.21
0.001400	8.182104	8.259	-0.94	150.06	149.1	0.64
0.001772	3.906561	3.98	-1.88	171.87	169.67	1.28
0.002210	2.120236	2.12	0.01	183.51	183.59	-0.04
0.002820	1.219652	1.235	-1.26	180.82	179.26	0.86
0.003570	0.817349	0.8315	-1.73	162.13	160.25	1.16
0.004460	0.59842	0.6139	-2.59	139.52	137.12	1.72
0.005667	0.436712	0.4527	-3.66	116.76	113.96	2.40
0.007160	0.319574	0.3342	-4.58	98.23	95.32	2.96

4 layer model		
layer	resistivity	thickness
1	167.6	119.9
2	39.22	119.1
3	66.6	94.53
4	0.1299	

FIG. 7(f) 2.5 Hz base frequency

sample time (s) ¹	voltage(nV) (einvrt6)	voltage(nV) (Asten)	diff (pct)	app. res. (rampres3)	app. res. (Asten)	diff (pct)
0.000885	37.64788	37.55	0.26	105.52	105.73	-0.20
0.001090	20.74924	20.7	0.24	116.45	116.65	-0.17
0.001400	10.32312	10.25	0.71	128.11	128.75	-0.50
0.001770	5.752387	5.754	-0.03	132.5	132.54	-0.03
0.002200	3.794719	3.798	-0.09	124.79	124.68	0.09
0.002800	2.716486	2.721	-0.17	106.62	106.49	0.12
0.003550	2.120549	2.123	-0.12	86.1	86.02	0.09
0.004430	1.735959	1.737	-0.06	68.86	68.82	0.06
0.005630	1.412082	1.412	0.01	53.57	53.55	0.04
0.007120	1.153543	1.157	-0.30	41.79	41.71	0.19
0.008760	0.96129	0.9639	-0.27	33.6	33.53	0.21
0.010870	0.790299	0.7927	-0.30	26.85	26.8	0.19
0.014000	0.621611	0.6238	-0.35	20.77	20.72	0.24
0.017720	0.490847	0.493	-0.44	16.47	16.42	0.30
0.022100	0.388203	0.3903	-0.54	13.37	13.32	0.37
0.028200	0.293727	0.2967	-1.01	10.75	10.68	0.65
0.035700	0.221132	0.2222	-0.48	8.79	8.76	0.34
0.044600	0.165141	0.1664	-0.76	7.38	7.34	0.54
0.056670	0.117512	0.119	-1.27	6.23	6.17	0.96
0.071600	0.083402	0.08395	-0.66	5.31	5.29	0.38

4 layer model		
layer	resistivity	thickness
1	75.88	141
2	66.45	81.91
3	97.82	103.2
4	0.3812	

Test Conducted August 21, 1998

¹sample times are with respect to the bottom of the transmitter waveform ramp

Appendix 3

GUESS MODEL USED IN
INVERSION EXERCISE

guess.out	guess.plt					
7	1	1	0	0	20	10
0.0040	0.010				1	
2.	3.				1.	
167.60	39.22				66.60	
119.90	119.10				94.53	
0	0	0	0	0	0	0
7.16000	0.319574E-03	250.			0.288E+03	300.
5.66700	0.436712E-03	250.			0.288E+03	300.
4.46000	0.598420E-03	250.			0.288E+03	300.
3.57000	0.817349E-03	250.			0.288E+03	300.
2.82000	0.121965E-02	250.			0.288E+03	300.
2.21000	0.212024E-02	250.			0.288E+03	300.
1.77200	0.390656E-02	250.			0.288E+03	300.
1.40000	0.818210E-02	250.			0.288E+03	300.
1.08700	0.178357E-01	250.			0.288E+03	300.
0.87600	0.328750E-01	250.			0.288E+03	300.
0.71200	0.558722E-01	250.			0.288E+03	300.
0.56300	0.956178E-01	250.			0.288E+03	300.
0.44300	0.152407E+00	250.			0.288E+03	300.
0.35500	0.221766E+00	250.			0.288E+03	300.
0.28000	0.315567E+00	250.			0.288E+03	300.
0.22000	0.435107E+00	250.			0.288E+03	300.
0.17700	0.568373E+00	250.			0.288E+03	300.
0.14000	0.747266E+00	250.			0.288E+03	300.
0.10900	0.992805E+00	250.			0.288E+03	300.
0.08900	0.124710E+01	250.			0.288E+03	300.

0.13 ← model resistivities (ohm-m)

← model thicknesses (m)

Appendix 4

```

      *
    * *
  * * *
* * * *
* EINVRT6 *
* * * *
*****

```

written by:
Stewart Sandberg

ver. 6.01 - 8/21/98

todays date is 7 8 1999
time at beginning= 15 11 54
input filename= guess.mod

initial guess results

	field data	theoretical	pct diff
TEM 1	102.22	102.18	0.0
TEM 2	122.57	122.52	0.0
TEM 3	148.10	148.01	0.1
TEM 4	174.34	174.21	0.1
TEM 5	197.79	197.58	0.1
TEM 6	205.37	205.28	0.0
TEM 7	197.46	197.37	0.0
TEM 8	178.64	178.50	0.1
TEM 9	162.01	161.92	0.1
TEM 10	154.41	154.41	0.0
TEM 11	153.17	153.17	0.0
TEM 12	158.33	158.33	0.0
TEM 13	173.02	173.02	0.0
TEM 14	194.89	194.89	0.0
TEM 15	228.80	228.80	0.0
TEM 16	276.07	276.07	0.0
TEM 17	331.95	331.95	0.0
TEM 18	408.88	408.88	0.0
TEM 19	513.47	513.46	0.0
TEM 20	618.33	618.33	0.0
rscsq=	0.00000		
ll norm=	0.00012		
time to do complete forward=	8.32926424E-04	hours	
TEM 1 1/20	0.001 15 11 59 0.0403 0.0823 0.0210-0.3240 0.8358 0.7450		
0.6194			
TEM 1 2/20	0.001 15 12 1 0.0307 0.1156 0.0224-0.3251 0.8218 0.7104		
0.5949			
TEM 1 3/20	0.001 15 12 3 0.0488 0.1744 0.0276-0.3234 0.7938 0.6282		
0.5419			
TEM 1 4/20	0.001 15 12 5 0.0910 0.2967 0.0421-0.3133 0.7397 0.4476		
0.4196			
TEM 1 5/20	0.001 15 12 7 0.1701 0.5516 0.0645-0.2790 0.6133 0.0657		
0.1594			
TEM 1 6/20	0.001 15 12 9 0.2748 0.8922 0.0884-0.2202 0.4405-0.4665		
-0.2105			
TEM 1 7/20	0.000 15 12 10 0.3598 1.1357 0.1003-0.1506 0.3135-0.8504		
-0.4847			
TEM 1 8/20	0.001 15 12 12 0.3930 1.1864 0.0948-0.0917 0.2728-0.9720		
-0.5869			
TEM 1 9/20	0.000 15 12 13 0.3914 1.0933 0.0775-0.0501 0.3024-0.8936		
-0.5525			
TEM 1 10/20	0.001 15 12 15 0.3775 0.9604 0.0592-0.0295 0.3583-0.7511		
-0.4716			
TEM 1 11/20	0.000 15 12 16 0.3620 0.8177 0.0414-0.0176 0.4211-0.5957		
-0.3816			
TEM 1 12/20	0.000 15 12 16 0.3444 0.6540 0.0220-0.0113 0.4970-0.4159		
-0.2757			
TEM 1 13/20	0.000 15 12 16 0.3363 0.5063 0.0054-0.0060 0.5635-0.2679		
-0.1912			
TEM 1 14/20	0.000 15 12 17 0.3371 0.3848-0.0058-0.0034 0.6133-0.1581		
-0.1283			
TEM 1 15/20	0.000 15 12 17 0.3502 0.2741-0.0123-0.0017 0.5847-0.0747		
-0.0786			
TEM 1 16/20	0.000 15 12 17 0.3778 0.1811-0.0138-0.0009 0.6530-0.0248		
-0.0457			
TEM 1 17/20	0.000 15 12 17 0.4157 0.1132-0.0123-0.0005 0.6303-0.0027		
-0.0275			
TEM 1 18/20	0.000 15 12 17 0.4689 0.0537-0.0097-0.0002 0.5734 0.0064		
-0.0161			
TEM 1 19/20	0.000 15 12 18 0.5357 0.0042-0.0070-0.0001 0.4764 0.0083		
-0.0093			
TEM 1 20/20	0.000 15 12 18 0.5923-0.0252-0.0052-0.0001 0.3762 0.0078		
-0.0061			

TEM 2 17/20 0.000 15 12 41 0.4157 0.1130-0.0124-0.0005 0.6304-0.0027
 -0.0277
 TEM 2 18/20 0.000 15 12 42 0.4690 0.0597-0.0097-0.0002 0.5735 0.0065
 -0.0162
 TEM 2 19/20 0.000 15 12 42 0.5359 0.0041-0.0070-0.0002 0.4763 0.0084
 -0.0094
 TEM 2 20/20 0.000 15 12 42 0.5925-0.0253-0.0052-0.0001 0.3759 0.0079
 -0.0060

Iteration # 2
 ammu= 0.010

no. eigenvalue

1 4.0126
 2 2.8241
 3 1.1226
 4 0.3134
 5 0.0764
 6 0.0145
 7 0.0059

parameter increments

1 -0.0001
 2 -0.0002
 3 0.0001
 4 -0.0003
 5 0.0001
 6 -0.0002
 7 -0.0001

old parameter	log	new parameter	log
167.57	2.2242	167.53	2.2241
39.18	1.5931	39.16	1.5929
66.68	1.8240	66.69	1.8241
0.13	-0.8876	0.13	-0.8879
119.94	2.0790	119.97	2.0791
118.94	2.0753	118.89	2.0751
94.55	1.9757	94.53	1.9756

field data theoretical pct diff

TEM				
TEM 1	102.22	102.22	0.0	
TEM 2	122.57	122.57	0.0	
TEM 3	148.10	148.09	0.0	
TEM 4	174.34	174.32	0.0	
TEM 5	197.79	197.72	0.0	
TEM 6	205.37	205.42	0.0	
TEM 7	197.46	197.50	0.0	
TEM 8	178.64	178.59	0.0	
TEM 9	162.01	161.97	0.0	
TEM 10	154.41	154.45	0.0	
TEM 11	153.17	153.19	0.0	
TEM 12	158.33	158.33	0.0	
TEM 13	173.02	173.02	0.0	
TEM 14	194.89	194.89	0.0	
TEM 15	228.80	228.79	0.0	
TEM 16	276.07	276.07	0.0	
TEM 17	331.95	331.96	0.0	
TEM 18	408.88	408.89	0.0	
TEM 19	513.47	513.47	0.0	
TEM 20	618.33	618.31	0.0	

rcsq= 0.00000

ll norm= 0.00005

TEM 3 1/20 0.001 15 12 47 0.0339 0.0852 0.0167-0.3204 0.8306 0.7503
 0.6137
 TEM 3 2/20 0.001 15 12 49 0.0345 0.1196 0.0204-0.3213 0.8220 0.7145
 0.5926
 TEM 3 3/20 0.001 15 12 51 0.0464 0.1691 0.0269-0.3206 0.7909 0.6230
 0.5351
 TEM 3 4/20 0.001 15 12 53 0.0851 0.2904 0.0409-0.3132 0.7299 0.4392
 0.4154
 TEM 3 5/20 0.001 15 12 55 0.1652 0.5450 0.0647-0.2804 0.6141 0.0599
 0.1559
 TEM 3 6/20 0.001 15 12 57 0.2750 0.8924 0.0870-0.2200 0.4398-0.4668
 -0.2126
 TEM 3 7/20 0.001 15 12 59 0.3597 1.1357 0.1000-0.1506 0.3133-0.8515
 -0.4858
 TEM 3 8/20 0.000 15 13 0 0.3934 1.1857 0.0942-0.0908 0.2721-0.9727
 -0.5878
 TEM 3 9/20 0.000 15 13 1 0.3922 1.0933 0.0779-0.0497 0.3024-0.8941
 -0.5527
 TEM 3 10/20 0.001 15 13 3 0.3781 0.9605 0.0592-0.0297 0.3582-0.7523
 -0.4725
 TEM 3 11/20 0.000 15 13 4 0.3621 0.8176 0.0412-0.0176 0.4211-0.5966
 -0.3822
 TEM 3 12/20 0.000 15 13 4 0.3446 0.6533 0.0219-0.0114 0.4970-0.4164
 -0.2763

```

TEM 3 13/20 0.000 15 13 5 0.3366 0.5062 0.0054-0.0060 0.5639-0.2682
-0.1917
TEM 3 14/20 0.000 15 13 5 0.3374 0.3600-0.0058-0.0033 0.6138-0.1583
-0.1285
TEM 3 15/20 0.000 15 13 5 0.3503 0.2737-0.0124-0.0018 0.5850-0.0749
-0.0789
TEM 3 16/20 0.000 15 13 5 0.3780 0.1809-0.0138-0.0008 0.6534-0.0247
-0.0457
TEM 3 17/20 0.000 15 13 5 0.4159 0.1127-0.0124-0.0005 0.6304-0.0027
-0.0277
TEM 3 18/20 0.000 15 13 6 0.4691 0.0532-0.0097-0.0003 0.5733 0.0064
-0.0163
TEM 3 19/20 0.000 15 13 6 0.5362 0.0039-0.0069-0.0001 0.4761 0.0085
-0.0093
TEM 3 20/20 0.000 15 13 6 0.5927-0.0254-0.0053-0.0001 0.3756 0.0079
-0.0061

```

```

Iteration #      3
ammu=      0.010

```

```

no.      eigenvalue
1          4.0133
2          2.8196
3          1.1194
4          0.3136
5          0.0793
6          0.0146
7          0.0027
parameter increments
1          0.0000
2          0.0000
3          0.0000
4          0.0000
5          0.0000
6          0.0000
7          0.0000

```

old parameter	log	new parameter	log
167.53	2.2241	167.52	2.2241
39.16	1.5929	39.16	1.5929
66.69	1.8241	66.70	1.8241
0.13	-0.8879	0.13	-0.8880
119.97	2.0791	119.98	2.0791
118.89	2.0751	118.88	2.0751
94.53	1.9756	94.54	1.9756

	field data	theoretical	pct diff
TEM 1	102.22	102.23	0.0
TEM 2	122.57	122.58	0.0
TEM 3	148.10	148.10	0.0
TEM 4	174.34	174.32	0.0
TEM 5	197.79	197.73	0.0
TEM 6	205.37	205.43	0.0
TEM 7	197.46	197.51	0.0
TEM 8	178.64	178.59	0.0
TEM 9	162.01	161.97	0.0
TEM 10	154.41	154.45	0.0
TEM 11	153.17	153.19	0.0
TEM 12	158.33	158.33	0.0
TEM 13	173.02	173.02	0.0
TEM 14	194.89	194.88	0.0
TEM 15	228.80	228.79	0.0
TEM 16	276.07	276.07	0.0
TEM 17	331.95	331.96	0.0
TEM 18	408.88	408.89	0.0
TEM 19	513.47	513.47	0.0
TEM 20	618.33	618.31	0.0

```

resq= 0.00000
ll norm= 0.00005
TEM 4 1/20 0.001 15 13 11 0.0149 0.0792 0.0116-0.3328 0.8304 0.7457
0.6106
TEM 4 2/20 0.001 15 13 13 0.0357 0.1157 0.0238-0.3192 0.8240 0.7108
0.5985
TEM 4 3/20 0.001 15 13 15 0.0474 0.1657 0.0246-0.3242 0.7907 0.6258
0.5331
TEM 4 4/20 0.001 15 13 17 0.0858 0.2923 0.0435-0.3141 0.7368 0.4424
0.4168
TEM 4 5/20 0.001 15 13 19 0.1639 0.5440 0.0607-0.2882 0.6084 0.0592
0.1552
TEM 4 6/20 0.001 15 13 21 0.2765 0.8906 0.0885-0.2190 0.4392-0.4694
-0.2105
TEM 4 7/20 0.001 15 13 23 0.3597 1.1346 0.1001-0.1508 0.3144-0.8524
-0.4869
TEM 4 8/20 0.000 15 13 24 0.3929 1.1866 0.0952-0.0908 0.2725-0.9723
-0.5867

```

TEM 4 9/20 0.001 15 13 26 0.3915 1.0935 0.0778-0.0499 0.3023-0.8944
 -0.5533
 TEM 4 10/20 0.000 15 13 27 0.3778 0.9 0.0591-0.0299 0.3582-0.7520
 -0.4726
 TEM 4 11/20 0.000 15 13 28 0.3624 0.8177 0.0414-0.0176 0.4213-0.5963
 -0.3823
 TEM 4 12/20 0.000 15 13 28 0.3447 0.6539 0.0220-0.0113 0.4971-0.4164
 -0.2761
 TEM 4 13/20 0.000 15 13 29 0.3367 0.5063 0.0055-0.0061 0.5640-0.2682
 -0.1917
 TEM 4 14/20 0.000 15 13 29 0.3375 0.3846-0.0058-0.0033 0.6138-0.1583
 -0.1285
 TEM 4 15/20 0.000 15 13 29 0.3504 0.2737-0.0124-0.0018 0.5851-0.0748
 -0.0788
 TEM 4 16/20 0.000 15 13 29 0.3780 0.1808-0.0138-0.0008 0.6534-0.0247
 -0.0458
 TEM 4 17/20 0.000 15 13 29 0.4159 0.1127-0.0123-0.0005 0.6304-0.0027
 -0.0277
 TEM 4 18/20 0.000 15 13 30 0.4692 0.0533-0.0096-0.0002 0.5733 0.0065
 -0.0162
 TEM 4 19/20 0.000 15 13 30 0.5363 0.0039-0.0070-0.0001 0.4761 0.0085
 -0.0094
 TEM 4 20/20 0.000 15 13 30 0.5927-0.0255-0.0053-0.0001 0.3755 0.0079
 -0.0061

Iteration # 4
 ammu= 0.010

no. eigenvalue

1 4.0134
 2 2.8208
 3 1.1213
 4 0.3144
 5 0.0778
 6 0.0185
 7 0.0043

parameter increments

1 0.0000
 2 0.0000
 3 0.0000
 4 0.0000
 5 0.0000
 6 0.0000
 7 0.0000

old parameter	log	new parameter	log
167.52	2.2241	167.53	2.2241
39.16	1.5929	39.16	1.5929
66.70	1.8241	66.69	1.8241
0.13	-0.8880	0.13	-0.8880
119.98	2.0791	119.97	2.0791
118.88	2.0751	118.88	2.0751
94.54	1.9756	94.53	1.9756

field data theoretical pct diff

TEM 1	102.22	102.23	0.0
TEM 2	122.57	122.57	0.0
TEM 3	148.10	148.09	0.0
TEM 4	174.34	174.31	0.0
TEM 5	197.79	197.73	0.0
TEM 6	205.37	205.43	0.0
TEM 7	197.46	197.50	0.0
TEM 8	178.64	178.59	0.0
TEM 9	162.01	161.97	0.0
TEM 10	154.41	154.45	0.0
TEM 11	153.17	153.19	0.0
TEM 12	158.33	158.33	0.0
TEM 13	173.02	173.01	0.0
TEM 14	194.89	194.88	0.0
TEM 15	228.80	228.79	0.0
TEM 16	276.07	276.06	0.0
TEM 17	331.95	331.96	0.0
TEM 18	408.88	408.89	0.0
TEM 19	513.47	513.47	0.0
TEM 20	618.33	618.31	0.0

rcsq= 0.00000

ll norm= 0.00005

changing ammu and recalculating parameters

ammu= 0.020

parameter increments

1 0.0000
 2 0.0000
 3 0.0000
 4 0.0000
 5 0.0000

6 0.0000
7 0.0000

old parameter	log	new parameter	log
167.52	2.2241	167.52	2.2241
39.16	1.5929	39.16	1.5929
66.70	1.8241	66.70	1.8241
0.13	-0.8880	0.13	-0.8880
119.98	2.0791	119.97	2.0791
118.88	2.0751	118.88	2.0751
94.54	1.9756	94.54	1.9756

field data theoretical pct diff

TEM 1	102.22	102.23	0.0
TEM 2	122.57	122.57	0.0
TEM 3	148.10	148.09	0.0
TEM 4	174.34	174.31	0.0
TEM 5	197.79	197.73	0.0
TEM 6	205.37	205.43	0.0
TEM 7	197.46	197.51	0.0
TEM 8	178.64	178.59	0.0
TEM 9	162.01	161.97	0.0
TEM 10	154.41	154.45	0.0
TEM 11	153.17	153.19	0.0
TEM 12	158.33	158.33	0.0
TEM 13	173.02	173.01	0.0
TEM 14	194.89	194.88	0.0
TEM 15	228.80	228.79	0.0
TEM 16	276.07	276.06	0.0
TEM 17	331.95	331.96	0.0
TEM 18	408.88	408.89	0.0
TEM 19	513.47	513.47	0.0
TEM 20	618.33	618.31	0.0

rcsq= 0.00000

ll norm= 0.00005

changing ammu and recalculating parameters

ammu= 0.040

parameter increments

1	0.0000
2	0.0000
3	0.0000
4	0.0000
5	0.0000
6	0.0000
7	0.0000

old parameter	log	new parameter	log
167.52	2.2241	167.52	2.2241
39.16	1.5929	39.16	1.5929
66.70	1.8241	66.70	1.8241
0.13	-0.8880	0.13	-0.8880
119.98	2.0791	119.97	2.0791
118.88	2.0751	118.88	2.0751
94.54	1.9756	94.54	1.9756

field data theoretical pct diff

TEM 1	102.22	102.23	0.0
TEM 2	122.57	122.57	0.0
TEM 3	148.10	148.09	0.0
TEM 4	174.34	174.32	0.0
TEM 5	197.79	197.72	0.0
TEM 6	205.37	205.43	0.0
TEM 7	197.46	197.51	0.0
TEM 8	178.64	178.59	0.0
TEM 9	162.01	161.97	0.0
TEM 10	154.41	154.45	0.0
TEM 11	153.17	153.19	0.0
TEM 12	158.33	158.33	0.0
TEM 13	173.02	173.01	0.0
TEM 14	194.89	194.88	0.0
TEM 15	228.80	228.79	0.0
TEM 16	276.07	276.06	0.0
TEM 17	331.95	331.96	0.0
TEM 18	408.88	408.89	0.0
TEM 19	513.47	513.47	0.0
TEM 20	618.33	618.31	0.0

rcsq= 0.00000

ll norm= 0.00005

changing ammu and recalculating parameters

ammu= 0.080

parameter increments

1	0.0000
2	0.0000
3	0.0000

4	0.0000
5	0.0000
6	0.0000
7	0.0000

old parameter	log	new parameter	log
167.52	2.2241	167.52	2.2241
39.16	1.5929	39.16	1.5929
66.70	1.8241	66.70	1.8241
0.13	-0.8880	0.13	-0.8880
119.98	2.0791	119.97	2.0791
118.88	2.0751	118.88	2.0751
94.54	1.9756	94.54	1.9756

	field data	theoretical	pct diff
TEM 1	102.22	102.23	0.0
TEM 2	122.57	122.57	0.0
TEM 3	148.10	148.09	0.0
TEM 4	174.34	174.32	0.0
TEM 5	197.79	197.72	0.0
TEM 6	205.37	205.43	0.0
TEM 7	197.46	197.50	0.0
TEM 8	178.64	178.59	0.0
TEM 9	162.01	161.97	0.0
TEM 10	154.41	154.45	0.0
TEM 11	153.17	153.19	0.0
TEM 12	158.33	158.33	0.0
TEM 13	173.02	173.01	0.0
TEM 14	194.89	194.88	0.0
TEM 15	228.80	228.79	0.0
TEM 16	276.07	276.06	0.0
TEM 17	331.95	331.96	0.0
TEM 18	408.88	408.89	0.0
TEM 19	513.47	513.47	0.0
TEM 20	618.33	618.31	0.0

```

rscsq= 0.00000
ll norm= 0.00005
TEM 5 1/20 0.001 15 13 44 0.0252 0.0862 0.0168-0.3237 0.8362 0.7465
0.6148
TEM 5 2/20 0.001 15 13 46 0.0362 0.1200 0.0232-0.3168 0.8258 0.7181
0.6034
TEM 5 3/20 0.001 15 13 48 0.0455 0.1696 0.0246-0.3258 0.7957 0.6279
0.5398
TEM 5 4/20 0.001 15 13 50 0.0826 0.2910 0.0374-0.3170 0.7307 0.4370
0.4113
TEM 5 5/20 0.001 15 13 52 0.1645 0.5463 0.0615-0.2846 0.6098 0.0619
0.1538
TEM 5 6/20 0.001 15 13 54 0.2773 0.8907 0.0877-0.2189 0.4389-0.4677
-0.2114
TEM 5 7/20 0.001 15 13 56 0.3609 1.1360 0.1011-0.1496 0.3141-0.8506
-0.4866
TEM 5 8/20 0.000 15 13 57 0.3945 1.1876 0.0948-0.0905 0.2726-0.9719
-0.5862
TEM 5 9/20 0.001 15 13 59 0.3918 1.0934 0.0773-0.0505 0.3023-0.8945
-0.5533
TEM 5 10/20 0.000 15 14 0 0.3780 0.9606 0.0595-0.0295 0.3583-0.7519
-0.4724
TEM 5 11/20 0.000 15 14 1 0.3624 0.8177 0.0413-0.0178 0.4215-0.5965
-0.3822
TEM 5 12/20 0.000 15 14 2 0.3448 0.6538 0.0220-0.0113 0.4972-0.4165
-0.2761
TEM 5 13/20 0.000 15 14 2 0.3366 0.5061 0.0053-0.0061 0.5638-0.2683
-0.1917
TEM 5 14/20 0.000 15 14 2 0.3374 0.3846-0.0057-0.0034 0.6137-0.1583
-0.1286
TEM 5 15/20 0.000 15 14 2 0.3504 0.2736-0.0124-0.0017 0.5850-0.0748
-0.0789
TEM 5 16/20 0.000 15 14 2 0.3781 0.1809-0.0138-0.0009 0.6534-0.0247
-0.0458
TEM 5 17/20 0.000 15 14 3 0.4160 0.1127-0.0123-0.0004 0.6304-0.0026
-0.0277
TEM 5 18/20 0.000 15 14 3 0.4691 0.0533-0.0097-0.0003 0.5733 0.0064
-0.0162
TEM 5 19/20 0.000 15 14 3 0.5362 0.0039-0.0070-0.0002 0.4761 0.0085
-0.0094
TEM 5 20/20 0.000 15 14 3 0.5928-0.0254-0.0053-0.0001 0.3756 0.0079
-0.0060

```

```

Iteration #      5
ammu= 0.040

```

no.	eigenvalue
1	4.0139
2	2.8265
3	1.1217

4	0.3142
5	0.0792
6	0.0167
7	0.0040
parameter increments	
1	0.0000
2	0.0000
3	0.0000
4	0.0000
5	0.0000
6	0.0000
7	0.0000

old parameter	log	new parameter	log
167.52	2.2241	167.52	2.2241
39.16	1.5929	39.16	1.5929
66.70	1.8241	66.70	1.8241
0.13	-0.8880	0.13	-0.8880
119.97	2.0791	119.97	2.0791
118.88	2.0751	118.88	2.0751
94.54	1.9756	94.54	1.9756

	field data	theoretical	pct diff
TEM 1	102.22	102.23	0.0
TEM 2	122.57	122.57	0.0
TEM 3	148.10	148.09	0.0
TEM 4	174.34	174.31	0.0
TEM 5	197.79	197.73	0.0
TEM 6	205.37	205.43	0.0
TEM 7	197.46	197.51	0.0
TEM 8	178.64	178.59	0.0
TEM 9	162.01	161.97	0.0
TEM 10	154.41	154.45	0.0
TEM 11	153.17	153.19	0.0
TEM 12	158.33	158.33	0.0
TEM 13	173.02	173.01	0.0
TEM 14	194.89	194.88	0.0
TEM 15	228.80	228.79	0.0
TEM 16	276.07	276.06	0.0
TEM 17	331.95	331.96	0.0
TEM 18	408.88	408.89	0.0
TEM 19	513.47	513.47	0.0
TEM 20	618.33	618.31	0.0

rcsq= 0.00000
 ll norm= 0.00005
 changing ammu and recalculating parameters
 ammu= 0.080

parameter increments	
1	0.0000
2	0.0000
3	0.0000
4	0.0000
5	0.0000
6	0.0000
7	0.0000

old parameter	log	new parameter	log
167.52	2.2241	167.52	2.2241
39.16	1.5929	39.16	1.5929
66.70	1.8241	66.70	1.8241
0.13	-0.8880	0.13	-0.8880
119.97	2.0791	119.98	2.0791
118.88	2.0751	118.88	2.0751
94.54	1.9756	94.54	1.9756

	field data	theoretical	pct diff
TEM 1	102.22	102.23	0.0
TEM 2	122.57	122.58	0.0
TEM 3	148.10	148.09	0.0
TEM 4	174.34	174.32	0.0
TEM 5	197.79	197.72	0.0
TEM 6	205.37	205.43	0.0
TEM 7	197.46	197.51	0.0
TEM 8	178.64	178.59	0.0
TEM 9	162.01	161.97	0.0
TEM 10	154.41	154.45	0.0
TEM 11	153.17	153.19	0.0
TEM 12	158.33	158.33	0.0
TEM 13	173.02	173.02	0.0
TEM 14	194.89	194.88	0.0
TEM 15	228.80	228.79	0.0
TEM 16	276.07	276.06	0.0
TEM 17	331.95	331.96	0.0
TEM 18	408.88	408.89	0.0

```

TEM 19 .    513.47    513.47    0.0
TEM 20      618.33    618.31    0
rcsq=    0.00000
ll norm=    0.00005
divergence has occurred!! ammu=    0.16000000

```

***** statistics *****

NSR= 4.09698026E-04

undamped 95% confidence intervals

```

parameter, high p, low p
167.52177429    169.26853943    165.79302979
39.16077423     41.50253296     36.95115280
66.69568634    2.17788576E+08    2.04249154E-05
0.12943162     0.17412481    9.62099805E-02
119.97495270    122.62989807    117.37749481
118.87535858    5564.39404297    2.53960299
94.53546143    17473.58593750    0.51145506

```

```

v-matrix
-0.3260 0.1523-0.6531 0.6196-0.2399 0.0501 0.0094
-0.6713 0.0223 0.5674 0.0524-0.4660 0.0740 0.0405
-0.0436 0.0022 0.0967 0.1813 0.1850-0.5365 0.7961
0.0611-0.2020-0.3568-0.5143-0.6451-0.3795 0.0585
-0.3866 0.7082-0.1996-0.4723 0.2792-0.0887-0.0160
0.4592 0.5171 0.1000 0.0204-0.4095 0.4337 0.3944
0.2779 0.4080 0.2551 0.3042-0.1711-0.6035-0.4530

```

```

1.0000 0.9998 0.9933 0.4784 0.0037 0.0000 0.0000

```

final result:

field	model	pct diff	time window
102.2	102.2	0.0	7.1600
122.6	122.6	0.0	5.6670
148.1	148.1	0.0	4.4600
174.3	174.3	0.0	3.5700
197.8	197.7	0.0	2.8200
205.4	205.4	0.0	2.2100
197.5	197.5	0.0	1.7720
178.6	178.6	0.0	1.4000
162.0	162.0	0.0	1.0870
154.4	154.4	0.0	0.8760
153.2	153.2	0.0	0.7120
158.3	158.3	0.0	0.5630
173.0	173.0	0.0	0.4430
194.9	194.9	0.0	0.3550
228.8	228.8	0.0	0.2800
276.1	276.1	0.0	0.2200
332.0	332.0	0.0	0.1770
408.9	408.9	0.0	0.1400
513.5	513.5	0.0	0.1090
618.3	618.3	0.0	0.0890

final parameters

layer	1	resistivity=	167.52177429
layer	2	resistivity=	39.16077423
layer	3	resistivity=	66.69568634
layer	4	resistivity=	0.12943162
layer	1	thickness=	119.97495270
layer	2	thickness=	118.87535858
layer	3	thickness=	94.53546143

} Final Solution

```

rcsq=    0.00000 ll=    0.00005 iterations completed= 4
time at end= 15 14 9

```

Appendix 5

GUESS MODEL USED FOR INVERSION

guess.out		guess.plt							
7	1	1	0	20	10	0	0		
0.0040	0.010								
2.	3.			1.		4.	5.	6.	
155.60	35.00	69.40				0.20	← resistivities (ohm-m)		
116.90	121.10	97.00				← thicknesses (m)			
0	0	0	0	0	0				
7.16000	0.319574E-03	250.		0.288E+03	300.	1000.			
5.66700	0.436712E-03	250.		0.288E+03	300.	1000.			
4.46000	0.598420E-03	250.		0.288E+03	300.	1000.			
3.57000	0.817349E-03	250.		0.288E+03	300.	1000.			
2.82000	0.121965E-02	250.		0.288E+03	300.	1000.			
2.21000	0.212024E-02	250.		0.288E+03	300.	1000.			
1.77200	0.390656E-02	250.		0.288E+03	300.	1000.			
1.40000	0.818210E-02	250.		0.288E+03	300.	1000.			
1.08700	0.178357E-01	250.		0.288E+03	300.	1000.			
0.87600	0.328750E-01	250.		0.288E+03	300.	1000.			
0.71200	0.558722E-01	250.		0.288E+03	300.	1000.			
0.56300	0.956178E-01	250.		0.288E+03	300.	1000.			
0.44300	0.152407E+00	250.		0.288E+03	300.	1000.			
0.35500	0.221766E+00	250.		0.288E+03	300.	1000.			
0.28000	0.315567E+00	250.		0.288E+03	300.	1000.			
0.22000	0.435107E+00	250.		0.288E+03	300.	1000.			
0.17700	0.568373E+00	250.		0.288E+03	300.	1000.			
0.14000	0.747266E+00	250.		0.288E+03	300.	1000.			
0.10900	0.992805E+00	250.		0.288E+03	300.	1000.			
0.08900	0.124710E+01	250.		0.288E+03	300.	1000.			

Appendix 6

```

      *
    * *
  * * *
 * * *
* * * *
* EINVRT6 *
* * * *
*****

```

written by:
Stewart Sandberg

ver. 6.01 - 8/21/98

todays date is 7 8 1999
time at beginning= 14 49 24
input filename= guess.mod

initial guess results

	field data	theoretical	pct diff
TEM 1	102.22	88.63	13.3
TEM 2	122.57	105.63	13.8
TEM 3	148.10	126.22	14.8
TEM 4	174.34	145.72	16.4
TEM 5	197.79	160.22	19.0
TEM 6	205.37	161.73	21.2
TEM 7	197.46	154.19	21.9
TEM 8	178.64	141.83	20.6
TEM 9	162.01	132.52	18.2
TEM 10	154.41	129.81	15.9
TEM 11	153.17	130.89	14.5
TEM 12	158.33	139.82	11.7
TEM 13	173.02	156.04	9.8
TEM 14	194.89	178.57	8.4
TEM 15	228.80	212.38	7.2
TEM 16	276.07	258.70	6.3
TEM 17	331.95	312.91	5.7
TEM 18	408.88	387.11	5.3
TEM 19	513.47	487.89	5.0
TEM 20	618.33	588.16	4.9
rscsq=	0.00677		
ll norm=	0.05992		
time to do complete forward=	8.32926424E-04	hours	
TEM 1 1/20	0.001 14 49 29 0.0239 0.1099 0.0229-0.3152 0.8022 0.7348		
0.6211			
TEM 1 2/20	0.001 14 49 31 0.0383 0.1465 0.0221-0.3186 0.7852 0.6780		
0.5878			
TEM 1 3/20	0.001 14 49 33 0.0622 0.2316 0.0351-0.3131 0.7464 0.5547		
0.5082			
TEM 1 4/20	0.001 14 49 35 0.1068 0.3927 0.0485-0.2998 0.6750 0.3093		
0.3503			
TEM 1 5/20	0.001 14 49 37 0.1832 0.6747 0.0671-0.2595 0.5473-0.1078		
0.0689			
TEM 1 6/20	0.001 14 49 39 0.2781 0.9741 0.0823-0.1940 0.4073-0.5766		
-0.2551			
TEM 1 7/20	0.000 14 49 40 0.3344 1.1372 0.0833-0.1318 0.3248-0.8468		
-0.4526			
TEM 1 8/20	0.001 14 49 42 0.3532 1.1327 0.0748-0.0796 0.3155-0.8896		
-0.5047			
TEM 1 9/20	0.000 14 49 43 0.3483 1.0160 0.0575-0.0439 0.3573-0.7817		
-0.4578			
TEM 1 10/20	0.001 14 49 45 0.3371 0.8801 0.0415-0.0264 0.4145-0.6382		
-0.3831			
TEM 1 11/20	0.000 14 49 45 0.3214 0.7322 0.0262-0.0176 0.4791-0.4745		
-0.2932			
TEM 1 12/20	0.000 14 49 45 0.3126 0.5841 0.0107-0.0097 0.5462-0.3231		
-0.2143			
TEM 1 13/20	0.000 14 49 45 0.3096 0.4438-0.0020-0.0052 0.6072-0.1893		
-0.1444			
TEM 1 14/20	0.000 14 49 46 0.3154 0.3300-0.0096-0.0029 0.6501-0.0951		
-0.0938			
TEM 1 15/20	0.000 14 49 46 0.3340 0.2283-0.0130-0.0015 0.6751-0.0293		
-0.0554			
TEM 1 16/20	0.000 14 49 46 0.3668 0.1446-0.0125-0.0008 0.6713 0.0048		
-0.0311			
TEM 1 17/20	0.000 14 49 46 0.4086 0.0837-0.0103-0.0004 0.6399 0.0159		
-0.0183			
TEM 1 18/20	0.000 14 49 46 0.4652 0.0304-0.0077-0.0002 0.5739 0.0173		
-0.0104			
TEM 1 19/20	0.000 14 49 47 0.5349-0.0135-0.0054-0.0001 0.4683 0.0147		
-0.0058			
TEM 1 20/20	0.000 14 49 47 0.5917-0.0394-0.0040-0.0001 0.3611 0.0120		
-0.0037			

Iteration # 1
 ammu= 0.010

no. eigenvalue

1	3.8602
2	2.6612
3	1.1680
4	0.3582
5	0.0825
6	0.0147
7	0.0048

parameter increments	
1	0.0363
2	0.0681
3	0.0316
4	-0.1017
5	0.0099
6	-0.0218
7	0.0456

old parameter	log	new parameter	log
155.60	2.1920	169.16	2.2283
35.00	1.5441	40.94	1.6122
69.40	1.8414	74.63	1.8729
0.20	-0.6990	0.16	-0.8006
116.90	2.0678	119.60	2.0777
121.10	2.0831	115.18	2.0614
97.00	1.9868	107.75	2.0324

field data theoretical pct diff

TEM 1	102.22	102.35	-0.1
TEM 2	122.57	122.66	-0.1
TEM 3	148.10	148.06	0.0
TEM 4	174.34	174.03	0.2
TEM 5	197.79	197.02	0.4
TEM 6	205.37	204.57	0.4
TEM 7	197.46	196.96	0.3
TEM 8	178.64	178.78	-0.1
TEM 9	162.01	162.75	-0.5
TEM 10	154.41	155.50	-0.7
TEM 11	153.17	154.35	-0.8
TEM 12	158.33	159.42	-0.7
TEM 13	173.02	174.11	-0.6
TEM 14	194.89	195.85	-0.5
TEM 15	228.80	229.47	-0.3
TEM 16	276.07	276.74	-0.2
TEM 17	331.95	332.56	-0.2
TEM 18	408.88	409.49	-0.1
TEM 19	513.47	514.21	-0.1
TEM 20	618.33	619.34	-0.2

rcsq= 0.00000
 ll norm= 0.00139

TEM 2 1/20	0.001 14 49 52 0.0240 0.0728 0.0093-0.3296 0.8010 0.7014
0.6861	
TEM 2 2/20	0.001 14 49 54 0.0391 0.1075 0.0212-0.3231 0.7958 0.6661
0.6644	
TEM 2 3/20	0.001 14 49 56 0.0530 0.1718 0.0350-0.3173 0.7718 0.5888
0.6044	
TEM 2 4/20	0.001 14 49 58 0.0938 0.2939 0.0526-0.3117 0.7084 0.4048
0.4683	
TEM 2 5/20	0.001 14 50 0 0.1693 0.5414 0.0768-0.2801 0.5848 0.0495
0.1900	
TEM 2 6/20	0.001 14 50 2 0.2750 0.8710 0.1026-0.2158 0.4186-0.4448
-0.1951	
TEM 2 7/20	0.001 14 50 4 0.3611 1.1022 0.1175-0.1495 0.2973-0.7965
-0.4852	
TEM 2 8/20	0.000 14 50 5 0.3931 1.1513 0.1112-0.0908 0.2567-0.9093
-0.5935	
TEM 2 9/20	0.001 14 50 7 0.3926 1.0654 0.0923-0.0498 0.2868-0.8370
-0.5621	
TEM 2 10/20	0.000 14 50 8 0.3793 0.9408 0.0717-0.0297 0.3419-0.7056
-0.4816	
TEM 2 11/20	0.000 14 50 9 0.3636 0.8056 0.0509-0.0179 0.4041-0.5608
-0.3905	
TEM 2 12/20	0.000 14 50 9 0.3460 0.6490 0.0283-0.0113 0.4789-0.3917
-0.2828	
TEM 2 13/20	0.000 14 50 10 0.3380 0.5080 0.0086-0.0063 0.5465-0.2514
-0.1969	
TEM 2 14/20	0.000 14 50 10 0.3383 0.3902-0.0049-0.0035 0.5976-0.1456
-0.1326	
TEM 2 15/20	0.000 14 50 10 0.3301 0.2811-0.0134-0.0017 0.6332 0.0610
-0.0815	
TEM 2 16/20	0.000 14 50 10 0.3372 0.1889-0.0160-0.0010 0.6426 0.0118
-0.0476	

TEM 2 17/20 0.000 14 50 11 0.4140 0.1204-0.0148-0.0005 0.6227 0.0067
 --0.0288
 TEM 2 18/20 0.000 14 50 11 0.4665 0.0611-0.0118-0.0002 0.5694 0.0147
 -0.0169
 TEM 2 19/20 0.000 14 50 11 0.5323 0.0097-0.0087-0.0002 0.4764 0.0148
 -0.0098
 TEM 2 20/20 0.000 14 50 11 0.5881-0.0206-0.0066-0.0001 0.3795 0.0129
 -0.0064

Iteration # 2
 ammu= 0.010

no. eigenvalue

1 3.9131
 2 2.8002
 3 1.1194
 4 0.3217
 5 0.0750
 6 0.0171
 7 0.0105

parameter increments

1 -0.0082
 2 -0.0240
 3 0.0151
 4 -0.0409
 5 0.0094
 6 -0.0198
 7 -0.0077

old parameter	log	new parameter	log
169.16	2.2283	166.00	2.2201
40.94	1.6122	38.74	1.5882
74.63	1.8729	77.28	1.8881
0.16	-0.8006	0.14	-0.8415
119.60	2.0777	122.22	2.0871
115.18	2.0614	110.04	2.0416
107.75	2.0324	105.84	2.0247

field data theoretical pct diff

TEM 1	102.22	102.33	-0.1
TEM 2	122.57	122.68	-0.1
TEM 3	148.10	148.21	-0.1
TEM 4	174.34	174.38	0.0
TEM 5	197.79	197.65	0.1
TEM 6	205.37	205.23	0.1
TEM 7	197.46	197.33	0.1
TEM 8	178.64	178.63	0.0
TEM 9	162.01	162.18	-0.1
TEM 10	154.41	154.72	-0.2
TEM 11	153.17	153.44	-0.2
TEM 12	158.33	158.42	-0.1
TEM 13	173.02	173.08	0.0
TEM 14	194.89	194.87	0.0
TEM 15	228.80	228.64	0.1
TEM 16	276.07	276.20	0.0
TEM 17	331.95	332.32	-0.1
TEM 18	408.88	409.41	-0.1
TEM 19	513.47	513.73	-0.1
TEM 20	618.33	617.81	0.1

rcsq= 0.00000

ll norm= 0.00035

TEM 3 1/20 0.001 14 50 16 0.0204 0.0816 0.0150-0.3167 0.8339 0.6809
 0.6903
 TEM 3 2/20 0.001 14 50 18 0.0439 0.1109 0.0247-0.3192 0.8284 0.6487
 0.6632
 TEM 3 3/20 0.001 14 50 20 0.0552 0.1673 0.0299-0.3150 0.8013 0.5657
 0.6059
 TEM 3 4/20 0.001 14 50 22 0.0915 0.2905 0.0484-0.3130 0.7340 0.3881
 0.4711
 TEM 3 5/20 0.001 14 50 24 0.1747 0.5342 0.0709-0.2837 0.6084 0.0218
 0.1909
 TEM 3 6/20 0.001 14 50 26 0.2869 0.8705 0.0983-0.2198 0.4323-0.4673
 -0.1999
 TEM 3 7/20 0.001 14 50 28 0.3759 1.1039 0.1122-0.1502 0.3031-0.8237
 -0.4923
 TEM 3 8/20 0.000 14 50 29 0.4081 1.1551 0.1053-0.0907 0.2621-0.9339
 -0.6018
 TEM 3 9/20 0.001 14 50 31 0.4060 1.0655 0.0870-0.0502 0.2930-0.8584
 -0.5705
 TEM 3 10/20 0.000 14 50 32 0.3913 0.9381 0.0685-0.0293 0.3508-0.7226
 -0.4892
 TEM 3 11/20 0.000 14 50 33 0.3741 0.7998 0.0488-0.0177 0.4149-0.5744
 -0.3976
 TEM 3 12/20 0.000 14 50 34 0.3555 0.6403 0.0277-0.0113 0.4922-0.3391
 -0.2893

TEM 3 13/20 0.000 14 50 34 0.3462 0.4953 0.0091-0.0062 0.5619-0.2583
 -0.2032
 TEM 3 14/20 0.000 14 50 34 0.3458 0.3762-0.0040-0.0035 0.6142-0.1491
 -0.1381
 TEM 3 15/20 0.000 14 50 34 0.3575 0.2648-0.0125-0.0018 0.6493-0.0643
 -0.0860
 TEM 3 16/20 0.000 14 50 34 0.3856 0.1715-0.0151-0.0010 0.6557-0.0125
 -0.0508
 TEM 3 17/20 0.000 14 50 35 0.4248 0.1030-0.0141-0.0005 0.6300 0.0101
 -0.0311
 TEM 3 18/20 0.000 14 50 35 0.4806 0.0439-0.0114-0.0003 0.5674 0.0179
 -0.0184
 TEM 3 19/20 0.000 14 50 35 0.5502-0.0039-0.0085-0.0002 0.4629 0.0176
 -0.0107
 TEM 3 20/20 0.000 14 50 35 0.6078-0.0314-0.0065-0.0001 0.3578 0.0151
 -0.0070

Iteration # 3
 ammu= 0.010

no. eigenvalue

1 3.9488
 2 2.8298
 3 1.1401
 4 0.3461
 5 0.0921
 6 0.0347
 7 0.0089

parameter increments

1 -0.0004
 2 -0.0024
 3 0.0021
 4 -0.0079
 5 0.0002
 6 0.0019
 7 -0.0061

old parameter	log	new parameter	log
166.00	2.2201	165.83	2.2197
38.74	1.5882	38.53	1.5858
77.28	1.8881	77.66	1.8902
0.14	-0.8415	0.14	-0.8494
122.22	2.0871	122.28	2.0874
110.04	2.0416	110.53	2.0435
105.84	2.0247	104.37	2.0186

field data theoretical pct diff

TEM	field data	theoretical	pct diff
TEM 1	102.22	102.27	0.0
TEM 2	122.57	122.62	0.0
TEM 3	148.10	148.16	0.0
TEM 4	174.34	174.35	0.0
TEM 5	197.79	197.66	0.1
TEM 6	205.37	205.27	0.0
TEM 7	197.46	197.35	0.1
TEM 8	178.64	178.58	0.0
TEM 9	162.01	162.08	0.0
TEM 10	154.41	154.58	-0.1
TEM 11	153.17	153.28	-0.1
TEM 12	158.33	158.35	0.0
TEM 13	173.02	172.92	0.1
TEM 14	194.89	194.71	0.1
TEM 15	228.80	228.51	0.1
TEM 16	276.07	276.09	0.0
TEM 17	331.95	332.23	-0.1
TEM 18	408.88	409.35	-0.1
TEM 19	513.47	513.67	0.0
TEM 20	618.33	617.73	0.1

rcsq= 0.00000

ll norm= 0.00026

TEM 4 1/20 0.001 14 50 40 0.0234 0.0808 0.0142-0.3209 0.8435 0.6866
 0.6770
 TEM 4 2/20 0.001 14 50 42 0.0397 0.1135 0.0280-0.3214 0.8339 0.6544
 0.6552
 TEM 4 3/20 0.001 14 50 44 0.0517 0.1671 0.0256-0.3251 0.7951 0.5662
 0.5924
 TEM 4 4/20 0.001 14 50 46 0.0924 0.2882 0.0436-0.3112 0.7404 0.3948
 0.4655
 TEM 4 5/20 0.001 14 50 48 0.1747 0.5370 0.0656-0.2826 0.6097 0.0280
 0.1895
 TEM 4 6/20 0.001 14 50 50 0.2875 0.8746 0.0932-0.2156 0.4345-0.4719
 -0.1985
 TEM 4 7/20 0.001 14 50 52 0.3744 1.1091 0.1081-0.1508 0.3042-0.8319
 -0.4892
 TEM 4 8/20 0.001 14 50 53 0.4084 1.1602 0.1011-0.0896 0.2646-0.9425
 -0.5990

TEM 4 9/20 0.001 14 50 55 0.4059 1.0706 0.0847-0.0495 0.2952-0.8658
 -0.5671
 TEM 4 10/20 0.000 14 50 56 0.3913 0.9112 0.0656-0.0297 0.3524-0.7292
 -0.4860
 TEM 4 11/20 0.001 14 50 58 0.3745 0.8022 0.0469-0.0177 0.4167-0.5798
 -0.3957
 TEM 4 12/20 0.000 14 50 58 0.2925 0.5788 0.0264-0.0116 0.4316-0.4060
 -0.2881
 TEM 4 13/20 0.000 14 50 58 0.3459 0.4964 0.0085-0.0063 0.5640-0.2605
 -0.2025
 TEM 4 14/20 0.000 14 50 58 0.3455 0.3755-0.0040-0.0035 0.6162-0.1505
 -0.1377
 TEM 4 15/20 0.000 14 50 58 0.3574 0.2636-0.0120-0.0018 0.6512-0.0024
 -0.0234
 TEM 4 16/20 0.000 14 50 59 0.3855 0.1702-0.0147-0.0010 0.6573-0.0129
 -0.0508
 TEM 4 17/20 0.000 14 50 59 0.4248 0.1016-0.0137-0.0005 0.6312 0.0097
 -0.0312
 TEM 4 18/20 0.000 14 50 59 0.4809 0.0428-0.0110-0.0002 0.5680 0.0176
 -0.0184
 TEM 4 19/20 0.000 14 50 59 0.5507-0.0049-0.0081-0.0002 0.4629 0.0172
 -0.0107
 TEM 4 20/20 0.000 14 50 59 0.6084-0.0322-0.0062-0.0001 0.3573 0.0148
 -0.0070

Iteration # 4
 ammu= 0.010

no. eigenvalue

1 3.9404
 2 2.8411
 3 1.1366
 4 0.3425
 5 0.0776
 6 0.0137
 7 0.0085

parameter increments

1 0.0006
 2 0.0010
 3 -0.0008
 4 0.0005
 5 -0.0007
 6 0.0012
 7 -0.0002

old parameter	log	new parameter	log
165.83	2.2197	166.05	2.2202
38.53	1.5858	38.61	1.5868
77.66	1.8902	77.52	1.8894
0.14	-0.8494	0.14	-0.8489
122.28	2.0874	122.08	2.0867
110.53	2.0435	110.83	2.0447
104.37	2.0186	104.32	2.0184

field data theoretical pct diff

TEM		field data	theoretical	pct diff
TEM 1		102.22	102.26	0.0
TEM 2		122.57	122.61	0.0
TEM 3		148.10	148.14	0.0
TEM 4		174.34	174.34	0.0
TEM 5		197.79	197.64	0.1
TEM 6		205.37	205.27	0.0
TEM 7		197.46	197.37	0.0
TEM 8		178.64	178.60	0.0
TEM 9		162.01	162.10	-0.1
TEM 10		154.41	154.60	-0.1
TEM 11		153.17	153.30	-0.1
TEM 12		158.33	158.36	0.0
TEM 13		173.02	172.92	0.1
TEM 14		194.89	194.70	0.1
TEM 15		228.80	228.48	0.1
TEM 16		276.07	276.04	0.0
TEM 17		331.95	332.17	-0.1
TEM 18		408.88	409.29	-0.1
TEM 19		513.47	513.68	0.0
TEM 20		618.33	617.85	0.1

rcsq= 0.00000

ll norm= 0.00025

TEM 5 1/20 0.001 14 51 5 0.0231 0.0840 0.0137-0.3173 0.8414 0.6890
 0.6814
 TEM 5 2/20 0.001 14 51 7 0.0359 0.1084 0.0253-0.3181 0.8307 0.6539
 0.6640
 TEM 5 3/20 0.001 14 51 9 0.0426 0.1644 0.0287-0.3268 0.7961 0.5676
 0.5917
 TEM 5 4/20 0.001 14 51 11 0.0910 0.2927 0.0451-0.3095 0.7405 0.3974
 0.4692

```

TEM 5 5/20 0.001 14 51 13 0.1782 0.5366 0.0710-0.2789 0.6128 0.0319
0.1904
TEM 5 6/20 0.001 14 51 15 0.2891 0.8799 0.0948-0.2189 0.4332-0.4702
-0.1975
TEM 5 7/20 0.000 14 51 16 0.3726 1.1095 0.1058-0.1500 0.3046-0.8323
-0.4889
TEM 5 8/20 0.001 14 51 18 0.4061 1.1622 0.1026-0.0901 0.2648-0.9429
-0.5976
TEM 5 9/20 0.000 14 51 19 0.4051 1.0716 0.0842-0.0501 0.2947-0.8664
-0.5673
TEM 5 10/20 0.000 14 51 20 0.3901 0.9423 0.0658-0.0296 0.3520-0.7294
-0.4860
TEM 5 11/20 0.001 14 51 22 0.3732 0.8032 0.0468-0.0179 0.4163-0.5801
-0.3955
TEM 5 12/20 0.000 14 51 22 0.2920 0.5800 0.0265-0.0114 0.4312-0.4061
-0.2877
TEM 5 13/20 0.000 14 51 22 0.3453 0.4976 0.0086-0.0062 0.5634-0.2608
-0.2023
TEM 5 14/20 0.000 14 51 22 0.3448 0.3766-0.0040-0.0035 0.6156-0.1507
-0.1376
TEM 5 15/20 0.000 14 51 23 0.3566 0.2649-0.0120-0.0018 0.6508-0.0026
-0.0232
TEM 5 16/20 0.000 14 51 23 0.3845 0.1713-0.0147-0.0009 0.6571-0.0131
-0.0508
TEM 5 17/20 0.000 14 51 23 0.4237 0.1028-0.0136-0.0005 0.6314 0.0095
-0.0311
TEM 5 18/20 0.000 14 51 23 0.4793 0.0437-0.0111-0.0004 0.5688 0.0173
-0.0185
TEM 5 19/20 0.000 14 51 23 0.5491-0.0041-0.0081-0.0002 0.4645 0.0170
-0.0107
TEM 5 20/20 0.000 14 51 24 0.6067-0.0316-0.0061-0.0001 0.3594 0.0147
-0.0070

```

```

Iteration #      5
ammu=      0.010

```

```

no.      eigenvalue
1          3.9418
2          2.8437
3          1.1369
4          0.3411
5          0.0781
6          0.0160
7          0.0080
parameter increments
1          0.0002
2          0.0005
3          -0.0007
4          -0.0002
5          -0.0003
6          0.0011
7          -0.0008

```

old parameter	log	new parameter	log
166.05	2.2202	166.13	2.2204
38.61	1.5868	38.66	1.5872
77.52	1.8894	77.40	1.8887
0.14	-0.8489	0.14	-0.8491
122.08	2.0867	122.00	2.0863
110.83	2.0447	111.11	2.0457
104.32	2.0184	104.12	2.0175

	field data	theoretical	pct diff
TEM 1	102.22	102.26	0.0
TEM 2	122.57	122.62	0.0
TEM 3	148.10	148.13	0.0
TEM 4	174.34	174.34	0.0
TEM 5	197.79	197.65	0.1
TEM 6	205.37	205.27	0.0
TEM 7	197.46	197.36	0.1
TEM 8	178.64	178.60	0.0
TEM 9	162.01	162.10	-0.1
TEM 10	154.41	154.59	-0.1
TEM 11	153.17	153.30	-0.1
TEM 12	158.33	158.36	0.0
TEM 13	173.02	172.92	0.1
TEM 14	194.89	194.71	0.1
TEM 15	228.80	228.48	0.1
TEM 16	276.07	276.04	0.0
TEM 17	331.95	332.16	-0.1
TEM 18	408.88	409.28	-0.1
TEM 19	513.47	513.69	0.0
TEM 20	618.33	617.89	0.1

```

rcsq= 0.00000
ll norm= 0.00025

```

TEM 6 1/20 0.001 14 51 29 0.0320 0.0880 0.0177-0.3203 0.8501 0.6942
 0.6784
 TEM 6 2/20 0.001 14 51 31 0.0335 0.1113 0.0254-0.3277 0.8234 0.6534
 0.6534
 TEM 6 3/20 0.001 14 51 33 0.0588 0.1684 0.0313-0.3206 0.8022 0.5702
 0.5955
 TEM 6 4/20 0.001 14 51 35 0.0865 0.2858 0.0438-0.3149 0.7343 0.3924
 0.4623
 TEM 6 5/20 0.001 14 51 37 0.1678 0.5389 0.0673-0.2828 0.6084 0.0296
 0.1895
 TEM 6 6/20 0.001 14 51 39 0.2850 0.8756 0.0947-0.2194 0.4352-0.4714
 -0.2005
 TEM 6 7/20 0.000 14 51 40 0.3701 1.1108 0.1066-0.1507 0.3056-0.8326
 -0.4886
 TEM 6 8/20 0.001 14 51 42 0.4061 1.1621 0.1016-0.0911 0.2639-0.9437
 -0.5981
 TEM 6 9/20 0.000 14 51 43 0.4043 1.0719 0.0842-0.0499 0.2948-0.8670
 -0.5664
 TEM 6 10/20 0.001 14 51 45 0.3899 0.9428 0.0654-0.0297 0.3521-0.7301
 -0.4853
 TEM 6 11/20 0.000 14 51 46 0.3730 0.8037 0.0468-0.0178 0.4164-0.5803
 -0.3947
 TEM 6 12/20 0.000 14 51 46 0.2918 0.5805 0.0264-0.0114 0.4312-0.4062
 -0.2872
 TEM 6 13/20 0.000 14 51 46 0.3449 0.4979 0.0084-0.0062 0.5632-0.2608
 -0.2019
 TEM 6 14/20 0.000 14 51 46 0.3445 0.3770-0.0041-0.0035 0.6154-0.1508
 -0.1373
 TEM 6 15/20 0.000 14 51 47 0.3563 0.2652-0.0121-0.0018 0.6505-0.0028
 -0.0230
 TEM 6 16/20 0.000 14 51 47 0.3841 0.1717-0.0147-0.0010 0.6568-0.0134
 -0.0506
 TEM 6 17/20 0.000 14 51 47 0.4233 0.1032-0.0136-0.0005 0.6313 0.0092
 -0.0309
 TEM 6 18/20 0.000 14 51 47 0.4789 0.0442-0.0110-0.0002 0.5691 0.0172
 -0.0182
 TEM 6 19/20 0.000 14 51 48 0.5485-0.0037-0.0080-0.0001 0.4652 0.0169
 -0.0107
 TEM 6 20/20 0.000 14 51 48 0.6061-0.0313-0.0061-0.0001 0.3602 0.0146
 -0.0070

Iteration # 6
 ammu= 0.010

no.	eigenvalue
1	3.9417
2	2.8431
3	1.1363
4	0.3391
5	0.0800
6	0.0139
7	0.0037
parameter increments	
1	0.0000
2	0.0001
3	-0.0004
4	-0.0004
5	-0.0001
6	0.0006
7	-0.0007

old parameter	log	new parameter	log
166.13	2.2204	166.14	2.2205
38.66	1.5872	38.67	1.5874
77.40	1.8887	77.32	1.8883
0.14	-0.8491	0.14	-0.8496
122.00	2.0863	121.97	2.0863
111.11	2.0457	111.26	2.0464
104.12	2.0175	103.94	2.0168

	field data	theoretical	pct diff
TEM 1	102.22	102.26	0.0
TEM 2	122.57	122.61	0.0
TEM 3	148.10	148.14	0.0
TEM 4	174.34	174.34	0.0
TEM 5	197.79	197.65	0.1
TEM 6	205.37	205.27	0.0
TEM 7	197.46	197.36	0.1
TEM 8	178.64	178.59	0.0
TEM 9	162.01	162.09	-0.1
TEM 10	154.41	154.59	-0.1
TEM 11	153.17	153.30	-0.1
TEM 12	158.33	158.36	0.0
TEM 13	173.02	172.93	0.1
TEM 14	194.89	194.71	0.1

TEM 15	228.80	228.49	0.1
TEM 16	276.07	276.04	
TEM 17	331.95	332.16	-0.1
TEM 18	408.88	409.27	-0.1
TEM 19	513.47	513.68	0.0
TEM 20	618.33	617.88	0.1

rcsq= 0.00000
 ll norm= 0.00025
 TEM 7 1/20 0.001 14 51 53 0.0264 0.0839 0.0200-0.3211 0.8459 0.6862
 0.6781
 TEM 7 2/20 0.001 14 51 55 0.0330 0.1110 0.0235-0.3272 0.8311 0.6587
 0.6530
 TEM 7 3/20 0.001 14 51 57 0.0558 0.1655 0.0309-0.3189 0.7950 0.5769
 0.5983
 TEM 7 4/20 0.001 14 51 59 0.0905 0.2877 0.0448-0.3159 0.7327 0.3942
 0.4622
 TEM 7 5/20 0.001 14 52 1 0.1718 0.5384 0.0656-0.2815 0.6106 0.0293
 0.1906
 TEM 7 6/20 0.001 14 52 3 0.2843 0.8748 0.0932-0.2199 0.4328-0.4709
 -0.1990
 TEM 7 7/20 0.000 14 52 4 0.3725 1.1111 0.1076-0.1504 0.3048-0.8309
 -0.4884
 TEM 7 8/20 0.001 14 52 6 0.4064 1.1640 0.1011-0.0903 0.2641-0.9446
 -0.5959
 TEM 7 9/20 0.000 14 52 7 0.4043 1.0724 0.0834-0.0503 0.2948-0.8678
 -0.5656
 TEM 7 10/20 0.001 14 52 9 0.3896 0.9435 0.0651-0.0297 0.3520-0.7309
 -0.4851
 TEM 7 11/20 0.000 14 52 10 0.3728 0.8039 0.0464-0.0179 0.4163-0.5808
 -0.3945
 TEM 7 12/20 0.000 14 52 10 0.2915 0.5806 0.0261-0.0116 0.4311-0.4066
 -0.2872
 TEM 7 13/20 0.000 14 52 10 0.3449 0.4981 0.0085-0.0061 0.5632-0.2609
 -0.2016
 TEM 7 14/20 0.000 14 52 11 0.3444 0.3770-0.0041-0.0035 0.6153-0.1510
 -0.1372
 TEM 7 15/20 0.000 14 52 11 0.3562 0.2652-0.0121-0.0019 0.6503-0.0030
 -0.0230
 TEM 7 16/20 0.000 14 52 11 0.3841 0.1718-0.0145-0.0010 0.6567-0.0135
 -0.0505
 TEM 7 17/20 0.000 14 52 11 0.4233 0.1033-0.0136-0.0005 0.6312 0.0091
 -0.0309
 TEM 7 18/20 0.000 14 52 11 0.4789 0.0442-0.0109-0.0003 0.5690 0.0170
 -0.0184
 TEM 7 19/20 0.000 14 52 12 0.5484-0.0036-0.0080-0.0002 0.4652 0.0168
 -0.0106
 TEM 7 20/20 0.000 14 52 12 0.6059-0.0312-0.0061-0.0001 0.3603 0.0145
 -0.0070

Iteration # 7
 ammu= 0.010

no. eigenvalue

1	3.9421
2	2.8428
3	1.1361
4	0.3402
5	0.0783
6	0.0148
7	0.0044

parameter increments

1	0.0001
2	0.0002
3	-0.0004
4	-0.0004
5	-0.0002
6	0.0008
7	-0.0008

old parameter	log	new parameter	log
166.14	2.2205	166.18	2.2206
38.67	1.5874	38.69	1.5876
77.32	1.8883	77.24	1.8879
0.14	-0.8496	0.14	-0.8500
121.97	2.0863	121.92	2.0861
111.26	2.0464	111.46	2.0471
103.94	2.0168	103.76	2.0160

field data theoretical pct diff

TEM 1	102.22	102.26	0.0
TEM 2	122.57	122.61	0.0
TEM 3	148.10	148.14	0.0
TEM 4	174.34	174.34	0.0
TEM 5	197.79	197.65	0.0
TEM 6	205.37	205.27	0.0

TEM 7	197.46	197.36	
TEM 8	178.64	178.60	
TEM 9	162.01	162.09	-0.1
TEM 10	154.41	154.59	-0.1
TEM 11	153.17	153.30	-0.1
TEM 12	158.33	158.36	0.0
TEM 13	173.02	172.93	0.1
TEM 14	194.89	194.71	0.1
TEM 15	228.80	228.62	0.1
TEM 16	276.07	276.04	0.0
TEM 17	331.95	332.16	-0.1
TEM 18	408.88	409.27	-0.1
TEM 19	513.47	513.68	0.0
TEM 20	618.33	617.90	0.1

```

rscsq= 0.00000
ll norm= 0.00023
TEM 8 1/20 0.001 14 52 17 0.0322 0.0848 0.0117-0.3219 0.8426 0.6912
0.6746
TEM 8 2/20 0.001 14 52 19 0.0315 0.1117 0.0242-0.3204 0.8249 0.6581
0.6530
TEM 8 3/20 0.001 14 52 21 0.0527 0.1644 0.0265-0.3232 0.8000 0.5729
0.5895
TEM 8 4/20 0.001 14 52 23 0.0896 0.2912 0.0454-0.3117 0.7399 0.3979
0.4637
TEM 8 5/20 0.001 14 52 25 0.1719 0.5382 0.0637-0.2825 0.6057 0.0290
0.1859
TEM 8 6/20 0.001 14 52 27 0.2881 0.8761 0.0927-0.2187 0.4348-0.4701
-0.2002
TEM 8 7/20 0.000 14 52 28 0.3723 1.1129 0.1055-0.1510 0.3056-0.8323
-0.4876
TEM 8 8/20 0.001 14 52 30 0.4051 1.1637 0.1014-0.0908 0.2646-0.9452
-0.5961
TEM 8 9/20 0.000 14 52 31 0.4032 1.0732 0.0829-0.0503 0.2952-0.8686
-0.5656
TEM 8 10/20 0.001 14 52 33 0.3897 0.9444 0.0648-0.0296 0.3521-0.7311
-0.4845
TEM 8 11/20 0.000 14 52 34 0.3729 0.8047 0.0464-0.0177 0.4166-0.5809
-0.3939
TEM 8 12/20 0.000 14 52 34 0.2912 0.5810 0.0261-0.0113 0.4311-0.4068
-0.2868
TEM 8 13/20 0.000 14 52 35 0.3446 0.4982 0.0083-0.0063 0.5631-0.2611
-0.2014
TEM 8 14/20 0.000 14 52 35 0.3442 0.3772-0.0042-0.0036 0.6151-0.1512
-0.1370
TEM 8 15/20 0.000 14 52 35 0.2935 0.2029-0.0746-0.0018 0.5876-0.0657
-0.0854
TEM 8 16/20 0.000 14 52 35 0.3840 0.1720-0.0145-0.0009 0.6567-0.0136
-0.0504
TEM 8 17/20 0.000 14 52 35 0.4230 0.1035-0.0135-0.0005 0.6312 0.0088
-0.0309
TEM 8 18/20 0.000 14 52 36 0.4786 0.0444-0.0109-0.0004 0.5692 0.0168
-0.0183
TEM 8 19/20 0.000 14 52 36 0.5480-0.0035-0.0080-0.0002 0.4655 0.0166
-0.0107
TEM 8 20/20 0.000 14 52 36 0.6055-0.0311-0.0061-0.0001 0.3607 0.0144
-0.0070

```

```

Iteration #      8
ammu= 0.010

```

```

no.      eigenvalue

```

1	3.9385
2	2.8222
3	1.1365
4	0.3535
5	0.0786
6	0.0533
7	0.0127

```

parameter increments
1 -0.0003
2 -0.0012
3 -0.0056
4 -0.0044
5 0.0002
6 -0.0013
7 -0.0008

```

old parameter	log	new parameter	log
166.18	2.2206	166.09	2.2203
38.69	1.5876	38.58	1.5864
77.24	1.8879	76.25	1.8823
0.14	-0.8500	0.14	-0.8543
121.92	2.0861	121.96	2.0862
111.46	2.0471	111.14	2.0459
103.76	2.0160	103.57	2.0152

	field data	theoretical	pct diff
TEM 1	102.22	102.24	
TEM 2	122.57	122.59	0.0
TEM 3	148.10	148.12	0.0
TEM 4	174.34	174.33	0.0
TEM 5	197.79	197.67	0.1
TEM 6	205.37	205.31	0.0
TEM 7	197.46	197.39	0.0
TEM 8	178.64	178.60	0.0
TEM 9	162.01	162.07	0.0
TEM 10	154.41	154.55	-0.1
TEM 11	153.17	153.25	-0.1
TEM 12	158.33	158.31	0.0
TEM 13	173.02	172.88	0.1
TEM 14	194.89	194.67	0.1
TEM 15	228.80	228.58	0.1
TEM 16	276.07	276.01	0.0
TEM 17	331.95	332.13	-0.1
TEM 18	408.88	409.24	-0.1
TEM 19	513.47	513.65	0.0
TEM 20	618.33	617.85	0.1

```

rcsq= 0.00000
ll norm= 0.00021
TEM 9 1/20 0.001 14 52 41 0.0205 0.0830 0.0160-0.3190 0.8412 0.6909
0.6740
TEM 9 2/20 0.001 14 52 43 0.0383 0.1127 0.0202-0.3197 0.8252 0.6546
0.6522
TEM 9 3/20 0.001 14 52 45 0.0587 0.1676 0.0321-0.3192 0.8031 0.5752
0.5948
TEM 9 4/20 0.001 14 52 47 0.0876 0.2872 0.0437-0.3130 0.7380 0.3953
0.4587
TEM 9 5/20 0.001 14 52 49 0.1705 0.5357 0.0662-0.2835 0.6108 0.0317
0.1866
TEM 9 6/20 0.001 14 52 51 0.2859 0.8736 0.0952-0.2188 0.4356-0.4696
-0.2009
TEM 9 7/20 0.001 14 52 53 0.3704 1.1135 0.1080-0.1487 0.3079-0.8311
-0.4908
TEM 9 8/20 0.000 14 52 54 0.4066 1.1635 0.1031-0.0898 0.2658-0.9446
-0.5990
TEM 9 9/20 0.001 14 52 56 0.4040 1.0731 0.0846-0.0502 0.2956-0.8684
-0.5673
TEM 9 10/20 0.000 14 52 57 0.3895 0.9434 0.0658-0.0295 0.3534-0.7309
-0.4867
TEM 9 11/20 0.000 14 52 58 0.3727 0.8039 0.0470-0.0179 0.4174-0.5809
-0.3955
TEM 9 12/20 0.000 14 52 58 0.3538 0.5806 0.0265-0.0115 0.4321-0.4069
-0.2880
TEM 9 13/20 0.000 14 52 59 0.3448 0.4979 0.0085-0.0063 0.5640-0.2612
-0.2021
TEM 9 14/20 0.000 14 52 59 0.3443 0.3770-0.0042-0.0034 0.6161-0.1513
-0.1373
TEM 9 15/20 0.000 14 52 59 0.2937 0.2028-0.0122-0.0018 0.5886-0.0660
-0.0855
TEM 9 16/20 0.000 14 52 59 0.3841 0.1718-0.0147-0.0010 0.6573-0.0141
-0.0505
TEM 9 17/20 0.000 14 53 0 0.4233 0.1034-0.0136-0.0005 0.6317 0.0085
-0.0309
TEM 9 18/20 0.000 14 53 0 0.4788 0.0442-0.0110-0.0003 0.5694 0.0165
-0.0183
TEM 9 19/20 0.000 14 53 0 0.5484-0.0036-0.0080-0.0001 0.4654 0.0164
-0.0106
TEM 9 20/20 0.000 14 53 0 0.6059-0.0313-0.0061-0.0001 0.3604 0.0142
-0.0070

```

```

Iteration # 9
ammu= 0.010

```

no.	eigenvalue
1	3.9451
2	2.8223
3	1.1371
4	0.3418
5	0.0820
6	0.0135
7	0.0049

parameter increments

1	-0.0006
2	-0.0009
3	-0.0001
4	-0.0017
5	0.0006
6	-0.0003
7	-0.0011

old parameter	log	new parameter	log
---------------	-----	---------------	-----

.166.09	2.2203	165.87	2.2198
38.58	1.5864	38.50	1.5855
76.25	1.8823	76.24	1.8822
0.14	-0.8543	0.14	-0.8560
121.96	2.0862	122.14	2.0869
111.14	2.0459	111.05	2.0455
103.57	2.0152	103.29	2.0141

	field data	theoretical	pct diff
--	------------	-------------	----------

TEM 1	102.22	102.23	0.0
TEM 2	122.57	122.59	0.0
TEM 3	148.10	148.12	0.0
TEM 4	174.34	174.34	0.0
TEM 5	197.79	197.68	0.1
TEM 6	205.37	205.34	0.0
TEM 7	197.46	197.41	0.0
TEM 8	178.64	178.60	0.0
TEM 9	162.01	162.06	0.0
TEM 10	154.41	154.54	-0.1
TEM 11	153.17	153.24	0.0
TEM 12	158.33	158.32	0.0
TEM 13	173.02	172.89	0.1
TEM 14	194.89	194.70	0.1
TEM 15	228.80	228.63	0.1
TEM 16	276.07	276.08	0.0
TEM 17	331.95	332.20	-0.1
TEM 18	408.88	409.30	-0.1
TEM 19	513.47	513.64	0.0
TEM 20	618.33	617.73	0.1

rscsq= 0.00000

ll norm= 0.00020

TEM10 1/20	0.001	14	53	5	0.0322	0.0787	0.0194	-0.3269	0.8436	0.6907
0.6761										
TEM10 2/20	0.001	14	53	7	0.0350	0.1153	0.0224	-0.3210	0.8330	0.6602
0.6483										
TEM10 3/20	0.001	14	53	9	0.0573	0.1673	0.0342	-0.3217	0.8007	0.5753
0.5922										
TEM10 4/20	0.001	14	53	11	0.0883	0.2866	0.0397	-0.3123	0.7363	0.3952
0.4581										
TEM10 5/20	0.001	14	53	13	0.1754	0.5395	0.0683	-0.2800	0.6137	0.0321
0.1884										
TEM10 6/20	0.001	14	53	15	0.2816	0.8745	0.0910	-0.2204	0.4328	-0.4725
-0.2024										
TEM10 7/20	0.001	14	53	17	0.3731	1.1111	0.1068	-0.1510	0.3066	-0.8340
-0.4917										
TEM10 8/20	0.000	14	53	18	0.4077	1.1633	0.1023	-0.0905	0.2666	-0.9457
-0.5987										
TEM10 9/20	0.001	14	53	20	0.4046	1.0724	0.0840	-0.0501	0.2956	-0.8693
-0.5675										
TEM10 10/20	0.000	14	53	21	0.3903	0.9428	0.0654	-0.0297	0.3536	-0.7319
-0.4867										
TEM10 11/20	0.000	14	53	22	0.3737	0.8034	0.0464	-0.0179	0.4181	-0.5816
-0.3955										
TEM10 12/20	0.000	14	53	23	0.3550	0.5800	0.0263	-0.0113	0.4330	-0.4070
-0.2877										
TEM10 13/20	0.000	14	53	23	0.3455	0.4970	0.0083	-0.0061	0.5649	-0.2613
-0.2019										
TEM10 14/20	0.000	14	53	23	0.3451	0.3759	-0.0042	-0.0035	0.6167	-0.1513
-0.1373										
TEM10 15/20	0.000	14	53	23	0.2946	0.2018	-0.0120	-0.0017	0.5892	-0.0660
-0.0855										
TEM10 16/20	0.000	14	53	23	0.3850	0.1707	-0.0147	-0.0009	0.6574	-0.0141
-0.0505										
TEM10 17/20	0.000	14	53	24	0.4243	0.1022	-0.0136	-0.0005	0.6313	0.0085
-0.0309										
TEM10 18/20	0.000	14	53	24	0.4802	0.0433	-0.0109	-0.0002	0.5684	0.0165
-0.0183										
TEM10 19/20	0.000	14	53	24	0.5499	-0.0045	-0.0080	-0.0002	0.4637	0.0163
-0.0107										
TEM10 20/20	0.000	14	53	24	0.6076	-0.0319	-0.0061	-0.0001	0.3583	0.0141
-0.0070										

Iteration # 10

ammu= 0.010

no.	eigenvalue
-----	------------

1	3.9462
2	2.8267
3	1.1385
4	0.3436
5	0.0805
6	0.0139
7	0.0061

parameter increments

1	0.0000
2	0.0000

3	-0.0005
4	-0.0005
5	0.0000
6	0.0004
7	-0.0006

old parameter	log	new parameter	log
165.87	2.2198	165.86	2.2197
38.50	1.5855	38.50	1.5855
76.24	1.8822	76.16	1.8817
0.14	-0.8560	0.14	-0.8566
122.14	2.0869	122.14	2.0868
111.05	2.0455	111.15	2.0459
103.29	2.0141	103.15	2.0135

	field data	theoretical	pct diff
TEM 1	102.22	102.23	0.0
TEM 2	122.57	122.59	0.0
TEM 3	148.10	148.13	0.0
TEM 4	174.34	174.34	0.0
TEM 5	197.79	197.68	0.1
TEM 6	205.37	205.33	0.0
TEM 7	197.46	197.42	0.0
TEM 8	178.64	178.61	0.0
TEM 9	162.01	162.06	0.0
TEM 10	154.41	154.54	-0.1
TEM 11	153.17	153.24	0.0
TEM 12	158.33	158.32	0.0
TEM 13	173.02	172.90	0.1
TEM 14	194.89	194.70	0.1
TEM 15	228.80	228.64	0.1
TEM 16	276.07	276.08	0.0
TEM 17	331.95	332.21	-0.1
TEM 18	408.88	409.31	-0.1
TEM 19	513.47	513.64	0.0
TEM 20	618.33	617.72	0.1

rcsq= 0.00000
ll norm= 0.00020

***** statistics *****

NSR= 1.50821009E-03

undamped 95% confidence intervals

parameter, high p, low p		
165.86206055	172.29045105	159.67352295
38.49991989	50.08969879	29.59178925
76.15578461	8.80055576E+12	6.59015786E-10
0.13912494	0.50898612	3.80280502E-02
122.13614655	137.32334900	108.62856293
111.14601898	423074.78125000	2.91991793E-02
103.15412903	840384.18750000	1.26617998E-02

v-matrix

-0.3390	0.1529	-0.6463	0.6369	-0.1884	0.0532	-0.0119
-0.6631	0.0124	0.5657	0.0690	-0.4674	0.1168	-0.0567
-0.0483	0.0034	0.1026	0.1606	0.1755	-0.5496	-0.7927
0.0632	-0.2019	-0.3500	-0.4417	-0.6853	-0.4097	-0.0071
-0.3873	0.7096	-0.1922	-0.4933	0.2336	-0.1045	0.0260
0.4548	0.4852	0.0499	0.0105	-0.4037	0.4597	-0.4252
0.2867	0.4436	0.2998	0.3540	-0.1673	-0.5397	0.4321

1.0000 1.0000 1.0000 0.9998 0.9453 0.0151 0.0006

final result:

field	model	pct diff	time window
102.2	102.2	0.0	7.1600
122.6	122.6	0.0	5.6670
148.1	148.1	0.0	4.4600
174.3	174.3	0.0	3.5700
197.8	197.7	0.1	2.8200
205.4	205.3	0.0	2.2100
197.5	197.4	0.0	1.7720
178.6	178.6	0.0	1.4000
162.0	162.1	0.0	1.0870
154.4	154.5	-0.1	0.8760
153.2	153.2	0.0	0.7120
158.3	158.3	0.0	0.5630
173.0	172.9	0.1	0.4430
194.9	194.7	0.1	0.3550
228.8	228.6	0.1	0.2800
276.1	276.1	0.0	0.2200

332.0	332.2	-0.1	0.1770
408.9	409.3	-0.1	0.0000
513.5	513.6	0.0	0.0000
618.3	617.7	0.1	0.0890

final parameters

layer	1	resistivity=	165.86206055	
layer	2	resistivity=	38.49991989	
layer	3	resistivity=	76.15578461	
layer	4	resistivity=	0.13912494	
layer	1	thickness=	122.13614655	400.70913696
layer	2	thickness=	111.14601898	364.65228271
layer	3	thickness=	103.15412903	338.43218994

} FINAL SOLUTION

rcsq= 0.00000 ll= 0.00020 iterations completed= 10
time at end= 14 53 27