MTU TIME SERIES FORMAT

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MTU TIME SERIES FORMAT
Phoenix Geophysics Limited V5-2000 System

OVERVIEW:

The Time Series data from a V5-2000 MT system is taken from the 24-bit A-D through a 24-bit bus DSP (Digital Signal Processor) and stored on a FLASH mass storage device. The input signal is sampled at a high rate by the 24-bit A-D. Then the DSP unit applies digital filter algorithms to this incoming digital data to remove the power line frequency and its harmonics as well as anti-alias filters and re-samples to produce three (3) Time Series data sets. This output data is saved in two files. The first file (FileName.TSH) saves the Hi-Range data (above 10 Hz.) and the second file (FileNmae.TSL) saves the Lo-Range data sampled at 24 Hz. Along with the Time Series data is a small Parameter Table file (FileName.TBL) which saves the parameters of acquisition, including the gains setting information and serial numbers of the unit and sensors. The record lengths in the data files are variable length, dependent on the sample rate. Each record saves data for one second interval. For synchronized time series, these records have to be matched in time. Therefor a 16 bit tag is saved with each time series record. Also, the gains which are set at the beginning of the sounding, can not be changed during the acquisition. After the MTU acquisition program (MTUP) has finished, these three files are transferred to a laptop computer for further processing.

The next step is to convert the variable length records, into a fixed record length of 1024 sample points per channel. Also, the parameter table is converted to an ASCII file with the DFT gains information appended. A program MTU-V5TS.exe will perform this operation. The output files are the following: FileName.HDR for the HEADER information and FileName.TSD for the time series data.

The Header file contains information such as site particulars like map location and equipment serial numbers. This is followed by gains information for 40 discrete frequencies for each channel measured. The gains data has the REAL and IMAGE calibration numbers for each channel at each discrete frequency. These numbers are the DFT coefficients for the hardware system response along with the digital filter response of the DSP. This gains information was saved in the MTU calibration files; Box: *.CLB and Coil: *.CLC . This data is then reformatted into the *.MTC files for the 50 Hz or 60 Hz data set. The *.HDR file has an 70 ASCII character information string saved at the beginning of the file. The first three ASCII character of the *.HDR file string will identify the file format (i.e. Alpha.5 is E0 FA 35 in Hex).

The time series data for each MTU box is stored as a 1024 Points/Chan records. This time series data is stored as a 3 Byte Integer format with an ASCII tag line of 70 characters at the beginning of each new time segment data record. The first three ASCII character of the *.TSD file string will identify the file format (Alpha.5 is E0 FA 35 in Hex). This file is opened as a random access file of length (70 +Chan*1024*3) where Chan is the number of channels (2, 3, or 5) and 1024 is the number of points per channel and 3 is the number of bytes per point.

The file name will be of the following form: TAG-NNNa.TSD where TAG is a 3 letter code to identify the survey project and NNN is the site number. The 'a' is the RUN ID letter (i.e. 'a' is first sounding, 'b' is second ... etc.). The default FileName from the MTU box is SnsnMdda.Ext where Snsn is the MTU box serial number, M is the Month in hex (1-9,A,B,C), dd is the day of the month, ‘a’ is Run ID and Ext is the extension of ‘TBL’ or ‘TSH’ or ‘TSL’. So in most cases the Filename is RENAME after transferring from the MTU Flash memory to the Laptop computer, so that the data can be identified with the site number.

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MTU Parameter Table Specification (Ver: C)

The following description list each variable saved in the (FileName.TBL) file. This file was created by a C routine. The definition (*.h) can be found in section **Parameter Table Definition.** The C structure file has a fixed length for each entry thereby making it a random access file of record length 25.

Each entry has the following variables:	Code[5]	char	5 bytes
(Used internal by MTUP)	Grp	short	2 bytes
(Used internal by MTUP)	Smph	long Int	4 bytes
	Type	TypePT	1 byte
	V	ValPT	13 bytes

		Record length	25 bytes

Note1: TypePT can be treated as a 'char'. It has the information of data type to follow:

0: IntPT, 1: FltPT, 2: StrPT, 3: UTCPT 4: PosPT, 5:AmxPT

Note2: ValPT has to be the data type defined by TypePT.

TypePT	defined	Type	Description .
IntPT	signed long	I	Signed 4 byte Integer,
FltPT	double	F	8 byte IEEE floating point.
StrPT	char	S[9]	String,+Null end [0-8 bytes].
UTCPT	char	UT[8]	UTC date and time encoded
PosPT	char	P[13]	GPS position info string
AmxPT	char	TD[8]	AMX timedate encoded

Codes:

P - Essential for post processing (not encoded in .TSH or .TSL files).

A - Do not update during acquisition.

F - Frequently updated

Note: An '*' beside the parameter indicates that the parameter is not yet implemented.

*** Denotes sections not yet written

"integer" data type is a 32 bit signed integer.

"string12" data type consists of up to 12 ASCII characters followed by a null terminator.

"string8" data type consists of up to 8 ASCII characters followed by a null terminator.

"double" data type is a double precision (8 byte) floating point number.

"datetime" data type is based on the AMX time data type

(8 bytes: s, min, h, day, month, year, day of week , century)

Mode parameter (updated by the MTU only):

MODE integer = 1 - Setup mode.
= 2 - Recording mode. Level 5 data is logged continuously. Level 3 and 4 data is logged on a schedule specified by parameters HTIM, ETMH and HSMP.
= 3 - Pot/coil check mode. ***
= 4 - Pot impedance measurement mode. Generate test waveform at 16 Hz *** and stack, in various configurations of + and - test signal input and + and - pot connection, to allow the impedance of each pot to be calculated. Log the stacked waveforms to a .TSP file ***.
= 7 - Box calibration mode. Generate test signals at three or four frequencies, analyze, and save frequency domain calibration to a .CLB file on disk.
= 8 - Magnetic sensor calibration mode. Generate test signals at three or four frequencies and log stacked waveforms to a .CLC file on disk.
= 9 - Shut down mode. Entered when the battery is low, the OFF switch is operated, when acquisition is complete and XDOS = 4, or when XDOS = 2. The MTU is powered down after a 10 s wait.
= 10 - Fatal Error mode. Entered when a non-recoverable hardware configuration error occurs.

Mode transition matrix										
Final mode>		1 Setup	2 Record	3 Pot/coil	4 Pot Z	7 Box Cal	8 Coil cal	9 Shut down	10 Fatal Error
Initial mode									
1	Setup		RQST	RQST	RQST	RQST	RQST	RQST OFF,BAT	Hardware problem
2	Record	RQST						RQST OFF,BAT ETIM & XDOS=4	Hardware problem
3	Pot/coil	RQST						RQST OFF,BAT	Hardware problem
4	Pot Z	RQST						RQST OFF,BAT	Hardware problem
7	Box Cal	RQST						RQST OFF,BAT	Hardware problem
8	Coil cal	RQST						RQST OFF,BAT	Hardware problem
9	Shut down								
10	Fatal Error								

Parameters which are set by the host only:

RQST	integer		Requests the MTU to change MODE to the specified value if rules allow it.
V5SR	integer	A	Set to 0 for V5-2000 sample rates: 15, 300, 2,400 Hz. Set to 1 for V-5 compatible sample rates: Selected by value of LFRQ. If LFRQ = 50 then sample rates: 24, 320, 2,560 Hz. if LFRQ = 60 then sample rates ; 24, 384, 3,072 Hz.
LFRQ	integer	A	Line frequency, Hz. Valid entry: 50 or 60.
L3NS	integer	A	Level3 acquisition contiguous section in seconds. Starts on minutes which are odd multiples of HSMP. Valid entry: 0 to 2
L4NS	integer	A	Level4 acquisition contiguous section in seconds. Starts on minutes which are even multiples of HSMP. Valid entry: 0 - 16
HSMP	integer	A	Set the high range sample interval in minutes. Level 4 is sampled on the hour, Level 3 is sampled HSMP minutes later, and so on.
SGIN	integer		Sets the signal input source. 0=External, 1=Test signal, 2=Both.
EGN	integer	AP	Gain for “E” channels. Valid entries: 10, 40, 160.
HGN	integer	AP	Gain for “H” channels. Valid entries: 3, 12, 48.
ACDC	integer	AP	“E” channel coupling. Valid entries: 0 for DC , 1 for AC coupling.
ACDH	integer	AP	“H” channel coupling. Valid entries: 0 for DC , 1 for AC coupling.
LPFR	integer	A	LowPass Filter setting. Valid entries: 1, 2, 3 E/H same setting for all FE brds.
TBLF*	string12		Change input parameter file to this file name from STARTUP.TBL. The .TBL extension is used regardless.
PTIM*	datetime		Time to read more parameters from the STARTUP.TBL file.
WAIT*	integer		Number of seconds to wait before reading next parameter. WAIT is set to 0 when the time expires and the next parameter is read.
SITE	string8	P	Site ID. Recorded in the *.TBL file.
FILE	string8	AP	DOS compliant file name for the data files and the parameter files. Normally the site name SnsnMdda where Snsn is serial number and Mdda is date code. The suffix is generated by the program. .TBL for parameter files, .TSL for level5 data, .TSH for level4 and level3 data files.
STIM	datetime	A	Start date/time of the data acquisition in UTC . If date is 0, then the date will be selected so that it is within ± 12 h of the present time.
HTIM	datetime	A	Start time to begin saving Level 3 & Level 4 data.
ETIM	datetime		End time of the data acquisition.
ETMH	datetime		End time of the high range data acquisition.
CMPY	string12	P	Name of company.
SRVY	string12	P	Survey ID.
EAZM	integer	P	Ex sensor azimuth from True North, deg. Range: +45 (E) to -45 (W)

EXLN	integer	P	Ex dipole length, m. Linear distance between N - S pots.
EYLN	integer	P	Ey dipole length, m. Linear distance between E - W pots.
HAZM	integer	P	Hx sensor azimuth from true north, deg. Range: +45 (E) to -45 (W) ***
HXSN	string8	P	Hx sensor Serial Number. If COIL is used : C-nnnn ***
HYSN	string8	P	Hy sensor serial number.
HZSN	string8	P	Hz sensor serial number. (What if air loop? ***)
TXPR	integer		Period of Polarity signal output in seconds when MTU is used as transmitter controller (MTUTXC.HW).

Parameters which are initialized by the MTU and never changed:

SNUM	integer	P	The serial number of the MTU unit.
HW	string8	P	Hardware configuration of box.
VER	string8		Software version string.
CHEX	integer		Front end channel for EX. Initialized to 1 in MTU-2E. Set to 0 in MTU-3H/2H unit.
CHEY	integer		Front end channel for EY. Initialized to 2 in MTU-2E. Set to 0 in MTU-3H/2H unit.
CHHX	integer		Front end channel for HX. Initialized to 0 in MTU-2E. Set to 1 in MTU-3H/2H unit.
CHHY	integer		Front end channel for HY. Initialized to 0 in MTU-2E. Set to 2 in MTU-3H/2H unit.
CHHZ	integer		Front end channel for HZ. Initialized to 0 in MTU-2E. Set to 3 if Hz in MTU-3H unit.
ADFS*	integer		A/D converter full scale, mV.
ADMX*	integer		A/D converter Max output corresponding to ADFS.
HATT	double		Gain of coil attenuator on interconnect board, mV/V.
TAMP*	integer		Test signal square wave input, uV peak.
HAMP	double		Coil test waveform amplitude, nT.
HNOM	double		Coil nominal gain, mV/nT.
TCMB	integer		Type of comb filter. 1: a = 0.75, 1st order, odd in level 5, all in level 3 and 4.
TALS	integer		Type of aliasing filter: 1 - 5 th order sinc. 2 - Flat to 80% of folding frequency.
CCMN	double		Minimum acceptable coil corner frequency, Hz.
CCMX	double		Maximum acceptable coil corner frequency, Hz.
CFMN	double		Minimum acceptable corner frequency, Hz.
CFMX	double		Maximum acceptable corner frequency, Hz.
CCLT	integer		Coil cal time multiplier.

Parameters which are updated by the MTU only:

AQST	integer		Acquisition status. 0 = not acquiring, 1 = Setting up, 2 = Acquiring data, 3 = Acquisition done.
NSAT	integer	F	Number of GPS satellites acquired by the GPS receiver.
CLST	integer	F	Clock Status = 0 if time is uninitialized, = 1 if time is based on CPU RTC, = 2 if synchronization to GPS is in progress (but MINCLK not synched) = 3 if time is based on a crystal oscillator which was initialized by GPS, = 4 if clock is locked to GPS.
NUTC	datetime	F	UTC time of most recent 1 Hz pulse. This is always an integral second.
TERR	integer	F	Error in sample time, us. + for late, - for early. Normally zero, will be non-zero during recovery from GPS dropout.
LFIX	datetime	F	UTC time of last GPS fix.
OCTR	integer	F	Oscillator control register value. The program sets it during tracking the 1 PPS signal of the GPS. Range: 0-255. *** We should raise some kind of caution flag when it approaches limits to allow for readjustment.
ELEV	integer	F	Elevation of site, m received from GPS. Set to 0 m. (Not accreted).
LATG	string12	PF	Latitude from GPS, degrees and minutes. Format “4348.519,N,”.
LNGG	string12	PF	Longitude from GPS, degrees and minutes. Format “07920.277,W”.
SRL3	integer		Sample rate for level 3, Hz. Set based on V5SR and LFRQ.
SRL4	integer		Sample rate for level 4, Hz. Set based on V5SR and LFRQ.
SRL5	integer		Sample rate for level 5, Hz. Set based on V5SR and LFRQ.
EXR*	integer		Ex pot resistance between N - S expressed in ohms.
EXAC	double	PF	Ex AC measurement between N - S expressed in V.
EXDC	double	PF	Ex DC measurement between N - S expressed in V.
EYR*	integer		Ey pot resistance between E - W expressed in ohms.
EYAC	double	PF	Ey AC measurement between E - W expressed in V.
EYDC	double	PF	Ey DC measurement between E - W expressed in V.
TOTL	integer	F	Total count of data records level3, level4 and level5 combined. ***
BADR	integer	F	Count of records flagged bad (not including saturations)
SATR	integer	F	Count of records containing saturations.
BAT1	integer	F	Battery #1 voltage in mV. (Input voltage pin A-D)
BAT2	integer	F	Battery #2 voltage in mV. (Input voltage pin B-C)
BAT3	integer	F	Battery #3 voltage in mV. (Internal Backup voltage)
TEMP	integer	F	Internal operating temperature (degrees C) of MTU unit

DISK	integer	F	Free disk space, bytes.
GFPG	integer		Return code from the FPGA loader for the GPS board. 0 = successful, -1 = not loaded, >0 = error.
FFPG	integer		Return code from the FPGA loader for all Front End boards. 0 = successful, -1 = not loaded, >0 = error.
DSP	integer		Return code from the DSP loader for all Front End boards. 0 = successful, -1 = not loaded, >0 = error.
CALS	integer		Box calibration status: 0 = calibration file is on disk, 1 = no calibration on disk, 3 = calibration is in progress, 4 = calibration failed.
CCLS	integer		Coil calibration status: 0 = calibration file is on disk, 1 = no calibration on disk, 3 = calibration is in progress, 4 = calibration failed.
XDOS	integer		1 = Exit to DOS. 4 = Shutdown at end of acquisition. Initialized to 0.

Parameter Table Definition:

```
/* PrmTblPT.h                    1:20 PM 02/04/97                              */
/* Defines the parameter table which controls and defines status of all        */
/* functions of the instrument.                                               */
/* 1996-Dec-31   DJD   Create.                                          */
#define PrmTblPT
typedef enum   {                 /* Defines data type of entries in parameter  */
                                 /* table. Corresponds to fields of type ValPT */
            IntPT,               /* Signed 4 byte integer.                     */
            FltPT,               /* 8 byte IEEE floating point (double)   */
            StrPT,               /* String, null terminated, 0-8 bytes.        */
            UTCPT,               /* UTC date and time, 1 s resolution.    */
            PosPT,               /* Geographical position. (char *)            */
            AmxPT                /* AMX time and date.                    */
} TypePT;
typedef union {          /* Defines a value in the parameter table.       */
                                 /* Corresponds to elements of type TypePT.    */
    signed long      I;          /* Signed 4 byte integer.                */
    double           F;          /* 8 byte IEEE floating point.                */
    char             S[9];       /* String, null terminated, 0-8 bytes.        */
    char             P[13];/* Geographical position,5m resolution.    */
    struct amxtds    TD;         /* AMX timedate.                              */
} ValPT;
typedef      struct {
    char             Code[5];    /* Ascii code for the parameter.         */
                                 /* Up to 4 characters, null terminated   */
                                 /* if less than 4. Case ignored.         */
    unsigned short   Grp;        /* Group of parameters of which this     */
                                 /* parameter is a member. One semaphore       */
                                 /* is shared by all parameters in a group. */
    long int         Smph;  /* ID of the semaphore which protects    */
                                 /* this parameter.                            */
    TypePT           T;          /* The data type of this parameter.           */
    ValPT            V;          /* The value of this parameter.          */
} TableEntryPT;
int  cdecl ReadPT( const char *code, TableEntryPT *ptp );
int  cdecl WritePT( const char *code, TableEntryPT *ptp );
int  cdecl SavePT( void );
void cdecl GetPT( void );
void cdecl PrmTblRP( void );
#define PrmFile         "STARTUP.TBL"       /* Startup Parameter File   */
#define BlnkFltPT       0
#define BlnkIntPT       0L
#define BlnkPosPT       0L
#define BlnkStrPT       0L
#define ETX             '\3'
```

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Times Series File (.TSH, .TSL) Format.

The file consists of records containing time series data, written in order of the time of the first sample in the record. The record lengths in one file may vary. Each record consists of a tag followed by time series data. The time series data in a record always starts exactly on a UTC second, and always has a sample rate which is an exact integer multiple of 1 Hz. The time series data is stored in 24 bit 2's complement format, 3 bytes per sample, least significant byte first. A complete "scan" of samples from all channels is stored together, in order of channel number. (Channels are numbered starting at 1, not 0.) Consecutive scans are stored in order of sample time.

Tag formats may vary, but the same tag format must be used throughout a file. The first tag format used in the V5-2000 was 16 bytes long and the records using these tags contained exactly one second of time series data. Typically this tag format is used in .TSH & .TSL files. The 16 byte tag format is as follows: Byte 0-7:

UTC time of first scan in record, in the format second, minute, hour, day, month, year (last two digits), day of week, century, one byte per field.

Byte 8-9: Serial number of the MTU-box (16 bit integer).

Byte 10-11: Scans of data in the record, 16 bit integer. (Since record with a 16 byte header contains 1 s of data, this is also the sample rate in Hz.)

Byte 12: Number of channels of data per scan.

Byte 13: Contains 0. [Defines the 16-byte tag code]

Byte 14: Status code.

- 0: Normal completion.
- 3: Saturation of Front End Board analog circuits.
- 4: Internal error in Front End board DSP.
- 6: Processor timed out waiting for data from Front End Board DSP.
- 1, 5, 7, 8: Internal errors.

Byte 15: Saturation flags. [Bit n is 1 if there is a saturation in channel n+1]

The UTC date and time, the serial number, and the sample rate uniquely identify the data record. No other data record can exist which duplicates all these fields (unless some are in error!). The tag defines the record length, which is the tag length + 3 x Channels per scan x Scans in the record. The "0" in byte 13 identifies this as a 16 byte tag, which can only have the format defined here. No other tag format is permitted to have "0" in byte 13.

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Reformat MTU Time Series.

To make use of existing reprocessing algorithms, a program was developed to read the MTU (1 sec) time series format and output a fix record length of 1024 points per chan for each channel of time series data. This program is named MTU-V5TS.exe. It is used to read MTU Time Series data files *.TBL and *.TSH and *.TSL files and convert to V-5 format Time Series files. The output is a header (*.HDR) file and a time series data (*.TSD) file. This program has an input parameter file in the C:\ root directory named MTU-FILE.prm. The following is an example. If the parameters 4 or 5 need to be changed then delete the file and the default values will be generated again otherwise just edit the entries from the program.

[1] 24FILE:C:\MTU-DATA\FileName.HDR
[2] 8STIM:09:00:00
[3] 8LTIM:09:00:00
[4] 15CDIR:C:\MTU-SW\BCAL\
[5] 4TSER:.TSD
[6] 9SDIR:E:\Oct04\

Parameter [1] is the default directory for output files *.HDR and *.TSD or *.TSR. The "FileName" is the current file being process. The PathName is the current time series data directory.

Parameter [2] is the default Start Time for data processing in Hi-Range.

Note: To synch to a V-5 Hi-Start Time of hh:00:00 then add +1 minute HH:01:00 where HH is the corresponding HOUR in UTC time. (Only required for *.TSR data.)

For TSD data just enter the Starting minute HH:MM:00 in UTC time format. The program searches for the *.TSH Time Tag of this time. If no Time Tag found then first record is used.

Parameter [3] is the default Start Time for data processing in Lo-Range.

Note: To synch to a V-5 Lo-Start Time of hh:30:00 then add +1 minute LL:31:00 where LL is the corresponding HOUR in UTC time.(Only required for *.TSR data.)

For TSD data just enter the Starting minute HH:MM:00 in UTC time format. The program searches for the *.TSL Time Tag of this time. If the requested Time Tag is before the first Time Tag then the program will re-synch to a recorded Time Tag that is the beginning of the next output record and continues processing the data.

Parameter [4] is the default directory for calibration files of MTU boxes and sensors.

Parameter [5] is the output Time Series type. It is ".TSR" for the Time Series to be V-5 compatible (i.e. Hi-Range & Lo-Range are sequential in acquisition time) or ".TSD" for MTU acquisition where Hi-Range and Lo-Range are simultaneous. The data source may be the same MTU Time Series files but the TAGs are different in the output file. For the *.TSR format the IT number is sequential like in the V-5 format. Also the RC number is the sequential record number for that IT number. However in the *.TSD format the IT number is the Julian Day of acquisition. And to distinguish Hi-Range from Lo-Range, 500 was added to the Julian Day for Level 5 Lo-Range data. The RC number was also changed in the Hi-Range *.TSD format. The first 4 digits of the 5 digit number is the running minute of that Julian day and the unit digit is the record of that minute. The following is a Time Series Tag:

TSD-TAG: SER05U SR=0024 N=05120 IT=620 RC=00001 GN=001 SA=0 UT=18:01:4
TSR-TAG: SERIES SR=0024 N=05120 IT=120 RC=00001 GN=001 SA=0 TM=18:01:4

Parameter [6] is the default directory for the source files. If the FileName.TBL is not found in the output directory then this directory is used for the *.TBL, *.TSH and *.TSL files. This will allow the source files to be read from a CD-ROM disk and the output files to be saved on the Hard-Disk.

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File Naming Conventions:

During the acquisition deployment, each site has been assigned an MTU box by Serial Number. The MTU box default data FileName is SnsnMdda.

Where: Snsn is Serial Number of the MTU box
M is hex of Month number (1 - 9,A,B,C)
dd is day of Month (1 - 31
a is Run ID letter (a - z)
The .ext is added automatically. [.TBL, .TSH and .TSL]

This will give an unique FileName for each data set. This has the disadvantage of no site name correlation. However, for data processing, a FileName that is related to the site name is easier to remember. The MTU Data can be RENAMEd after data transfer to the following FileName: TAG-NNNa.EXT

Where: TAG is the Survey Project designation
NNN is the Site Number on the Survey Line(001 - 999)
a is Run ID letter (a - z)
EXT is Extension ID:
TBL - TaBLe file of MTU parameters
TSH - Time Series Hi-range data
TSL - Time Series Lo-range data
PRM - PaRaMeter processing file
HDR - HeaDeR file for processed TSD data
TSD - Time Series Data Hi&Lo in V5 format
MT - MT processed XPR data file

Processing NON-0-STATUS codes:

After the parameters have been edited by the program inputs, the source data is checked for NON-0 STATUS codes and missing records. The following action is taken by the MTU-V5TS program.

1) If an NON-0 STATUS code is found in Hi-Range then the record is not used and the programs skips to the next minute of data.

2) If an NON-0 STATUS code is found in Lo-Range then special processing is required. The following status codes are programmed:

i) STATUS - 3 Saturation Flag. The SA flag is set in the output data TAG.

ii) STATUS - 6 Missing data for 1 second only. The previous data is copied to give correct spacial positioning of succeeding data.
Missing data for more then 1 second. A time break in the time series data is processed. The program skips ahead to the first second of data for the next output record. This will cause a RC record to be missing.

iii) STATUS - 9 DSP error Flag. The program is halted for input options:
1:DEL - 0:OK - 2:Add - DATA ? Q:Quit

In this case the Time Tags of previous 2 records and the current record along with the next two records are displayed. The program is halted for an input option:

Option 0 will continue with the reformatting.
Option 1 will remove a 1 second record from the output data.
Option 2 will add another record of 24 points to the output data.
Option Q will terminate the program and close all files keeping current data.
Note: If option 1 or 2 is used then the output data may be out of synch with another time series file.

Program MTU-V5TS Input Parameters:

Execute the program MTU-V5TS.exe from a DOS command. The first screen will give a brief description of the program function. Check that the data format will be *.TSD.

OUTPUT data will be written to *.TSD MTU file.
Will convert all MTU-data to 1024 point RECORDS.
<ENTER>

The first entry (Parameter[1]) is the PathName (directory) for output files and the FileName.HDR

Keys: <ENTER>, <INS>, <DEL>, <ESC>, <BKSP>, <arrows>
OUTPUT FILE NAME for Site HEADER File. *.HDR
Default: C:\MTU-DATA\PHX-209a.HDR
Entry: C:\MTU-DATA\PHX-209a.HDR
Is this the correct Entry ? (Y/N)

At this point the default entry can be edited. The following editing functions are programmed.

Use the <ENTER> key or <right arrow> to move to next character in the string.
Use the <INS> key or <up arrow> to insert a character into the string.
Use the <DEL> key or <down arrow> to delete a character from the string.
Use the<BKSP> key or <left arrow> to move back one character in the string.
Use the <ESC> key or <ENTER> to end of string to accept current string.
Type 'Y' or <ENTER> for YES reply to the question.
Type 'N' or <SPACE> for NO reply to the question.
Use the <ESC> key when a question is asked will terminate the program.

After the first parameter is entered, the FileName.TBL file is checked for existence in the PathName directory. If it is found then, the source directory and output directory are the same. If the FileName.TBL file is NOT found in the output directory then a source directory PathName is requested as follows:

Keys: <ENTER>, <INS>, <DEL>, <ESC>, <BKSP>, <arrows>
INPUT the SOURCE DIRECTORY for Time Series Data.
Default: C:\MTU-DATA\
Entry: C:\MTU-DATA\FEB09\
Is this the correct Entry ? (Y/N)

This will allow the program to read the time series data from a CD-ROM and save the output data to the hard-disk for further processing. If the FileName.TBL file is NOT found in the source directory then the following message is given:

TABLE File: C:\MTU-DATA\FEB09\PHX-209a.TBL
FILE: C:\MTU-DATA\FEB09\PHX-209a.TBL
PARAMETER TABLE FILE (*.TBL) NOT FOUND.
PLEASE correct Filename and try again.
Stop - Program terminated.

At this point the FileName.TBL file has been found. It is now read and parameter information is displayed. An example is given in the next diagram. Just press <ENTER> key when ready to proceed.

```
TABLE File: c:\mtu-data\feb09\PHX-209a.TBL
        73 Parameters Found
SNUM:         1012    SITE: PHX-209         FILE: 1012209A
DATE: 2000/02/09      STIM: 08:00:00        ETIM: 00:00:00
 EGN:           10     HGN:             3
ACDC:            1    LPFR:             3    LFRQ:            60
ELEV:          824    LATG:  3156.211,N     LNGG: 13047.960,E
NSAT:            4      HW: MTU5S           CNAM: ExEyHxHyHz
SRVY: PHX-TEST        CMPY: PHOENIX
EXLN:         55.0    EAZM:          -27.0  EYLN:          64.5
HXSN: COIL1130        HAZM:          -27.0
HYSN: COIL1131        HZSN: COIL1132
BAT1:        11531    TEMP:            23


To Reprocess MTU-data, from *.TSH & *.TSL files
the DATA needs to be RE-FORMATED from MTU format
to V-5 Time Series Format for REPROCESSING.
 Files: TAG-NNNa.HDR   &  TAG-NNNa.TSD
Will USE the standard MTU-gains PLUS A/D Factor.

 Are these PARAMETERS OK ? (Y/N)
```

An example of parameter information displayed from a FileName.TBL file.

The acquisition parameters are read from the parameter table file and entered as defaults for the HEADER (*.HDR) file. The parameters of SNUM, FILE, DATE, STIM, EGN, HGN, LFRQ, ELEV, LATG, LNGG, CNAM are used in this current version of MTU-V5TS. The other parameters can be used as desired.

```
.                          MTU RUN INFORMATION

    PROJECT: MT ACQUISITION TEST          STN Number: PHX-00-209a
     CLIENT: PHOENIX                       Site Desc: Test site 3
        JOB: PHX-00                       Lat  31:56:13 N Long 130:47:58 E
                                          Elevation: 0824.0 Meters.
   OPERATOR:MTU
       DATE:2000/02/09                    Site Permitted by: PHOENIX
   UTC-TIME:08:00:00                      Site Layout by: PHOENIX

                                          MTU-Box Serial Number: U-1012
                                          MTU-Box Gains:E`s x010   H`s x003
                                          MTU-Ref Serial Number: U-2000
                                          Comp Chan#    Sensor      Azimuth
                                           Ens   1      55.00 M   -27.0 DEG.
                                           Eew   2      64.50 M   +90.0 DEG.
                                           Hx1   3    COIL1130    -27.0 DEG.
                                           Hy2   4    COIL1131    +90.0 DEG.
                                           Hz3   5    COIL1132     Vertical.
                                          Notch Filters set for 60 Hz.
                                          E1 Pot Resist: 0.300 K Ohms
                                          E1 Voltage:AC=75.6mV, DC=06.8mV
                                          E2 Pot Resist: 0.250 K Ohms
                                          E2 Voltage:AC=31.7mV, DC=30.0mV
RET/TAB:next ESC:exit INS:insert DEL:del BKSP:previous DOWN:restore UP:clear
```

An example of the input fields for the HEADER file information.

Note: The file name entered for STN Number will be used for the processed XPR data. (PHX-209a.MT) The MTU serial number, E-lengths, and Azimuth as well as the COILnnnn and Azimuth will be used in the reprocessing program. The other input fields are used for site information in the HEADER file. The serial numbers are used to identify which calibration data files are needed for the gains information.

After pressing the <ESC> key the following information is displayed while the GAINS data is read from the calibration files determined by the serial numbers of the MTU box and COIL sensors.

```
          RUN INFORMATION

PROJECT: MT ACQUISITION TEST
 CLIENT: PHOENIX
    JOB: PHX-00

OPERATOR: MTU
    DATE: 2000/02/09
UTC-TIME: 08:00:00
RUN DESC: PHX-00-209a
PROGRAM VERSION: MTU5MAQ.B0
LATEST REVISION: 1998 Jul. 20

REFERENCE FIELD: LOCAL H - REF.
  XPR WEIGHTING: RHO VARIANCE.
    CUTOFF VALUE:  .000
  MAX COH VALUE: 1.000
Notch Filters set for 60 Hz.
    System Calibration
Comp      Date       File Number
U-1012               60U-1012.mtc
U-1012               60U-1012.mtc
C-1130               60C-1130.mtc
C-1131               60C-1131.mtc
C-1132               60C-1132.mtc
```

```
            STATION 1
STN Number: PHX-00-209a
 Site Desc: Test site 3
Lat  31:56:13 N Long 130:47:58 E
Elevation:   0824 Meters.
Reference Site:
Site Permitted by: PHOENIX
Site Layout by: PHOENIX
        SYSTEM INFORMATION
MTU-Box Serial Number: U-1012
MTU-Box Gains:E's x010 H's x003
MTU-Ref Serial Number: U-2000
Comp Chan#   Sensor     Azimuth
 Ens   1     55.00 M   -27.0 DEG.
 Eew   2     64.50 M    63.0 DEG.
 Hx1   3    COIL1130   -27.0 DEG.
 Hy2   4    COIL1131    63.0 DEG.
 Hz3   5    COIL1132
 Rx1   6      none       0.0 DEG.
 Ry2   7      none      90.0 DEG.

E1 Pot Resist: 0.300 Kohms
E1 Voltage:AC=75.6mV, DC=06.8mV
E2 Pot Resist: 0.250 Kohms
E2 Voltage:AC=31.7mV, DC=30.0mV
```

An example of the information saved for the *.HDR file.

The above information is saved in the FileName.HDR file. This information like E-line lengths, Gain factors and Azimuth is used by the reprocessing program as input parameters. Please check the following data to make sure the ASCII information in the above file can be read for correct gain factors. If the field for E-length or Azimuth is not entered properly (character '_' still in the field) then the conversion to numbers may not be correct. It is best to put in '0's to pad the number and completely fill the input field for this information.

```
C:\MTU-SW\BCAL\60U-1012.mtc
Polarity      1.000000        1.000000        1.000000        1.000000
Egn:       10.000000 Ens:      55.000000 Eew:      64.500000          60
Hx: C:\MTU-SW\BCAL\60C-1130.mtc
B.5GAINS SN:U1012 LF=60 EG=010 HG=003 LP=3AC DT=00/02/08 Ch5ExEyHxHyHz
Hy: C:\MTU-SW\BCAL\60C-1131.mtc
Hz: C:\MTU-SW\BCAL\60C-1132.mtc
Hgn:   3.0   Hx: COIL1130   Hy: COIL1131   Hz: COIL1132   Ugan:233.000
B.5GAINS SN:U1012 LF=60 EG=010 HG=003 LP=3AC DT=00/02/08 Ch5ExEyHxHyHz
```

An example of the information displayed after the calibration data is read.

Check that Egn is 10, 40 or 160 in value. Also check that Ens and Eew are the E-lengths entered.

For the Sensor information, make sure the correct calibration file has been read

```
 Input File for *.TSL c:\mtu-data\feb09\PHX-209a.TSL
 Input File for *.TSH c:\mtu-data\feb09\PHX-209a.TSH
Output File for *.TSD C:\MTU-DATA\PHX-209a.TSD
READ the first few BTAG of *.TSH File.
 REC:  0001          2000/02/09 - 08:00:00     1012   384     5     0
 REC:  0002          2000/02/09 - 08:00:01     1012   384     5     0
 REC:  0003          2000/02/09 - 08:00:02     1012   384     5     0
 REC:  0004          2000/02/09 - 08:00:03     1012   384     5     0
 REC:  0005          2000/02/09 - 08:00:04     1012   384     5     0
 REC:  0006          2000/02/09 - 08:00:05     1012   384     5     0
 REC:  0007          2000/02/09 - 08:00:06     1012   384     5     0
 REC:  0008          2000/02/09 - 08:00:07     1012   384     5     0
 REC:  0009          2000/02/09 - 08:06:00     1012  3072     5     0
 REC:  0010          2000/02/09 - 08:12:00     1012   384     5     0
 REC:  0011          2000/02/09 - 08:12:01     1012   384     5     0
 REC:  0012          2000/02/09 - 08:12:02     1012   384     5     0
 ------------------------------------------------
READ the first few BTAG of *.TSL File.
 REC:  0001          2000/02/09 - 07:59:59     1012    24     5     0
 REC:  0002          2000/02/09 - 08:00:00     1012    24     5     0
 REC:  0003          2000/02/09 - 08:00:01     1012    24     5     0
 REC:  0004          2000/02/09 - 08:00:02     1012    24     5     0
 REC:  0005          2000/02/09 - 08:00:03     1012    24     5     0
Pause - Please enter a blank line (to continue) or a DOS command.
```

An example of the Begin Time information for the *.TSH and *.TSL files.

The next section is to enter the START TIME of the Time Series data. If multiple time series files are being processed together, then the same START TIME has to be entered to make the time series data synchronized. If there is missing data (i.e. The MTU was late in starting the acquisition from the program start time) then the common START TIME should still be entered. The MTU-V5TS program will compare the START TIME entered to the time in the first record of *.TSH file and take appropriate action to synchronize the output data.

This entry (Parameter[2]) is the HI Start Time for output time series data.

Keys: <ENTER>, <INS>, <DEL>, <ESC>, <BKSP>, <arrows>
Enter V5-HI Start Time in UTC units.
Default: 08:00:00
Entry: 08:00:00
Is this the correct Entry ? (Y/N)

The next entry is very important in order to have the same start time for all time series files that will be processed together. This is the time reference point for synchronizing the continuous time series data.

This next entry (Parameter[3]) is the LOW Start Time for output time series data. If there is missing data (i.e. The MTU was late in starting the acquisition from the program start time) then the common START TIME should still be entered. The MTU-V5TS program will compare the START TIME entered to the time in the first record of *.TSL file and take appropriate action to synchronize the output data.

Keys: <ENTER>, <INS>, <DEL>, <ESC>, <BKSP>, <arrows>
Enter V5-LOW Start Time in UTC units.
Default: 08:00:00
Entry: 08:00:00
Is this the correct Entry ? (Y/N)

After the start time for HI time series and for LOW time series have been entered, the program then reads the *.TSH file and *.TSL file looking for the record with the corresponding time in its tag. It also counts how many records are in each file and checks for bad records, missing records in time and counts those records in the data that have been marked as having exceeded the dynamic range of the hardware.

```
Script Item number for Low-Range:        540
Counting the Number of Records in the File *.TSH
     DATE    -   Time        SNUM  SCAN   CHAN   STUS
  2000/02/09 - 08:00:00      1012   384     5     0
Start Time 08:00:00 Found at Record:            1
  2000/02/09 - 23:36:07      1012   384     5     0
Number of Records found in *.TSH Level 3 is :          78
Number of Records found in *.TSH Level 4 is :         632
The total Records found in *.TSH HIrange is :         710
Number of acquisition Minutes from Start Time:        158
PEAK Det: Ch1:     0  Ch2:     0  Ch3:     0  Ch4:     0  Ch5:     0
Effective number of Hi-hours for Reprocessing:  2.6 Hrs.

Counting the Number of Records in the File *.TSL
     DATE    -   Time        SNUM  SCAN   CHAN   STUS
 2000/02/09 - 07:59:59      1012    24     5     0
Start Time 08:00:00 Found at Record:            2
 2000/02/09 - 23:36:08      1012    24     5     0
The total Records found in *.TSL Lo-Range is:       56170
Number of acquisition hours from  Start Time:          15
PEAK Det: Ch1:     0  Ch2:     0  Ch3:     0  Ch4:     0  Ch5:     0
Effective number of Lo-hours for Reprocessing: 15.6 Hrs.
Pause - Please enter a blank line (to continue) or a DOS command.
```

An example of the analysis of the *.TSH & *.TSL files.

What is important here is to record the number of effective hours of data in each range for reprocessing input parameters. Also check that extreme numbers of 'PEAK DET' do not exist. Press the <ENTER> key when ready to proceed.

```
Random Access Record Length is:       15430
READ the MTU-HI-data and WRITE out V5-Format data.
 00001  000              2000/02/09 - 08:00:00     1012  384    5    0
 0000  SER05U SR=0384 N=05120 IT=040 RC=04801 GN=001 SA=0 UT=08:00:03   00001
 1024  SER05U SR=0384 N=05120 IT=040 RC=04802 GN=001 SA=0 UT=08:00:07   00002
 2048  SER05U SR=0384 N=05120 IT=040 RC=04803 GN=001 SA=0 UT=08:00:07   00003
 0000  SER05U SR=3072 N=05120 IT=040 RC=04861 GN=001 SA=0 UT=08:06:00   00004
 1024  SER05U SR=3072 N=05120 IT=040 RC=04862 GN=001 SA=0 UT=08:06:00   00005
 2048  SER05U SR=3072 N=05120 IT=040 RC=04863 GN=001 SA=0 UT=08:06:00   00006
 0000  SER05U SR=0384 N=05120 IT=040 RC=04921 GN=001 SA=0 UT=08:12:03   00007
 1024  SER05U SR=0384 N=05120 IT=040 RC=04922 GN=001 SA=0 UT=08:12:07   00008
 2048  SER05U SR=0384 N=05120 IT=040 RC=04923 GN=001 SA=0 UT=08:12:07   00009
```

An example of HI-range *.TSD tag data as it is written to output file.

This type of display output will stream up the monitor until the end of record is found in the *.TSH file. If any problems with the *.TSH data, the MTU-V5TS program will take appropriate action.

The following is an example of the monitor display as the FileName.TSL file is read and reformatted to the FileName.TSD file.

```
READ the MTU-LO-data and WRITE out V5-Format data.
 00003          2000/02/09 - 08:00:01     1012   24    5    0
 00004          2000/02/09 - 08:00:02     1012   24    5    0
 00005          2000/02/09 - 08:00:03     1012   24    5    0
 00006          2000/02/09 - 08:00:04     1012   24    5    0
 00007          2000/02/09 - 08:00:05     1012   24    5    0
 0016  SER05U SR=0024 N=05120 IT=540 RC=00001 GN=001 SA=0 UT=08:00:43   00472
 0008  SER05U SR=0024 N=05120 IT=540 RC=00002 GN=001 SA=0 UT=08:01:26   00473
 0024  SER05U SR=0024 N=05120 IT=540 RC=00003 GN=001 SA=0 UT=08:02:08   00474
 0016  SER05U SR=0024 N=05120 IT=540 RC=00004 GN=001 SA=0 UT=08:02:51   00475
 0008  SER05U SR=0024 N=05120 IT=540 RC=00005 GN=001 SA=0 UT=08:03:34   00476
 0024  SER05U SR=0024 N=05120 IT=540 RC=00006 GN=001 SA=0 UT=08:04:16   00477
 0016  SER05U SR=0024 N=05120 IT=540 RC=00007 GN=001 SA=0 UT=08:04:59   00478
 0008  SER05U SR=0024 N=05120 IT=540 RC=00008 GN=001 SA=0 UT=08:05:42   00479
 0024  SER05U SR=0024 N=05120 IT=540 RC=00009 GN=001 SA=0 UT=08:06:24   00480
 0016  SER05U SR=0024 N=05120 IT=540 RC=00010 GN=001 SA=0 UT=08:07:07   00481
 0008  SER05U SR=0024 N=05120 IT=540 RC=00011 GN=001 SA=0 UT=08:07:50   00482
```

An example of LO-range *.TSD tag data as it is written to output file.

Note that the IT number has been increased by 500 to mark the LO-range data for processing. Also note the RC numbers are sequential to denote continuos data from record to record.

```
 0008  SER05U SR=0024 N=05120 IT=540 RC=01307 GN=001 SA=0 UT=23:29:26   01778
 0024  SER05U SR=0024 N=05120 IT=540 RC=01308 GN=001 SA=0 UT=23:30:08   01779
 0016  SER05U SR=0024 N=05120 IT=540 RC=01309 GN=001 SA=0 UT=23:30:51   01780
 0008  SER05U SR=0024 N=05120 IT=540 RC=01310 GN=001 SA=0 UT=23:31:34   01781
 0024  SER05U SR=0024 N=05120 IT=540 RC=01311 GN=001 SA=0 UT=23:32:16   01782
 0016  SER05U SR=0024 N=05120 IT=540 RC=01312 GN=001 SA=0 UT=23:32:59   01783
 0008  SER05U SR=0024 N=05120 IT=540 RC=01313 GN=001 SA=0 UT=23:33:42   01784
 0024  SER05U SR=0024 N=05120 IT=540 RC=01314 GN=001 SA=0 UT=23:34:24   01785
 0016  SER05U SR=0024 N=05120 IT=540 RC=01315 GN=001 SA=0 UT=23:35:07   01786
 0008  SER05U SR=0024 N=05120 IT=540 RC=01316 GN=001 SA=0 UT=23:35:50   01787
XXX END OF DATA XXX            2000/02/09 - 23:36:08              01788
Total Hi Rec:   471    Total Lo Rec:  1316
```

An example of the final display for the MTU-V5TS program

If the program ended normally then there will be two new files in the output directory. Namely FileName.HDR and FileName.TSD. These files can be used with in a time series reprocessing algorithm to produce MT Resistivity data plots.

MTU TIME SERIES FORMAT
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File Format for FileName.HDR.

The following ASCII strings are found in a FileName.HDR file. The first string is the Header TAG data .It consists of 70 ASCII characters with following information:

Htag$(70) A 70 character string of the HEADER RUN ID TAG data. Examples are given below.

a.5HEAD5U CH=05 NS=01 LF=60 RN=TSC-99-001a/R TM=99/10/27 12:14:20 MTU
a.5HEAD3H CH=03 NS=01 LF=60 RN=TSM-99-001a/R TM=99/10/27 12:14:20 MTU
a.5HEAD2E CH=02 NS=01 LF=60 RN=TSE-99-001a/R TM=99/10/27 12:14:20 MTU

where the following fields in Htag$ are described:

Htag$(01:03) File format identifier Alpha.5 [E0 FA 35 in Hex]
Htag$(04:10) Header type identifier HEADxx where xx is 5U: MTU-5, 3H: MTU-3H, 2E: MTU-2E
Htag$(11:16) Number of Channels in the acquisition data CH=nn where nn is 2, 3 or 5
Htag$(17:22) Number of Station of acquisition. (Generally 1 for MTU) NS=01
Htag$(23:28) Line Frequency of the Power line in the area of acquisition. LF=50 or LF=60
Htag$(29:48) Data acquisition RUN name. Generally Site ID FileName name. RN=TAG-99-001a...
Htag$(49:67) Date and Time of the record being saved. yy/mm/dd hh:mm:ss
Htag$(68:70) Acquisition System Identifier. MTU

The following is an example of the details included in the HEADER information.

Runifo$[55](32) is an array of 55 strings of 32 characters. Note the numbers and '|' are only printed here for reference and are NOT included the file.

```
01 |        RUN INFORMATION                | 31 |        STATION 1                      |
02 |                                       | 32 |STN Number: TAG-96-001a                |
03 |PROJECT: MT ACQUISITION TEST.          | 33 |Site Desc:  Map Location               |
04 | CLIENT: PHOENIX GEOPHYSICS LTD.       | 34 |Lat  43:48:36 N Long 079:20:20 E       |
05 |    JOB: TAG-99                        | 35 |Elevation:   208  Meters.              |
06 |                                       | 36 |Reference Site: TAG-96-001R            |
07 |OPERATOR: V-5                          | 37 |Site Permitted by:                     |
08 |    DATE: 99/10/27                     | 38 |Site Layout by:                        |
09 |    TIME: 13:14:15                     | 39 |       SYSTEM INFORMATION              |
10 |RUN DESC: TAG-99-001a/R                | 40 |MTU Serial Number:   U1052             |
11 |PROGRAM VERSION: V5MTAQ.G3             | 41 |SPbox Gains: E's  .0dB H's  .0dB       |
12 |LATEST REVISION: 1999 Jan. 20          | 42 |SP Box Serial Number:  B9660           |
13 |                                       | 43 |Comp Chan#   Sensor     Azimuth        |
14 |REFERENCE FIELD: LOCAL H - REF.        | 44 | Ex    1     100.0 M    0.0 DEG.          |
15 |  XPR WEIGHTING: RHO VARIANCE.         | 45 | Ey    2     100.0 M   90.0 DEG.          |
16 |   CUTOFF VALUE:  .000                 | 46 | Hx    3    COIL9694    0.0 DEG.          |
17 |  MAX COH VALUE: 1.000                 | 47 | Hy    4    COIL9693   90.0 DEG.          |
18 |Notch Filters set for 60 Hz.           | 48 | Hz    5    COIL9692
19 |    System Calibration                 | 49 | Rx   11    COIL9694    0.0 DEG.          |
20 |Comp     Date      File Number         | 50 | Ry   12    COIL9693   90.0 DEG.          |
21 |V5664  96Nov01       22-01             | 51 |                                       |
22 |B9660  96Nov02       23-01             | 52 |Ex Pot Resist: 0.325 K Ohms            |
23 |C9694  96Nov03       24-01             | 53 |Ex Voltage:AC=1.10mV, DC= 5.6mV        |
24 |C9693  96Nov03       24-02             | 54 |Ey Pot Resist: 0.250 K Ohms            |
25 |C9692  96Nov03       24-03             | 55 |Ey Voltage:AC=1.20mV, DC= 2.5mV        |
```

Following the Header information is the GAINS data. The first string is the GAINS TAG.It consists of an ASCII string with following information such as MTU serial number, gain factors and filter settings.

Gtag$(70) is a 70 character string with the GAINS ID TAG data. Examples are given below.

b.5GAINS SN=U1052 LF=60 EG=010 HG=003 LP=3AC DT=00/02/08 Ch5ExEyHxHyHz

b.5GAINS SN=E1042 LF=60 EG=010 HG=000 LP=3AC DT=00/02/08 Ch2ExEyXxXxXx

b.5GAINS SN=H1022 LF=60 EG=000 HG=003 LP=3AC DT=00/02/08 Ch2HxHyXxXxXx

b.5GAINS SN=H1032 LF=60 EG=000 HG=003 LP=3AC DT=00/02/08 Ch3HxHyHzXxXx

where the following fields in Gtag$ are described:

Gtag$(01:03) File format identifier Beta.5 [E1 2E 35 in Hex]

Gtag$(04:09) Gains type identifier GAINS for MTU-5, MTU-2E, MTU-2H, or MTU-3H

Gtag$(10:18) Serial Number of MTU box and type. U: MTU-5, E: MTU-2E, H: MTU-2H/3H

Gtag$(19:24) Line Frequency of the Power line in the area of acquisition. LF=50 or LF=60

Gtag$(25:31) The gain of the E-channels on the Front End board. EG=010 or EG=040 or EG=160.

Gtag$(32:38) The gain of the H-channels on the Front End boards. HG=003 or HG=012 or HG=048.

Gtag$(39:42) The Low-Pass Filter setting for the Front End Boards. LP=3AC 1:Wk, 2:Med 3: Stg

Gtag$(43:45) The type of coupling set on the Front End boards. AC or DC.

Gtag$(46:57) Date of the acquisition of the record data. yy/mm/dd

Gtag$(58:60) Number of channels of data in the file. Ch2 or Ch3 or Ch5.

Gtag$(61:70) Channel Name of data type in the file: ExEyHxHyHz Note Xx is unused channel.

Following the Gtag$ string is a list of numbers in ASCII format. Every two numbers will form a complex number (A+jB) having REAL part A and IMAGINARY part B. They are written in '2E16.7' format. An example for 5 channels is given.

.107695534E+03 -.555671196E+02 .102591766E+03 -.551787453E+02 .169856211E+05

-.863552704E+02 .169297012E+05 .475127045E+03 -.497755518E+04 .325839160E+04

These channels are Ex Ey Hx Hy Hz as defined in Gtag$(61:70). In the example above, the gain for frequency #1 is given for each of the five channels. The remaining frequencies follow in sequential order.

Ex(A+jB) =	(+0.107695534E+03	-0.555671196E+02)	=	Tgain(1,1)
Ey(C+jD) =	(+0.102591766E+03	-0.551787453E+02)		Tgain(1,2)
Hx(E+jF) =	(+0.169856211E+05	-0.863552704E+02)		Tgain(1,3)
Hy(G+jH) =	(+0.169297012E+05	+0.475127045E+03)		Tgain(1,4)
Hz(I+jJ) =	(-0.497755518E+04	+0.325839160E+04)		Tgain(1,5)

The complex gains arrays are defined as follows where Chan is the number of channels (5, 3, or 2).
An example of F77 code to read the information is given.

```
      COMPLEX       Tsgain, Tgain(40,5)
      CHARACTER  Ascstr*32
      DO 40 Ifrq = 1, 40
         DO 5 Ich = 1, Chan
            CALL FREAD(Iunit,Ascstr,32,Ierr)          <= a utility to READ next 32 bytes in a file.
            READ(Ascstr,'(2E16.7)') Tsgain
            Tgain(Ifrq,Ich) = Tsgain
 5       CONTINUE
 40   CONTINUE
```

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Time Series 3-byte Representation.

The Time Series information is stored in a compact Three Byte Integer format. An example of how this is done follows:

12345678	Integer number from the A-D.
BC 61 4E	HEX of the Integer number.
1011 1100 0110 0001 0100 1110	24 bit representation of the Integer number.
10111100 01100001 01001110	Split into three bytes
188 97 78	Decimal representation of each byte.
¼ a N	ASCII representation of individual bytes.
Na¼ <= SWAP bytes	How the data is stored (Continuous / NO spaces)
Na¼90%@APack	Four integers stored as 3 byte threesome.

Please see an ASCII Table to find the ASCII representation of each byte.

File Format for FileName.TSD.

The following ASCII strings are found in a FileName.TSD file. The first string is the Series TAG data .It consists of an ASCII string with following information such as Sample Rate and Record IDs:

Stag$(70) A 70 character string of the TIME SERIES TAG data. Examples are given below.

a.5SER05U SR=0384 N=05120 IT=040 RC=04801 GN=001 SA=0 UT=08:00:03
a.5SER02E SR=3072 N=02048 IT=040 RC=04862 GN=001 SA=0 UT=08:06:00
a.5SER03H SR=0024 N=03072 IT=540 RC=00001 GN=001 SA=0 UT=08:00:43

where the following fields in Stag$ are described:

Stag$(01:03) File format identifier Alpha.5 [E0 FA 35 in Hex]
Stag$(04:10) SERIES type identifier SERxxB where xB is 5U: MTU-5, 3H: MTU-3H, 2E: MTU-2E
Stag$(11:18) Sample Rate of the Time Series data
Stag$(19:26) Number of Sample points N= 1024*Chan
Stag$(27:32) The Item Number. Set to the Julian Day of Acquisition. (Lo-range add 500)
Stag$(33:41) The RECORD number. If sequential then continuous data from record to record.
Stag$(42:48) The Gain Number. Should be 1. Only changes if Gain is changed during acquisition.
Stag$(49:53) The Saturation Flag for the Time Series data. Set to 1 if Peak detection occurs.
Stag$(54:64) Time of the record being saved. hh:mm:ss
Stag$(65:70) Pad. (Last three bytes has string length of data to follow ?)

The following example can be used to read the 3 Byte Integer data.

```
      CHARACTER Stag*70, Cdata(1024*Chan*4)
      INTEGER*4  Rlen, Chan, Idata(1:1024,1:Chan), Lrec
      EQUIVALENCE (I4data,C4data)
         Lrec = 70 + Chan * 1024 * 3
      OPEN(UNIT=2000,FILE=Filnam,ACCESS='DIRECT',STATUS='UNKNOWN',RECL=Lrec)
         Rlen = 1024 * Chan
      READ(2000,Rec=N) Stag, (Cdata(4*I-2),Cdata(4*I-1),C4data(4*I),I=1,Rlen)
      DO100 Ipt = 1, 1024
        DO 100 Ich = 1, Chan
              I4data(Ipt,Ich) = I4data(Ipt,Ich) / 256
  100 CONTINUE
```

This will copy the 3 Byte Integer into the 3 most significant Bytes of a 4 Byte Integer. Then DIVIDE by 256 to right shift the data and carry the sign. The Time Series data (*.TSH, *.TSL) is stored in continuous order for each digitized point for each channel having the form [Pt 1:ExEyHxHyHz - Pt 1024:] However, the *.TSD Time Series data is organized as {[Ex Pt1 ... Pt 1024],[Ey Pt1 ... Pt 1024], ...}. Note that the record numbers do not increment for Level 3 & 4 because the sequential blocks are not continuous Time Series segments. The data is continuous only with in
each block. A block of data is the amount of time series data saved for each minute. However in Level 5, the data is continuous from one block to the next and so the record number do increment from one block of data to the next block. Note that theV5-2000 (MTU-5) system can record Hi-Range and Lo-Range simultaneously. If the Time Series Data has been properly terminated then an END OF RECORD tag should be at the end of all the data It has the end time.

a.5XXX END OF DATA XXX 2000/02/09 - 23:36:08.

Frequencies of Acquisition.

	Data Freq(60 Hz.)	Sample Rate	Data Freq(50 Hz.)	Sample Rate
1)	384.00	3072.0	320.00	2560.0
2)	288.00	3072.0	240.00	2560.0
3)	192.00	3072.0	160.00	2560.0
4)	144.00	3072.0	120.00	2560.0
5)	96.00	3072.0	80.00	2560.0
6)	72.00	3072.0	60.00	2560.0
7)	48.00	384.0	40.00	320.0
8)	36.00	384.0	30.00	320.0
9)	24.00	384.0	20.00	320.0
10)	18.00	384.0	15.00	320.0
11)	12.00	384.0	10.00	320.0
12)	9.00	384.0	7.50	320.0
13)	6.000	24.0	6.000	24.0
14)	4.500	24.0	4.500	24.0
15)	3.000	24.0	3.000	24.0
16	2.250	24.0	2.250	24.0
17)	1.500	24.0	1.500	24.0
18)	1.125	24.0	1.125	24.0
19)	0.750	24.0	1.333 Sec.	24.0
20)	0.5625	24.0	1.778 Sec.	24.0
21)	0.3750	24.0	2.667 Sec	24.0
22)	0.28125	24.0	3.556 Sec	24.0
23)	0.18750	24.0	5.333 Sec	24.0
24)	0.1406250	24.0	7.111 sec	24.0
25)	0.0937500	24.0	10.667 Sec	24.0
26)	0.0703125	24.0	14.222 Sec	24.0
...		〃 〃		〃 〃
37)	0.0014648	24.0	682.67 Sec	24.0
38)	0.0010986	24.0	910.22 Sec	24.0
39)	0.0007324	24.0	1365.3 Sec	24.0
40)	0.0005493	24.0	1820.4 Sec	24.0