AUSTRALIAN SOCIETY OF EXPLORATION GEOPHYSICISTS
(A.B.N. 71 000 876 040)

FORMAT FOR EXCHANGE OF ELECTRICAL SURVEY DATA

ASEG ESF FORMAT

Developed by the ASEG Technical Standards Committee
Version 001 - August 2012 with minor updates

Table of Contents

ASEG-ESF Format for exchange of electrical survey data

Overview: A standard format for data exchange is required so that data can be passed between users in a format which allows the data to be read with minimal user input and processed with a minimum of additional information. Rather than defining what can't be written to a file the standard defines the file structure, those pieces of information that must be included and associates standard meanings to common keywords. Anything else should be allowed to be written to the file as long as it follows the file format and does not use a listed keyword for another purpose. The standard should be flexible enough to allow for unforseen changes in instrument output over time and the format should be ASCII to allow it to be both platform independent and durable.

The AMIRA format has become a defacto industry standard for EM and likewise the Geosoft DAT format for IP data. This has largely been because they are documented and thus useable by others. Additions to the original definitions of both formats have being added by software vendors but as these are usually not documented, there has been some divergence in the format which this new standard attempts to remedy. The standard needs to allow for both time and frequency domain data and all electrical survey types viz, EM, IP, MMR, CSAMT, MALM, SP, ERI as well as AMT and MT although there is already a SEG standard for these two. Although the original AMIRA format was designed with IP data in mind it requires extension to handle these data. The Geosoft IP DAT format is currently the defacto standard for IP data exchange and because of general similarity in the data types it is intended that these two formats merge to become one.

The standard is intended for all electrical survey types, borehole, surface and airborne. The standard has been designed so that a single ESF file can capture all the survey data as well as all the survey metadata. However it is also flexible enough to allow linked parameter files where particular survey parameters (e.g the transmitter waveform or loop layout) are verbose. If this feature is used then all the files linked in the ESF file are required in order to comply with the standard. These parameter files may be single files for each parameter type or more simply a single file which concatenates all the individual files into a single .CON file.

Modifications to the standard: The format should not be static, however it should be general enough so that any future changes are backward compatible so that older versions of software can read it. Changes to the format must be documented and easily available to anyone who needs them. A suggested mechanism to achieve this is through a standards topic on the ASEG user web forum. Well supported changes could then be added to the standard document generated by the Technical Standards Committee and be made available for download.

Standard File Definition:

The file extension for the file is .ESF

The file has a standard layout as follows;

Record 1: Title
Record type 2: Constant Definitions - multiple consecutive records allowed
Record type 3: Optional @Keywords - multiple consecutive records allowed
Record 4: Column Definitions

Record 5+: Data Records

Records 1 to 4 should only occur at the start of the file, not be repeated throughout the file.

In addition to these the file may contain any number of comment records

The record terminator is not defined and may be O/S dependent. e.g. Hex 0D0A - MSDOS/Windows, 0D - Macintosh, 0A - Unix. Given that most commercial IP processing software is MSDOS/Windows based 0D0A would be preferred.

Record 1: - Title

This consists of ASCII text of arbitrary length. It should include the version number of the EM/IP file format to allow for future changes which may not be backward compatible and to draw a line between the new format and past practice. The format for declaring the version number is VER:#### where #### is a 4 digit number starting at 0001 and hopefully never reaching 9999!

Record type 2: - Constant Definitions

This record consists of zero or more constant declarations in the form CONSTANT:VALUE or CONSTANT=VALUE. The constants should be separated by one or more spaces or tabs. Any field defined on this record is said to be a Constant. As spaces or tabs are used as delimiters neither should exist immediately after the : or = delimiter. Multiple instances of Record Type 2 are allowed as long as they are consecutive.

Record type 3: - Optional @Keywords

At or @ Keywords can be used instead of an external file to define array type constants such as window times, transmitter wire vertices, frequencies or transmitter waveform. Except in the case of very long arrays the use of @Keywords is preferred over direction to an external file. This reduces the chance of important information becoming detached from the data file during de-archiving. The @Keyword must only be used at the start of a line in the file and has the form @KEYWORD= *an array of* ***comma*** *separated constants.* Multiple instances of Record Type 3 are allowed as long as they are consecutive.

Record 4: - Column Definitions

This record consists of one or more column titles which describe the data in the data records which follow. The column definitions should be separated by one or more spaces or tabs and can not therefore contain spaces or tabs. Any field defined here is said to be a Variable. Because multiple instances or Record 2 or 3 are allowed the code needs some way to automatically recognise a Column Definition line. The labels used in the Column Definition line should therefore not include the characters : or = as at least one of these will be used in Records 2 or 3. The parsing code can then read a line of text and check for the existence of : or = and if not found assume the line is Record 4

Record 5 to End of File: - Data Records

Each data record consists of one or more data values. Data values may contain any characters except spaces and tabs. They are separated by one or more spaces and/or tabs. There should be one data value for each column title. There is no requirement that data values line up underneath column titles. The *n*th value is assigned to the *n*th column variable. There may not be any missing values. If a value is unknown, a null value must be entered

Nulls:

A null value may be represented in any of the following ways:

1. Declared in the header using the Keyword NULL: followed by a Constant representing the null value. This is the preferred method however for backward compatibility with AMIRA and Geosoft the following null options will be recognised. New software should write option 1 not the backward compatible options.
2. An asterisk (*).
3. The numeric value 1.0e33. As this value is numeric the formatting is not important. For example 1e33, 1.0E+033 etc. are all null values.
4. A string consisting of a minus sign followed by six or more nines. Since this is a string, the formatting is important. -999999 or -999999999999 are both nulls, but -0.9999999999e10 is not a null value.

Comments:

Any line which begins with a forward slash (/) followed by a space. For backward compatibility a back slash (\) is also allowed but should not be used on new data files. The requirement to have a space following the forward slash allows for slash Keywords e.g. \TIMES to indicate that windows times will follow. Slash keywords should be deprecated and replaced with @ Keywords. This should reduce the chances of software writers confusing the slash and slash Keywords.

Conventions:

The units of certain variables should be a constant, e.g. all Times should be in milliseconds, Current should be in Amps and loop areas or moments should be in square metres even if the distance units are imperial.

All times are relative to time zero which is defined as the start of transmitter turn off viz. The top of the ramp. For processed galvanic electrical data electrode C1 is the current electrode closest to the potential electrodes. Electrode P1 is the potential electrode closest to the current electrodes. If using Pole arrays C2 and or P2 should be the remote electrode and may be specified as constants in Record 2. For field data this ordering may not always be achievable however where possible this ordering convention should be

followed.

Writing Constants, Variables and Keywords:

Keywords, Constants and Variables must not contain spaces, tabs, a colon (:) or an equals sign (=). Quotes or brackets are not considered to be special characters.

Defined Variables and Constants:

In the following table the AMIRA or Geosoft defined fields are shown in black, existing alternates for these in green and proposed new fields in blue. New code should output the preferred rather than alternate Keyword. The case of the Keywords is not defined and Keywords should be designed to avoid ambiguity if the input line has its case changed by the input software.

This keyword list is not intended to be a limit what can be written to a file - any relevant information should be able to be written to the file. This keyword list is intended to provide a standard meaning to commonly used variables and constants so that they have a consistent meaning across different files and so that parsing programs can be adapted to recognise them.

Keyword (preferred)	Description - Variable or Constant	Mandatory	Keyword (alternate)
ARRAY	Constant - The array type used to acquire the data Examples - 4 letter acronyms preferred; DPDP - dipole dipole PLDP, PDP - pole dipole DPPL - dipole pole PLPL - pole pole GRAD - gradient SCHL - schlumberger WENN - wenner USER - other than above. If used then all electrode co-ords must be specified	Yes (IP)	
AZIMUTH	Variable - Rotation of the direction of a survey traverse clockwise from North. Specified in degrees. The convention for North (grid or magnetic) is specified in NORTHTYPE	No	AZIM
BARALT	Variable - Barometric Altitude in UNITS.LENGTH if airborne	No	BAROALT BAROMETRICALTIMETER
BFIELD	Constant - Yes/No answer if data is Bfield response. Overrides any implied response in UNITS.EMIP.	Yes if BField	
BOUNDARY	Constant or @Keyword - Array of Lat/Long pairs describing the outer limits of the survey. To be used for automatically making polygons for GIS indexing. Lat/Longs in decimal degrees	No	

Keyword (preferred)	Description - Variable or Constant	Mandatory	Keyword (alternate)
BOUNDFILE	Constant defining filename containing Boundary Information in decimal degrees	No	
C1X	Variable - X location of the first current electrode. X can either be station along line or down hole in which case Y for all electrodes are obtained from the line variable or it can be the easting (local or UTM) in which case Y must be specified as a variable	Yes(IP)	FX1, C1, F1, F1X, T1X, TX1,C1E, C1EAST, C1_STATION
C1Y	Constant or Variable - Y location of the first current electrode. If a constant this could be equivalent to either a line number or a northing for a remote pole electrode if a variable Y should be the northing (local or UTM)	Yes (if IP & ARRAY is USER)	FY1, F1Y, T1Y, TY1,C1N, C1NORTH, C1_LINE
C1Z C1D	Constant or Variable - Z location of the first potential electrode where Z is the elevation, increasing upwards If borehole data and C2D is used D is depth positive down	No	M1Z,R1Z, C1LEVEL
C2X	Constant or Variable - X location of the second current electrode. X can either be station along line or down hole in which case Y for all electrodes are obtained from the line variable or it can be the easting (local or UTM) in which case Y must be specified as a variable	Yes(IP)	FX2, C2, F2, F2X, T2X, TX2,C2E, C2EAST, C2_STATION
C2Y	Constant or Variable - Y location of the second current electrode. If a constant this could be equivalent to either a line number or a northing for a remote pole electrode if a variable Y should be the northing (local or UTM)	Yes (if IP & ARRAY is USER)	FY2, F2Y, T2Y, TY2, C2N, C2NORTH, C2_LINE
C2Z C2D	Constant or Variable - Z location of the second current electrode where Z is the elevation, increasing upwards. If borehole data and C2D is used D is depth positive down	No	F2Z,T2Z, C2LEVEL
CnX CnY CnZ CnD	Constant or Variable - location of the nth current electrode (N>2)	No	
CnE_UTM CnN_UTM CnELEV Cn_LAT Cn_LONG	Constant or Variable - location of the nth current electrode (N>0) in UTM space, datum to be defined using Keyword DATUM If in Geographic co-ords Lat/Long to be given in decimal degrees	No	TXEASTn TXNORTHn TXELEVn
CHANNELFILE	Constant - Name of User defined channel file with window times e.g. CHANNELFILE=MYINST.CHN Because this requires a separate file which may become detached from the data file the use of the @Keywords @TIMESSTART and @TIMESEND is recommended	No	
CHn	Variable - Amplitude of measured field for EM, amplitude of secondary voltage normalised by the primary voltage at window n for TDIP or magnitude and phase of CR data. The original Geosoft format allowed for data too noisy to read with the Keyword TN. In the digital age this	Yes for Time Domain	IPn, Mn, [n], AResn.

Keyword (preferred)	Description - Variable or Constant	Mandatory	Keyword (alternate)
	should be unnecessary and only retained for backward compatibility. The use of CH rather than IP converges with the AMIRA format. If using CH then n=1..max number of windows recorded if using IP n=0 to max-1 number of windows recorded. This conforms with both the AMIRA and Geosoft standards. CHn preferred.		
COLE_C	Variable - Cole-Cole c exponent	No	
COLLARFILE	Constant - Collar file name for down hole data. File has a header line using standard keywords listed here for hole, east, north and rl. The collar will normally be the top of the hole but may be a wedge point for surveys that start with depth 0 at the wedge.	No	
COMPONENT	Variable - Direction in which EM field is measured. Maintain a right hand rule. **General surface surveys** X = Horizontal in an EAST direction. Y = Horizontal in a NORTH direction. Z = Vertical. With polarity positive upwards. **Down Hole** A = Axial. Along the hole with polarity positive towards the collar. i.e a vertical downward hole will have A positive up, a vertical upward hole will have A positive down. U = Perpendicular to A and V in a vertical plane containing the hole and positive away from gravity (up). V = Perpendicular to A and U in a horizontal plane. Looking into the hole from the collar, positive at 9 o'clock **FEM** HCP = Horizontal Co-Planar VCP = Vertical Co-Planar VCA = Vertical Co-Axial **For backward compatibility** C = Same as Z but implies Coincident Loop data. I = Same as Z but implies In Loop data.	No	C CMP COMP
CONFIG	Constant - Survey configuration COINCIDENT Synonyms COINCIDENT_LOOP COINC_L DOWNHOLE Synonyms DOWN_HOLE LTX_DHR DRILLHOLE BOREHOLE FIXEDLOOP Synonyms FIXED_LOOP FIXED LTX_SRX INLOOP Synonyms IN_LOOP	Yes(EM)	CONFIGURATION LAYOUT TYPE SURVEY_TYPE AIRBORNETYPE ABTYPE

Keyword (preferred)	Description - Variable or Constant	Mandatory	Keyword (alternate)
	LTX_ILR INOUT No Synonyms SLINGRAM Synonyms SLNGRM Airborne survey type if data are airborne. **Input Geometry** TOWEDBIRD TOWED_BIRD BIRD **Dighem Geometry** SEPARATEDCOILS SEPARATED_COILS SEPCOILS **In-Loop Geometry** INLOOP IN_LOOP **Fixed Wing FEM** BROADSIDE WINGTIP		
CONTRACTOR	Constant - Contractor or group acquiring the data	No	
CPI###	Variable - In-phase Coplanar amplitude for frequency ###	No	
CPQ###	Variable - Quadrature Coplanar amplitude for frequency ###	No	
CURRENT	Constant or Variable - Transmitter current in Amps	Yes	CURR I TXI
CXI###	Variable - In-phase Coaxial amplitude for frequency ###	No	
CXQ###	Variable - In-phase Quadrature amplitude for frequency ###	No	
DATATYPE	Constant - Type of data in the file. TEM = Transient EM. FEM = Frequency EM APPRES = Computed apparent resistivity.from EM data APPCOND = Computed apparent conductivity. DCRES = Measured DC Resistivity - use for ERI data TDIP = Time domain IP FDIP = Frequency Domain IP MMRT = Magnetometric resistivity/IP collected using time domain software MMRF = Magnetometric resistivity/IP collected with frequency domain software CSAMT = Controlled Source AMT SP = Self Potential MALM = Misse a la masse VOLTAGE = Same as TEM (For Backward Compatibility).	Yes	
DATE	Constant or Variable - Survey Date as a number in the format YYYYMMDD	No	

Keyword (preferred)	Description - Variable or Constant	Mandatory	Keyword (alternate)
DATUM	Constant - Datum for UTM co-ords if supplied. Note that spaces are not allowed in the datum acronym	No	
DATETIME	Variable - Reading time as a string YYYYMMDD_HHMMSS.SS	No	
DECPH	Variable - Decoupled phase.	No	IP 3PT
DIPOLE	Constant or Variable - the electrode a spacing (MN) used to acquire the data. This is currently a Geosoft constant although there are already many surveys where this is not the case. It could be a Variable or a Constant, set to the minimum a spacing used in the file.	Yes for IP unless both RXDIPOLE and TXDIPOLE are used	
DELAY	Constant or @Keyword - Array of times for delay time in milliseconds. Specified from time zero to the centre of the window. If not used as a @Keyword use only in Channel File in combination with WIDTH	No[2]	TIMES
DEPTH	Variable - Vertical depth below reference point in UNIT.LENGTH units.	No	
DIP -DIP	Variable - Angle from horizontal, negative downwards. To allow for previous AMIRA usage which has positive downwards place a negative sign immediately in front of the keyword to signify a sign flip	No	
DISTANCE	Variable - Distance along line or borehole in the units of UNITS.LENGTH	No	DIST DIST_ABS
DUTYCYCLE	Constant - Duty Cycle of the transmitter - expressed as a percentage	No	DC
EAST/LONG	Variable - The easting or Longitude (decimal degrees) of the plot point for a reading	No	EASTING
ELEVATION	Variable - Station height (Z co-ord)	No	ELEV Z
ERRMAG	Variable - Error in magnitude/real reading. How the error is calculated is not specified	No	ERROR SEM
ERRPHZ	Variable - Error in Phase/Imaginary reading. How the error is calculated is not specified	No	
@F=	Constant - Comma delimited array of the frequencies acquired if harmonic data. In the Geosoft DAT format the Data section uses normal IP labels for magnitude and phase and the data are ordered by magnitude followed by the phases. Deprecate this practice in favour of the more intuitive MAGn and PHn	No	
FREQ	Constant or Variable - Instrument channel frequency - historically used to derive window times. Use of the @Keyword @TIMES, @TIMESSTART, @TIMESEND or use of CHANNELFILE to derive window times would be preferable as access to historical window times is limited. Not to be confused with TXFREQ Available instruments and frequencies are:	No	FREQUENCY BFREQ BASEFREQ CHANNELS

Keyword (preferred)	Description - Variable or Constant	Mandatory	Keyword (alternate)
	Bison TDEM 2000 BISON1 - Time Group 1 Sensitivity 1 BISON2 - Time Group 2 Sensitivity 2 BISON3 - Time Group 2 Sensitivity 3 **Crone PEM** 10 or 10Channel 20 or 20Channel 30 or 30Channel 50 or 50Channel 150 or 150Channel **EM37** 25Hz or HIGH or H 6.25Hz or MEDIUM or M 2.5Hz or LOW or L **Geotem Airborne** 25Hz or G25 (Geotem Deep) 75Hz or G75 125Hz or G125 **Protem** 2.5Hz or P2.5 6.25Hz or P6.25 25 Hz or P25 62.5Hz or P62.5 250Hz or P250 **Questem Airborne** 37.5Hz or Q37.5 75Hz or Q75 **Sirotem MkII** STANDARD or S EARLY or E		
FREQ (Cont)	**Sirotem Mk3** STANDARD or S or S3 EARLY or E or E3 COMPOSITE or C or C3 HI-RES or H or H3 **Zonge GDP-16/32** 32Hz or Z32 16Hz or Z16 8Hz or Z8 4Hz or Z4 2Hz or Z2 1Hz or Z1 0.5Hz or Z0.5 0.25Hz or Z0.25 0.125Hz or Z0.125 0.0625Hz or Z0.0625 **Monex TerraTem** TI = Intermediate Times TL= Long Times TH=High Res Times TIS = New Intermediate Times TLS= New Long Times THS=New High Res Times **EMIT SMARTem** standard = SMARTem standard times All other instrument frequency values are assumed to be user defined. A user defined instrument can be called by any name not		

Keyword (preferred)	Description - Variable or Constant	Mandatory	Keyword (alternate)
	defined in the list above. For example FREQUENCY=U would expect a CHANNELFILE constant to be found, but so would FREQUENCY=ACME25 or some other meaningful instrument name not listed. FREQUENCY=USERDEFINED with and accompanying CHANNELFILE specification is also acceptable.		
GAIN	Variable - Gain setting of receiver for this reading	No	G
GPSALT	Variable - For airborne Surveys GPS Altitude in metres relative to ellipsoid	No	GPSALTIMITER
INITDELAY	Constant or Variable - Time from the start of Tx turn off to time zero (in milliseconds). Can be positive or negative with reference to the top of the ramp.	Yes if Time domain unless window times are relative to the top of the ramp	INIT INIT_DELAY
INSTRUMENT	Constant - Instrument Used. Some below included for backward compatibility, for future use only use this for self contained instruments with built in transmitters. Available include: BISON CRONE DIGEM EM37 EM63 GDP16 (synonym for ZONGE) GEOTEM HOISTEM MAXMIN POSEM PROTEM QUESTEM QUESTEM450 SALTMAP SIROTEM (for Sirotem MkII) SIROTEM3 (for Sirotem Mk3) SPECTREM TEMPEST TERRATEM UTEM ZONGE. STINGSWIFT SYSCAL LIPPMANN OHMMAPPER For split systems use with RECEIVER and TRANSMITTER Keywords instead	No	INST TEMINST
KFACT	Variable - geometric factor for calculation of apparent resistivity in galvanic arrays	No	
LASALT	Variable - Laser altimeter in UNITS.LENGTH	No	LASERALTIMETER
LINE	Constant or Variable - A string containing the line	Yes	BOREHOLE

Keyword (preferred)	Description - Variable or Constant	Mandatory	Keyword (alternate)
	number or hole ID. The line number may have a directional suffix e.g. E, N, W, S to indicate the line direction.		HOLE PROFILE
LOOP	Constant or Variable - The EM Loop number for the data NOT the loop type	No	
LOOPSHAPE	Constant - the shape of the EM loop Options Include SQUARE DIAMOND RECTANGLE CIRCLE	No[1]	
LRADIUS	Constant - Tx loop radius in metres - for circular loops	No[1]	
LSIDE	Constant - length of a side of the Tx loop	No[1]	LOOPSIDE TXSIDE
LSIDEX LSIDEY	Constant - length of a side of the Tx loop in the X (along line) and Y (across line) direction for rectangular loops, if one used both must be. Use for rectangular moving loops	No[1]	
LVnX	Constant - X co-ordinate of the nth Loop vertex	No	
LVnY	Constant - Y co-ordinate of the nth Loop vertex	No	
LVnZ	Constant - Z co-ordinate of the nth Loop vertex	No	
MAGn	Variable - Magnitude of secondary response for Frequency domain survey. Index starting at MAG1 for the fundamental, Harmonics to be labelled incrementally not by the order of the harmonic viz MAG2 = 3rd harmonic	No	
MX	Variable - User selected chargeability value	No	IP, CHT
MX_START MX_END	Constant - Integration start and end times for user selected chargeability. Note that current usage has a space between MX and Start/End - this would no longer be accepted.	No	
NBOUND	Constant - number of vertices in a boundary. To be used only in the Boundary File	Yes if Boundary File used	
NORTH/LAT	Variable - Northing or Longitude (Decimal Degrees) of plot point for a reading	No	NRTH NORTHING
NORTHTYPE	Constant - definition of North for AZIMUTH: Options Include GRID MAGNETIC	Yes if AZIMUTH used	
NORMEM	Constant - Normalisation type for UTEM or Converted Step Response - Options CONTINUOUS, CONT POINT, PT	No - unless data are normalised	NORMALISATION NORMALIZATION
NORMPYX	Variable or Constant - The X co-ordinate to be used for point primary field normalisation. Primary field normalisation must be set to point normalisation for this to have any effect.	No - unless data are point normalised	NORMALISEPTX NORMALIZEPTX

Keyword (preferred)	Description - Variable or Constant	Mandatory	Keyword (alternate)
NORMPYY	Variable or Constant - The Y co-ordinate to be used for point primary field normalisation. Primary field normalisation must be set to point normalisation for this to have any effect.	No - unless data are point normalised	NORMALISEPTY NORMALIZEPTY
NORMPYZ	Variable or Constant - The Z co-ordinate to be used for point primary field normalisation. Primary field normalisation must be set to point normalisation for this to have any effect.	No	NORMALISEPTZ NORMALIZEPTZ
NORMV	Constant - YES/NO flag to indicate primary voltage has been current normalised. Discourage voltage normalisation as knowing the actual current is useful.	No - unless data are normalised	
NSPACE	Variable - N level for IP pseudosection plotting	No	NLEVEL N - obsolete
NSTACK	Variable - Number of stacks as defined by the equipment manufacturer.	No	CYCLE DUR
NSURV	Constant - the number of survey points in a SURVEYFILE, only to be used in a SURVEYFILE context	Yes if Surveyfile used	
NULL	Constant - A character string representing the null value used in the data section. This is to be read as a character string to both allow for the Geosoft * and to allow numbers originally stored in double or quad precision to be read into single precision arrays. e.g. the Intrepid ERMapper null value of -5.0e+75 which is NaN to a 4 byte real input.	No	
NUMHOLES	Constant - Number of holes in a collar file	No	
NUMTIMES	Constant or Variable - Number of delay times or channels	No	NCH WINDOWS
NVERT	Constant - Number of vertices in transmitter wire or loop - only used in WIREFILE	Yes if wirefile used	
OFFTIME	Constant - Transmitter off time in mSec	Yes if Time domain	
ONTIME	Constant - Transmitter on time in mSec	Yes if Time domain	PULSEWIDTH
P1X	Variable - X Location of the first potential electrode. X can either be station along line or down hole in which case Y for all electrodes are obtained from the line variable or it can be the easting (local or UTM) in which case Y must be specified as a variable	Yes(IP)	MX1, P1, M1, M1X, R1X
P1Y	Constant or Variable - Y location of the first potential electrode. If a constant this could be equivalent to either a line number or a northing for a remote pole electrode if a variable Y should be the northing (local or UTM)	Yes (if IP & ARRAY is USER	MY1, M1Y, R1Y, P1_LINE
P1Z P1D	Constant or Variable - Z location of the first current electrode where Z is the elevation, increasing upwards upwards If borehole data and C2D is used D is depth positive down	No	M1Z,R1Z

Keyword (preferred)	Description - Variable or Constant	Mandatory	Keyword (alternate)
P2X	Constant or Variable - X location of the second potential electrode. X can either be station along line or down hole in which case Y for all electrodes are obtained from the line variable or it can be the easting (local or UTM) in which case Y must be specified as a variable	Yes(IP)	MX2, P2, M2, M2X, R2X
P2Y	Constant or Variable - Y location of the second potential electrode. If a constant this could be equivalent to either a line number or a northing for a remote pole electrode if a variable Y should be the northing (local or UTM)	Yes (if IP & ARRAY is USER)	MY2, M2Y, R2Y, P2_LINE
P2Z P2D	Constant or Variable - Z location of the second potential electrode where Z is the elevation, increasing upwards upwards If borehole data and C2D is used D is depth positive down	No	M2Z,R2Z
PnX PnY PnZ	Constant or Variable - location of the nth potential electrode (N>2) for future generations who want to complicate life more than necessary	No	
PnE_UTM PnN_UTM PnELEV Pn_LAT Pn_LONG	Constant or Variable - location of the nth potential electrode (N>0) in UTM space, datum to be defined using Keyword DATUM If in Geographic co-ords Lat/Long to be given in decimal degrees	No	RXEASTn RXNORTHn RXELEVn
PLTPT PLTX PLTY PLTZ	Variable - Pseudosection plotpoint in the horizontal direction. Extended to include 3D plot point	No	STATION PltEast PltNorth PltElev
PHn	Variable - Phase of secondary response for Frequency domain survey. Index starting at PH1 for the fundamental, Harmonics to be labelled incrementally not by the order of the harmonic viz PH2 = 3rd harmonic	No	
PROJECT	Constant - Project/Prospect Name - no spaces allowed	No	PROJ PROSPECT
PROJFILE	Constant - file name for projection information using standard ESRI prj file format	No	
RADALT	Variable - Radar Altimeter in UNITS.LENGTH	No	RADARALTIMETER
RECEIVER	Constant - Receiver make/model	No	RX
RES	Variable - Apparent Resistivity in Ohm m	No	RHO RESIST APPRES
RL	Variable - Station relative level in UNITS.LENGTH	No	
RS	Variable - Contact Resistance in kOhms	No	POT-RES
RXDIPOLE	Variable - Potential dipole length	No	
RXSIDE	Constant - length of a side of the Rx loop	No[1]	
RXAREA RXAREAX RXAREAY RXAREAZ RXAREAA	Constant or Variable - Receiver effective area (includes internal electronic gain and number of turns) Units of square metres. Extended to define effective area for three coil systems and frequency domain coils	Yes(EM)	

Keyword (preferred)	Description - Variable or Constant	Mandatory	Keyword (alternate)
RXAREAU RXAREAV RXAREAHCP RXAREAVCA RXAREAVCP			
RXDELAY	Constant or Variable - Electronic delay associated with receiver coil **if not already taken into account by the receiver.** For example: **SIROTEM Single Component RVR** has RXDelay = 0.0011 ms **SIROTEM Mk 3 RVR Model 3c** Z Component RXDELAY = 0.0010 X Component RXDELAY = 0.0005 Y Component RXDELAY = 0.0005 **SIROTEM Mk 3 RCR Model 3x** Z Component RXDELAY = 0.0019 X Component RXDELAY = 0.0013 Y Component RXDELAY = 0.0013	Yes if EM unless the receiver has already corrected for this.	
RXDX	Constant or Variable - Centre distance horizontally along line between the transmitter and receiver loops in Slingram (Separated Loop) or Input (airborne) survey mode. The polarity of the offset distance is always receiver relative to transmitter, hence a positive value (in X) implies the receiver loop is at a higher station number than the transmitter	Yes if SLINGRAM used	SEPARATION SEP
RXDY	Constant or Variable - Centre distance horizontally across line between the transmitter and receiver loops in Slingram (Separated Loop) or Input (airborne) survey mode. The polarity of the offset distance is always receiver relative to transmitter, hence a positive value (in Y) implies the receiver loop to the left of the transmitter when looking down the line towards higher station numbers	No	SEPARATIONACROSS SEPACROSS ASEP
RXDZ	Constant or Variable - Centre distance vertically between the transmitter and receiver loops in Slingram (Separated Loop) or Input (airborne) survey mode. The polarity of the offset distance is always receiver relative to transmitter, hence a positive value (in Z) implies the receiver loop is above the transmitter. A negative value implies the receiver is below the transmitter.	No	SEPARATIONVERT VERTSEPARATION VSEP
RXELEV	Variable - Receiver elevation if different from Tx or station elevation	No	RXHT RECEIVERHEIGHT
SD	Variable - Standard Deviation of the reading	No	STDDEV
SENSOR	Constant or Variable - Receiver sensor type and brand Examples Generic:- COIL ZONGETEM3 SIROTEM SIROTEM3 GEONICS3	No	RXCOIL

Keyword (preferred)	Description - Variable or Constant	Mandatory	Keyword (alternate)
	CURTIN GEONICSBH43 SIROTEMBH1 CRONEA CRONEUV CRONEAUV - for combined data UTEM TRC-1 TRC-3 VECTEM Generic:- FLUXGATE EMIT FUGRO ATLANTIS Generic:- LTSQUID IPHT-SUPRACON Generic:- HTSQUID LANDTEM Generic:-WIRE IP:- POROUSPOT IP:- STAINLESS		
SP	Variable - Self Potential in mV	No	
STATION	Variable - Station location along line	Yes	READING SOUNDING STN FID FIDUCIAL
SRVFILE	Constant - Survey file name for down hole data. File has a header line using standard keywords listed here for hole, azimuth, dip and depth down hole for 0 point (usually collar but may be wedge point in the case of daughters)	No	
T=	Constant - Delay time to first window followed by a comma delimited array of the width of each window in the decay. Times in mSec. Retained for backward combatibilty with Geosoft DAT format. Deprecate in favour of @TIMESSTART and @TIMESEND arrays.	No	
TAU	Variable - Cole-Cole time constant	No	
TIMESEND	Constant or @Keyword - Array of time for end of each window in mSec. If not used as a @Keyword use only in Channel File in combination with TIMESSTART	No[2]	
TIMESSTART	Constant or @Keyword - Array of time for start of each window in mSec. If not used as a @Keyword use only in Channel File in combination with TIMESEND	No[2]	
TRANSMITTER	Constant - Transmitter make/model	No	TRANS TX
TURNOFF	Constant or Variable - Transmitter turn off time (ramp) in mSec	Yes(Time domain EM)	RAMP RMP
TURNON	Constant or Variable - Transmitter turn on time in mSec	No	RISETIME

Keyword (preferred)	Description - Variable or Constant	Mandatory	Keyword (alternate)
TXAREA	Constant or Variable - Transmitter loop area (defined in square metres). If more than one turn is used, the effective turns moment should be used.	Yes(EM)	LOOPAREA
TXCENTX	Constant or Variable - Easting (X) coordinate specification for the centre of an In-Out survey transmitter loop.	Yes if using In-Out	
TXCENTY	Constant or Variable - Northing (Y) coordinate specification for the centre of an In-Out survey transmitter loop.	Yes if using In-Out	
TXDIPOLE	Variable - Current Dipole Length	No	
TXFREQ	Constant or Variable - Transmitter base frequency	Yes if Frequency Domain unless @F= used	
TXTURNS	Constant or Variable - Number of turns in Tx Loop	Yes if EM unless only 1 turn or TXAREA specified properly	TURNS
TXWAVEFORM	Constant - descriptor for shape of Tx waveform Valid values include : PERIODICRECT or PERIODICSTEP or BIPOLAR : Bipolar waveform. UTEM or PERIODICTRI : Triangular waveform. CRONESTEP : Triangular waveform essentially the same as Utem. HALFSINE or HSINE : A bipolar half sine waveform. AEROTEM : A triangular waveform with off time. The default value is PERIODICRECT.	No	
UNITS.EMIP	Constant - Data units for the EM variable. (μV/A) - microvolts per amp (TEM). (nV/Am2) - nanovolts per amp metre squared (TEM) (ppm) -Parts per million (Airborne TEM) (Ohm-m) - Ohm-metres (resistivity) (S/m) - Siemens per metre (conductivity). MV/V - millivollts per volt (IP) PFE - percentage frequency effect (IP) MRAD - milliradians (FEM/FIP) (μV) - microvolts (TEM) (nT/Sec) - nanoTeslas per second (TEM) (pT/A) - picoTeslas per Amp (TEM) (pT) - picoTeslas (TEM) (nT) - nanoTeslas (TEM) (pV/Am4) - picoVolts per Amp metre^4 (TEM) (pVmS/Am4) - picoVolt milliseconds per Amp metre^4 (TEM) nV - nanovolts pV - picovolts nT - nanotesla pT - picotesla	Yes	UNITS

Keyword (preferred)	Description - Variable or Constant	Mandatory	Keyword (alternate)
	fT - femtotesla ppm Hp - parts per million of the primary field in that component ppt Hp - parts per thousand of the primary field in that component pp2t Hp or pp2000 Hp - parts per two thousand of the primary field in that component - Spectrem uses these units ppm Ht - parts per million of the total primary field at the sensor ppt Ht - parts per thousand of the total primary field at the sensor ppm Hz - parts per million of the primary field in the Z component at the sensor ppt Hz - parts per thousand of the primary field in the Z component at the sensor ppm Hx - parts per million of the primary field in the X component at the sensor ppt Hx - parts per thousand of the primary field in the X component at the sensor %Ht - percentage of the total primary field. Note that Maxwell used to call this %Hp but the terminology has been changed to bring it in line with the ppm and ppt terms. nT/s - nanotesla per second pT/s - picotesla per second uV/m2 nV nV/A nV/Am2 nV/m2 pV pV/A pV/Am2 pV/m2 nT/As nT/Asm2		
UNITS.EMIP (cont)	pT/As pT/Asm2 nT nT/A nT/Am2 nT/m2 pT pT/A pT/Am2 pT/m2 fT fT/A fT/Am2 fT/m2		
UNITS.LENGTH	Constant - Units of distance measurement. M = metres FT = feet	No	LENGTH_UNITS UNITS
UNITS.XXXX	Constant - for use in mixed datatype files, e.g	No	

Keyword (preferred)	Description - Variable or Constant	Mandatory	Keyword (alternate)
	CSAMT where both E field and H field measurements need to have their units declared XXXX is replaced by the keyword for the variable concerned. Where the Keyword includes a numeral for its order in the array this numeral is dropped. E.g UNITS.PH might define the units for Phase while UNITS.MAG would define the units for Amplitude. Its use to redefine the units for Current and Primary Voltage is discouraged		
VER	Constant used only in Record 1 - Version of the data transfer format used to allow for future changes not being backward compatible (last resort).	Yes	
VP	Variable - Primary Voltage in mV	Yes(IP)	MAG
WAVEFORM	Constant - lead to a waveform file describing the Transmitter waveform using TIMES and CURRENT e.g. WAVEFORM:TXWFORM.WFF	No	
WIDTH	Constant or @Keyword - Array of times for Channel window width (defined in milliseconds). If not used as a @Keyword use only in Channel File in combination with DELAY	No[2]	
WIREPATH	@Keyword Array of XYZ values describing the path of the Tx wire The order of vertices should be such that the field in the centre of the loop is up. For a grounded dipole direction is from positive to negative electrode	No	
WIREFILE	Constant - defining name of file containing an array of XYZ values describing the location of the loop. The order of vertices should be such that the field in the centre of the loop is up. For a grounded dipole direction is from positive to negative electrode	No	
XCOLLAR	Constant or Variable - X co-ordinate or drill hole collar	No	COLE
YCOLLAR	Constant or Variable - Y co-ordinate or drill hole collar	No	COLN
ZCOLLAR	Constant or Variable - Z co-ordinate or drill hole collar	No	COLRL
ZONE	Constant - UTM Zone if UTM co-ords supplied	No	

Notes:

1 The transmitter loop effective area must be specified as must its shape if not rectangular. The effective area can be specified using a combination of LSIDE or LVnXYZ and NTURNS or directly by TXAREA

2 Window times must be specified either using a paired combination of @DELAY and @WIDTH or @TIMESSTART and @TIMESEND as @keywords in the header or by using their non-@ equivalents in the channel file.

Obsolete Keywords for defined Variables and Constants:

The following Keywords are in current usage and may need to be supported for backward compatibility but should not be included in the standard. The keyword may be used in output files but it will not have a standard meaning.

Keyword	Description - Variable or Constant	Mandatory	Keyword (alternate)
F	Constant used as an alias for FREQ - potentially confusing with @F array of frequencies		
RXLINE	Variable - Line for receiver in offset arrays - replace with direct specification of P1X, P1Y, and P2X, P2Y		
TIME	Constant - Time base of instrument in seconds e.g. 2 = 2 second off, 2 second on. Has the potential to be confused with EM @Keyword TIMES defining the window centre times	No	
TXLINE	Variable - Line for transmitter in offset arrays - replace with direct specification of C1X, C1Y, and C2X, C2Y	No	
/TIMES(ms)	Constant - Array of centre times for windows. Time units are defined by the standard, (ms) is thus redundant see TIMES		
/TIMESEND(ms)	Constant - Array of end times for windows. Time units are defined by the standard, (ms) is thus redundant see TIMESEND		
/TIMESSTART(ms)	Constant - Array of start times for windows. Time units are defined by the standard, (ms) is thus redundant see TIMESSTART		
UNITS	Constant - Distance units. M - metres FT - feet *This clashes with the AMIRA use of the Keyword UNITS which is used to define the measurement units e.g. mV/V or mRad Replace in both DAT and AMIRA with UNITS.LENGTH (spatial)and UNITS.EMIP (data)*	Yes	
X	Variable - Synonym for EAST. Not recommended, as confusion may arise between X coordinate and X component.		
Y	Variable - Synonym for NORTH. Not recommended, as confusion may arise between Y coordinate and Y component.		
Z	Variable - Synonym for ELEV. Not recommended, as confusion may arise between Z coordinate and Z component.		

The AMIRA standard allowed for continuation lines designated with an ampersand symbol. This has not been carried through to the new standard.

Unspecified Variables and Constants:

The file may contain any number of other variables or constants which the parsing program may choose to read or ignore.

Example ESF files:

An example of an older AMIRA type format slightly modified to conform to the new format. Only one window amplitude is shown in the data section.

```
VER:0001 - TEST DATA FOR TEM DATA FORMAT
DATATYPE=TEM UNITS,EMIP=(uV/A) TXAREA=10000 RXAREA=10000 INSTRUMENT=SIROTEM3 RXDELAY=0.001
CONFIG=INLOOP
LOOP LINE STATION LSIDE CURRENT TURNOFF GAIN FREQ COMPONENT NUMTIMES VP Ch1 Ch2....cont
/SIROTEM Mk3 FIELD DATA
/SURVEY AREA :TEST EL 1000
/PROSPECT :TEST Test
/DATE :31\6\96
/CURRENT NORMALIZATION ALTERED FROM VALUE USED BY SIROTEM Mk3= 7.00 TO VALUE ACTUALLY TRANSMITTED =
14.00
BHP01 6600N 10940E 100 13 6 .33 0 S Z 18 0 -9.075e+02 ...cont
BHP01 6600N 10940E 100 13.6 .33 0 S Z 18 0 -9.035e+02
BHP01 6600N 10940E 100 13.6 .33 0 E Z 18 0 -1.127e+04
BHP01 6600N 10960E 100 13.6 .33 0 S Z 18 0 -1.431e+03
BHP01 6600N 10960E 100 13.6 .33 0 S Z 18 0 -1.428e+03
BHP01 6600N 10960E 100 13.6 .33 0 S Z 18 0 -1.422e+03
BHP01 6600N 10960E 100 13.6 .33 0 E Z 18 0 -1.875e+04BHP01 6600N 10980E
100 13.6 .33 0 S Z 18 0 -3.005e+03
BHP01 6600N 10980E 100 13.6 .33 0 S Z 18 0 -3.005e+03
BHP01 6600N 10980E 100 13.6 .33 0 E Z 18 0 -2.594e+04
BHP01 6600N 10990E 100 13.6 .33 0 S Z 18 0 -2.570e+03
BHP01 6600N 10990E 100 13.6 .33 0 S Z 18 0 -2.572e+03
```

A slightly more complicated example, note that it includes labels not included in the list of recognised keywords. The parsing program can chose to read or ignore these. The data lines have been truncated for simplicity. Note that this is a standard SMARTem V dump file only slightly edited to conform to the standard

```
VER:0001 SMARTem V TEM data file - created Sun May 02 11:39:19 2004
LINE:391850 DATATYPE:TEM RECEIVER:SMARTem UNITS,EMIP:(uV/A) CONFIG:INLOOP RXAREA:10000 INITDELAY:0.680
TRANSMITTER:ZT-30 LSIDE:100
@TIMESSTART=0.02,0.07,0.13,0.18,0.22,0.32,0.43,0.52,0.62
@TIMESEND=0.07,0.13,0.18,0.22,0.32,0.43,0.52,0.62,0.82
STATION LOOP RDNG COMPONENT DATETIME OPERATOR FREQ CURRENT SAMP_RATE GAIN NSTACKS TURNOFF
INITDELAY NOISE NUMTIMES CH1 CH2 CH3 CH4 CH5 CH6 CH7 CH8 CH9 453000 1 4103 Z 20040503_1311.00 Cam 0.500000
18.400 20000.000 1.0 64 20.0 0.68 0.02 2.167582e+00 44 3.6756e+04 3.6007e+04 3.5230e+04 3.4424e+04 3.3160e+04 ....cont
453000 1 4103 Y 20040503_1311.00 Cam 0.500000 18.400 20000.000 4.0 64 20.0 0.68 0.02 3.406500e-01 44 -4.2265e+03
-4.0923e+03 -3.9509e+03 -3.8069e+03 -3.5889e+03
453000 1 4103 X 20040503_1311.00 Cam 0.500000 18.400 20000.000 4.0 64 20.0 0.68 0.02 1.848191e-01 44 -7.4757e+01
-1.4945e+02 -2.2082e+02 -2.8929e+02 -3.8078e+02
453000 1 4104 Z 20040503_1314.00 Cam 0.500000 16.900 20000.000 10.0 64 20.0 0.68 0.02 2.105967e+00 44 2.0590e+04
2.0267e+04 1.9916e+04 1.9538e+04 1.8915e+04
453000 1 4104 Y 20040503_1314.00 Cam 0.500000 16.900 20000.000 10.0 64 20.0 0.68 0.02 3.373084e-01 44 -4.4487e+03
-4.3062e+03 -4.1609e+03 -4.0109e+03 -3.7801e+03
453000 1 4104 X 20040503_1314.00 Cam 0.500000 16.900 20000.000 10.0 64 20.0 0.68 0.02 2.286031e-01 44 -8.4895e+01
-1.6359e+02 -2.3969e+02 -3.1189e+02 -4.0841e+02
453000 1 4105 Z 20040503_1317.00 Cam 0.500000 16.500 20000.000 10.0 64 20.0 0.68 0.02 2.110939e+00 44 2.0945e+04
2.0611e+04 2.0251e+04 1.9862e+04 1.9227e+04
453000 1 4105 Y 20040503_1317.00 Cam 0.500000 16.500 20000.000 10.0 64 20.0 0.68 0.02 3.875816e-01 44 -4.5494e+03
-4.4047e+03 -4.2527e+03 -4.0979e+03 -3.8656e+03
453000 1 4105 X 20040503_1317.00 Cam 0.500000 16.500 20000.000 10.0 64 20.0 0.68 0.02 2.136802e-01 44 -5.0453e+01
-1.3003e+02 -2.0526e+02 -2.7840e+02 -3.7950e+02
453050 1 4100 Z 20040503_1256.00 Cam 0.500000 20.800 20000.000 1.0 64 20.0 0.68 0.02 7.175902e-01 44 3.6858e+04
3.6011e+04 3.5125e+04 3.4205e+04 3.2761e+04
453050 1 4100 Y 20040503_1256.00 Cam 0.500000 20.800 20000.000 4.0 64 20.0 0.68 0.02 4.141825e-01 44 -4.9712e+03
-4.8161e+03 -4.6473e+03 -4.4689e+03 -4.1927e+03
453050 1 4100 X 20040503_1256.00 Cam 0.500000 20.800 20000.000 4.0 64 20.0 0.68 0.02 2.539622e-01 44 1.9840e+03
2.0165e+03 2.0314e+03 2.0315e+03 1.9995e+03
453050 1 4101 Z 20040503_1259.00 Cam 0.500000 19.300 20000.000 10.0 64 20.0 0.68 0.02 6.098337e-01 44 1.9015e+04
```

1.9015e+04 1.9014e+04 1.9015e+04 1.9015e+04
453050 1 4101 Y 20040503_1259.00 Cam 0.500000 19.300 20000.000 10.0 64 20.0 0.68 0.02 3.779330e-01 44 -5.2024e+03 -5.0394e+03 -4.8642e+03 -4.6791e+03 -4.3880e+03
453050 1 4101 X 20040503_1259.00 Cam 0.500000 19.300 20000.000 10.0 64 20.0 0.68 0.02 2.235410e-01 44 2.0784e+03 2.1129e+03 2.1305e+03 2.1296e+03 2.0963e+03
453050 1 4102 Z 20040503_1301.00 Cam 0.500000 18.400 20000.000 10.0 64 20.0 0.68 0.02 5.445768e-01 44 1.9945e+04 1.9946e+04 1.9945e+04 1.9945e+04 1.9945e+04
453050 1 4102 Y 20040503_1301.00 Cam 0.500000 18.400 20000.000 10.0 64 20.0 0.68 0.02 3.798470e-01 44 -5.2438e+03 -5.0782e+03 -4.9001e+03 -4.7126e+03 -4.4205e+03
453100 1 4091 X 20040503_1208.00 Cam 0.500000 21.500 20000.000 4.0 64 20.0 0.68 0.02 2.504953e-01 44 7.4065e+02 6.9924e+02 6.5801e+02 6.1517e+02 5.4861e+02

Here is an example using some IP data, again the data lines have been truncated to fit on this page. Note that this is a standard TQIP output file only slightly edited to conform to the standard

VER:0001 IP DATA FROM : 7537500N.mdb (TQIPdb V2.01) 15/05/2010
DATATYPE:TDIP LINE:7537500N ARRAY:DPDP DIPOLE:100.0 UNITS.LENGTH:M NUMTIMES:11 INITDELAY:50 Mx_start:590 Mx_end:1450
@WIDTH=20,40,40,80,80,140,140,230,230,360,360
C1X C2X P1X P2X RxDipole Line PltPt Nlevel SP CURRENT VP RES MX SD Nstack CH1 CH2 CH3 CH4 CH5 CH6 CH7 CH8 CH9 CH10 CH11
600700.0 600900.0 601000.0 601100.0 100.0 7537500 600925.00 1.0 -4.162 28.700 326.7609 17.17 11.72 0.4015 14 54.02299 43.54736 35.80276 29.64072 24.74292 20.74040 17.39645 14.54538 12.07556
600700.0 600900.0 601000.0 601100.0 100.0 7537500 600925.00 1.0 -4.179 25.800 292.6193 17.10 10.95 0.3882 15 54.82899 43.80673 35.72467 29.35610 24.23649 20.05334 16.56073 13.67969 11.28234
600700.0 600900.0 601100.0 601200.0 100.0 7537500 600975.00 2.0 -1.067 28.700 125.8773 23.62 3.78 0.0511 14 22.79920 18.71280 15.27414 12.17962 9.64479 7.60129 6.00451 4.77176 3.86301 3.19372
600700.0 600900.0 601100.0 601200.0 100.0 7537500 600975.00 2.0 -1.086 25.800 112.7033 23.53 4.48 0.2286 15 25.54502 20.77415 16.88750 13.38124 10.56419 8.40590 6.74873 5.47274 4.56066 3.89326

A more complete example of a conformable file with three Record type 2 and no Record type 3 - all arrays defined in external files.

VER:001 EXAMPLE TEM DATA FILE
DATATYPE:TEM BFIELD:No CHANNELFILE:SPECIAL.CON CONFIG:IN_LOOP CONTRACTOR:ACNE_BROTHERS DATUM:GDA94 DUTYCYCLE:50 LOOPSHAPE:RECTANGLE LSIDE:100 NULL:-1.0E30
OFFTIME:1000 ONTIME:1000 PROJECT:BIG_MOUNTAIN RECEIVER:SMARTem25 TRANSMITTER:BEAST10000 RXAREA:100000 RXDELAY:0.015 SENSOR:WILLOWBRANCH TXTURNS:1
UNITS.EMIP:uV/A UNITS.LENGTH:M WAVEFORM:SPECIAL.CON ZONE:46
STATION LOOP RDNG COMPONENT DATETIME OPERATOR FREQ CURRENT SAMP_RATE GAIN NSTACKS TURNOFF INITDELAY NOISE NUMTIMES CH1 CH2 CH3 CH4 CH5 CH6 CH7 CH8 CH9 453000 1 4103 Z 20040503_1311.00 Cam 0.500000 18.400 20000.000 1.0 64 20.0 0.68 0.02 2.167582e+00 44 3.6756e+04 3.6007e+04 3.5230e+04 3.4424e+04 3.3160e+04 ....cont
453000 1 4104 Z 20040503_1314.00 Cam 0.500000 16.900 20000.000 10.0 64 20.0 0.68 0.02 2.105967e+00 44 2.0590e+04 2.0267e+04 1.9916e+04 1.9538e+04 1.8915e+04
453000 1 4105 Z 20040503_1317.00 Cam 0.500000 16.500 20000.000 10.0 64 20.0 0.68 0.02 2.110939e+00 44 2.0945e+04 2.0611e+04 2.0251e+04 1.9862e+04 1.9227e+04

Support Files:

The individual support files may be concatenated into a .CON file, the format for which is described at the end of this section. If a concatenated file is used the file names used in Record type 2 of the ESF file should point to the CON file not the individual components.

Boundary Files

A boundary file describes the outer boundary of the survey. The intention is that this file can be quickly used to make a polygon for a GIS package for quick indexing. Multiple survey boundaries can exist within the one file. The co-ordinates of the boundary should be in decimal degrees. It is not a requirement that the boundary close i.e the last vertex does not have to be the same as the first vertex although it may be. Any parsing software that requires a closed polygon will have to check that the first and last points are identical and if not add an extra point. Likewise software that automatically closes the polygon will have to check if the first and last point are identical and remove the last point. The standard allows for both.

The extension should be .BND

The records used to define the instrument time gates are:

Record 1
A title describing the boundary name(s)

Record 2
The number of vertices in the boundary. Record 2 may be repeated where multiple boundaries are listed.

Record 3
Field labels indicating the order of the Longitude and Latitude. Note that if a boundary is specified using the @BOUNDARY array Keyword the order must be Latitude followed by Longitude. This restriction does not apply to the Boundary File.

Record 4 to End of File or next Record 3
Co-ordinates of the vertices of the boundary in decimal degrees in the order specified by Record 3

Example:

```
Example boundary for two surveys
NUMBOUND=4
LAT    LONG
-20.000 123.000
-20.000 124.000
-21.000 124.000
-21.000 123.000
NUMBOUND=4
-10.000 113.000
```

-10.000 114.000
-11.000 114.000
-11.000 113.000

Channel Files

The channel files are used to define the delay times and widths or start and end times of the time gates used to acquire the data. The file is comprised of three header records followed by the individual channel times.

The file extension should be .CHN

The records used to define the instrument time gates are:

Record 1
A title describing the instrument name and frequency setting.

Record 2
The number of channel 'gate' times to follow in the file. Also in most files will be an Offtime parameter. This value is included where the Offtimes and Ontimes of the transmitter waveform are equal and where it is invariant for the frequency setting. In some instruments, for example the SIROTEM Mk II and SIROTEM Mk3, the Offtime varies with the number of channels recorded. In these cases the Offtime parameter is not included.

Record 3
Either the pair DELAY and WIDTH or the pair TIMESSTART and TIMESEND to define the instrument columns to follow.

Record 4 to End of File
Delay channel times and widths.

Note: The number of channel times and widths as specified must be the same as the value of NUMTIMES parameter specified in Record 2 and greater than or equal to the value of any NUMTIMES parameter specified in the ESF file. Consequently the NUMTIMES specified in the ESF file may be less than the value specified in the channel file.

The Delay times listed specify the middle or centre time of the delay time gate. The Width parameter spans the Delay time values with half the Width before and after the Delay time.

The Time start and Time end indicate the start and end times for each window or time gate.

All times are specified in milliseconds with respect to time zero.

Two examples of CHANNELFILEs are shown below, both describe identical time gates :

```
UserDefined Instrument  -  MYINSTR.CHN
NUMTIMES:23                                                    OFFTIME:31.25
DELAY              WIDTH
0.09               0.027
0.117              0.027
0.15075   0.0405
0.198              0.054
0.25875   0.0675
.... cont

UserDefined Instrument  -  MYINSTR.CHN
NUMTIMES:23                                                    OFFTIME:31.25
TIMESSTART         TIMESEND
0.0765             0.1035
0.1035             0.1305
0.1305             0.171
0.171              0.225
0.225              0.2925
.... cont
```

Collar files

Used to specify collar co-ordinates for down hole surveys. Use in conjunction with a survey file. Hole names should match exactly in both files

The file extension should be .COL

The records used to define the deviation are;

Record 1
A title describing the collar project name

Record 2
The number of holes in the file, NUMHOLES
Record 3
The field labels HOLE, EAST, NORTH and ELEVATION to define the collar positions to follow.

Record 4 to End of File
Co-ordinates for the holes

An example of a COLLARFILE is shown below:

```
Project X collars
NUMHOLES: 7
HOLE EAST NORTH ELEVATION
13 345678 7654254 1003.4
KDD014 556789 7683479 992.5
cont.......
```

Survey files

Used to describe the deviation of drill holes for down hole surveys. May be used in conjunction with a collar file.

The file extension should be .SUR

The records used to define the deviation are;

Record 1
A title describing the survey name

Record 2
The number of survey points in the file, NSURV

Record 3
The field labels HOLE, DEPTH, AZIMUTH and DIP or -DIP to define the deviation to follow.

Record 4 to End of File
Survey points down the holes. Ordered by top to bottom for each hole

An example of a SURVEYFILE is shown below:

```
Eastman point Surveys
NSURV:134
HOLE DEPTH AZIMUTH DIP
13   0    127  - 60
13   50 120    -63
KDD014 10 270 -58
KDD014 70 265 -60
cont.....
```

Wire Files

Used to describe the path of the transmitter wire or loop where a simple two or four point description in Record 2 of the ESF file would not suffice

The file extension should be .TXW

The records used to define the wire path are;

Record 1
A title describing the wire or loop name

Record 2
The number of vertices (NVERT) in the path to follow in the file.

Record 3
Either the triplex EAST, NORTH and ELEVATION or the pair EAST and NORTH to define the vertices to follow.

Record 4 to End of File
Vertices of wire or loop. The vertices should be specified in an order from positive electrode to negative electrode for dipoles and so that the magnetic field is pointing up in the centre of a loop. In the case of InOut or Double Loops this has no meaning and vertex order is not specified.

An example of a WIREFILE is shown below:

```
Waste Dump Loop
NVERT:213
```

```
EAST   NORTH   ELEVATION
345672.4 7653287.2 1003.2
345652.3 7653283.7 1009.4
345635.7 7653295.6 1023.6
cont.....
```

Waveform File

Used to describe the transmitter waveform

The file extension should be .WFF

The records used to define the transmitter waveform are;

Record 1
A title describing the transmitter and waveform

Record 2
The number of sample times, NUMTIMES, to follow in the file.

Record 3
Either the pair DELAY and CURRENT or the pair DELAY and CH to define the waveform to follow.

Record 4 to End of File
The transmitter waveform specified as a series of times and amplitudes of either current or the secondary field. Remember that the expected units of current are amps, secondary field, the same as specified by UNITS.EMIP

An example of a WAVEFORM file is shown below:

```
VTEM 25 waveform
NUMTIMES:3840
DELAY     CURRENT
0                              -9.93364833255039E-09
0.00520833333333333            -1.44865704849693E-08
0.0104166666666667             -1.61421785403944E-08
0.015625              -1.77977865958195E-08
0.0208333333333333             -6.41548121477213E-08
0.0260416666666667             -6.43617631546494E-07
cont...
```

Concatenated file

All the support files above may be appended into a concatenated file. To try and minimise the number of support metadata files which need to travel with the data and thus reduce the chance of one being not copied on a transfer.

The extension of a concatenated file is .CON. If a Concatenated file is used then all the references to support files in Record type 2 of the data file header should point to the .CON file.

The records used to define the concatenated file are;

Record 1
The keyword for the data type to follow

Record 2 to end of record block
Records 1 to 4 of the associated data type.

A blank line may be added between data types for readability but it is not required.

An example of a Concatenated file is shown below:

```
CHANNELFILE
UserDefined Instrument  -  MYINSTR.CHN
NUMTIMES:23                                                                    OFFTIME:31.25
DELAY                WIDTH
0.09                 0.027
0.117                0.027
0.15075   0.0405
0.198                0.054
0.25875   0.0675
.... cont

WAVEFORM
VTEM 25 waveform
NUMTIMES:3840
DELAY     CURRENT
0                                  -9.93364833255039E-09
0.00520833333333333          -1.44865704849693E-08
0.0104166666666667           -1.61421785403944E-08
0.015625               -1.77977865958195E-08
0.0208333333333333           -6.41548121477213E-08
0.0260416666666667           -6.43617631546494E-07
cont...

BOUNDARY
Example boundary for two surveys
NUMBOUND=4
LAT    LONG
-20.000 123.000
-20.000 124.000
-21.000 124.000
-21.000 123.000
```

Edit History:

30 June, 2013: Clarified Sign convention for UVA components to reference gravity rather than azimuth to remove ambiguity for up holes. Removed need for TXFREQ to be mandatory if @F used instead. - KF.
12 September, 2014: Corrected typo. Removed trailing S from WIDTH in channel file example - KF
25 September, 2015: Corrected typo. Edited ARRAY type PDPD to PLDP to conform to acronym and typical usage. Removed F as an alternate keyword for FREQ to avoid confusion with @F – KF
6 March 2019: Corrected typo. Edited example waveform file format to replace NVERT with NUMTIMES in Record 2. - KF