

Laser-Scan Ltd.
Software Product Specification
IMP package
For LAMPS V4.4

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1 DESCRIPTION

The Laser-Scan IFF Map Processing (IMP) package consists of independent modules which together form a powerful data manipulation system within an automated mapping environment. All the modules have common command syntax which is decoded using the Command Line Interpreter as used by the VAX/VMS utilities. IMP modules all generate VMS format messages and set VMS DCL symbol \$STATUS on image exit. In command files the success of a preceding IMP module may be tested using \$STATUS before proceeding. All IMP modules are comprehensively documented in the IMP Reference Manual and the documentation includes an explanation of messages output by the modules together with suggested user action. All IMP modules handle IFF HI (HISTORY), ZS (three dimensional strings), TS (Text Status), CB (coordinate block) and type 2 MD (Map Descriptor) entries. (For a detailed description of these and the other IFF entries see the IFF Users Guide). These entries could not be handled by the DAMP (Data Manipulation Package) utilities which IMP was designed to replace. IMP is supplied with on-line help which is available via the VMS HELP utility.

1.1 Introduction Of New IFF Entries For IMP.

Four new IFF entry types are available for use with IMP programs.

- (i) HI (HISTORY) entry. This is a mechanism for automatically recording statistics in an IFF file each time it is updated, so that it may be determined which users and programs contributed to the final state of the file. The HI entry contains up to 100 80-byte ASCII records each with the following format:

Date	Time	Username	Program	Function	Elapsed	CPU	STATUS
23-JUL-1986	12:22	CLARKE	IMERGE	Merge: rest	1:31:34	00:09:05	00000001

- (ii) MD (type 2 Map Descriptor) entry, upwards compatible with the existing type 1 MD. This entry contains projection, scale and spheroid information etc. It also contains an origin offset. This is an (X,Y) coordinate pair, each held as a REAL*8 (double precision) number, that is added to any pair of coordinates in the IFF file to give the true projection coordinates of the points. This allows the absolute size of the coordinates in the IFF file, which are only held as REAL*4 (single precision) numbers to be reduced, thus avoiding problems of truncation and reduced accuracy.
- (iii) TS (Text Status) entry. In the past IFF text features could contain only one text string, with associated location and descriptive data. With the introduction of the IFF TS entry text features may be **composite** - that is composed of several sub-texts or text components, which may be manipulated independently or as a single entity.
- (iv) ZS (3 dimensional string) entry. The ZS 3 dimensional strings are held as x,y,z coordinates in a similar fashion to the existing IFF 2 dimensional ST (STring) entries.
- (v) CB (Coordinate Block) entry. In January 1988 the CB entry was introduced to replace the functionality of ST and ZS entries and offer the description of per-point attributes in addition to the X,Y and Z

coordinates.

1.2 A Note On The DAMP Package.

IMP is designed to replace the existing Laser-Scan DAMP (DATA Manipulation Package). The following summary listing of the DAMP package can be made to indicate the functional correspondence between the two packages.

REPLACED DAMP MODULE	DAMP MODULE FUNCTION	NEW IMP
CHKLP	Check for loops in IFF data	ICHECK
CMPIFF	Compare two IFF files	IDIFFERENCE
I2TEXT		ITOTEXT
and TEXT2I	IFF/text file conversion (both ways)	IFROMTEXT
ICE	IFF combine and extract (for edge matching)	IMERGE
ICLIP	Map clipping	IWINDOW
IED	IFF patch editor	IPATCH
IFINFO	Summarise the contents of an IFF file	IINFO
IFIX	Correct specific faults in IFF data	IFIXAREA
IFSN	Reallocate feature serial numbers	IRENUMBER
IFT	Tidy up an incomplete IFF file	IMEND
IPR	Process (transform or clip) IFF data	ITRANS
IRN	Reallocate internal sequence numbers	IRENUMBER
LIT	Change or extract feature codes within layers	ILAYFC
MER	Merge IFF files or extract IFF layers	IMERGE
MIF	Mend an improperly closed IFF file	IMEND
SCI	Scan an IFF file, giving statistics	IINFO
SELAC	Select features on the basis of ACs or FSNs	ISELAC
SIF	Sort on FSN, ISN or FC	ISORT

This list may be compared with the IMP package details in the following section. All major DAMP package functionality is retained in IMP, although the module which provides that functionality may have changed. In addition IMP offers many more functions than the DAMP package.

2 FACILITIES

The facilities offered by IMP are described by module in alphabetical order of module.

*** ICHECK** (vector data geometry checking)

DAMP module equivalent: CHKLP

ICHECK is an IFF geometry checking utility. It scans the coordinates of an IFF file and reports on the following potential errors within features or between features:

- o loops within features, for example where the digitiser has looped back upon itself,
- o crossing features or touching features, IFF layers and feature codes may be selected,
- o open features which do not intersect with a user defined sheet neatline and which start, or end, within a border zone offset from the neatline.
- o feature characteristics at variance with the graphical type of that feature. The graphical types are read from a FRT (Feature Representation Table) file.

Specific features may be selected for checking on the basis of IFF layer and/or feature code. Text output may be directed to file, printer or terminal. An option is provided to enable generation of an IFF file containing error markers for error overlay plotting. An option to output a LITES2 command file is provided to enable automated assistance in editing.

*** ICUT** (IFF feature manipulator)

DAMP module equivalent: none

ICUT is a utility for converting selected input features from an existing IFF file. Conversion is attained by imposing constraints on the selected features. The resulting features (converted and not converted) are written to a new output IFF file.

Features are selected on the basis of:

- o IFF layer number,
- o IFF feature codes.

Constraints that can be set on the output features are:

- o to limit the number of points contained in the features,
- o to limit the length of the features,
- o to restrict the output features to 2-dimensions,

- o that the features do not contain invisible line breaks.

In addition, the following attributes of the input features can be attached to the output features:

- o height,
- o feature code,
- o feature serial number.

*** IDIFFERENCE** (IFF file comparator)

DAMP module equivalent: CMPIFF

IDIFFERENCE is a program for comparing two IFF files. The features inside them need not be sorted in order of feature serial number.

The program detects:

- o missing features (in either file),
- o differences in feature code,
- o differences in ancillary codes,
- o differences in texts,
- o changes in the coordinates within features.
- o differences in the HI (HISTORY),
- o differences in the MD (Map Descriptor),
- o differences in the RA (RANGE),
- o differences in the CP (Control Point)
- o and the CC (Cubic Coefficient) entries.

Output may be directed to file, printer or terminal.

*** IFILTER** (IFF string filtering and/or smoothing)

DAMP module equivalent: None, IFILTER is a new IMP utility.

IFILTER is designed to smooth or filter, or smooth and then filter IFF strings using one of the following algorithms:

FILTERS:

- o least squares "BUNCH" filter,
- o Douglas-Peucker filter.

SMOOTHING OPTIONS:

- o linear interpolation,
- o Akima cubic interpolation.
- o McConalogue cubic interpolation
- o Bezier interpolation

Smoothing and filtering takes place by default for all features in the file. Alternatively a restricted class of features may be selected on the basis of IFF layer or feature code.

*** IFIXAREA** (area feature check and repair)

DAMP module equivalent: DAMP IFIX

IFIXAREA is designed to read an IFF file and test for errors relating to area features. The errors to be checked for are specified on the IFIXAREA command line, and may be any combination of the following:

- o repeated adjacent vertices,
- o 'almost repeated' vertices - i.e. adjacent points in a feature which become equal when their co-ordinates are rounded to the nearest integer, or lie within a specified tolerance of each other,
- o open features - i.e. having at least three points and unequal start and end points,
- o the direction of feature digitising (the usual orientation for an area feature being anticlockwise)

Checking takes place by default for all features in the file. Alternatively a restricted class of features may be selected on the basis of IFF layer or feature code for checking.

Error log output may be directed to file, printer or terminal.

* **IFROMTEXT** (Refer to ITOTEXT)

* **IINFO** (IFF file scan and summary)

DAMP module equivalent: IFINFO and SCI

IINFO gives brief general information about the specified IFF file. The default information given is as follows:

- o full file specification,
- o RA (RAnge) entry,
- o HI (HISTORY) entry,
- o CP (Control Point) entry,
- o optionally, MD (Map Descriptor) entry,
- o information per overlay; number of features, number of points and line length,
- o information per feature code; number of features, number of points and line length,
- o totals information,

And optionally:

- o the maximum and minimum values of any point heights, integer contour heights and real contour heights in the IFF file,
- o a scan of all the entries in the IFF file,
- o timings statistics based on the IFF HI (HISTORY) entry values for elapsed and CPU usage during the files history,
- o interpretation and text output of the files MD (Map Descriptor) entry.

Output may be directed to terminal or printer.

* **ILAYFC** (IFF feature code reallocation - by whole IFF layer)

DAMP module equivalent: LIT

ILAYFC enables the user to set all of the feature codes in one or more layers in an IFF file to specified values.

Optionally ILAYFC processes in-situ on the input file.

* **IMEND** (IFF file recovery)

DAMP module equivalent: MIF and IFT

IMEND enables recovery of IFF files which have been improperly closed as a result of system failure or operator error. Options exists to update the RA (RAnge) entry after mending a file or to suppress the addition of EF,EO,EM and EJ entries which terminate an IFF file.

* **IMERGE** (IFF file joining, layer selection or file splitting)

DAMP module equivalent: MER

IMERGE is an IFF file merge utility. It is used in four circumstances:

- o After a map has been digitised on LASERTRAK and processed by LAPROCESS, IMERGE should be run to consolidate all the layer parts from different sessions, before further processing.
- o To concatenate two or more IFF files into a single map, possibly offsetting the string coordinates using information from the IFF Map Descriptor entries.
- o IMERGE can be used to merge out of the input file(s) only selected layers. The layers are selected using the /LAYER qualifier.
- o To split a single (or multiple) input IFF file(s) into two separate output files on the basis of IFF layer. One output file contains all the features which lay within IFF layers selected from the input IFF file(s) and while the other contains the rest of the layers, i.e. those which were not selected. The output IFF files may use the layer numbers used in the input file(s) or a new single layer may be specified for each output file.

*** IPATCH** (IFF patch editor)

DAMP module equivalent: IED

IPATCH is the IFF file patch editor. It allows the user to inspect, edit or delete the various entries in the file. The file is not copied, and changes made in write mode are performed in-situ. As IFF files have serial structure it is thus not possible to add additional IFF entries nor re-write an entry of greater length than the original.

The default mode of operation is to open the IFF file for reading only.

IPATCH offers:

- o optional journalling facility
- o optional input from external command file

*** IRECODE** (IFF layer, feature code and AC reallocation)

DAMP module equivalent: None, IRECODE is a new IMP utility.

IRECODE enables the user to change selected Layers, Feature Codes or AC type numbers in an IFF file to specified new values.

IRECODE offers the option of recoding specified IFF input file attributes in-situ.

IRECODE allows the translation of alphanumeric feature codes held in AC entries into numeric feature codes.

*** IRENUMBER** (IFF feature serial number reallocator)

DAMP module equivalent: DAMP IFSN

IRENUMBER takes an IFF file and creates a new version of the file in which the Feature Serial Numbers (FSNs) are reallocated in monotonically increasing order. IRENUMBER is intended mainly for recovery from error situations which have resulted in multiply allocated FSNs within an IFF file.

IRENUMBER offers:

- o an option to specify the base feature serial number,
- o the increment,
- o the lower limit of feature serial numbers to be reallocated,
- o the upper limit of feature serial numbers to be reallocated,

- o whether processing is to be conducted in-situ on the input file.

*** IREPORT** (IFF contents presence/absence reporting by specified entity)

DAMP module equivalent: None, IREPORT is a new IMP utility.

IREPORT gives information about every occurrence of the selected IFF entries. Alternatively the absence of the specified entry may be detected.

An option to output a LITES2 command file is provided.

*** ISELAC** (IFF feature selection on the basis of AC contents)

DAMP module equivalent: SELAC

ISELAC reads an IFF file and writes selected features to a new IFF file. Feature selection is based on AC (Ancillary Code) type or on one or more of the attributes associated with an AC entry. ISELAC utilises a series of dynamic command tables created from a user-defined 'skeleton' file, to offer greater AC selection flexibility.

ISELAC offers the following features:

- o command driven,
- o dynamic command table definition,
- o feature selection may be based on complex attributes in IFF Ancillary Codes (ACs)

*** ISELECT** (IFF feature selection by user specified IFF entry)

DAMP module equivalent: None, ISELECT is a completely new IMP utility.

ISELECT creates a new IFF file containing features selected from an existing IFF file on the basis of attributes specified by qualifiers on the command line. All specified criteria have to match for a feature to be copied.

Selection may be based on:

- o IFF AC (Ancillary Code) entry,
- o IFF Feature serial number (NF entry),
- o IFF FC (Feature Code),

- o feature height,
- o a height modulus,
- o IFF layer.
- o any combination of the above.

*** ISORT** (IFF file sorting)

DAMP module equivalent: SIF, IRN

ISORT is an IFF file sort program. It sorts the features in an IFF file into ascending Feature Serial Number (FSN) order, ascending Internal Serial Number (ISN) or ascending Feature Code (FC).

ISORT features are:

- o summary of feature serial number allocation including duplicated feature serial numbers and gaps in the sequence of feature serial numbers,
- o option to discard duplicate features with a duplicate feature serial number,
- o option to sort based on the feature internal sequence number,
- o option to sort based on the feature code.

*** ISTART** (IFF template file generation)

DAMP module equivalent: None, ISTART is a new IMP utility.

ISTART is designed to create an IFF file as a pre-digitising template. The file is then filled with data captured during the digitising process. ISTART enables the user to specify the control points, map scale and origin offset information which are written to the template CP (Control Point) and MD (Map Descriptor) entries. The values for the control points may either be typed at the users terminal, or they may be coordinates captured from a manual digitising table. The LASERAID digitiser may then be started up in 'OLD' mode reducing the time spent by the user in poor lighting conditions typing in control point values.

ISTART creates customer specific MH (Map Header) entries if the appropriate customer command qualifiers are specified. In Ordnance Survey mode ISTART prompts for header information and then generates a grid in layer 0. Laser-Scan MUART (Multi-UART) and TABLE_MONITOR driven digitising tables may be addressed.

The default mode of operation is to prompt the user at the terminal for control point and origin offset values.

The first IFF layer may be specified.

Either registration ticks or crosses may be placed in layer 0 at the location of the control point values.

*** ITOTEXT and IFROMTEXT** (IFF to text and text to IFF conversion)

DAMP module equivalent: DAMP I2TEXT and TEXT2I

ITOTEXT and IFROMTEXT are two programs which have been designed for the conversion of an IFF file into text, and vice versa. It is envisaged that ITOTEXT will be used for the conversion of data into text form for transfer to external customers, and IFROMTEXT for creating template IFF files, standard grids, etc. The two programs can also be used to enable text editing of IFF files. This is done by converting an IFF file into text form using ITOTEXT, editing the text file, and creating a new IFF file from the edited text file using IFROMTEXT.

ITOTEXT offers:

- o optional output of addresses of IFF entries,
- o a brief option, IFF entry mnemonics only, no entry contents,
- o optional listing annotation with IFF entry addresses,
- o listing of customer map header contents,
- o optional output of coordinate values as double precision absolute numbers, in a user defined format if required.

Output may be directed to file, printer or terminal.

IFROMTEXT offers:

- o input may optionally be read from the terminal,
- o optional comments in the text will be ignored,
- o optional echo of text to terminal as input file is read,
- o optional reading of coordinate values as double precision absolute numbers relative to a supplied origin offset.

*** ITRANS** (IFF coordinate transformation)

DAMP module equivalent: Projection computation and transformation functions of IPR

ITRANS is a powerful general map projection program.

It allows transformation between spheroidal data (latitude and longitude) and specified map projections and will also transform data from one map projection directly into another.

Plane transformations ("empirical transformations") can also be carried out.

ITRANS is primarily intended for operation on data held in IFF files, but it can also be used to transform individual points.

ITRANS transforms coordinates from one coordinate system into another. It has no knowledge of any implied connection between these coordinates. Users must be aware, particularly when using data sets covering large portions of the earth's surface, that points that are close together in one system may be far apart on another and this may give unexpected results when these points are adjacent vertices in an IFF feature.

The MD (map descriptor) entry in the IFF file carries information about the projection that the coordinate data is currently held in. Each run of ITRANS will ask the operator for details of the required projection and the data in the file will be transformed into this projection in a new IFF file with a corresponding MD entry.

ITRANS can be used to edit an existing version 2 MD entry (or insert one, if none exists) without transforming any of the coordinate data.

The version 2 map descriptor contains the following information:-

(i) The local origin for the IFF file.

(ii) The scale of the map that the IFF file represents.

This is a REAL*8 (double precision) number which when multiplied by map (or sheet) units gives IFF units - e.g. 50000.0 for a 1:50000 map.

It is used to relate IFF units to e.g. symbol and text sizes on the map sheet and also as a general indication of the accuracy of the digital data.

(iii) The spheroid that the data relates to.

All geographical data is ultimately related to a particular spheroid.

The spheroid is the geometrical model of the earth that was used when the original survey was carried out. It is possible, using ITRANS, to convert data from one spheroid to another, but the relationships between the particular geodetic datums that the spheroids are part of must be known.

The spheroids that ITRANS knows about are as follows:-

- Clarke 1866
- Clarke 1880
- Bessel
- New International 1967
- International 1924 (Hayford 1909)
- World Geodetic System 72 (WGS 72)
- Everest
- World Geodetic System 66 (WGS 66)
- Geodetic Reference System 1980 (GRS 1980)
- Airy
- Modified Everest
- Modified Airy
- Walbeck
- Southeast Asia
- Australian National
- Krassovsky
- Hough
- Mercury 1960
- Modified Mercury 1968
- Sphere of radius 6370997 M
- Sphere of radius 6371229.3M
- Clarke 1880 (IGN)
- World Geodetic System 84 (WGS 84)
- User specified spheroid

(iv) The projection that the data are on.

The projections that ITRANS can work with (and their codes) are:

- 0 Unset
- 1 Universal Transverse Mercator
- 2 State Plane Coordinates
- 3 Albers Conical Equal Area
- 4 Lambert Conformal Conic
- 5 Mercator
- 6 Polar Stereographic
- 7 Polyconic
- 8 Equidistant Conic
- 9 Transverse Mercator
- 10* Stereographic
- 11* Lambert Azimuthal Equal Area
- 12* Azimuthal Equidistant
- 13* Gnomonic
- 14* Orthographic
- 15* General Vertical Near-Side Perspective
- 16* Sinusoidal
- 17* Equirectangular
- 18* Miller Cylindrical
- 19* Van der Grinten
- 20 Oblique Mercator (Hotine)
- 21* Oblique Mercator (Spherical)

22 Stereographic (UKSL formulae)
23 Cassini
24 Krovak
25 Bonne
26* Mollweide
27* Hammer-Aitoff
28* Winkel III
100 Geographic (ie Latitude and Longitude)
101 UK national grid (a special case of 9)

NOTES

1) Those projections marked with * are only defined for a sphere, not a spheroid

2) Data can be held in spheroidal, or spherical, coordinates (i.e. Latitude and Longitude) by specifying projection code 100.

3) When using projection code 100, it should be noted that the coordinates are stored in the IFF file in the order Longitude, Latitude as this corresponds most closely to X and Y on a cartesian system.

4) In all LAMPS software a right handed coordinate system is assumed. ITRANS only produces right handed systems even when particular projections are traditionally used to produce left handed systems.

The projections listed above specify the formulae to be used in the projection, but in any particular case more data will be required. There is provision in the map descriptor to store up to 15 additional pieces of data as REAL*8 (double precision) numbers, such as projection zone, origin etc.

(v) The units that the data represent.

The possible units in IFF files, and their codes are:

0 Unset
1 Feet (assuming projection units are metres)
2 Projection units (i.e. units used to specify spheroid)
 These will be International metres, except for
 user-specified spheroids.
3 Seconds of arc (only valid if projection is 100)
4 Degrees of arc (only valid if projection is 100)
5 Radians (only valid if projection is 100)
101 mms on table (digitising scale)
102 mms on map sheet (source scale)
103 thousands of inch on table (digitising scale)
104 thousands of inch on map sheet (source scale)
105 user specified units
110 1/10 seconds of arc (only valid if projection is 100)

* **IWINDOW** (clips IFF map data to a rectangular boundary)

DAMP module equivalent: DAMP ICLIP

The clipping rectangle can be given explicitly using /NORTH, /SOUTH, /EAST and /WEST qualifiers on the command line. Alternatively it can be extracted from the map header or control point entries.

IWINDOW offers:

- o clipping of IFF 2 dimensional and 3 dimensional strings,
- o where 3 dimensional strings intersect with a clipping boundary a Z-value for the intersection point is calculated using linear interpolation between the two data points which straddle the boundary. The line between the two points is then clipped,
- o Ordnance Survey mode, which caters for the special requirements of Ordnance survey map digitising,
- o selective clipping on the basis of IFF feature code,
- o selective clipping on the basis of IFF layer,
- o clipping to a void within the source map,
- o coordinate offset handling.

3 **PREREQUISITES**

3.1 **Computer Hardware Prerequisites**

The following computer hardware requirements are needed to run IMP.

- * Any DEC VAX, MicroVAX, VAXstation, or Alpha AXP computer supported by the current version of VMS.

- * At least 10MB available disc space for software, plus sufficient for data files.
- * Any DEC-compatible alphanumeric terminal.
- * Any DEC-supported magnetic tape or cartridge tape drive.
- * At least a 4096 pages working set per process is needed for efficient operation of the larger utilities.
- * ISTART requires a Laser-Scan supported digitising table. The table may either be on direct serial line to host computer, or controlled by a Laser-Scan MUART (Multi-UART) board. Laser-Scan should be consulted if the use of a digitising table is considered as further software development may be required.

3.2 **Software Prerequisites**

IMP modules run under OpenVMS Version 5.5-2, or OpenVMS AXP V1.5 (or higher version, assuming continued upwards compatibility by DEC) concurrently with other interactive and batch processes.

Laser-Scan provide all relevant interface libraries. Laser-Scan's LITES2 interactive digitising and editing software running on the same host computer is recommended for digitising vector input data. LASERAID automated digitising is recommended for large numbers of input documents.

It is recommended that the reader becomes familiar with the LAMPS Environment Guide which outlines in greater detail the hardware and software environment required by the LAMPS package as a whole (of which IMP is but a part).

3.3 **Growth Considerations**

The minimum hardware and software requirements for any future version of this product may be different from the minimum hardware and software requirements for the current version.

4 **SUPPORT LEVEL**

IMP is a fully supported Laser-Scan standard software product.

5 **RELATED PACKAGE**

In addition to the standard IMP package Laser-Scan provide an optional related package, STRUCTURE.

The main module in the STRUCTURE package is ILINK, an IFF geometry tidying and link-node structuring utility offering the following features:

- o Geometry idealisation:

- Digitising inaccuracy can be corrected.

- Duplicate feature sections can be merged into single shared features.

- Features can be broken where they intersect.

- Unique junction points can be created where features meet or cross.

- o Link/node data structuring of IFF files.

The structured data generated by ILINK permits network processing operations, such as polygon generation, route planning, map colouring and structured data-base compilation.

For more information on ILINK please see the separate STRUCTURE Software Product Specification (SPS).