Phoenix Control Source System
Operation Note for Training

January 2016

Phoenix Geophysics

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MISSCELLANEOUS

ADDITIONAL DOCUMENTS, REFERENCES and FILES in USB

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- **X2** TDEM Parameter Table
- **X3** Examples of Survey Plan/Layout with Dipole-Dipole Array for TDIP/SIP with T3 or TXU transmitter and Measurement Procedure
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SYSTEM DESCRIPTION and PREPARATION

In this note description, the following unit Serial Numbers are used. For individual user, apply actual Serial numbers.

System Rx	**V8-4340**	**V8-4339**	**V8-4321**	**V8-4319**	**„**
RXU	**RXU-3ER units 4414, 4415, 4416, 4417, 4418, 4419, „**				
Coils	**MTC50 coils**		**AMTC30 coils**		
Tx	**T3-1394**	**T3-1393**	**T4-0816**	**TXU30-8248**	
CMU	**CMU-1272**				
RXU-TMR	**TMR-4334**	**TMR-4333**	**TMR-4190**		
PAIM Pilot	**Pal-1 units**				

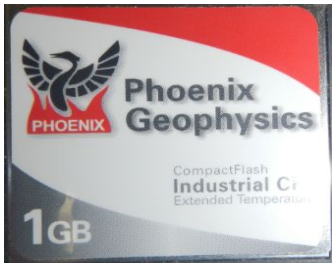
External CF Cards Preparation

for V8 units **for RXU-3ER units** **for RXU-TMR units**

It is recommended to name each CF card with label in such way as
"V8-4340"„„ "RXU-xxxx"„„ "TMR-4343" „ and "TXU-8248"

In each CF card, create the following folders

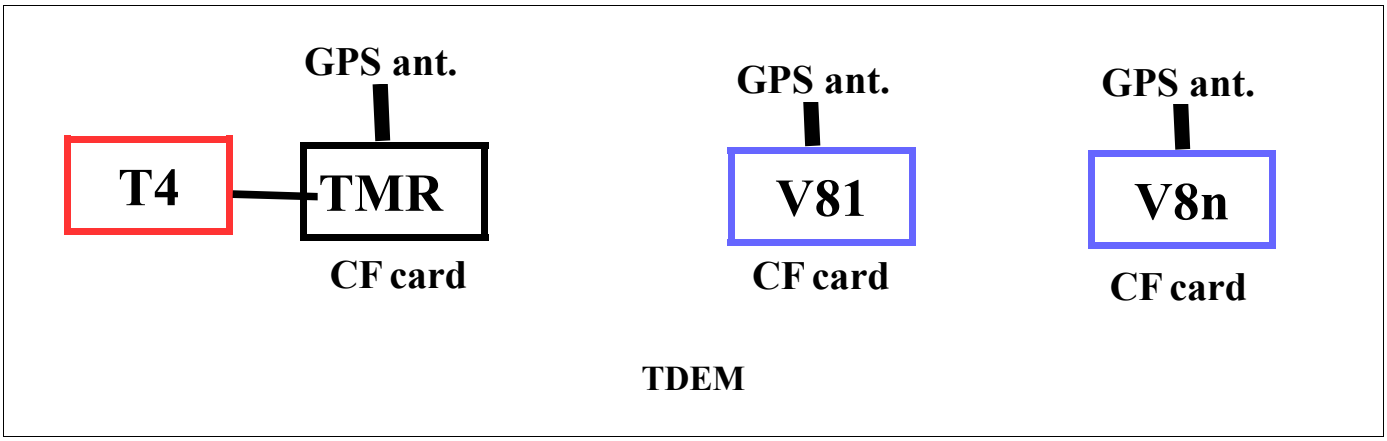
- **CAL**
- **CALNEW**
- **LICNEW**
- **DATA-CMT**
- **DATA-TEM**
- **DATA-SIP**
- **DATA-TIP**
- **DATA-MT**

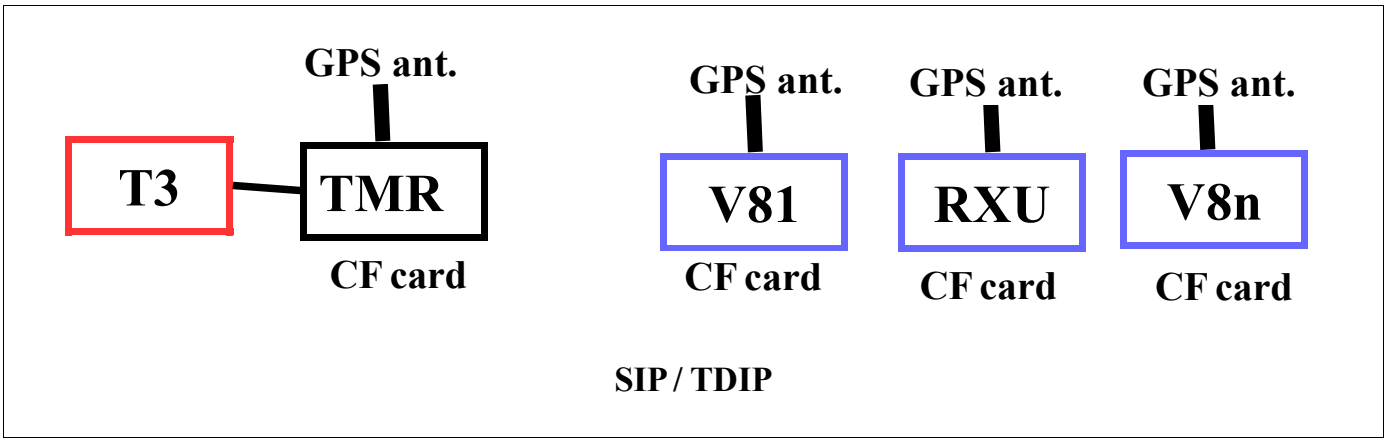


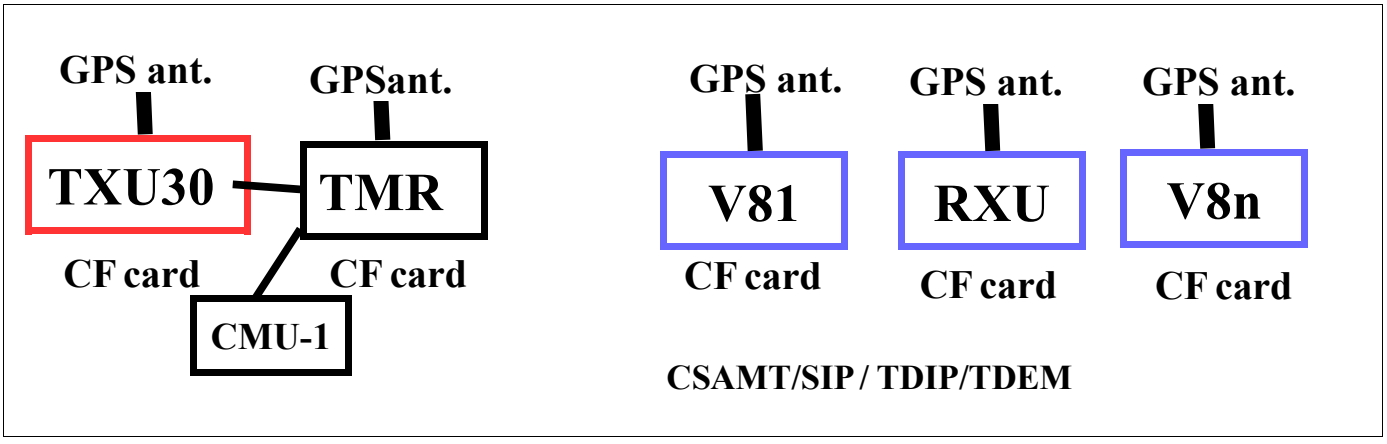
Note: For actual use, Rename one with function to use to "DATA"

Warning: **CF card on market may cause problem, even damage unit.**
Phoenix industrial specified CF is recommended.

GPS Timing and Frequency Control on Tx-Rx System







TMR Functions:

GPS Sync.
Tx Timing Control
Tx Output Signa/Current Record
Lan communication with V8 when possible

CALIBRATION

A Box Calibration Usually done once 1n an area of power line 50hz or 60hz frequency
There are several ways to do box cal for TMR and RXU units

Individual Box Calibration : V8, TMR (RXU-TMR) , RXU (RXU-3ER)

A1 Preparation

A1.1 On each CF card, prepare Empty >DATA folder and install to each unit

A1.2 Set units in open field with GPS antenna, battery and turn power on

A1.3 Wait for GPS Synchronization

A2 V8 Box Cal

A2.1 Power save mode
(Black screen and red LED ON)

A2.2 Push any key to display-on mode

A2.3 [SIP Site Setup] screen appears

A2.4 Push [Ctrl] and [D] to exit

A2.5 SIPAcquisition screen,
select [Setup] with down arrow key,
select [Exit SIP]

A2.6 V8 main menu appears
Select [Calibration] by arrow key

A2.7 [Calibration] screen
Select [60Hz] or [50Hz]
by arrow key, then
[Enter] to match local P.L.Freq

A2.8 Select [Calibration]

A2.9 Select [Box Calibration]

A2.10 Warning – "Do you want to
calibrate the box"
[Yes] to start calibration

A2.11 On Calibration screen
[Box not Cal] indicate starting
Box cal started

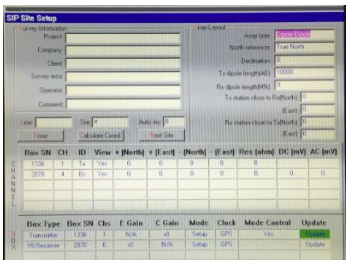
Then after some time,
[Box in Progress] is indicated

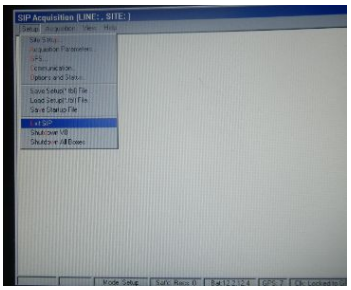
A2.12 At the completion it turns to
[Box Cal OK]

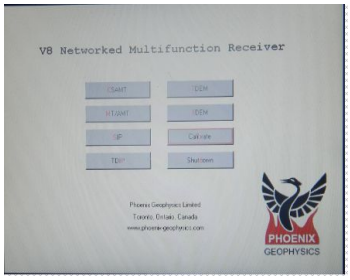
A2.13 On the Calibration screen
select [View]

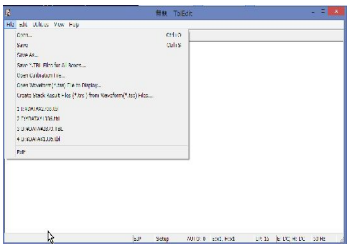
A2.13 Select [Plot Parameter], then

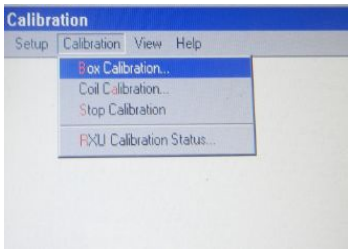
V8 Display

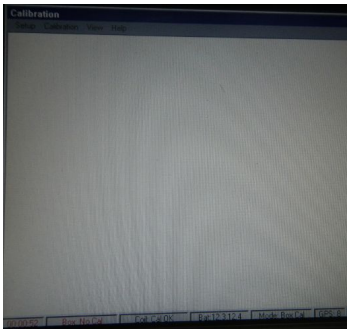


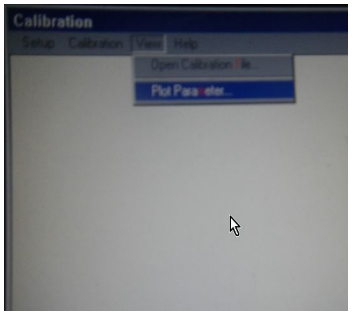












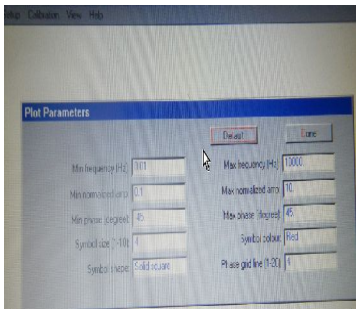
Enter, on the parameter table
Min Freq = 0.01
Max Freq =10000
Min Amp = 0.1
Max amp = 10
Min phase = -45
Max phase = 45
then [Ctrl] & [D] to exit

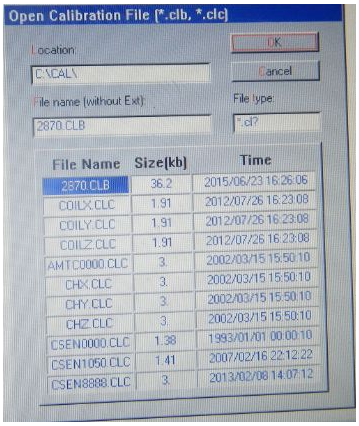
A2.14 Select [Open Calibration File]
Select [xxxx.CLB] by arrow key
then [Ctrl] & [O]

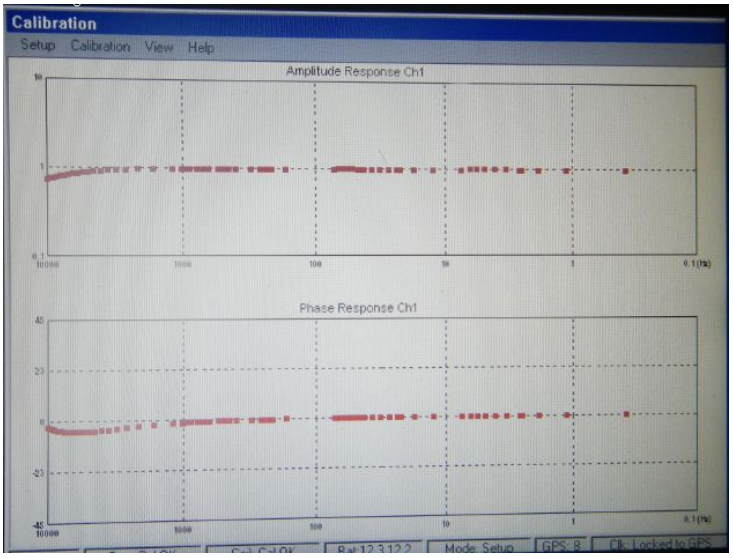
A2.15 Normalized Amplitude and Phase of Box calibration data is plotted,,, (Smooth curves similar to graphs shown indicates successful V8 Box Cal)

A2.16 Select [Setup],
then [Exit Calibration]

A2.17 Returns to V8 Main Menu then select [Shatdown] to Turn OFF V8, Now CF card can be removed out.







A3 RXU Box Cal (RXU-3ER, RXU-TMR)

Note Controlled unit individually by Palm Pilot

Note: It is important to recharge. If left long time without charging, the software, [RXU Pilot] might be lost, and even Palm Pilot itself may be damaged. Therefore, recharge before store long time without using.

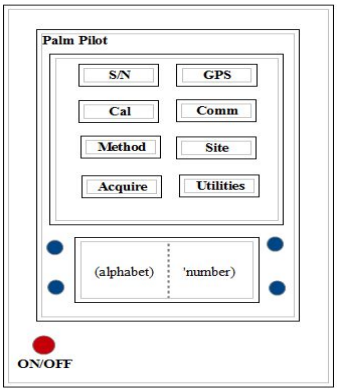
A3.1 After preparation described at A1, wait until 4 consecutive red LED flashing for GPS timing

A3.2 Turn on the Palm Pilot unit

A3.2 Touch to [S/N]
[Serial/Number (S/N)] shown
Enter 4 digit S/N in number area
or touch the corner for number key
Then, touch [OK]

A3.3 Aim Palm LED to RXU sensor

A3.4 Select [GPS] then in [GPS Status], check No. of Satellites (>4) and Clock error (~0uS) and Clock ~ aligned to GPS, then [Done]



A3.5 On main menu, select :[Acquire]

A3.6 On Acquisition menu, select Acquisition Setup : [Edit]

A3.7 On Acquisition Setup, select[Line Frequency : [Line Freq]

A3.8 On Line Frequency, select [50Hz] or [60Hz], then [OK]

A3.9 Touch [Done] on Acquisition Setup
Touch [Done] on Acquisition
Back to Main Menu

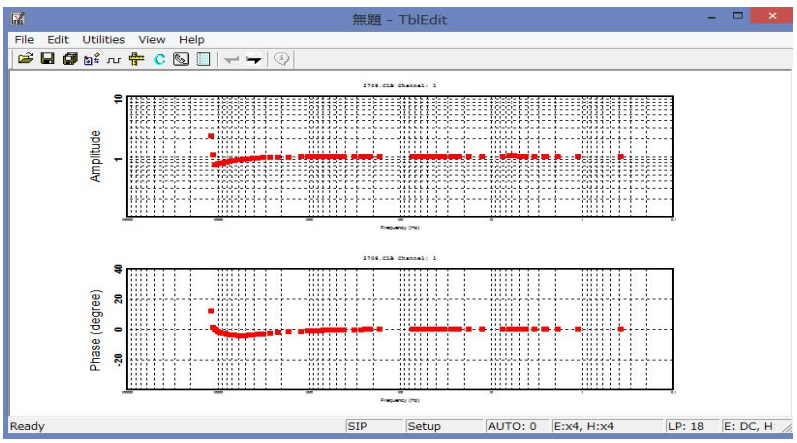
A3.10 Touch [Cal] to start Box cal]

A3.11 Touch [Box Cal] on Calibration screen
On Box Calibration screen, Touch [Start], then [Yes] on warnig
when Mode changed from [Setup] to [Box Cal], Box cal started. Wait,,,
Check the status by touching [Update], message "In progres",,
When status message with [Update] turnes to – Box Cal Status : Cal File present
Touch [Stop], then [Yes] in warning message
It turns to Mode : Setup, then touch [Done],
Then Touch [Done] in Calibration screen, Palm go back to Main menu.

A3.11 Turn OFF (wait until LED off) the unit and take out CF card and set to PC

A3.12 Start TblEdit program
Open [File], then select
[Open Calibration File]
then, open CAL: xxxx.CLB

A3.13 Check the plot



Perform the Box Cal with all necessary RXU units including RXU-TMR in the same procedure

B Current Sensor Calibration

B1 T3 and T4 (Internal Current Sensor Calibration

B1.1 Prepare Empty DATA folder in CF card and set to TMR unit

B1.2 Set T3 (T4) and TMR where >4 GPS can be obtained
Connect T3 (T4) and TMR with supplied cable
Connect TMR and battery, T3 (T4) and Battery Pack with supplied cable

B1.3 Turn ON TMR unit and wait for GPS synchronization in the same way described for RXU Box calibration (A3)

B1.4 Note: T3 -When 12V battery is connected, if Inter Lock indicator is ON, Swich Power ON to make Inter Lock Indicator OFF, then Power OFF
Note: T4 -Input Power ON (Not Output ON)

B1.5 Using Palm, proceed operation in the same way described *A3: A3.1 ~ A3.9*

B1.6 Touch [Current Cal]
Touch [Edit] in Current Sensor Calibration screen
Touch [Change] in Current sensor information screen
Enter T3-1394 (or T4-0816) in Current Sensor Serial Number screen
then [OK], then [Done] in the following screen
(note: Serial number with T3-xxxx, T4-yyyy recommended for easy matching with Tx unit to be used)

B1.7 Touch [Start], then [Yes] in warning screen,,,,, Current Sensor calibration starts

B1.8 Check the status by touching [Update]

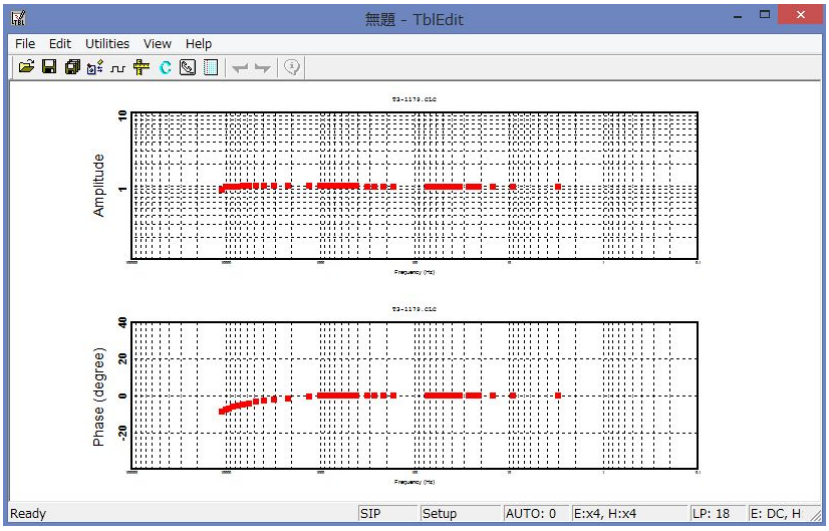
B1.9 Status: Cal file present indicate completion of Current Sensor Calibration

B1.10 Touch [Stop], then followed by [Yes] in warning message,,,
Mode changed to [Setup] indicating completion of Current sensor calibration

B1.11 Touch [Done], then followed by touching [Done] in Calibration screen
Palm goes to Main Menu

B1.12 Turn OFF (wait until LED off) the unit and take out CF card and set to PC

B1.13 Start TblEdit program
Open [File], then select
[Open Calibration File]
then, open
CAL: T3-1394.CLC
Check the plot



B1.14 Copy the .CLC cal file to all CF card of V8 and TMR by copying into CALNEW folder.

B2 External Current Sensor (CMU) Calibration

B2.1 Prepare Empty DATA folder in CF card and set to TMR unit

B2.2 Connect External Current Sensor to TMR with supplied cable and side switch to [Cal]

B2.3 Turn ON TMR unit and wait for GPS synchronization in the same way described for RXU Box calibration (A3)

B2.4 Using Palm, proceed operation in the same way described *A3: A3.1 ~ A3.9*

B2.5 Touch [Current Cal]

Touch [Edit] in Current Sensor Calibration screen

Touch [Change] in Current sensor information screen

Enter CMU-1272 in Current Sensor Serial Number screen

then [OK], then [Done] in the following screen

B2.6 Touch [Start], then [Yes] in warning screen,,,,, Current Sensor calibration starts

B2.7 Check the status by touching [Update]

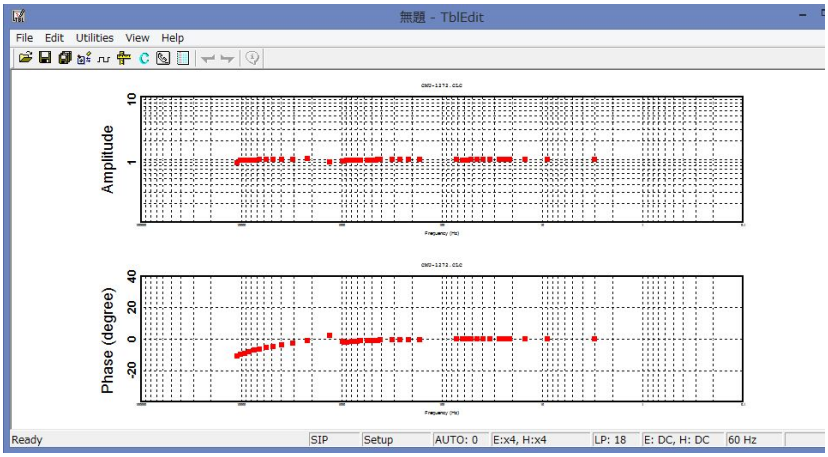
B2.8 Staus: Cal file present indicate completion of Current Sensor Calibration

B2.9 Touch [Stop], then followed by [Yes] in waring message,,,
Mode changed to [Setup] indicating completion of Current sensor calibration

B2.10 Touch [Done], then followed by touching [Done] in Calibration screen
Palm goes to Main Menu

B2.11 Turn OFF (wait until LED off) the unit and take out CF card and set to PC

B2.13 Start TblEdit program,
Open [File], then select
[Open Calibration File]
then, open
CAL: T3-1394.CLC
Check the plot



B2.14 Copy the .CLC cal file to all CF card of V8 and TMR by copying into CALNEW folder.

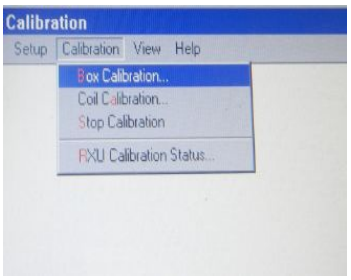
C Induction Coil Sensor Calibration

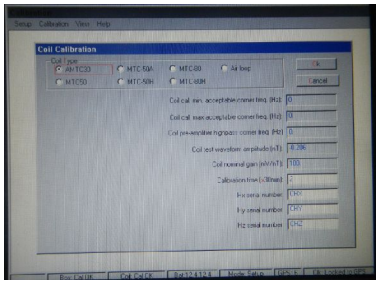
C1 AMTC30 Coil Sensor Calibration

C1.1 On each CF card, prepare Empty [DATA] folder and install to already calibrated (Box Cal) V8

C1.2 Set V8 in open low cultural noise area with GPS antenna, battery and coil sensors to be calibrated.

C1.3 Set up to 3 AMTC30 coils connecting to 3-way cable connector in parallel at least 1 m apart horizontally on the ground





C1.4 Turn V8 ON and Wait for GPS Synchronization

C1.5 Take the same procedure to Calibration screen shown right

C1.6 Select [Coil Calibration] by arrow key, then [Enter]

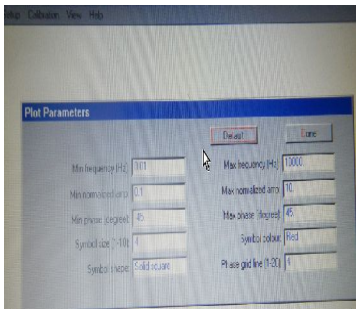
C1.7 Check [AMTC30] and Enter serial numbers in Hx ~ Hz column such as Hx serial number [AMTC1234]
Hy serial number [AMTC1235]
Hz serial number [AMTC1236]

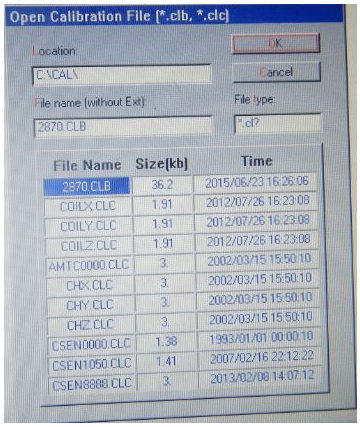
C1.8 [Ctrl] & [O] to start calibration, [Coil in progress] is indicated, then wait

C1.9 [Coil Cal OK] indicates completion of calibration

C1.10 On the Calibration screen select [View] with [Menu] and arrow

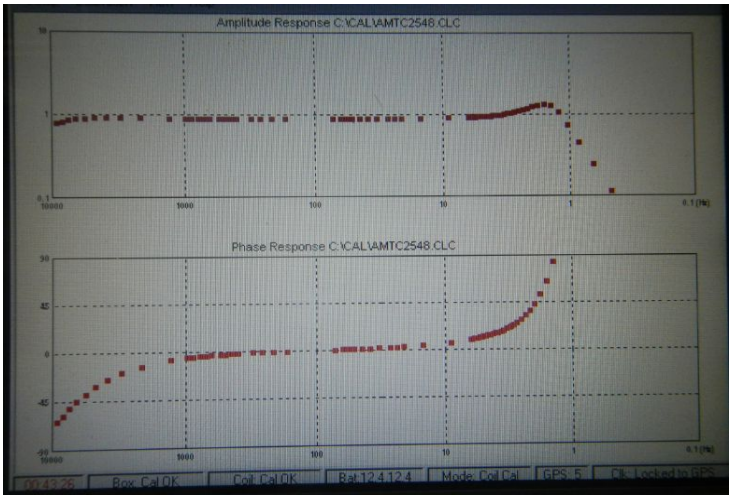
C1.11 Select [Plot Parameter], then Enter, on the parameter table
Min Freq = 0.01
Max Freq =10000
Min Amp = 0.1
Max amp = 10
Min phase = -90
Max phase = 90
then [Ctrl] & [D] to exit





C1.12 Select [Open Calibration File]
Select [AMTCxxxx.CLC] by arrow key
[Ctrl] & [O]

C1.13 Normalized Amplitude and Phase of Coil calibration data is plotted,,,
(Smooth curves indicate successful Sensor Coil Cal)



C1.14 [Menu], [Setup], then select [Exit Calibration:

C1.15 Returns to V8 Main Menu then select [Shutdown] to Turn OFF V8, Now CF card can be removed out.

DATAACQUISITION

D TDEM

D1 Survey Layout

D1.1 Central Loop Sounding with one V8 and one RXU-TMR in area with 50hz line freq.

Preparation of CF cards

1-Make one DATA folder or rename to DATA from DATA-TEM

Only one DATA folder. If DATA folder for other function exist, rename to such as DATA-CMT.

2-Create TBL file

2a On PC, open [TblEdit]

Click on 4th mark [Acqusition)]

Acquisition window open

Check - [Setup], [TDEM]

E-gain=[x0.25], Hgain=[x1]

H: [DC coupling] E: [DC coupling]

LP Filter : [Off] Line F. : [50]

Check [Site Setup]

V8/TMR SN input window opens

Enter V8 and TMR Serial Nos, Click [OK]

TDEM Site Setup window opens

Enter or check

Ramp time = 12 (example)

(get value from Table X2)

Tx loop length = 100 (ex.)

Tx loop width = 100 (ex.)

Tx type = T4 TMR S/N = xxxx

V8 S/N = yyyy

Clicks to get Mode control

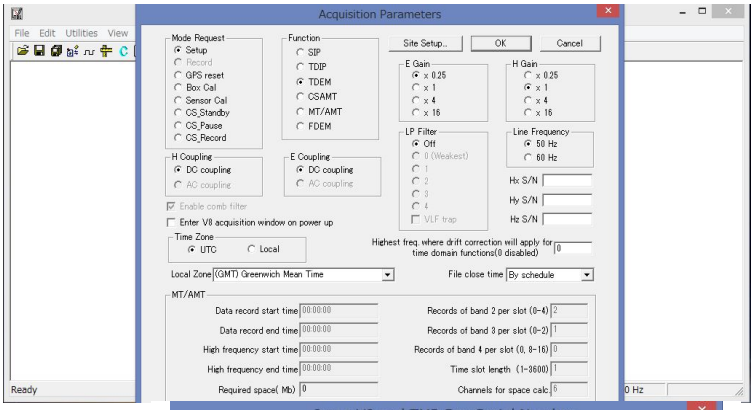
Clicks to get View

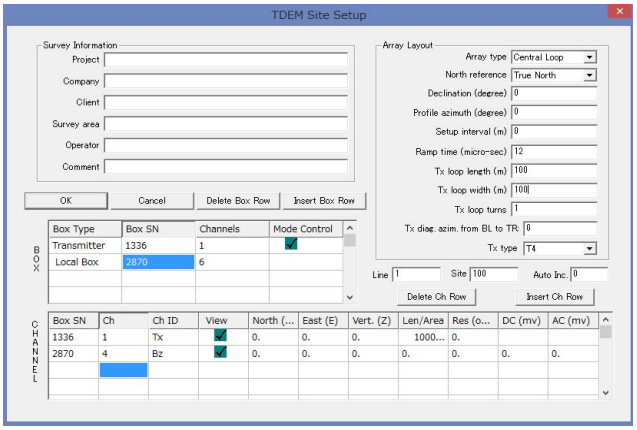
Specify V8 Ch. No. to use (4, 5 or 6)

Enter Ch.ID = Bz

Check [OK] to exit Site Setup,

Check [OK] to exit Acquisition Parameter.





Click on 5th mark

[TDEM Window Parm] opens

Select [Auto Step]

Freq per octave = 1

Lowest Freq. = 2.5 or 25

Cycle per Freq. = 60

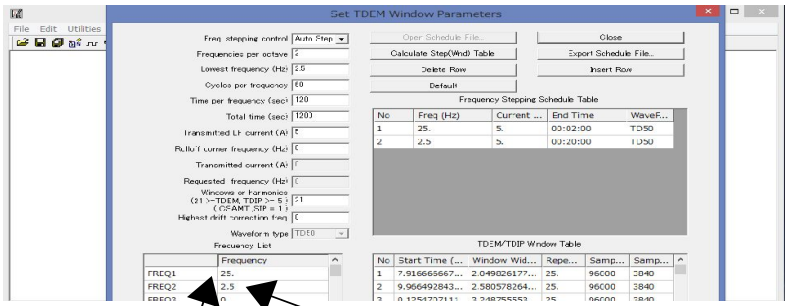
Rime per freq = 120

Total time = 1200 or 120

Tx LF current = 5 (est

Roll off corner freq. = 0

Windows or harmonics = 21

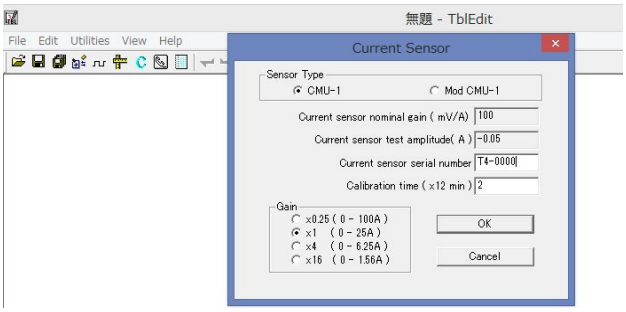


Enter FREQ1 = 25 FREQ2 = 2.5

Click [Calculate Step table] for[Freq Step Schedule Table] & [TDEM Window Table

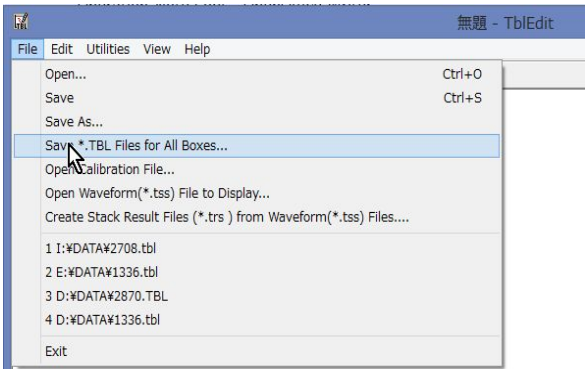
Click [Close] to exit step

Click [C] to open [Current Sensor window] on [TblEdit] window
Specify [CMU-1]
Sensor S/N = T4-0000 ex.
Gain = [x1]
Click [OK] to exit to TblEdit
Click [C] to open Wireless Setting window
on TblEdit window
Make sure SN numbers of
Local Box (V8) S/N and
Tx Box (TMR) S/N
Click [OK] to open TblEdit window



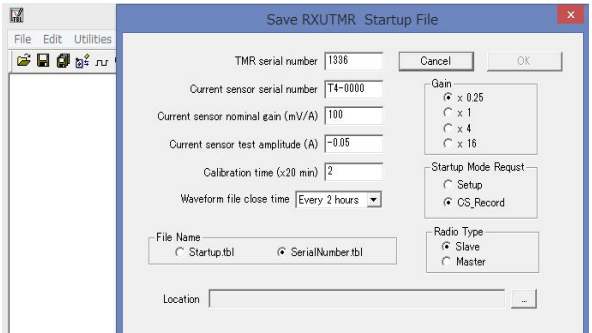
2b Saving [*.TBL] in DATA folder of each CF cards

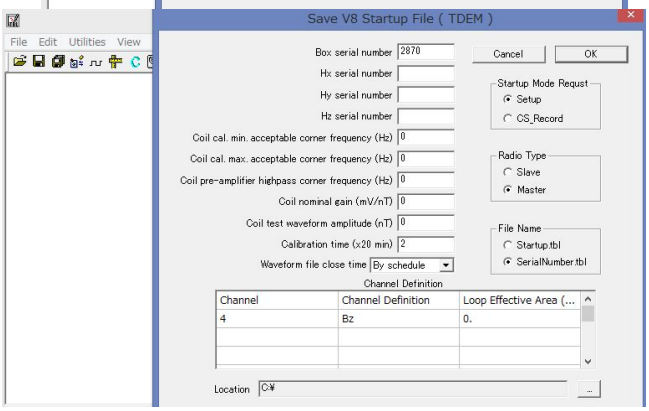
Click [Save *.TBL files all Boxes]
[Save RXU-TMR Setup File] opens
Confirm or Set the followings
Gain = [x1]
Waveform close time = [By schedule]
Startup Mode = [Setup]
Radio type = [Slave]
File Name = [Serial Number.TBL]
Insert CF card for TMR in USB reader
Go to Location to DATA in CF card
by clicking Location button
Check [OK] and remove CF card



[Save V8 Setup File] opens

Confirm the followings
Box serial number
Startup mode = [Setup]
Radio type =]Master]
File Name = [Serial Number. TBL]
Wave File Close Time = [By schedule]
Channel = 4 (or 5 or 6)
Channel Definition = Bz
Loop Effective Area = 100
Insert CF card for V8 in USB reader
Go to Location to DATA in CF card
by clicking Location button
Check and correct if necessary
Channel, Ch. ID, Loop Eff,Area
Check [OK] after shut down
remove CF card





D2 System configuration and Layout

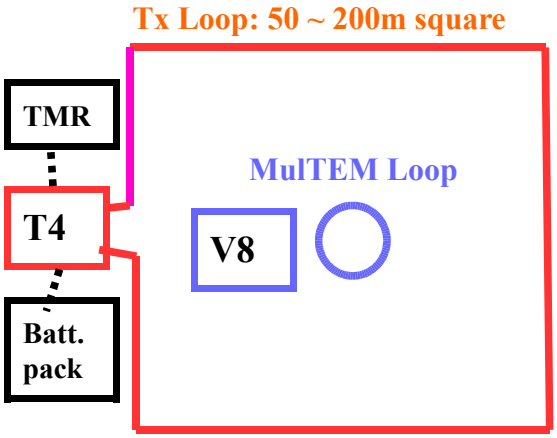
Tx : Set close to Tx loop end

Timing : RXU-TMR with 12V battery set beside T4 unit and connected to T4 with supplied cable, GPS and Radio antennas and 12V battery

Tx Loop : 50 ~ 200m square with loop wire l

Power : Battery pack for T4 power output connect T4 battery terminals (Make sure to be fully charged)

Rx: V8 set ~ 20m from MulTEM loop which is placed the center of Tx loop and connect with GPS and Radio antenna and 12V battery



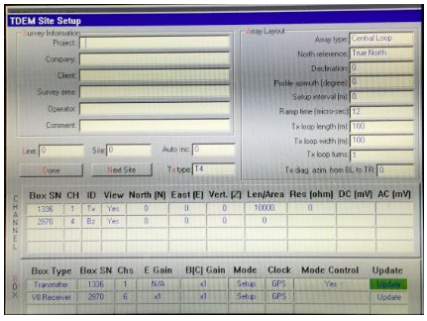
MulTEM Loop: Lay horizontally on the grrond around the loop center and connect to one of (Ch4~6) 3-Way cable to V8
Make total resistance (wire + any additional series resister if necessary)) more than 3 ohms

Estimation of Loop Resistance, Damping Resister and Ramp time of the Tx loop
Refer to the Tx TDEM Loop Table in this manual

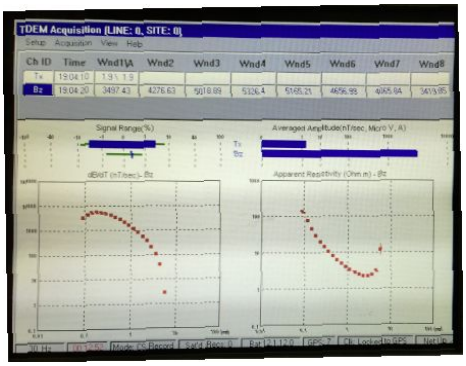
D3 TDEM Central Loop Sounding Data Acquisition

D3.1 Set field layout as described in D2
Insert CF cards prepared for TDEM to V8 and TMR
Turn Power them ON and Wait for GPS sync.

Case 1 With V8 – TMR radio control mode
Reading Current output
Turn T4 Input Power ON
Set Timing switch to [Test]
Read Current Output(A)
Set Timing Switch to [EXT 1]
Check V8 and TMR Timing on GPS with green
Enter Survey Information (if necessary once)
by [Ctrl] [S]
[Ctrl] [L] Enter Line and [Ctrl] [T] Enter site



Start data recording by [Ctrl] [D]
In ~1min, Decay / App.Res. curves displayed with decay value
if decay shows negative values, stop by [Ctrl] [S],
then turn of T4 output,
then Switch T4 loop output connection +<>-,
then turn power output ON and Re-start V8
When Decay and App.Res. Curves becomes good
[Ctrl] [S] to stop recording and
Switch T4 power OFF
On V8, select [Setup] in {TDEM Acquisition]
Select [Shutdown all Boxes] to shutdown V8 & TMR
Move Tx-Rx set to next site



Case 2 Without V8 – TMR radio control mode

Reading Current output

Turn T4 Input Power ON

Set Timing switch to [Test]

Read Current Output(A)

Set Timing Switch to [EXT 1]

Set, control TMR unit by Palm Pilot aiming TMR in the same way shown A3

Touch [Acquire]

Touch [Select] in Acquisition screen

Touch [Record] = stat recording on Control Source Acquisition making Current Mode ~ [CS Record]

Start V8 as described in Case 1

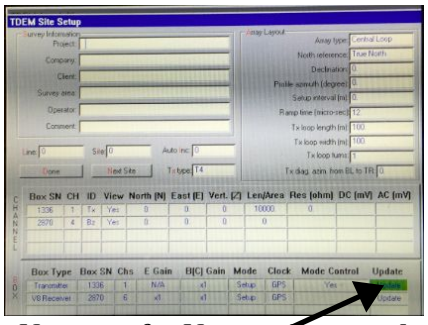
In [TDEM Site Setup] on V8

Enter Survey Information (if necessary once) by [Ctrl] [S] [Ctrl] [L] Enter Line and [Ctrl] [T] Enter site

Start data recording by [Ctrl] [D]

In ~1min, Decay / App.res. curves displayed with decay value

(If decay shows negative values, stop by [Ctrl] [S], then turn of T4 output, then Switch T4 loop output connection +<>-, then turn power output ON and Re-start V8 acquisition)

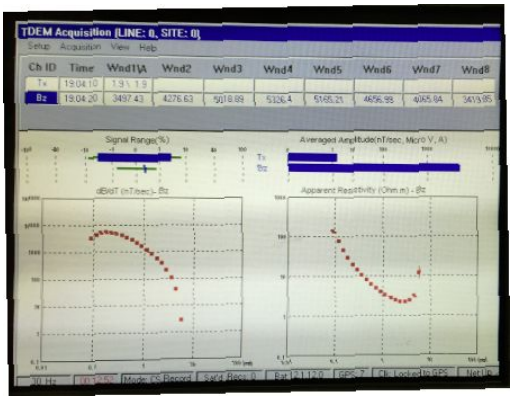


No green for Non mode control

When Decay and App.Res. Curves becomes smooth [Ctrl] [S] to stop recording on V8

Turn off TMR by turn off switch

wait until LED OFF for completion of filing



On V8, select [Setup] in {TDEM Acquisition]

Select [Shutdown V8] to shutdown V8

Move Tx-Rx set to next site

E CSAMT

Also Refer to CSAMT-2006

E1 Survey Plan/Layout

E1.1 Planned Investigation depth and Measurement frequency range

D b = ~ 350 * (F/ ρ)^0.5

Db : (Bostik) investigation depth (m)
F : frequency (hz)
ρ : ~ resistivity of ground (Ω·m)

Then Fl (lowest frequency) needed is to investigate Db depth is

Fl = Db^2 / 350^2 * ρ

Preferable min. Rx-Tx distance, Ly is

Skin depth (m) = 503 * (ρ / Fl)^0.5

Ly = (3~5) * Skin depth
= (1500 ~ 2500) * (ρ / F)^0.5

(Refer to CSAMT-2006, p5, p11, p19)

E1.2 Survey Lines

If geological strike is known, layout survey lines approx. Perpendicular to the strike. Draw them to a map

E1.3 Tx Dipole

Signal strength at Rx is approximately function as below

$$\text{Sig strength} \propto I * AB / L^3$$

where I : Tx Current(A),
AB : Tx dipole length ,
L : Tx-Rx distance

Therefore, ***make AB longer, make contact resistance of A&B electrode as low as possible.***

E1.4 Range of survey lines

As illustrated right

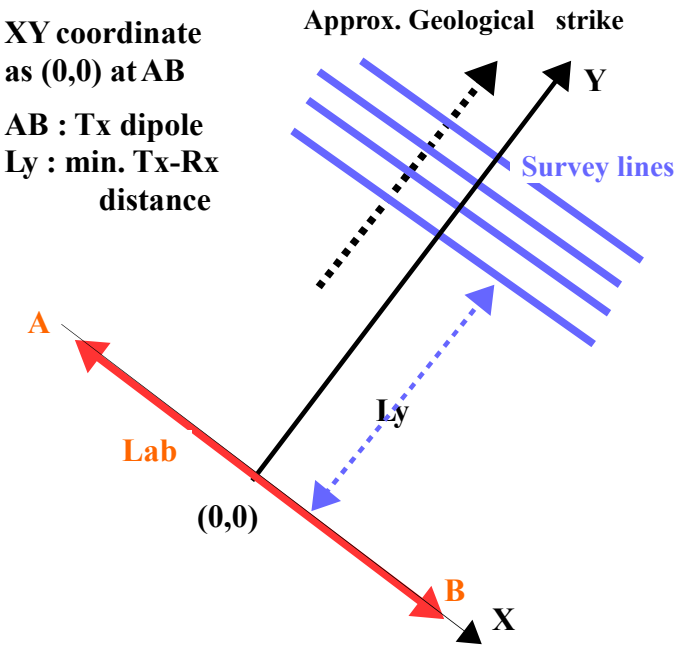
(Refer to CSAMT-2006, Fig 2-1 ~ 2-4)

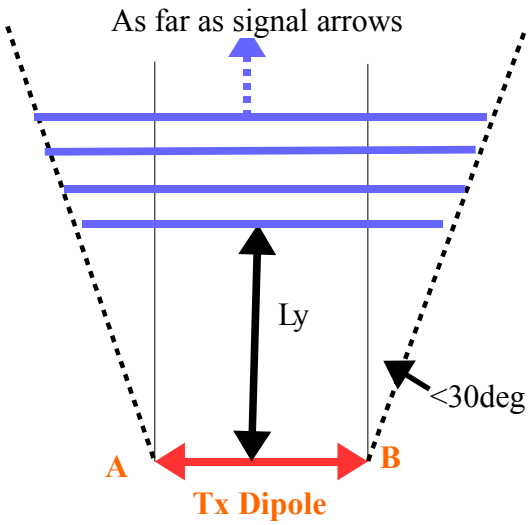
E1.5 Scalar Measurement Rx Layout

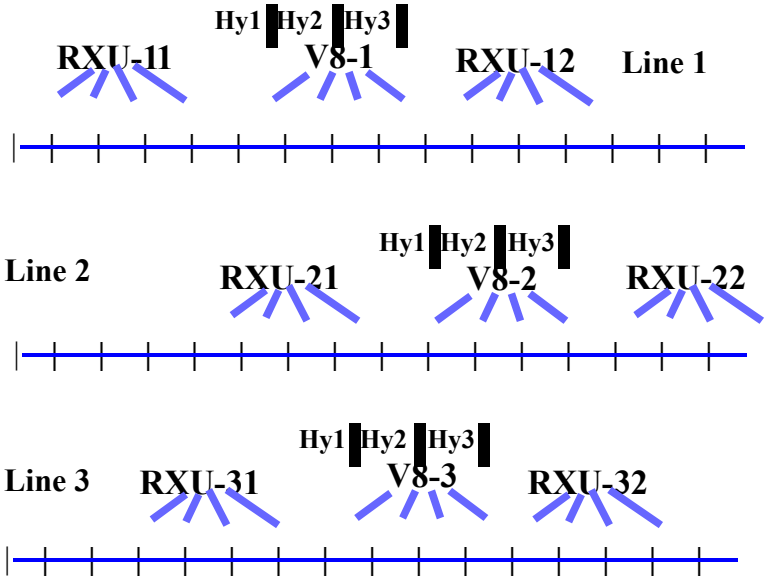
Layout example (right figure)

Example : Set V8-1, Set V8-2 and/or Set V8-3 can be layout independently and start/finish independently while Tx is continuously operated.

(V8 : Hy and 1~3 Ex dipole(s)
RXU: Hy and 1~2 Ex dipole(s)
Hy(s) are perpendicular to survey lines laid horizontally on ground)







E2 Measurement Frequency table

Mode	Frequency	Tx-I	End-Time
FD	9600.00000	1.00	00:00:50
FD	7680.00000	1.00	00:01:40
FD	6400.00000	1.00	00:02:30
FD	4800.00000	1.00	00:03:20
FD	3840.00000	1.00	00:04:10
FD	3200.00000	1.00	00:05:00
FD	2560.00000	1.00	00:05:50
FD	1920.00000	1.00	00:06:40
FD	1536.00000	1.00	00:07:30
FD	1280.00000	1.00	00:08:20
FD	1024.00000	1.00	00:09:10
FD	768.00000	1.00	00:10:00
FD	512.00000	1.00	00:10:50
FD	384.00000	1.00	00:11:40
FD	256.00000	1.00	00:12:30
FD	192.00000	1.00	00:13:20
FD	128.00000	1.00	00:14:10
FD	96.00000	1.00	00:15:00
FD	64.00000	1.00	00:15:50
FD	48.00000	1.00	00:16:40
FD	32.00000	1.00	00:17:30
FD	24.00000	1.00	00:18:20
FD	16.00000	1.00	00:19:10
FD	12.00000	1.00	00:20:00
FD	8.00000	1.00	00:21:00
FD	6.00000	1.00	00:22:00
FD	4.00000	1.00	00:23:30
FD	3.00000	1.00	00:25:00
FD	2.00000	1.00	00:26:30
FD	1.50000	1.00	00:28:00
FD	1.00000	1.00	00:30:00

~ 2 freqs / Binary step

Mode	Frequency	Tx-I	End-Time
FD	9600.00000	1.00	00:00:50
FD	7680.00000	1.00	00:01:40
FD	6400.00000	1.00	00:02:30
FD	5120.00000	1.00	00:03:20
FD	4800.00000	1.00	00:04:10
FD	3840.00000	1.00	00:05:00
FD	3200.00000	1.00	00:05:50
FD	2560.00000	1.00	00:06:40
FD	1920.00000	1.00	00:07:30
FD	1536.00000	1.00	00:08:20
FD	1280.00000	1.00	00:09:10
FD	1024.00000	1.00	00:10:00
FD	768.00000	1.00	00:10:50
FD	640.00000	1.00	00:11:40
FD	512.00000	1.00	00:12:30
FD	384.00000	1.00	00:13:20
FD	320.00000	1.00	00:14:10
FD	256.00000	1.00	00:15:00
FD	192.00000	1.00	00:15:50
FD	160.00000	1.00	00:16:40
FD	128.00000	1.00	00:17:30
FD	96.00000	1.00	00:18:20
FD	80.00000	1.00	00:19:10
FD	64.00000	1.00	00:20:00
FD	48.00000	1.00	00:20:50
FD	40.00000	1.00	00:21:40
FD	32.00000	1.00	00:22:30
FD	24.00000	1.00	00:23:20
FD	20.00000	1.00	00:24:10
FD	16.00000	1.00	00:25:00
FD	12.00000	1.00	00:26:00
FD	10.00000	1.00	00:27:00
FD	8.00000	1.00	00:28:00
FD	6.00000	1.00	00:29:15
FD	5.00000	1.00	00:30:30
FD	4.00000	1.00	00:31:45
FD	3.00000	1.00	00:33:00
FD	2.50000	1.00	00:34:30
FD	2.00000	1.00	00:36:00
FD	1.50000	1.00	00:38:00
FD	1.25000	1.00	00:40:00
FD	1.00000	1.00	00:45:00

~ 23reqs / Binary step

Mode	Frequency	Tx-I	End-Time
FD	9600.00000	1.00	00:00:50
FD	8533.33330	1.00	00:01:40
FD	7680.00000	1.00	00:02:30
FD	6400.00000	1.00	00:03:20
FD	5120.00000	1.00	00:04:10
FD	4800.00000	1.00	00:05:00
FD	3840.00000	1.00	00:05:50
FD	3200.00000	1.00	00:06:40
FD	2844.44440	1.00	00:07:30
FD	2560.00000	1.00	00:08:20
FD	1920.00000	1.00	00:09:10
FD	1536.00000	1.00	00:10:00
FD	1280.00000	1.00	00:10:50
FD	1024.00000	1.00	00:11:40
FD	960.00000	1.00	00:12:30
FD	768.00000	1.00	00:13:20
FD	640.00000	1.00	00:14:10
FD	512.00000	1.00	00:15:00
FD	480.00000	1.00	00:15:50
FD	384.00000	1.00	00:16:40
FD	320.00000	1.00	00:17:30
FD	256.00000	1.00	00:18:20
FD	240.00000	1.00	00:19:10
FD	192.00000	1.00	00:20:00
FD	160.00000	1.00	00:20:50
FD	128.00000	1.00	00:21:40
FD	106.66667	1.00	00:22:30
FD	96.00000	1.00	00:23:20
FD	80.00000	1.00	00:24:10
FD	64.00000	1.00	00:25:00
FD	56.88889	1.00	00:26:00
FD	48.00000	1.00	00:27:00
FD	40.00000	1.00	00:28:00
FD	32.00000	1.00	00:29:00
FD	28.44444	1.00	00:30:00
FD	24.00000	1.00	00:31:00
FD	20.00000	1.00	00:32:15
FD	16.00000	1.00	00:33:30
FD	14.22222	1.00	00:34:45
FD	12.00000	1.00	00:36:00
FD	10.00000	1.00	00:37:30
FD	8.00000	1.00	00:39:0(
FD	7.11111	1.00	00:40:3(
FD	6.00000	1.00	00:42:0(
FD	5.00000	1.00	00:43:4[illegible]
FD	4.00000	1.00	00:45:3(
FD	3.55555	1.00	00:47:1[illegible]
FD	3.00000	1.00	00:49:0(
FD	2.50000	1.00	00:50:4[illegible]
FD	2.00000	1.00	00:52:3(
FD	1.77778	1.00	00:54:1[illegible]
FD	1.50000	1.00	00:56:0(
FD	1.25000	1.00	00:58:0(
FD	1.00000	1.00	01:00:0(

~ 4 freqs / Binary step

Edit in Excel fom then

Make these in CSV file

FD Frequency Domain

Tx-I Tx current
For T3, usually enter [1]
For TXU, specify values by initial Tx test

Time End (GPS) Time of each frequency can be modified

Frequency can be deleted , can be modified and/or can be added frequencies specified in manual

Creating .FST file (* = 2 ~ 8)

1. **convert table to ***.CSV**
2. **Execute >FREQTABL ***.CSV**
3. **Rename ***.FST to 2~8.FST**
   Put in DATA folder of CF card
   (2~8) has to be from 2 in sequence .
   Can not be 2.FST, 4.FST

E3 Preparation of TBL files

Examples of FST as master

2.FST :	9600 ~ 1Hz	31 Freqs	30 min / cycle
3.FST :	9600 ~10 Hz	24 Freqs	20 min / cycle
4.FST :	9600 ~ 1Hz	42 Freqs	45 min / cycle
5.FST :	9600 ~10Hz	32 Freqs	30 min / cycle
6.FST :	9600 ~ 1Hz,	54 Freqs	60 min / cycle

E3.1 Case 1: One or Multiple V8 with TXU + TMR (No Radio Control assumed)

a- Create TBL files on CF cards

a0 Put frequency Stepping file 2~7.FST in DATA folder of all CF cards

a1 Open TblEdit

a2 Click 4th mark (Acquisition)

Set/Enter/Select parameters

[Setup] [CAMT]

E-gain = [x1] H-gain = [x1]

LP Filter = [2] Line F = [50]

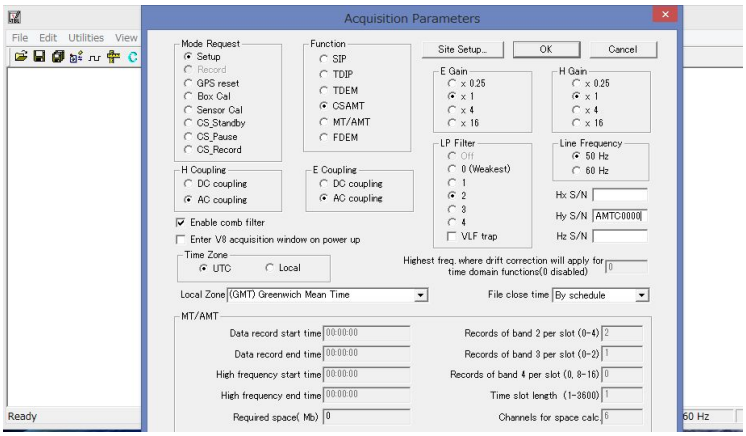
H: [AC coup,,] E:[AC coup.,]

[Enabl comb] Time zone [UTC]

Hy S/N [AMTC0000]

File close time [By schedule]

Click [Site setup]



On (Input V8 TMR S / N) menu

Enter TMR S/N [8888] and V8 S/N [1111]

Click [OK]

a3 On (Site Setup) window

Enter (Survey Information) if wanted

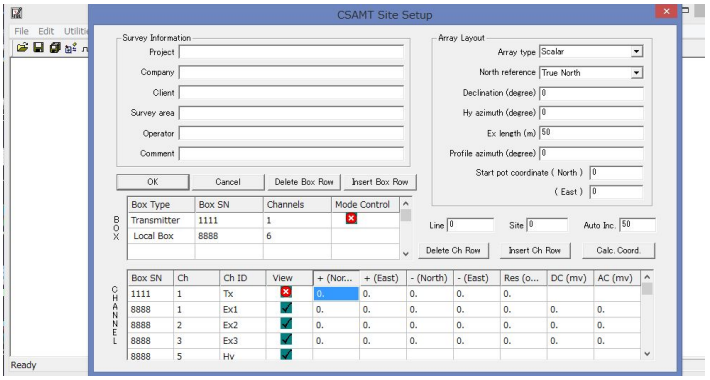
Enter/select/specify/confirm

In BOX entry

BoxType	BoxSN	Channels	Mode
Transmitter	[1111]	[1]	[x]
Receiver	[2222]		[6]

Ex length [100] (example)

Line [xxxx] Site [yyyy]

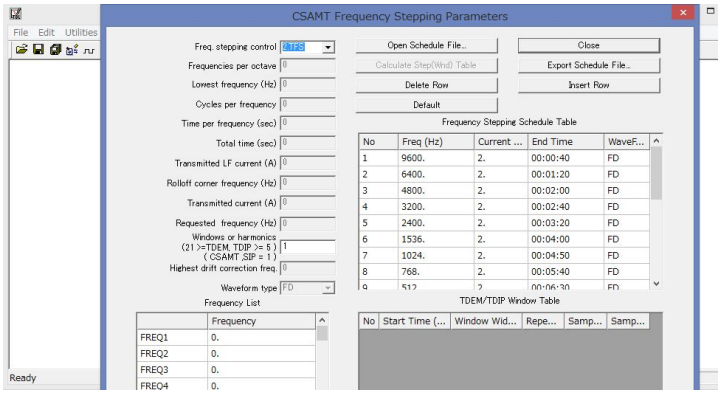


In Channel entry

BoxSN	Ch	ChID	View
0000	1	Tx	x
1111	1	Ex1	/
1111	2	Ex3	/
1111	3	Ex3	/
1111	5	Hy	/

Note: Box SN - By clicking the box

Click [OK] , go back to (Acquisition) window, Click [OK] to TblEdit



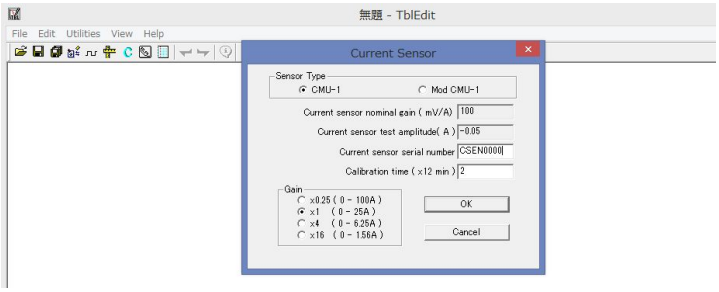
a4 Click 5th mark (Stepping)

Select [*.TFS] and Open schedule file (*.FST)

Freq. Stepping table displayed

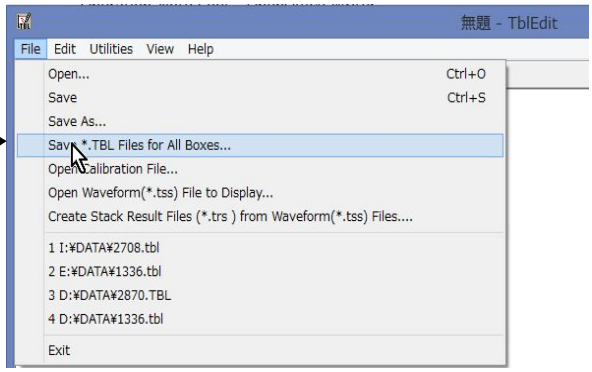
Click [Close]]

a5 Click 7th mark [C] (Current Sensor)
Check [CMU-1]
Enter C sensor SN [CSEN0000]
Check [x0.25] or [x1]
Click [OK]

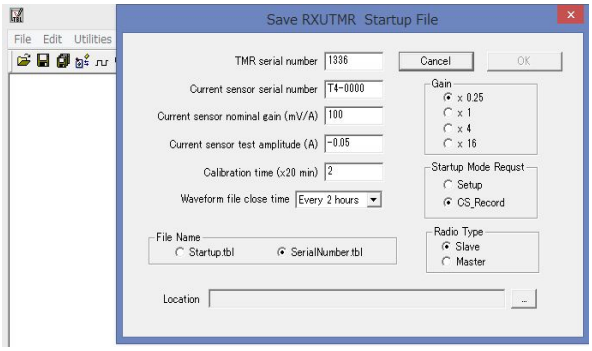


Click [OK] to open TblEdit window

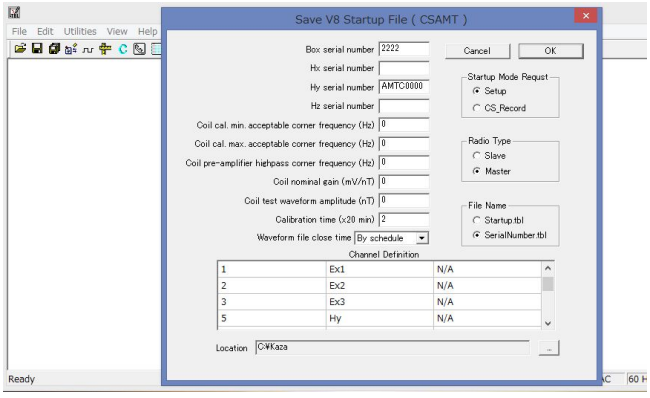
a6 Saving [*.TBL] in DATA folder of CF cards
(in the same way described in D1-1^2b)
Click [Save *.TBL files all Boxes]



[Save RXU-TMR Setup File] opens
Confirm or Set the followings
Gain = [x1] or [x4]
Waveform close time = [By schedule]
Startup Mode = [Setup]
Radio type = [Slave]
File Name = [Serial Number. TBL]
Insert CF card for TMR in USB reader
Got o Location to DATA in CF card
by clicking Location button
Check [OK] and remove CF card



[Save V8 Setup File] opens
Confirm the followings Box serial number
Startup mode = [Setup]
Radio type =]Master]
File Name = [Serial Number. TBL]
Wave File Close Time = [By schedule]
Channel = 5 (or 4 or 6)
Channel Definition = Ex1
Channel Definition = Ex2
Channel Definition = Ex3
Channel Definition = Hy
Insert CF card for V8 in USB reader
Go to Location to DATA in CF card
by clicking Location butten
Check [OK]



after shut down remove CF card
note: If RXU units to be used, RXUs have to be added

E4 System configuration and Layout for Scalar CSAMT with multi V8s+RXUs and TXU30+TMR

E4.1 TXU30

Initial Test

Prepare Tx dipole making Contact resistant as low as possible

Measure Tx dipole total resistance with analog meter

Connect Tx dipole, GPS antenna and MG to TXU30

Measure output current at 1Hz and output current (A)

Shut off TXU and MG

Editing TBL file for TXU30

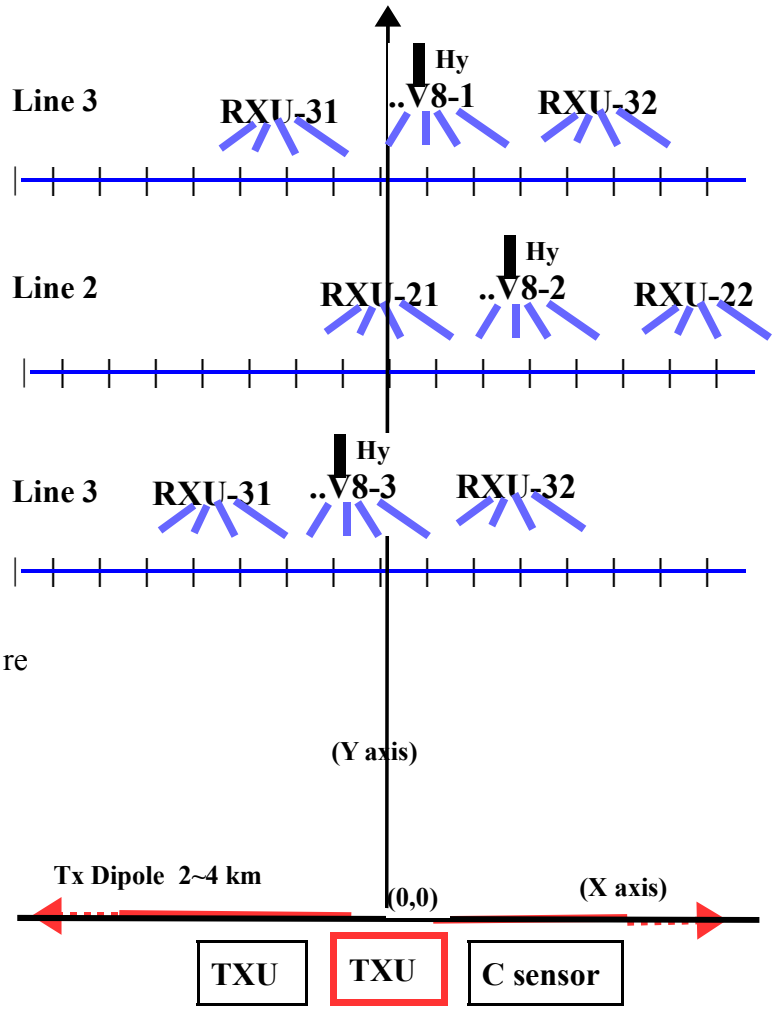
Load TblEdit

Edit current value in Freq. Stepping Table

Refer to X6 Current setting on Freq. Step. Table for CF Card for TXU30

and operation using TXU30 for CSAMT ans SIP

Scalar CSAMT layout



E5 Scalar CSAMT Data Acquisition

E5.1 Start TXU30 with selected FST table

a- When it started transmission, inform Receiver side

b- Keep transmitting until Receiver side to inform to stop

c- Shutdown TMR, then TXU30, then MG.

Note: For TXU30 operation, refer to the TXU30 manual

E5.2 Setup V8-1 system with the same frequency stepping table (*.FST) as for TXU+TMR

a- Edit {Site Setup) on V8 display such as [Line] and [Site]

b- Start Recording by [Start Recording] at anytime

c- Monitor data quality on V8 display

d- After once cycle of frequency step, if data quality is acceptable, Stop Recording by [Ctrl] [S] or continue for more cycle.

e- Pickup V8-1 sets and move to next site

F5.3 With multiple V8 sets, each V8 set can independently setup, start recording and stop recording, then move to next site.

F5.4 When all measurements are done, inform Transmitter

F5.5 Shutdown TXU30 set up

F.5.6 Remove CF cards from all units

F SIP / Resistivity

F1 Survey Plan/Layout with Dipole-Dipole Array with T3 or TXU transmitter

Refer to : X3 Examples of Survey Plan/Layout with Dipole-Dipole Array with T3 or XUU transmitter and Measurement Procedure

F2 Measurement Frequency table (Refer to Master Frequency Stepping Table)

Mode	Frequency	Tx-I	End-Time
FD	256.00000000	16.00	00:00:40
FD	192.00000000	16.00	00:01:20
FD	128.00000000	16.00	00:02:00
FD	96.00000000	16.00	00:02:40
FD	64.00000000	16.00	00:03:20
FD	48.00000000	16.00	00:04:00
FD	32.00000000	16.00	00:04:50
FD	24.00000000	16.00	00:05:40
FD	16.00000000	16.00	00:06:30
FD	12.00000000	16.00	00:07:20
FD	8.00000000	16.00	00:08:10
FD	6.00000000	16.00	00:09:00
FD	4.00000000	16.00	00:10:00
FD	3.00000000	16.00	00:11:00
FD	2.50000000	16.00	00:12:00
FD	2.00000000	16.00	00:13:00
FD	1.50000000	16.00	00:14:00
FD	1.00000000	16.00	00:15:00
FD	0.66666667	16.00	00:16:30
FD	0.50000000	16.00	00:18:00
FD	0.33333333	16.00	00:20:00
FD	0.25000000	16.00	00:22:30
FD	0.16666667	16.00	00:25:30
FD	0.12500000	16.00	00:30:00

256hz ~ 8 sec
~ 2 freqs / Binary step

Mode	Frequency	Tx-I	End-Time
FD	512.00000000	16.00	00:00:40
FD	384.00000000	16.00	00:01:20
FD	256.00000000	16.00	00:02:00
FD	192.00000000	16.00	00:02:40
FD	128.00000000	16.00	00:03:20
FD	96.00000000	16.00	00:04:00
FD	64.00000000	16.00	00:04:40
FD	48.00000000	16.00	00:05:20
FD	32.00000000	16.00	00:06:00
FD	24.00000000	16.00	00:07:00
FD	16.00000000	16.00	00:08:00
FD	12.00000000	16.00	00:09:00
FD	8.00000000	16.00	00:10:00
FD	6.00000000	16.00	00:11:00
FD	4.00000000	16.00	00:12:00
FD	3.00000000	16.00	00:13:20
FD	2.00000000	16.00	00:14:40
FD	1.50000000	16.00	00:16:00
FD	1.00000000	16.00	00:17:40
FD	0.66666670	16.00	00:19:20
FD	0.50000000	16.00	00:21:00
FD	0.33333330	16.00	00:23:00
FD	0.25000000	16.00	00:25:00
FD	0.16666667	16.00	00:27:00
FD	0.12500000	16.00	00:29:00
FD	0.08333333	16.00	00:32:00
FD	0.06250000	16.00	00:36:00
FD	0.04166667	16.00	00:40:00
FD	0.03125000	16.00	00:45:00

512 – 32 sec
~2reqs / Binary step

Mode	Frequency	Tx-I	End-Time
FD	512.00000000	16.00	00:00:40
FD	384.00000000	16.00	00:01:20
FD	320.00000000	16.00	00:02:00
FD	256.00000000	16.00	00:02:40
FD	192.00000000	16.00	00:03:20
FD	160.00000000	16.00	00:04:00
FD	128.00000000	16.00	00:04:40
FD	96.00000000	16.00	00:05:20
FD	80.00000000	16.00	00:06:00
FD	64.00000000	16.00	00:06:40
FD	48.00000000	16.00	00:07:20
FD	40.00000000	16.00	00:08:00
FD	32.00000000	16.00	00:08:40
FD	24.00000000	16.00	00:09:20
FD	20.00000000	16.00	00:10:00
FD	16.00000000	16.00	00:10:40
FD	12.00000000	16.00	00:11:20
FD	9.60000000	16.00	00:12:00
FD	8.00000000	16.00	00:12:50
FD	6.00000000	16.00	00:13:40
FD	5.00000000	16.00	00:14:30
FD	4.00000000	16.00	00:15:20
FD	3.00000000	16.00	00:16:10
FD	2.50000000	16.00	00:17:00
FD	2.00000000	16.00	00:18:00
FD	1.50000000	16.00	00:19:00
FD	1.25000000	16.00	00:20:00
FD	1.00000000	16.00	00:21:00
FD	0.66666670	16.00	00:22:20
FD	0.50000000	16.00	00:23:40
FD	0.40000000	16.00	00:25:00
FD	0.33333330	16.00	00:26:40
FD	0.25000000	16.00	00:28:30
FD	0.20000000	16.00	00:30:20
FD	0.16666667	16.00	00:32:20
FD	0.12500000	16.00	00:34:40
FD	0.10000000	16.00	00:37:20
FD	0.08333333	16.00	00:40:40
FD	0.06250000	16.00	00:44:40
FD	0.05000000	16.00	00:49:20
FD	0.04166667	16.00	00:54:40
FD	0.03125000	16.00	01:00:00

512Hz ~ 32 sec ~
~3 freqs / Binary step

Edit in Excel form then
Make these in CSV file
FD Frequency Domain
Tx-I Tx current
T3 does not use, so any
for TXU, specify values by initial Tx test
End-time (GPS) of each freq, can be modified
Frequency can be deleted , can be modified
can be added frequencies specified in manual
Creating .FST file (* = 2 ~ 8)

1. convert a table to ***.CSV
2. Execute >FREQTABL ***.CSV
3. Rename ***.FST to 2~8.FST

Put in DATA folder of CF card
(2~8) has to be from 2 in sequence . Can not be 2.FST, 4.FST

F3 Preparation of TBL files

Examples of FST as master

2.FST :	256Hz ~ 8 sec	24Freqs	30 min / cycle
3.FST :	512Hz ~32 sec	29 Freqs	45 min / cycle
4.FST :	512Hz ~ 32 sec	42 Freqs	60 min / cycle

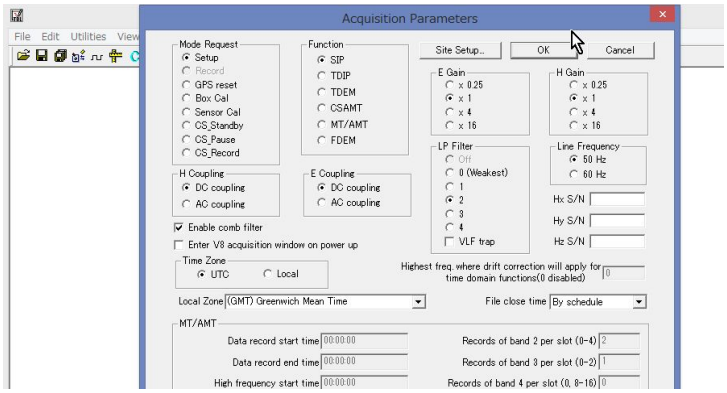
F3.1 Case 1: One or Multiple V8 with TXU + TMR and RXUs if any

f- Create TBL files on CF cards

f0 Put frequency Stepping file 2~7.FST in DATA folder of all CF cards

f1 Open TblEdit

f2 Click 4th mark (Acquisition)



Set/Enter/Select parameters

[Setup] [SIP]

E-gain = [x1] H-gain = [x1]

LP Filter = [2] Line F = [50]

H: [DC coup,,] E:[DC coup.,]

[Enable comb] Time zone [UTC]

File close time [By schedule]

Click [Site setup]

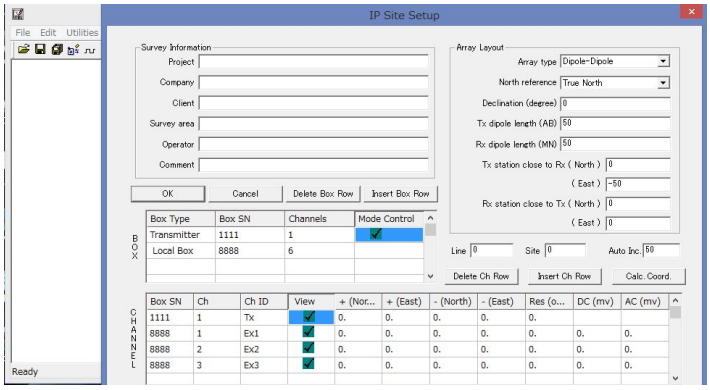
On (Input V8 TMR S / N) menu

Enter TMR S/N [1111] V8 S/N [8888]

Aux1 Box S/N [2222] if any, Aux2 Box S/N [3333] if anymore

Click [OK]

f3 On (Site Setup) window



Enter (Survey Information) if wanted

Enter/select/specify/confirm

Select Array Type [Dipole-Dipole]

Enter site AB, MN site co-ordinates

In [BOX] entry

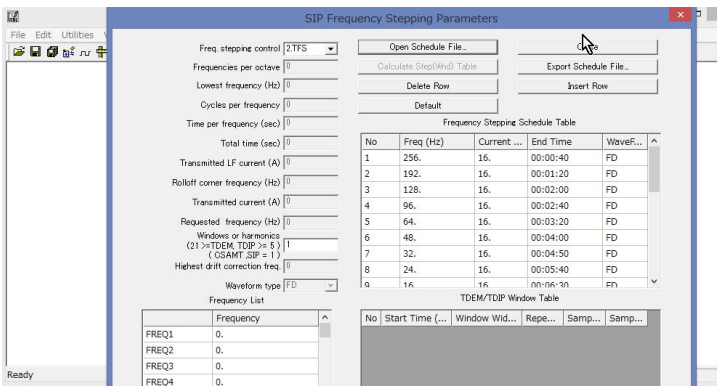
BoxType	BoxSN	Channels	Mode
Transmitter	[1111]	[1]	[x]
Receiver	[8888]	[6]	
Aux Box	[2222]	if any	
Ex length	[100]	(example)	
Line [xxxx]	Site [yyyy]		

In [Channel] entry

BoxSN	Ch	ChID	View
0000	Tx	x	
1111	1	Ex1	/
1111	2	Ex3	/
1111	3	Ex3	/

Note: Box SN - By clicking box

Click [OK], go back to (Acquisition) window, Click [OK] to TblEdit



f4 Click 5th mark (Stepping)

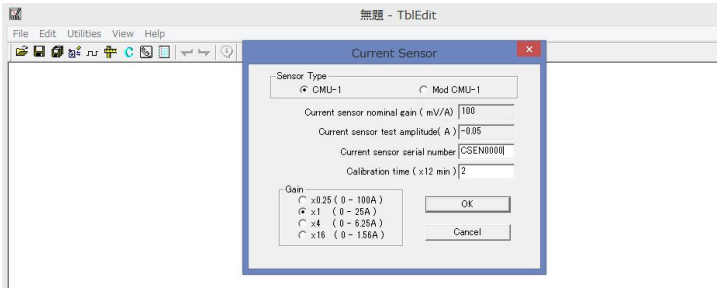
Select [*.TFS]

Open schedule file (*.FST)

Freq. Stepping table displayed

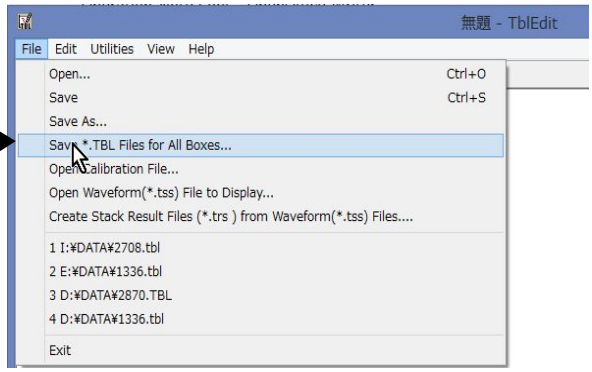
Click [Close]]

f5 Click 7th mark [C] (Current Sensor)
Check [CMU-1]
Enter C sensor SN [CSEN0000]
Check [x0.25] or [x1]
Click [OK]

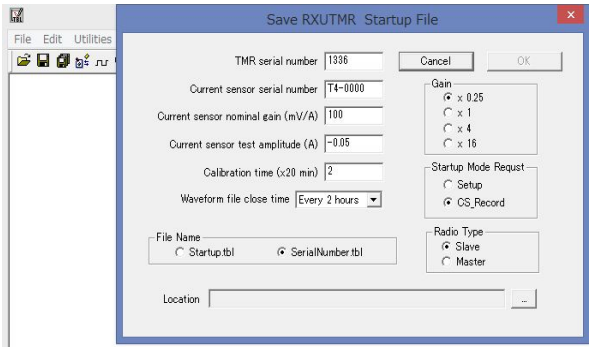


Click [OK] to open TblEdit window

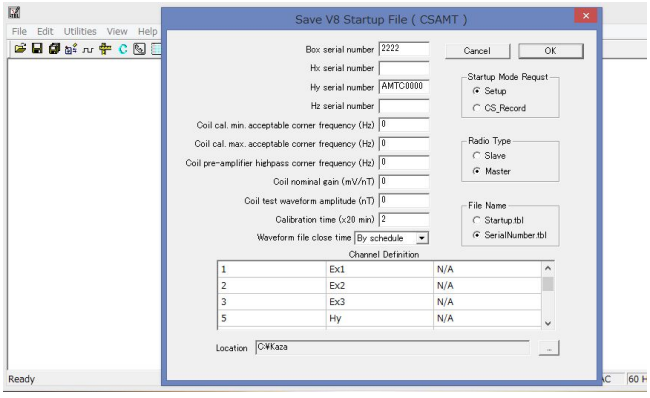
f6 Saving [*.TBL] in DATA folder of CF cards
(in the same way described in D1-1^2b)
Click [Save *.TBL files all Boxes]



[Save RXU-TMR Setup File] opens
Confirm or Set the followings
Gain = [x1] or [x4]
Waveform close time = [By scedule]
Startup Mode = [Setup]
Radio type = [Slave]
File Name = [Serial Number.TBL]
Insert CF card for TMR in USB reader
Go to Location to DATA in CF card
by clicking Location button
Check [OK] and remove CF card



[Save V8 Setup File] opens
Confirm the followings Box S/N
Startup mode = [Setup]
Radio type =]Master]
File Name = [Serial Number. TBL]
Wave File Close Time = [By schedule]
Channel = 5 (or 4 or 6)
Channel Definition = Ex1
Channel Definition = Ex2
Channel Definition = Ex3
Channel Definition = Ex4
continue if anymore for RXU
Insert CF card for V8 in USB reader
Go to Location to DATA in CF card
by clicking Location button
Check [OK]



after shut down remove CF card
note: If RXU units to be used, RXUs have to be added

F4 SIP Data Acquisition with Dipole-Dipole Array

F4.1 Layout Tx, V8s and RXUs if used as shown in F1 Survey Layout
Make sure all connections, E-line+pot with measuring each AB, MNs

F4.2 Start Tx with selected FST table

a- When it started transmission, inform Receiver side

b- Keep transmitting until Receiver side to inform to stop

c- Shutdown TMR, then TXU30, then MG.

For TXU30 operation, the current values should be edited.
Refer to: X6 Current setting on Freq. Step. Table for CF Card for TXU-30
and operation using TXU30 for CSAMT ans SIP

E4.3 Setup V8-1 system with the same frequency stepping table (*.FST) as ifor TXU+TMR

a- Edit {Site Setup) on V8 display such as [Line] and [Site]

b- Start Recording by [Start Recording] or [Ctrl] [R] at anytime

c- Monitor data quality on V8 display

d- After once cycle of frequency steps, if data quality is acceptable,
Stop Recording by [Ctrl] [S] or continue for more cycle until satisfactory data shown

e- Pickup V8-1 sets and move to next site

F5.3 With multiple V8 sets, each V8 set can independently
setup, start recording and stop recording, then move to next site.

F5.4 When all measurements are done, inform Transmitter

F5.5 Shutdown TXU30 set up

F.5,6 Remove CF cards from all units

Refer to

X3 Examples of Survey Plan/Layout with Dipole-Dipole Array
for SIP/TDIP with T3 or TXU

G TDIP / Resistivity

G1 Survey Plan/Layout with Dipole-Dipole Array with T3 or TXU transmitter

G2 Preparation of TBL files

Case 1: One or Multiple V8 with TXU + TMR and RXUs if any as a set

g- Create TBL files on CF cards

g1 Open TblEdit

g2 Click 4th mark (Acquisition)

Set/Enter/Select parameters

[Setup] [TDIP]

E-gain = [x1] H-gain = [x1]

LP Filter = [Off] Line F = [50]

H: [DC coup,,] E:[DC coup.,]

Time zone [UTC]

File close time [By schedule]

Click [Site setup]

On (Input V8 TMR S / N) menu

Enter TMR S/N [1111]

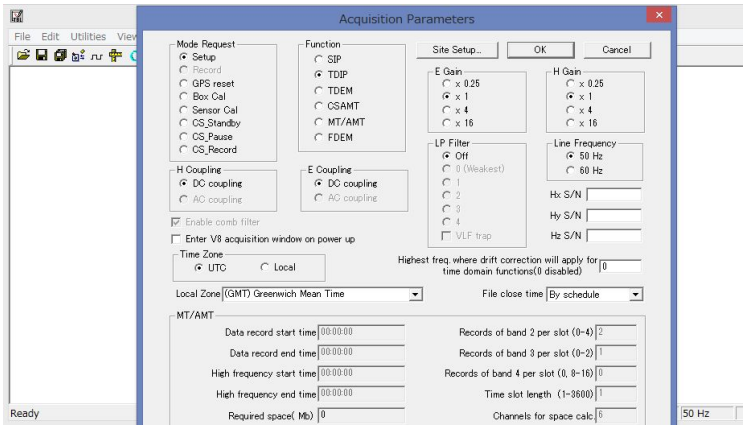
V8 S/N [8888]

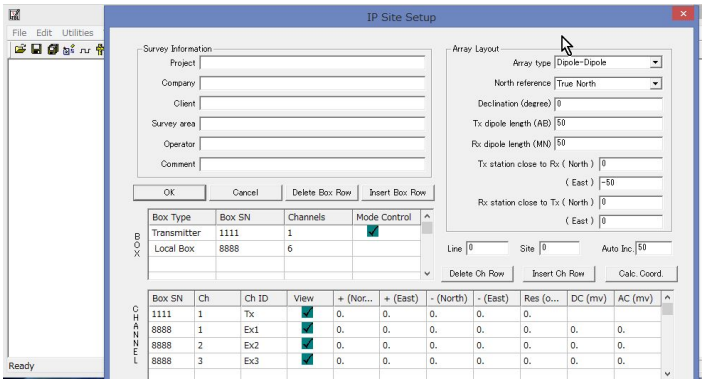
Aux1 Box S/N [2222] if any,

Aux2 Box S/N [3333]

Continue if anymore

Click [OK]





g3 On (Site Setup) window

Enter (Survey Information) if any

Enter/select/specify/confirm

Tx dipole length (AB) : [50]

Rx dipole length (MN) : [50]

Tx close to Rx (North) : [0] (East) : [-50]

Rx close to Tx (North) : [0] (Est) : [0]

In BOX entry

Box Type	BoxSN	Channels	Mode
Transmitter	[1111]	[1]	[x]
Receiver	[2222]		[6]
Ex length	[100]	(example)	
Line	[xxxx]	Site [yyyy]	

Click [OK] , go back to (Acquisition)

[OK] to TblEdit

In Channel Entry

BoxSN	Ch	ChID	View
1111	1	Tx	x
8888	1	Ex1	/
8888	2	Ex3	/
8888	3	Ex3	/
2222	1	Ex4	/

more if any In Channel entry

g4 Click 5th mark (Stepping)

Select Freq. Step Control [No Step]

Transmit Current [5] ex.

Requested Freq. [0.125] ex.

Window or harmonic [21]

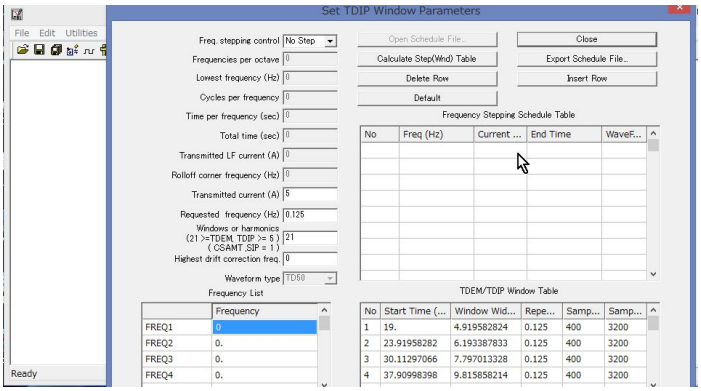
Tx low current [7] ex.

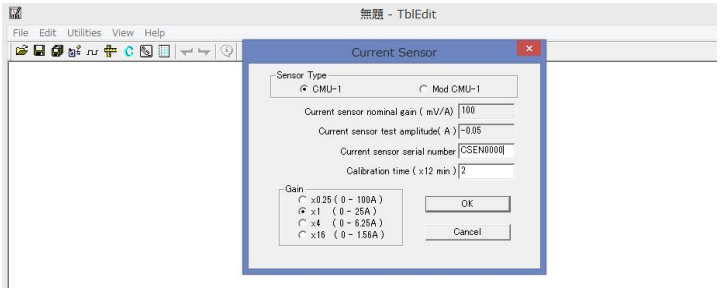
Windows or harmonic [21]

Click [Calculate step table)

TDIP window table appears

Click [Close]]

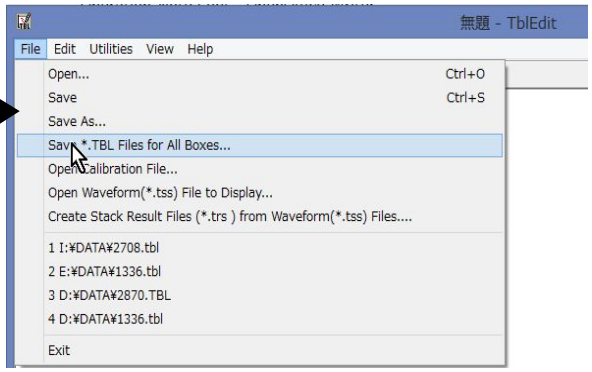




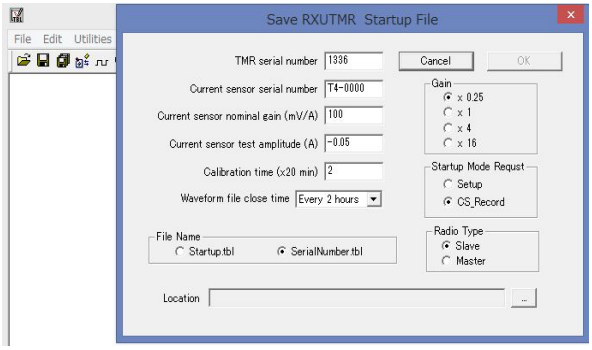
g5 Click 7th mark [C] (Current Sensor)
Check [CMU-1]
Enter C sensor SN [CSEN0000]
Check [x0.25] or [x1]
Click [OK]

Click [OK] to open TblEdit window

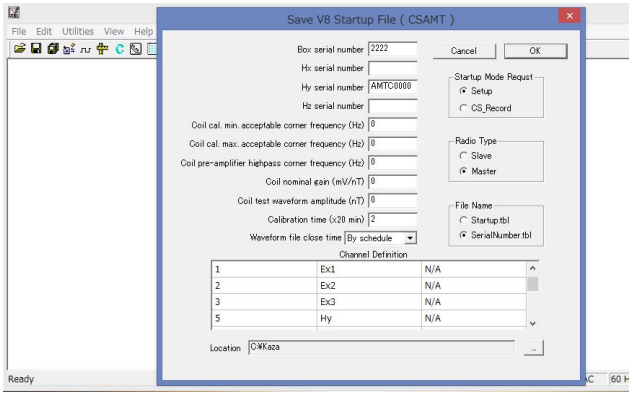
g6 Saving [*.TBL] in DATA folder of CF cards
(in the same way described in D1-1^2b)
Click [Save *.TBL fiels all Boxws]



[Save RXU-TMR Setup File] opens
Confirm or Set the followings
Gain = [x1] or [x4]
Waveform close time = [By scedule]
Startup Mode = [Setup]
Radio type = [Slave]
File Name = [SerialNumber.TBL]
Insert CF card for TMRin USB reader
Go to Location to DATA in CF card
by clicking Location button
Check [OK] and remove CF card



[Save V8 Setup File] opens
Confirm the followings Box S/N
Startup mode = [Setup]
Radio type =]Master]
File Name = [Serial Number. TBL]
Wave File CloseTime = [By schedule]
Channel = 5 (or 4 or 6)
Channel Definition = Ex1
Channel Definition = Ex2
Channel Definition = Ex3
Channel Definition = Ex4
continue if anymore for RXU
Insert CF card for V8 in USB reader
Go to Location to DATA in CF card
by clicking Location button
Check [OK]



after shut down remove CF card
note: If RXU units to be used, RXUs have to be added

G3 TDIP Data Acquisition with Dipole-Dipole Array

G3.1 Layout Tx, V8s and RXUs if used as shown in F1 Survey Layout
Make sure all connections, E-line+pot with measuring each AB, MNs

G4.2 Start Tx with **. TBL in CF card**

a- When it started transmission, inform Receiver side

b- Keep transmitting until Receiver side to inform to stop

c- Shutdown TMR, then TXU30, then MG.
Note: For TXU30 operation, refer to the TXU30 manual

G4.3 Setup V8-1 system with **.TBL in CF card**

a- Edit {Site Setup) on V8 display such as [Line] and [Site]

b- Start Recording by [Start Recordig] or [Ctrl] [R] at anytime

c- Monitor data quolity on V8 display

d- After once cycle of frequency steps, if data quality is acceptable,
Stop Recording by [Ctrl] [S] or continue for more cycle until satisfactory data shown

e- Pickup V8-1 sets and move to next site

G5.3 With multiple V8 sets, each V8 set can independently
setup, start recording and stop recording, then move to next site.

G5.4 When all measurements are done, inform Transmitter

G5.5 Shutdown TXU30 set up

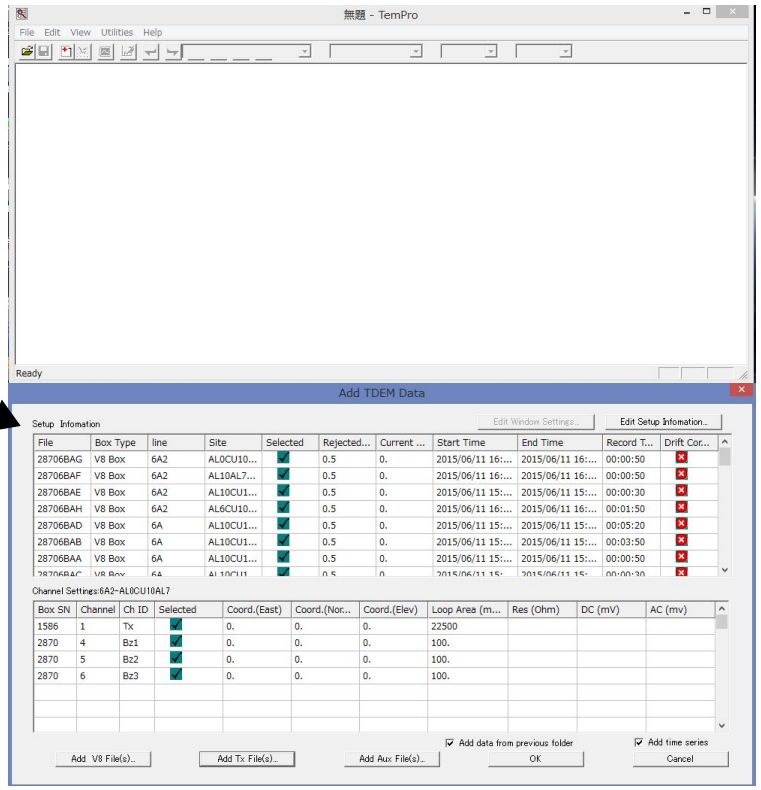
G5,6 Remove CF cards from all units

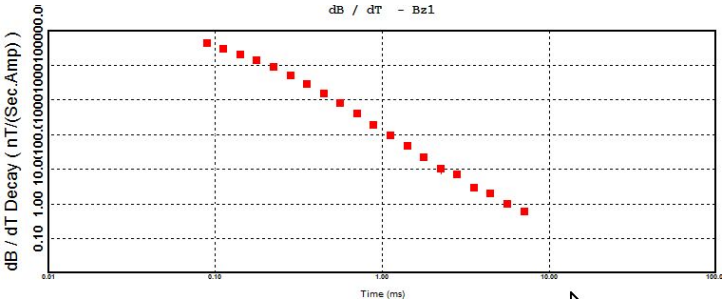
DATA PROCESSING

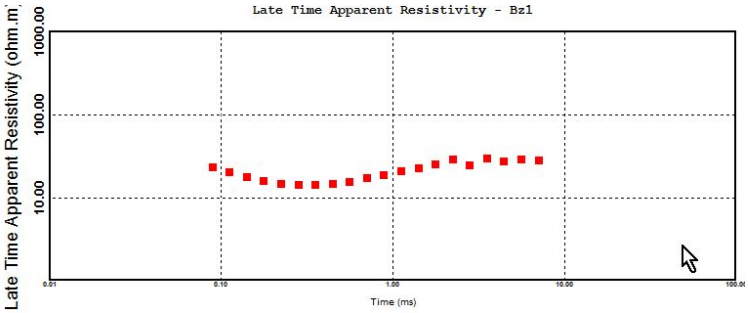
H TDEM

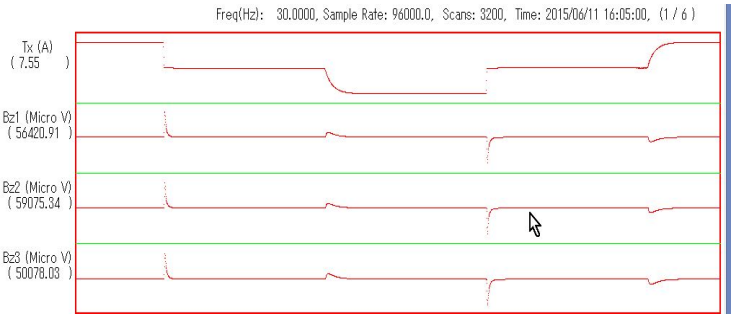
H1 TemPro Open TemPro

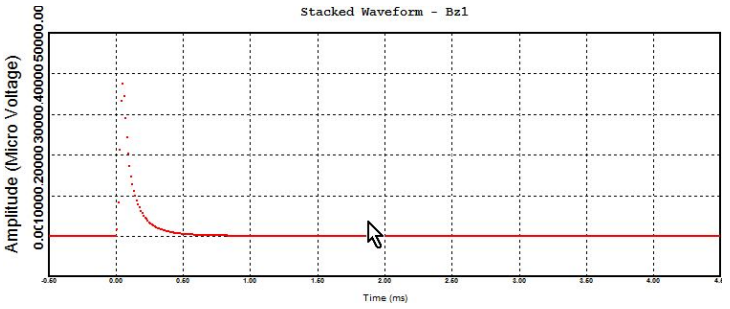
Check 3rd (+) mark (Add TDEM Data)
(Add TDEM Data) screen appears
Check [Add V8 Files]
Open V8 DATA and open .TRS files
Open TMR DATA and open TRS files
Display all data selected
Click [OK]
Click [View] , then [Set Plot Parameter]
Set parameters for reasonable plot
Min time [0.01] Max time [1000]
Min I (A) [0.1] Max I(A) [100]
Min dB/dT [0.01] Max dB/dT [100000]
Check [OK]
Select Site, Channel (Bz1, Bz2,,,)
then various plots







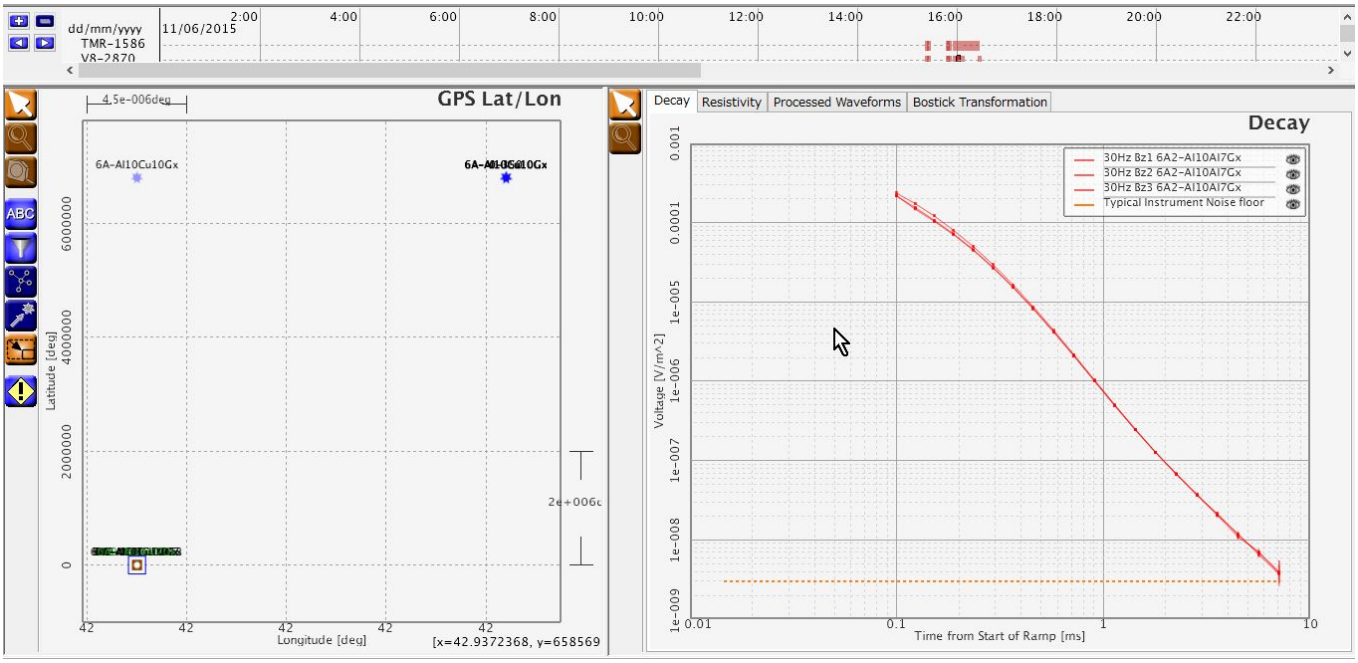




Select various list output by checking [File]

(Edited and added)

H2 TemPro Open TemPro

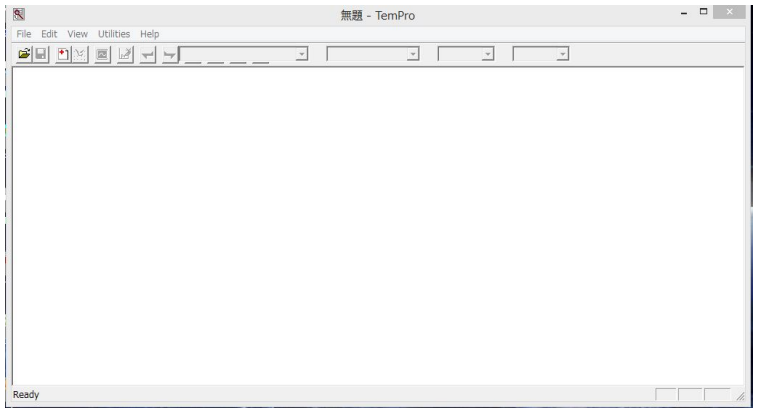


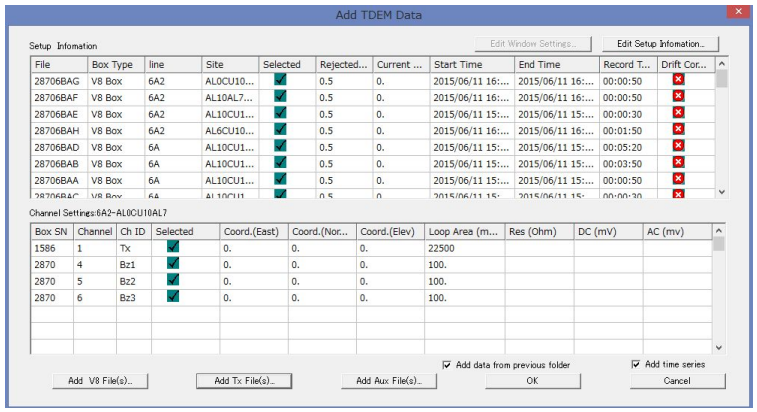
(to be continued)

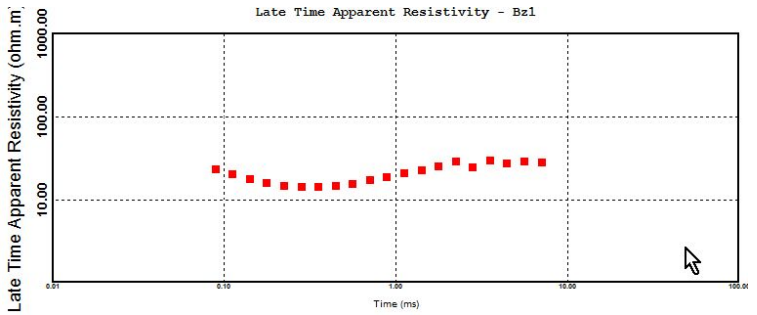
J TDIP

J1 TipPro Open TipPro

Check 3rd (+) mark (Add TDEM Data)
(Add TDEM Data) screen appears
Check [Add V8 Files]
Open V8 DATA and open .TRS files
Open TMR DATA and open TRS files
Disply all data selected
Click [OK]
Click [View] , then [Set Plot Parameter]
Set parameters for reasonable plot
Min time [0.01] Max time [1000]
Min I (A) [0.1] Max I(A) [100]
Min dB/dT [0.01] Max dB/dT [100000]
Check [OK]
Select Site, Channel (Bz1, Bz2,,,)
then various plots







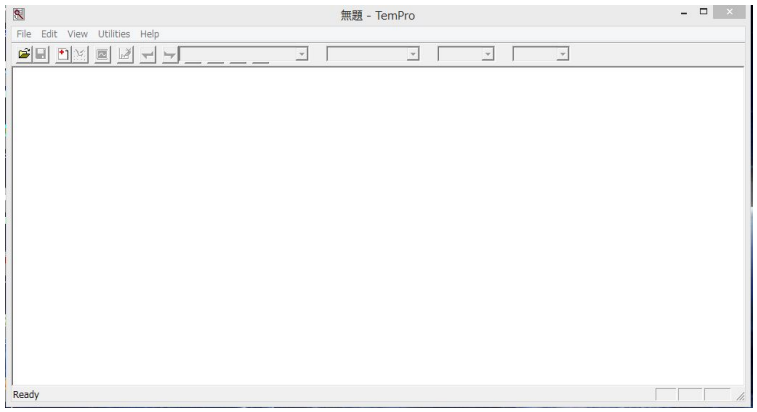
Select various list output by checking [File]

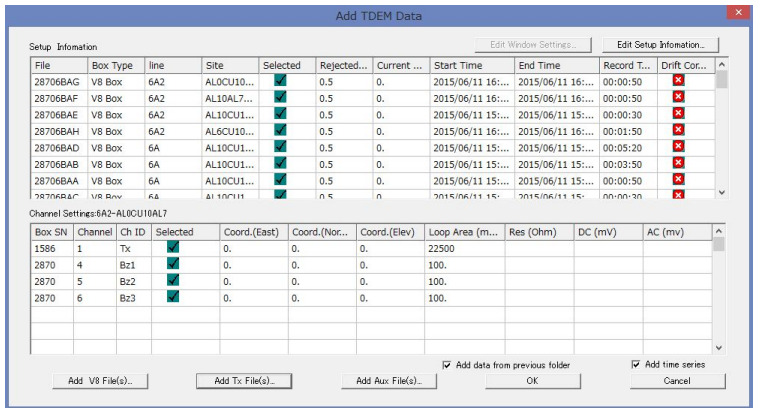
(to be edited, added and continued)

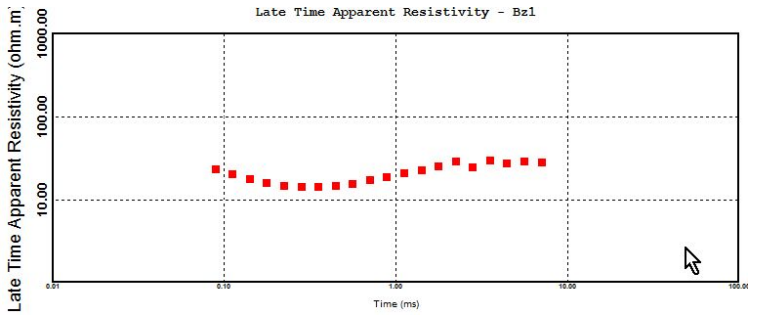
K SIP

K1 SipPro Open SipPro

Check 3rd (+) mark (Add TDEM Data)
(Add TDEM Data) screen appears
Check [Add V8 Files]
Open V8 DATA and open .TRS files
Open TMR DATA and open TRS files
Display all data selected
Click [OK]
Click [View] , then [Set Plot Parameter]
Set parameters for reasonable plot
Min time [0.01] Max time [1000]
Min I (A) [0.1] Max I(A) [100]
Min dB/dT [0.01] Max dB/dT [100000]
Check [OK]
Select Site, Channel (Bz1, Bz2,,,)
then various plots







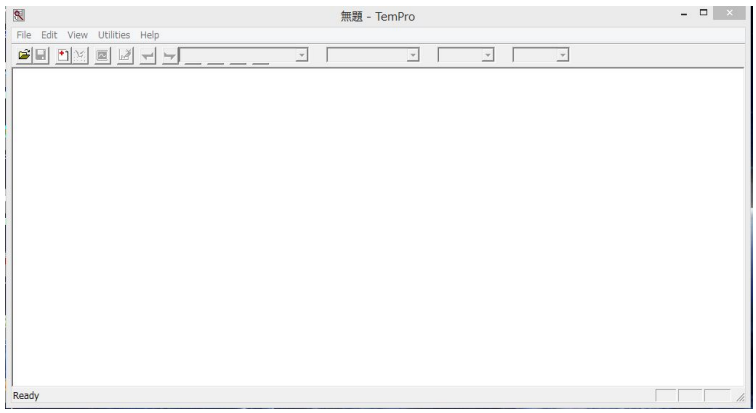
Select various list output by checking [File]

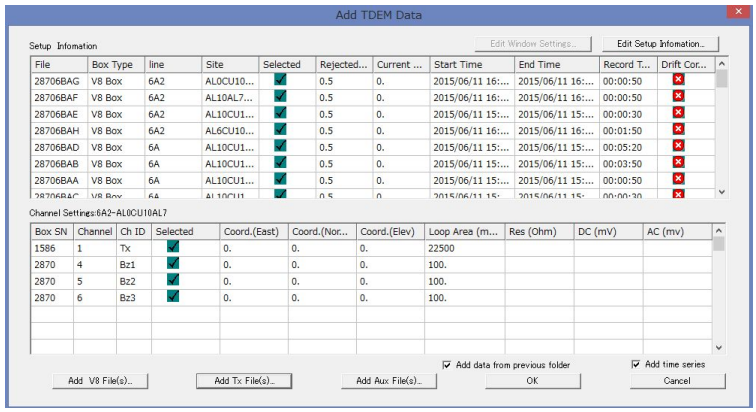
(to be edited, added and to be continued)

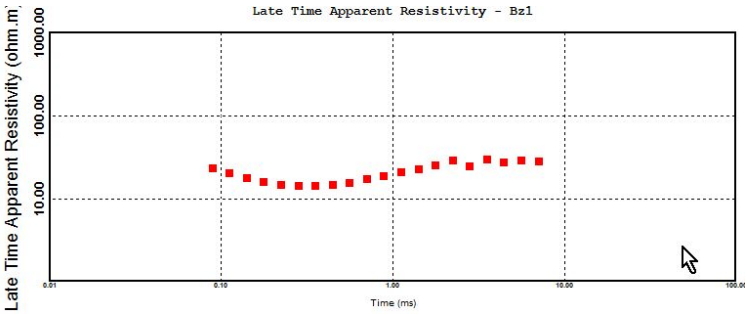
L CSAMT

L1 SipPro Open SipPro

Check 3rd (+) mark (Add TDEM Data)
(Add TDEM Data) screen appears
Check [Add V8 Files]
Open V8 DATA and open .TRS files
Open TMR DATA and open TRS files
Display all data selected
Click [OK]
Click [View] , then [Set Plot Parameter]
Set parameters for reasonable plot
Min time [0.01] Max time [1000]
Min I (A) [0.1] Max I(A) [100]
Min dB/dT [0.01] Max dB/dT [100000]
Check [OK]
Select Site, Channel (Bz1, Bz2,,,)
then various plots







Select various list output by checking [File]

(to be edited, added and to be continued)

X1 Controlled Source Audio-Frequency Magnetotelluric (CSAMT)

CSAMT-2006

Controlled Source Audio-Frequency Magnetotelluric

(CSAMT)

2006

Mitsuru Yamashita, P.Eng
Geophysicist

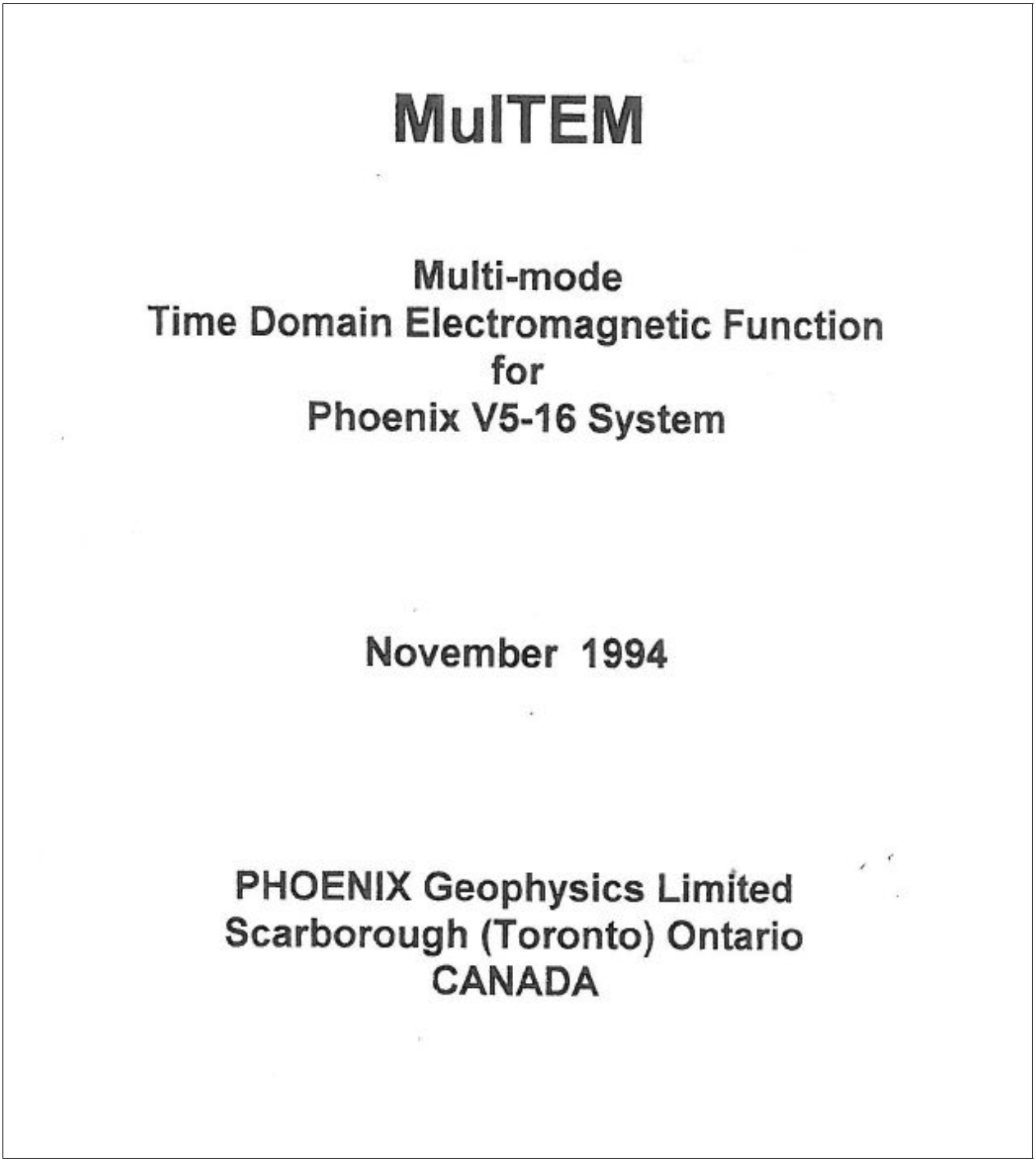
Phoenix Geophysics Limited

1

Copy (36 pages) canbe oftained from Phoenix.

X2 TDEM

Although the document below is old, there are usuful informations.



MulTEM

Multi-mode
Time Domain Electromagnetic Function
for
Phoenix V5-16 System

November 1994

PHOENIX Geophysics Limited
Scarborough (Toronto) Ontario
CANADA

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Recommended Series and Parallel (Damping) Resistor

And Applying Voltage, Ramp Time for Various Tx Loop Sizes using T4 (battery) & T3 (battery) and T3/T30/TXU (MG)

Loop Size	Loop		T4 with DC input							T3 with DC input							T3 wih MG power (>2.2kW)					
(mxmxturns)	#14	Induc	Damp	Batt	+res	Out.I	Pwr	Pwr	Ramp	Damp	Batt	+res	Out.I	Pwr	Pwr	Ramp	MG	+res	Out.I	Pwr	Pwr	Ramp
	R	L	Rd	In.(out)	Ra	I	50% for Rd		Tr	Rd	In.(out)	Ra	I	50% for Rd		Tr	Out	Ra	I	50% for Rd		Tr
	(ohm)	(mH)	(ohm)	(V)	(ohm)	(A)	(W)	(W)	(uSec)	(ohm)	(V)	(ohm)	(A)	(W)	(W)	(uSec)	(v)	(ohm)	(A)	(W)	(W)	(uSec)
25 x 25 x 1	0.83	0.19	539	24 (21)	1.0	11.5	140	1	2.19	76	12 (9)	1.0	4.9	30	1	65	200	25	7.7	800	100	5
25 x 25 x 2	1.65	0.76	1026	24 (21)	0.0	12.7	160	1	9.7	216	12 (9)	0.0	5.5	40	1	290	200	25	7.5	750	100	18
50 x 50 x 1	1.65	0.41	770	24 (21)	0.0	12.7	160	1	5.2	136	12 (9)	0.0	5.5	40	1	157	200	25	7.5	750	100	10
50 x 50 x 2	2.48	1.60	1451	24 (21)	0.0	8.5	100	1	13.6	377	24 (18)	0.0	7.3	90	1	406	200	25	7.3	750	50	37
75 x 75 x 1	2.48	0.68	975	24 (21)	0.0	8.5	100	1	5.8	198	24 (18)	0.0	7.3	90	2	173	200	25	7.3	750	100	16
75 x 75 x 2	4.96	2.70	1850	48 (45)	0.0	9.0	220	1	24.3	559	48 (36)	0.0	7.7	200	2	343	200	25	6.7	700	40	57
100 x 100 x 1	3.31	0.92	1122	48 (45)	0.0	13.6	330	1	12.5	249	24 (18)	0.0	5.4	70	1	175	200	25	7.1	700	70	20
100 x 100 x 2	6.62	3.70	2142	48 (45)	0.0	6.8	170	1	25.2	709	60 (50)	0.0	7.6	230	3	352	200	25	6.3	650	30	74
150 x 150 x 1	4.97	1.40	1363	48 (45)	0.0	9.1	220	1	12.7	341	48 (36)	0.0	7.6	190	3	177	200	25	6.7	700	60	29
200 x 200 x 1	6.63	1.90	1572	60 (57)	0.0	8.6	260	1	16.3	429	60 (50)	0.0	7.5	230	4	181	200	25	6.3	650	50	38
300 x 300 x 1	9.94	3.10	1973	60 (57)	0.0	5.7	180	1	17.7	621	60 (50)	0.0	5.0	150	3	196	200	25	5.7	500	30	56
400 x 400 x 1	13.3	4.20	2273	60 (57)	0.0	4.3	130	1	18.1	780	60 (50)	0.0	3.8	120	2	199	250	25	6.5	800	40	69
600 x 600 x 1	19.9	6.60	2804	60 (57)	0.0	2.9	90	1	19.1	1095	60 (50)	0.0	2.5	80	2	209	250	25	5.6	700	30	93
	#16		For 25x25m loop, AWG#16 wire avoiding a series resistor (Ra) is recommended with T4 and T3 with battery																			
25 x 25 x 1	1.32	0.19	539	24 (21)	0.0	15.9	200	1	3.0	76	12 (9)	0.0	6.8	50	1	91	200	25	7.7	800	100	5
25 x 25 x 2	2.63	0.76	1026	24 (21)	0.0	8.0	100	1	6.1	216	24 (18)	0.0	6.8	90	2	182	200	25	7.5	750	100	17

Tr formula: $Tr_{(uSec)} = I_{(A)} * L_{(mH)}$ ✓

Rd formula: $Rd_{(ohms)} = 1166 * L_{(mH)}^{0.465}$

L formula: $L_{(mH)} = 0.005 * X^{1.127} * N^{2}$ ✓ ✓

$Tr_{(uSec)} = 630 * L_{(mH)} / (R+Ra)_{(ohms)}$

$Rd_{(ohms)} = 265 * L_{(mH)}^{0.752}$ ← New Parm

X : Side length of square loop, N : Number of Turns

Notes

T4 Damping Res. Setting

Sw#	Res(ohms)
5	500
4	750
3	1000
2	1500
1	2000
Min	No

Select the nearest Rd

T3 Damping Res. Network with resistors

a-100-b-200-c-300-d-400-e-100-f

100	A – B	600	A – D
200	B – C	700	C – E
300	C – D	800	C – F
400	D – E	900	B – E
500	B – D	1000	A – E
		1100	A – F

Select the nearest Rd

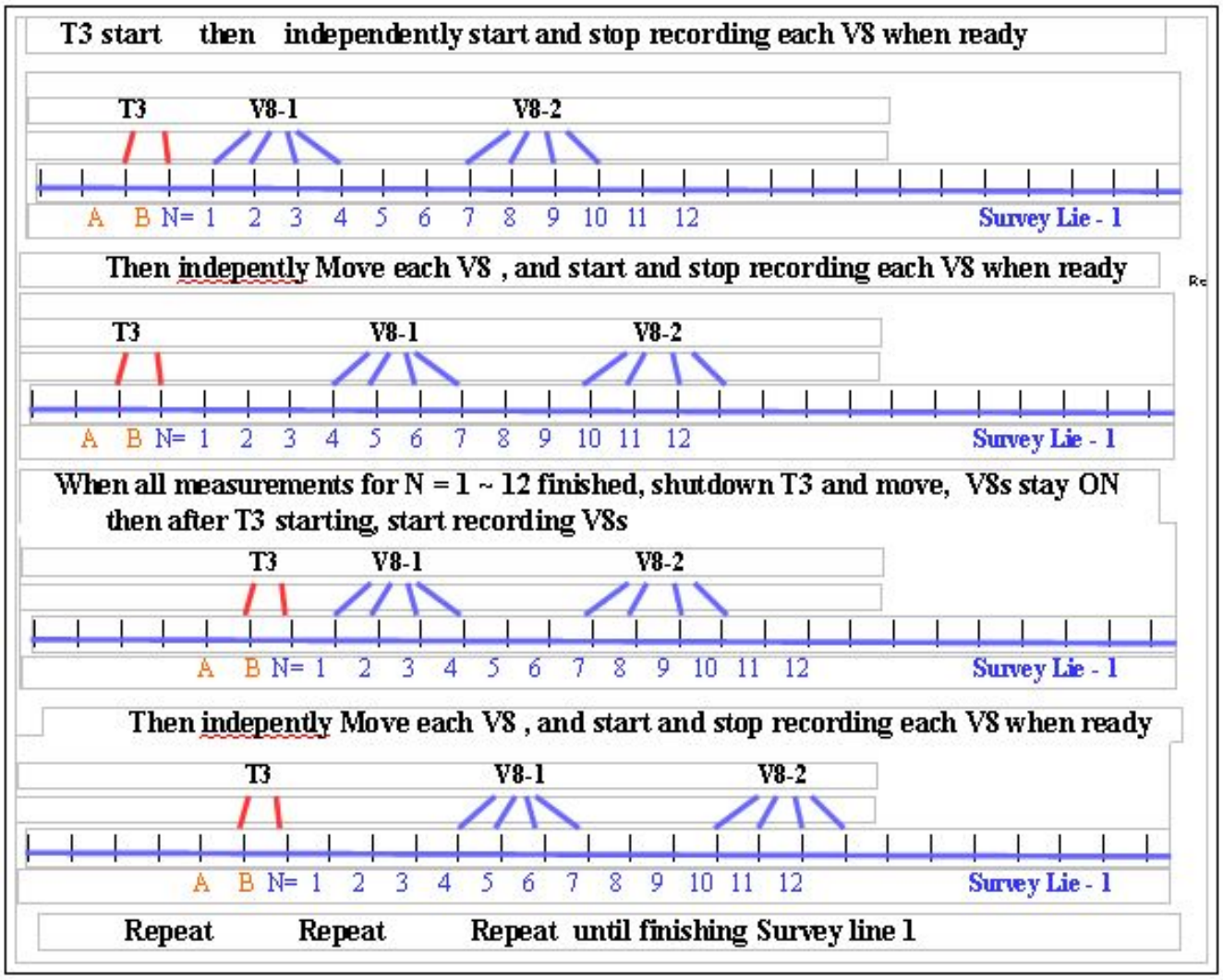
Serial Resistor of 25ohms/900W
To be configured with
4 x 100ohms/225W resistors
In parallel

Above formulas are derived from actual measured data values

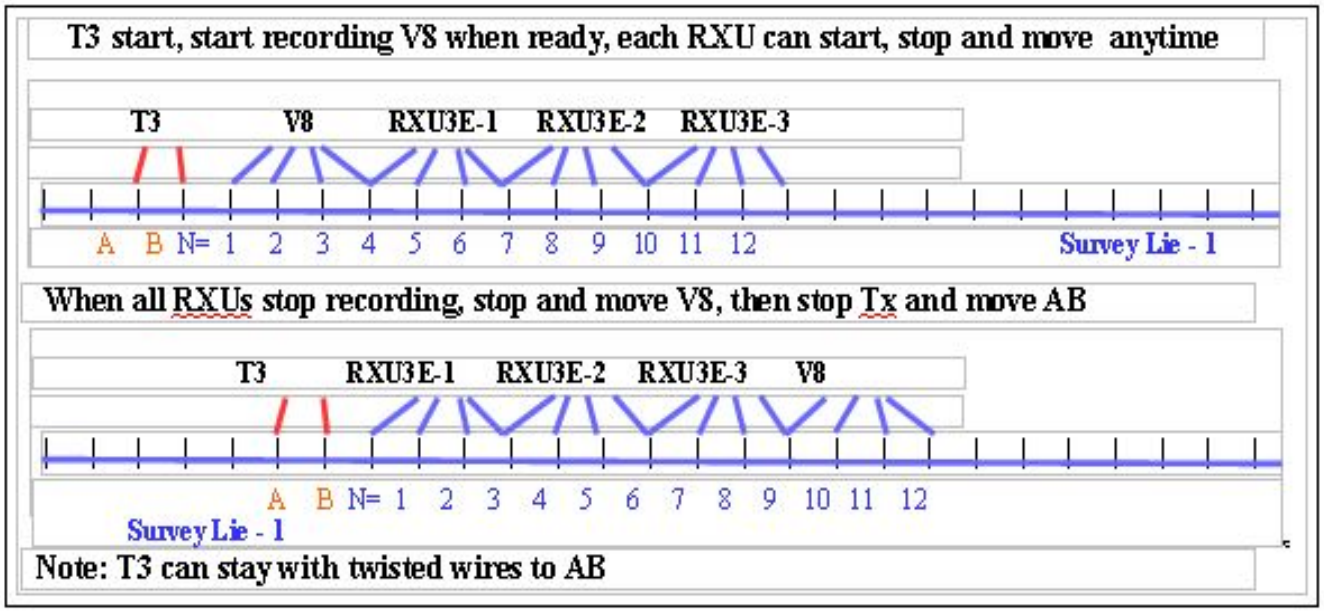
Figure X2

X3 Examples of Survey Plan/Layout with Dipole-Dipole Array for SIP/TDIP with T3 or TXU

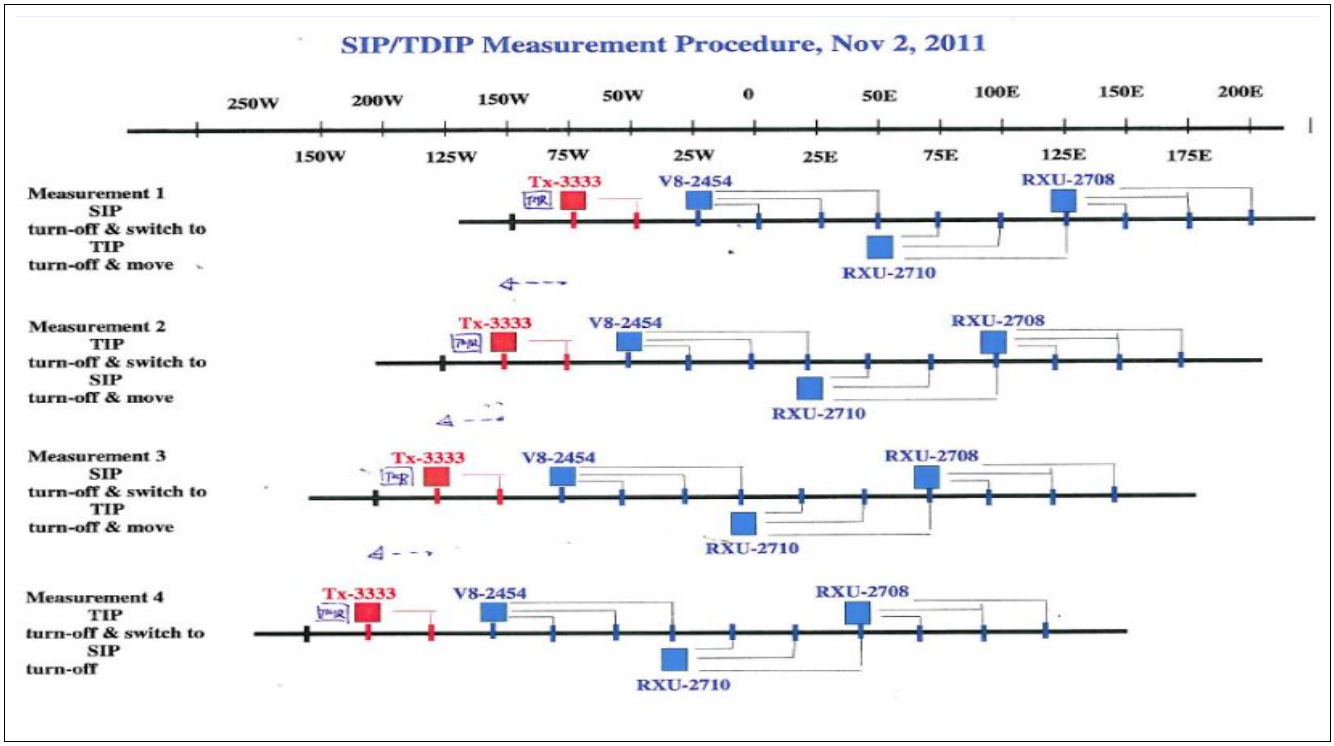
Case 1 using multiple V8s



Case 2 using one V8 and multiple RXU-3E (3xEx)



Case 3 Example of SIP/TDIP combined measurement in Dipole-Dipole array



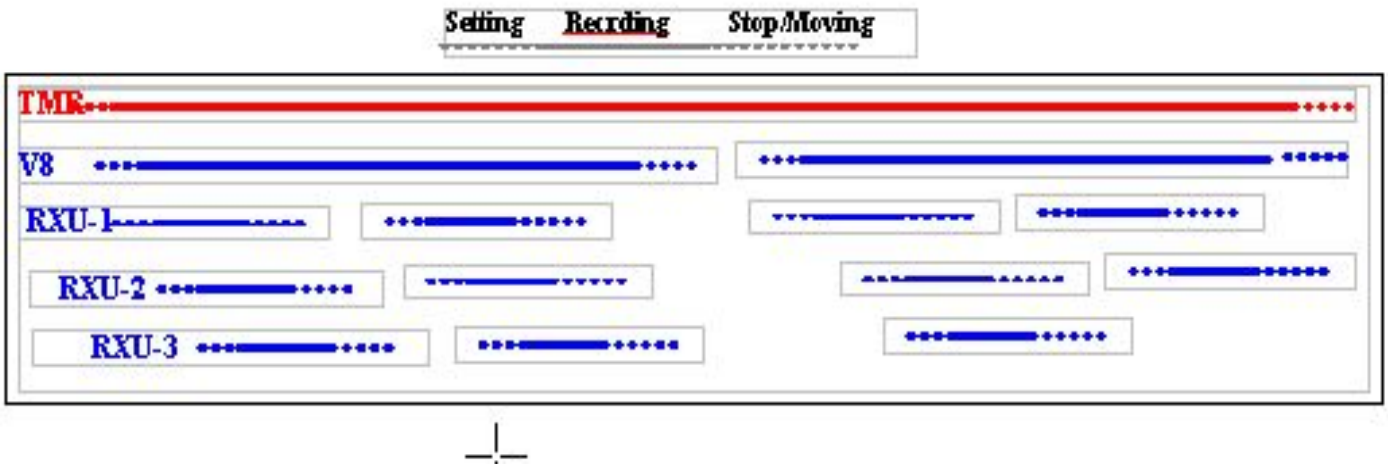
Measurment Time Arrangement when TMR, V8 and RXUs are employed.

Start TMR Recording
  Start V8 Recording
    Start RXU-1 Recording, 、 、 、 、
      Start RXU-2 Recording (can be overlapped with RXU-1)
        Start RXU-3 Recording (can be overlapped with RXU-1 and/or RXU-2)
  Stop V8 Recording and move
  Start V8 Recording
    Start and stop RXUs recording independently

  Stop V8 Recording
Stop TMR Recording and move AB

Start TMR Recording
  Start V8 Recording
    Start RXU-1 Recording, 、 、 、 、
      Start RXU-2 Recording (can be overlapped with RXU-1)
        Start RXU-3 Recording (can be overlapped with RXU-1 and/or RXU-2)
  Stop V8 Recording and move
  Start V8 Recording
    Start and stop RXUs recording independently

  Stop V8 Recording
Stop TMR Recording and move AB



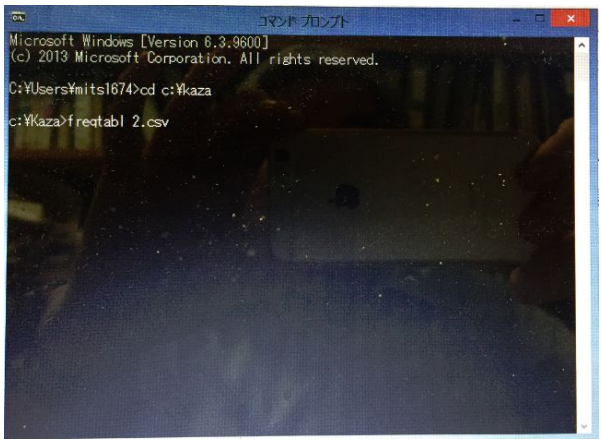
X4 How to execute FREQTABL to create *.FST (frequency Stepping Tabl) for CSAMT and SIP
Prepare FST table in CSV using Master Frequency Stepping Table in the way as described in E2 for CSAMT and F2 for SIP

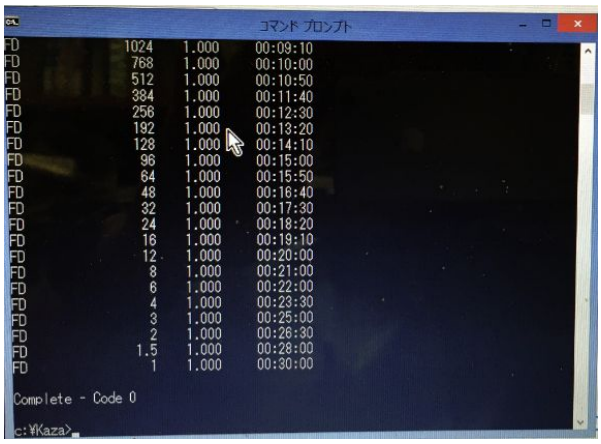
FREQTABL in Window8

1.- Bring mouse to bottom right edge of display
2- Click Search mark
3- Enter “CMD”
4- Command Prompt Screen appears
5- >FREQTABL *.CSV
6- *.FST file is created

FREQTABL in XP / Window7

1.- Click [Start]
2- Select [Run]
3- Enter “CMD”
4- Command Prompt Screen appears
5- >FREQTABL *.CSV
6- *.FST file is created





Master Frequency Stepping Table

CSAMT

	A	B	C	D
2	FD	Measure freq	Tx I	End time
3		(Hz)	(A)	utc(h:m:s)
4	FD	9600.00000000	5.00	00:00:00
5	FD	8533.33330000	5.00	00:00:10
6	FD	7680.00000000	5.00	00:00:20
7	FD	6400.00000000	5.00	00:00:30
8	FD	5120.00000000	5.00	00:00:40
9	FD	4800.00000000	5.00	00:00:50
10	FD	4266.66666666	5.00	00:01:00
11	FD	3840.00000000	5.00	00:01:10
12	FD	3200.00000000	5.00	00:01:20
13	FD	3072.00000000	5.00	00:01:30
14	FD	2560.00000000	5.00	00:01:40
15	FD	2400.00000000	5.00	00:01:50
16	FD	2133.33333330	5.00	00:02:00
17	FD	1920.00000000	5.00	00:02:10
18	FD	1536.00000000	5.00	00:02:20
19	FD	1280.00000000	5.00	00:02:30
20	FD	1024.00000000	5.00	00:02:40
21	FD	853.33333333	5.00	00:02:50
22	FD	768.00000000	5.00	00:03:00
23	FD	640.00000000	5.00	00:03:10
24	FD	512.00000000	5.00	00:03:20
25	FD	426.66666667	5.00	00:03:30
26	FD	384.00000000	5.00	00:03:40
27	FD	320.00000000	5.00	00:03:50
28	FD	256.00000000	5.00	00:04:00
29	FD	213.33333333	5.00	00:04:10
30	FD	192.00000000	5.00	00:04:20
31	FD	160.00000000	5.00	00:04:30
32	FD	128.00000000	5.00	00:04:40
33	FD	106.66666667	5.00	00:04:50
34	FD	96.00000000	5.00	00:05:00
35	FD	80.00000000	5.00	00:05:10
36	FD	64.00000000	5.00	00:05:20
37	FD	56.88888889	5.00	00:05:30
38	FD	48.00000000	5.00	00:05:40
39	FD	40.00000000	5.00	00:05:50
40	FD	32.00000000	5.00	00:06:00
41	FD	28.44444444	5.00	00:06:10
42	FD	24.00000000	5.00	00:06:20
43	FD	20.00000000	5.00	00:06:30
44	FD	16.00000000	5.00	00:06:40
45	FD	14.22222222	5.00	00:06:50
46	FD	12.00000000	5.00	00:07:00
47	FD	10.00000000	5.00	00:07:10
48				
49	FD	8.00000000	5.00	00:07:20
50	FD	7.11111111	5.00	00:07:30
51	FD	6.00000000	5.00	00:07:40
52	FD	5.00000000	5.00	00:07:50
53	FD	4.00000000	5.00	00:08:00
54	FD	3.55555556	5.00	00:08:10
55	FD	3.00000000	5.00	00:08:20
56	FD	2.50000000	5.00	00:08:30
57	FD	2.00000000	5.00	00:08:40
58	FD	1.77777778	5.00	00:08:50
59	FD	1.50000000	5.00	00:09:00
60	FD	1.25000000	5.00	00:09:10
61	FD	1.00000000	5.00	00:09:20
62				
63	FD	0.83333333	5.00	00:09:30
64	FD	0.75000000	5.00	00:09:40
65	FD	0.62500000	5.00	00:09:50
66	FD	0.50000000	5.00	00:10:00
67	FD	0.41666667	5.00	00:10:10
68	FD	0.37500000	5.00	00:10:20
69	FD	0.30000000	5.00	00:10:30
70	FD	0.25000000	5.00	00:10:40
71	FD	0.20833333	5.00	00:10:50
72	FD	0.18750000	5.00	00:11:00
73	FD	0.15000000	5.00	00:11:10
74	FD	0.12500000	5.00	00:11:20
75	FD	0.10000000	5.00	00:11:30

SIP

	A	B	C	D
2	FD	Measure Freq	Tx.I	End time
3		(Hz)	(A)	hh:mm:ss
4	FD	512.00000000	16.00	00:00:40
5	FD	436.36363636	16.00	00:00:00
6	FD	384.00000000	16.00	00:00:00
7	FD	320.00000000	16.00	00:00:00
8	FD	256.00000000	16.00	00:00:00
9	FD	218.18181818	16.00	00:00:00
10	FD	192.00000000	16.00	00:00:00
11	FD	160.00000000	16.00	00:00:00
12	FD	128.00000000	16.00	00:00:00
13	FD	109.09090909	16.00	00:00:00
14	FD	96.00000000	16.00	00:00:00
15	FD	80.00000000	16.00	00:00:00
16	FD	64.00000000	16.00	00:00:00
17	FD	54.54545454	16.00	00:00:00
18	FD	48.00000000	16.00	00:00:00
19	FD	40.00000000	16.00	00:00:00
20	FD	32.00000000	16.00	00:00:00
21	FD	27.27272727	16.00	00:00:00
22	FD	24.00000000	16.00	00:00:00
23	FD	20.00000000	16.00	00:00:00
24	FD	16.00000000	16.00	00:00:00
25	FD	13.13131313	16.00	00:00:00
26	FD	12.00000000	16.00	00:00:00
27	FD	9.60000000	16.00	00:00:00
28	FD	8.00000000	16.00	00:00:00
29	FD	6.81818182	16.00	00:00:00
30	FD	6.00000000	16.00	00:00:00
31	FD	5.00000000	16.00	00:00:00
32	FD	4.00000000	16.00	00:00:00
33	FD	3.40909091	16.00	00:00:00
34	FD	3.00000000	16.00	00:00:00
35	FD	2.50000000	16.00	00:00:00
36	FD	2.00000000	16.00	00:00:00
37	FD	1.80000000	16.00	00:00:00
38	FD	1.50000000	16.00	00:00:00
39	FD	1.25000000	16.00	00:00:00
40	FD	1.00000000	16.00	00:00:00
41	FD	0.80000000	16.00	00:00:00
42	FD	0.66666670	16.00	00:00:00
43	FD	0.57142857	16.00	00:00:00
44	FD	0.50000000	16.00	00:00:00
45	FD	0.40000000	16.00	00:00:00
46	FD	0.33333330	16.00	00:00:00
47	FD	0.28571429	16.00	00:00:00
48	FD	0.25000000	16.00	00:00:00
49	FD	0.20000000	16.00	00:00:00
50	FD	0.16666667	16.00	00:00:00
51	FD	0.14285714	16.00	00:00:00
52	FD	0.12500000	16.00	00:00:00
53	FD	0.10000000	16.00	00:00:00
54	FD	0.08333333	16.00	00:00:00
55	FD	0.07142857	16.00	00:00:00
56	FD	0.06250000	16.00	00:00:00
57	FD	0.05000000	16.00	00:00:00
58	FD	0.04166667	16.00	00:00:00
59	FD	0.03571429	16.00	00:00:00
60	FD	0.03125000	16.00	00:00:00
61	FD	0.02500000	16.00	00:00:00
62	FD	0.02083330	16.00	00:00:00
63	FD	0.01785714	16.00	00:00:00
64	FD	0.01562500	16.00	00:00:00
65	FD	0.01250000	16.00	00:00:00
66	FD	0.01041667	16.00	00:00:00
67	FD	0.01000000	16.00	00:00:00
68	FD	0.00892857	16.00	00:00:00
69	FD	0.00781250	16.00	00:00:00

Frequency stepping : **4 freq / octave** **1 freq / octave** **2 freqs / octave**

X5 Wire / Loop Resistance / Inductance/ Impedance calculation

Impedance (Z) Resistance (R) Inductive Reactance (XL)
Inductance (L) and f : frequency
XL = 2*pi*f*L Z = (R^2 + XL^2)^0.5
Inductance Table :

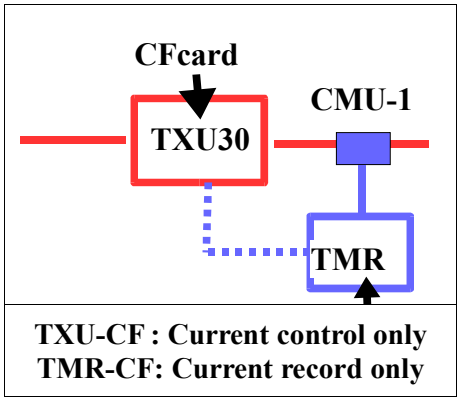
Line	1000m	2000m	3000m	4000m	R(/100m)
.5mm	2.11mH	4.49mH	6.98mH	9.54mH	8.0 ohms
1mm	1.97mH	4,22mH	6.57mH	8.99mH	2.0 ohms
2mm	1.83mH	3.94mH	6.15mH	8.43mH	0.5 ohms
Sq.oop	100m	200m	500m	1000m	
.5mm	0.97mH	2.05mH	5.49mH	11.5mH	
1mm	0.92mH	1.94mH	5.22mH	11.0mH	
2mm	0.86mH	1.83mH	4.94mH	10.4mH	

X6 Current setting on Freq. Step. Table for CF Card for TXU-30 and operation using TXU30 for CSAMT ans SIP

In *.FST (Frequency Stepping Table), although current v values are not used with T3, it is important for TXU.

1- Output current varies by transmitting frequency especially with long dipole or large loop due to Inductance (refer to X5).

2. If current value is set to too high, TXU 30 try to increase output voltage to reach to the specified current value and if the voltage is increased beyond specified max. output voltage, 500V or 1000V, TXU stops output.



TXU-CF : Current control only
TMR-CF: Current record only

Editing current value of FST table in Excel software

Example : In Excel

-1 Obtain loop resistance or contact resistance R

-2 obtain Line or Loop inductance L

-3 Calculate XL at each Freq in column E =2*pi*f*L/1000

-4 Calculate Impedance Z at each freq in column F =(R^2+XL^2)^0.5

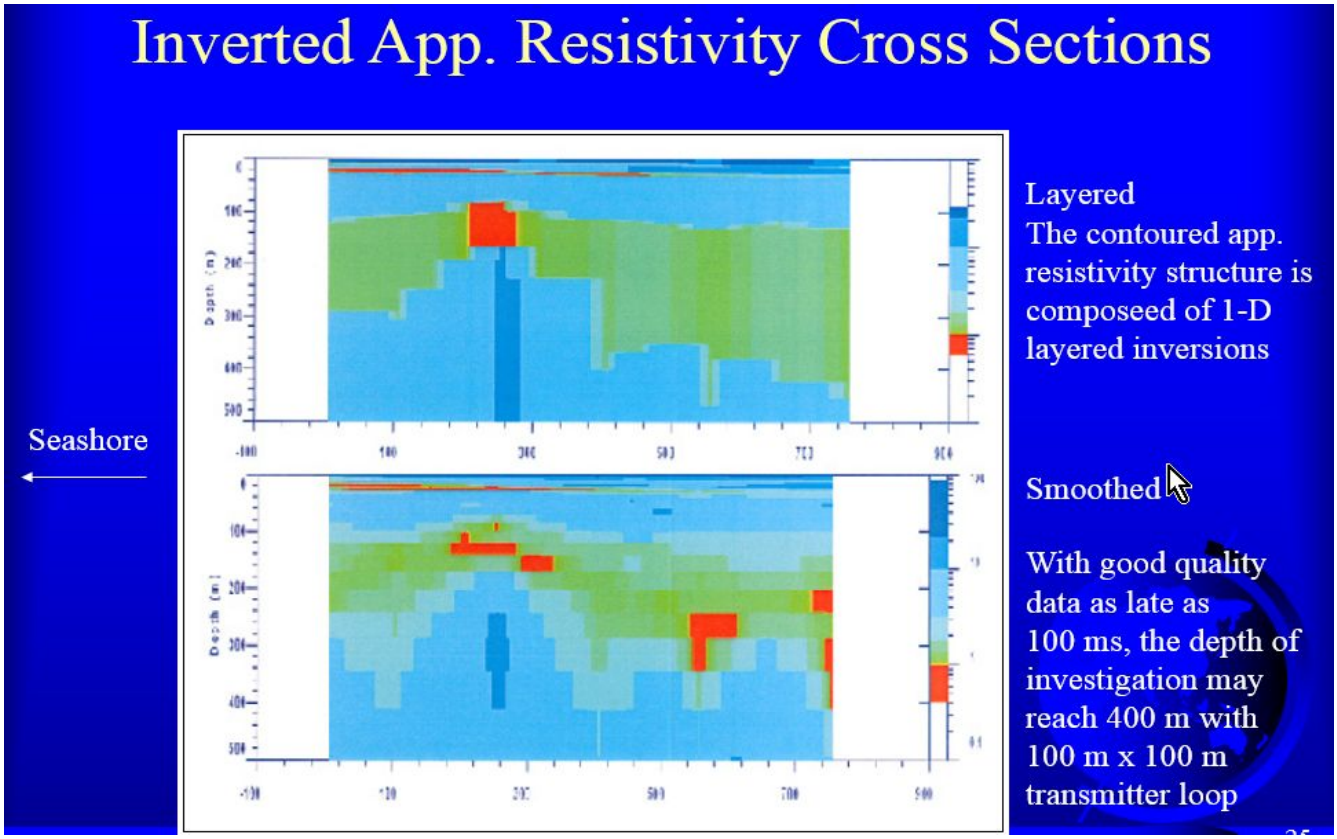
-4 Now calculate allowable max current at each freq in column B for 80% of Max output V = 800 / (F)

Re genarate *.FST

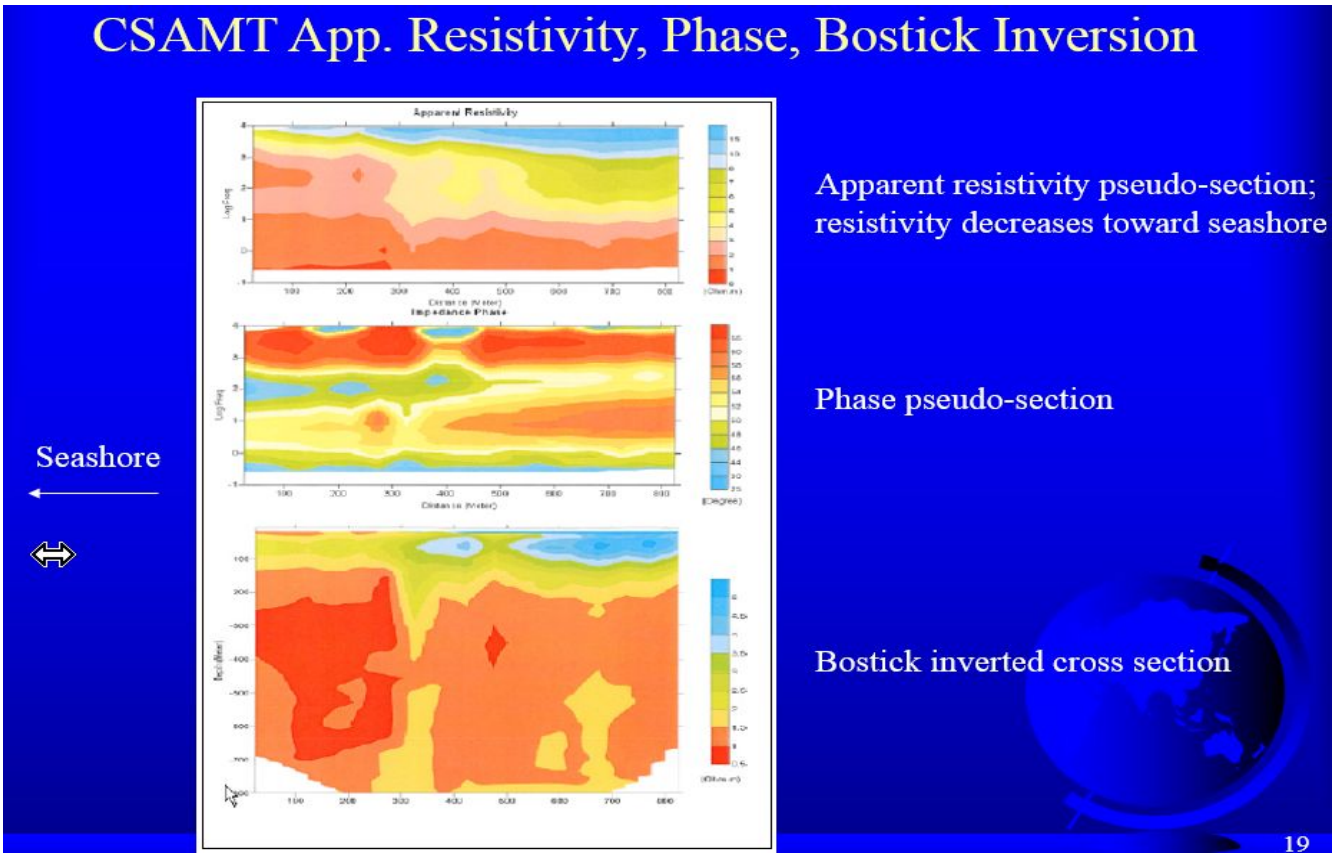
A	B	C	D	E	F
		800V		1mm, 400	,80ohms
				80ohms	L: 9mH
	f			XL	Z
FD	9600.00000	1.46	00:00:40	542.59	548.46
FD	6400.00000	2.16	00:01:20	361.73	370.47
FD	4800.00000	2.83	00:02:00	271.3	282.85
FD	3200.00000	4.05	00:02:40	180.86	197.77
FD	2400.00000	5.08	00:03:20	135.65	157.48
FD	1536.00000	6.78	00:04:00	86.81	118.05
FD	1024.00000	8.10	00:04:50	57.88	98.74
FD	768.00000	8.79	00:05:40	43.41	91.02
FD	512.00000	9.40	00:06:30	28.94	85.07
FD	384.00000	9.65	00:07:20	21.7	82.89
FD	256.00000	9.84	00:08:10	14.47	81.3
FD	192.00000	9.91	00:09:00	10.85	80.73
FD	128.00000	9.96	00:10:00	7.23	80.33
FD	96.00000	9.98	00:11:00	5.43	80.18
FD	64.00000	9.99	00:12:00	3.62	80.08
FD	32.00000	10.00	00:13:00	1.81	80.02
FD	16.00000	10.00	00:14:00	0.9	80.01
FD	8.00000	10.00	00:15:00	0.45	80
FD	4.00000	10.00	00:16:00	0.23	80
FD	2.00000	10.00	00:18:20	0.11	80
FD	1.00000	10.00	00:20:00	0.06	80

X7 Examples of Psedosection plots

TDEM

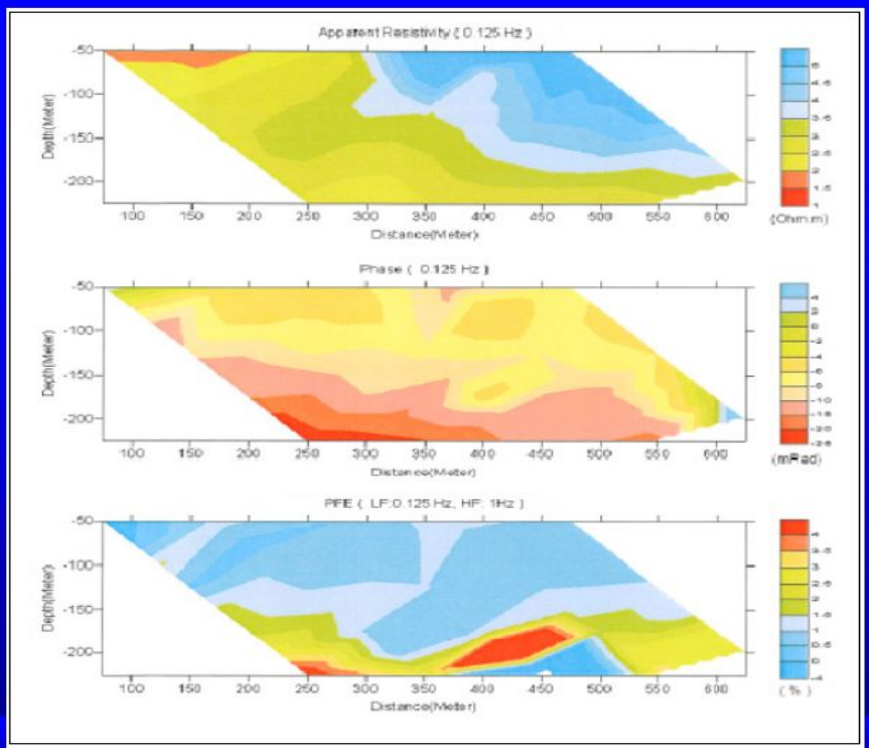


CSAMT



SIP

SIP Cross Sections



Seashore ←

(No decoupling process at this stage)

App. Resistivity at 0.125 Hz; similar to CSAMT, resistivity decreases toward seashore

Phase at 0.125 Hz

PFE at 0.125 Hz and 1.0 Hz

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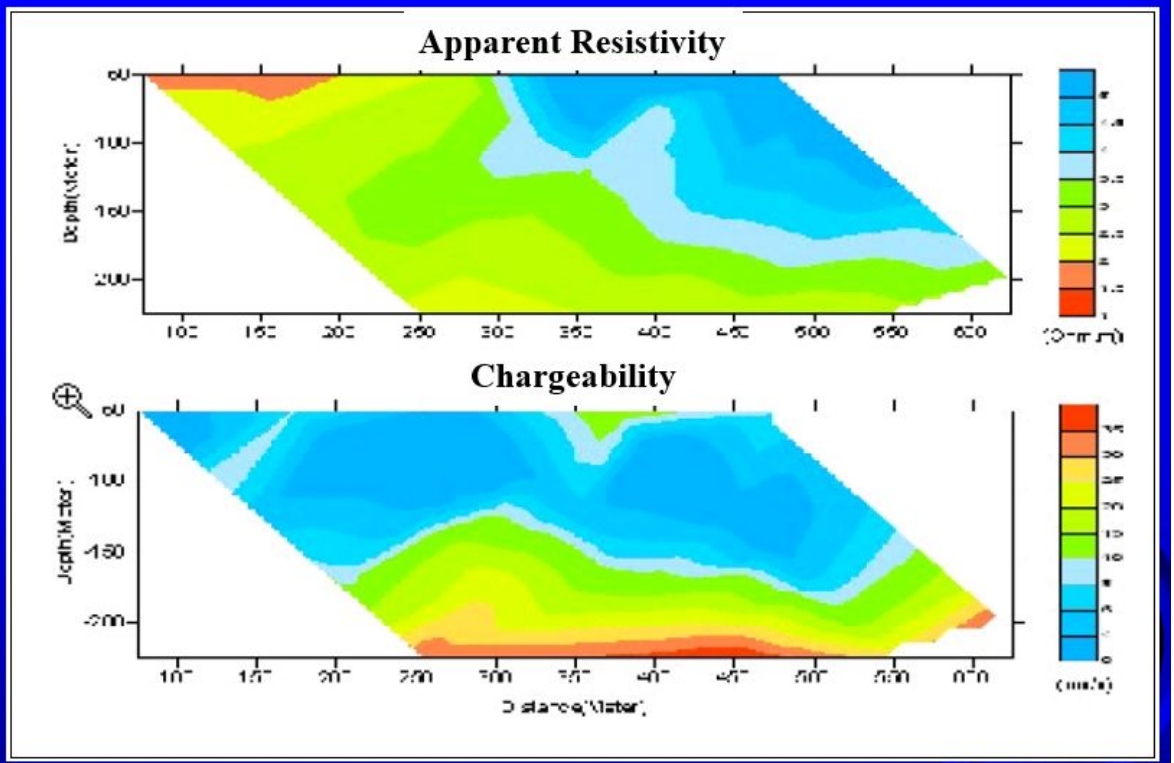
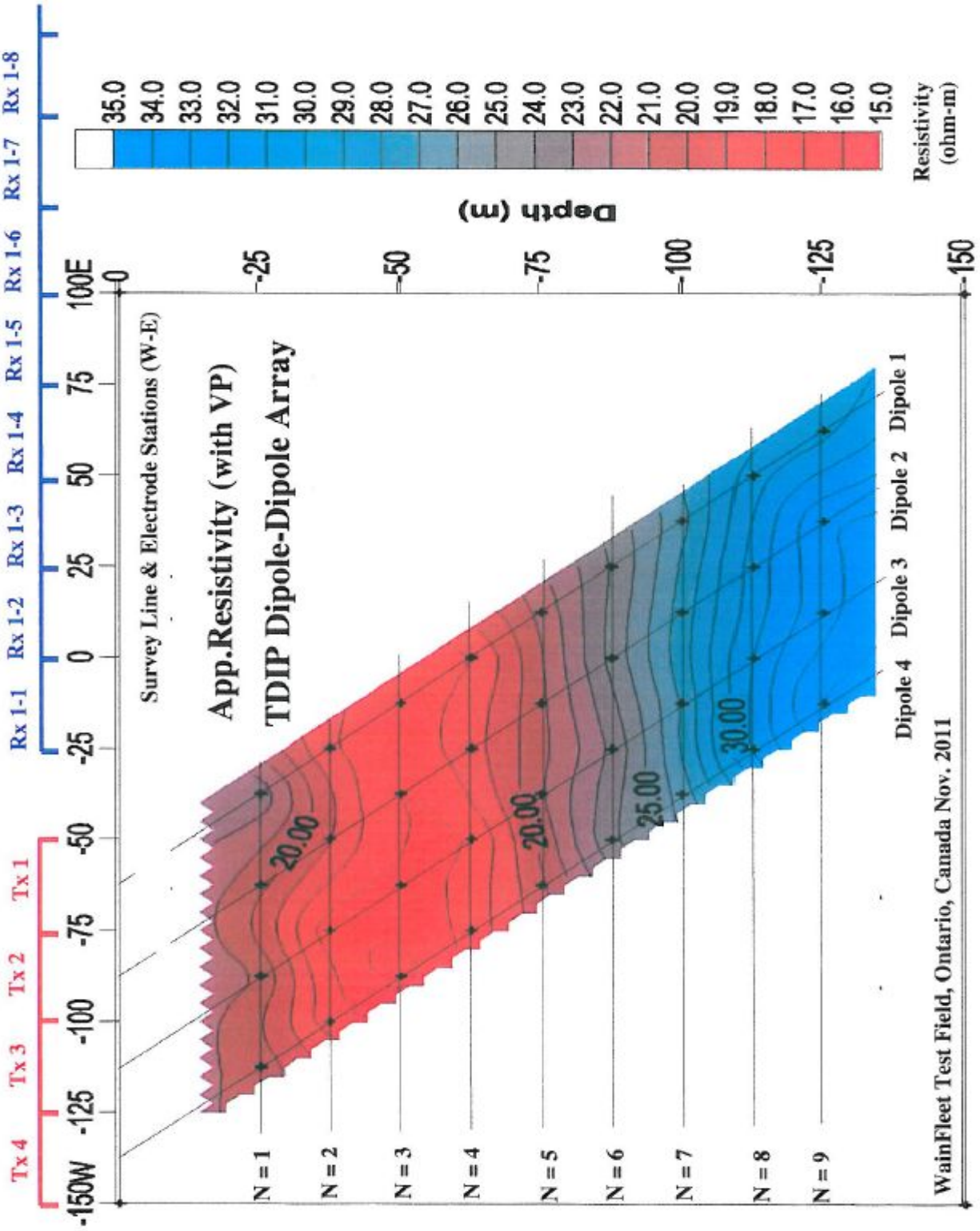
TDIP

TDIP Cross Sections



Seashore ←



Dipole-Dipole Signal strength vs. N (Chargeability = Vs / Vp in mv/V)

N=	1	2	3	4	5	6	7	8	9	10	11	12	13
Vp (mV)	10,000		2,500	1,000	500.0	285.7	178.6	119.0	83.33	60.61	45.45	34.97	27.47
Vs (ex.10ppt)	100.0	25.00	13.00	5.000	2.857	1.786	1.190	0.833	0.606	0.452	0.350	0.275	

Note : above Vs is an example