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## The BULLET.H file

The BULLET.H file contains the exact definitions of all the BULLET data packs and functions. It is highly recommended that you refer to this file for information on the structures and (for C/C++ programmers) the naming conventions which should be used. For ease of reference, the entire contents of this file are given below. Pay particular attention to the byte-alignment requirement, because your program will not run correctly unless this is so. To differentiate Bullet for Windows from other versions, the LIB file is named WBULLET.LIB.

```
/*      bullet.h

        Defines the BULLET library's structs, consts, and function declaration

        v1.10 12-Jul-94

        *****
        * NOTE: BULLET is for medium, large, or huge models (do not use tiny, *
        * ---- small, or compact since these allow for only 1 code segment). *
        *-----
        *****

        Struct types must be standard byte packed; do not special align elements.
        YOUR PROGRAM WON'T RUN CORRECTLY UNLESS ALL BULLET-USED STRUCTURES ARE BYTE-ALIGNED!
*/

#pragma pack(1)

#define __BULLET_H

#ifdef __cplusplus
extern "C" {
#endif
int    far pascal BULLET(void far *datapack);
#ifdef __cplusplus
}
#endif

#define INITXB      0          /* system */
#define EXITXB      1
#define AEXITXB     2
#define MEMORYXB    3
#define BREAKXB     4
#define BACKUPFILEXB 5
#define STATHANDLEXB 6
#define GETEXTERRORXB 7
#define DVMONCXB    9

#define CREATEDXB   10         /* data control mid-level */
#define OPENDXB     11
#define CLOSEDXB    12
#define STATDXB     13
#define READDHXB    14
#define FLUSHDHXB   15
#define COPYDHXB    16
#define ZAPDHXB     17

#define CREATEKXB   20         /* key control mid-level */
#define OPENKXB     21
#define CLOSEKXB    22
#define STATKXB     23
#define READKHXB    24
```

```

#define FLUSHKHXB      25
#define COPYKHXB      26
#define ZAPKHXB       27

#define GETDESCRIPTORXB 30      /* data access mid-level */
#define GETRECORDXB    31
#define ADDRECORDXB    32
#define UPDATERECORDXB 33
#define DELETERECORDXB 34
#define UNDELETERECORDXB 35
#define PACKRECORDSXB  36

#define FIRSTKEYXB     40      /* key access mid-level */
#define EQUALKEYXB     41
#define NEXTKEYXB      42
#define PREVKEYXB      43
#define LASTKEYXB      44
#define STOREKEYXB     45
#define DELETEKEYXB    46
#define BUILDKEYXB     47
#define CURRENTKEYXB   48

#define GETFIRSTXB     60      /* key & data access high-level */
#define GETEQUALXB     61
#define GETNEXTXB      62
#define GETPREVXB      63
#define GETLASTXB      64
#define INSERTXB       65
#define UPDATEXB       66
#define REINDEXXB      67

#define LOCKXB         80      /* network control */
#define UNLOCKXB       81
#define LOCKKEYXB      82
#define UNLOCKKEYXB    83
#define LOCKDATAXB    84
#define UNLOCKDATAXB  85
#define DRIVEREMOTEXB 86
#define FILEREMOTEXB  87
#define SETRETRIESXB   88

#define DELETEFILEDOS  100     /* DOS file I/O low-level */
#define RENAMFILEDOS   101
#define CREATEFILEDOS  102
#define OPENFILEDOS    103
#define SEEKFILEDOS    104
#define READFILEDOS    105
#define WRITEFILEDOS   106
#define CLOSEFILEDOS   107
#define ACCESSFILEDOS  108
#define EXPANDFILEDOS  109
#define MAKEDIRDOS     110

#define cUNIQUE        1      /* key type flags */
#define cCHAR          2
#define cINTEGER       16
#define cLONG          32
#define cNLS           0x4000 /* note: cNLS is set by BULLET */
#define cSIGNED        0x8000

#define READONLY       0      /* do NOT use O_RDONLY,O_WRONLY,O_RDWR */

```

```

#define WRITEONLY      1
#define READWRITE     2

#define COMPAT        0X0000    /* okay to use SH_DENYRW, etc. */
#define DENYREADWRITE 0x0010    /* or O_DENYREADWRITE, etc. */
#define DENYWRITE     0x0020
#define DENYREAD      0x0030
#define DENYNONE      0x0040
#define NOINHERIT     0x0080

```

```

struct accesspack {
    unsigned    func;
    unsigned    stat;
    unsigned    handle;
    long        recno;    /* signed */
    void        far *recptr;
    void        far *keyptr;
    void        far *nextptr;
}; /* 22 */

```

```

struct breakpack {
    unsigned    func;
    unsigned    stat;
    unsigned    mode;
}; /* 6 */

```

```

struct copypack {
    unsigned    func;
    unsigned    stat;
    unsigned    handle;
    char        far *filenameptr;
}; /* 10 */

```

```

struct createdatapak {
    unsigned    func;
    unsigned    stat;
    char        far *filenameptr;
    unsigned    nofields;
    void        far *fieldlistptr;
    unsigned    fileid;
}; /* 16 */

```

```

struct createkeypack {
    unsigned    func;
    unsigned    stat;
    char        far *filenameptr;
    char        far *keyexptr;
    unsigned    xblink;
    unsigned    keyflags;
    int         codepageid;
    int         countrycode;
    char        far *collateptr;
}; /* 24 */

```

```

struct fielddesctype {
    char        fieldname[11];
    char        fieldtype[1];    /* [] may be removed */
    unsigned long fieldda;
    unsigned char fieldlen;
    unsigned char fielddc;
};

```

```

        long        fieldrez;
        char        filler[10];
}; /* 32 */

struct descriptorpack {
    unsigned        func;
    unsigned        stat;
    unsigned        handle;
    unsigned        fieldnumber;
    struct fielddesctype  fd;
}; /* 40 */

struct dosfilepack {
    unsigned        func;
    unsigned        stat;
    char            far *filenameptr;
    unsigned        handle;
    unsigned        asmode;
    unsigned        bytes;
    long            seekoffset;
    unsigned        method;
    void            far *bufferptr;
    unsigned        attr;
    char            far *newnameptr;
}; /* 30 */

struct dvmonpack {
    unsigned        func;
    unsigned        stat;
    unsigned        mode;
    unsigned        handle;
    unsigned        vs;
}; /* 10 */

struct exitpack {
    unsigned        func;
    unsigned        stat;
}; /* 4 */

struct handlepack {
    unsigned        func;
    unsigned        stat;
    unsigned        handle;
}; /* 6 */

struct initpack {
    unsigned        func;
    unsigned        stat;
    unsigned        jftmode;
    unsigned        dosver;
    unsigned        version;
    unsigned        osversion;
    unsigned long   exitptr;
}; /* 14 */

struct memorypack {
    unsigned        func;
    unsigned        stat;
    unsigned long   memory;
};

```

```

struct openpack {
    unsigned    func;
    unsigned    stat;
    unsigned    handle;
    char        far *filenameptr;
    unsigned    asmode;
    unsigned    xblink;
}; /* 14 */

struct remotepack {
    unsigned    func;
    unsigned    stat;
    unsigned    handle;
    unsigned    isremote;
    unsigned    flags;
    unsigned    isshare;
}; /* 12 */

struct setretriespack {
    unsigned    func;
    unsigned    stat;
    unsigned    mode;
    unsigned    pause;
    unsigned    retries;
}; /* 10 */

struct statdatapack {
    unsigned    func;
    unsigned    stat;
    unsigned    handle;
    unsigned char filetype;
    unsigned char dirty;
    unsigned long recs;
    unsigned    reclen;
    unsigned    fields;
    char        f1;
    unsigned char luyear;
    unsigned char lumonth;
    unsigned char luday;
    unsigned    hereseg;
    char        filler[10];
}; /* 32 */

struct statkeypack {
    unsigned    func;
    unsigned    stat;
    unsigned    handle;
    unsigned char filetype;
    unsigned char dirty;
    unsigned long keys;
    unsigned    keylen;
    unsigned    xblink;
    unsigned long xbrecono;
    unsigned    hereseg;
    unsigned    codepageid;
    unsigned    countrycode;
    unsigned    collatetablesizes;
    unsigned    keyflags;
    char        filler[2];
}; /* 32 */

```

```
struct stathandlepack {
    unsigned    func;
    unsigned    stat;
    unsigned    handle;
    unsigned    id;
    char        far *filenameptr;
}; /* 12 */
```

```
struct xerrorpack {
    unsigned    func;
    unsigned    stat;
    unsigned    errclass;
    unsigned    action;
    unsigned    location;
}; /* 10 */
```

```
#pragma pack()
```

```
/* end of BULLET.H */
```

## License agreement

Before using this software you must agree to the following:

1. You are not allowed to operate more than one (1) copy of this software package at one time per license. This means that if you have 10 programmers that COULD possibly use the BULLET library at the same time, you must also have ten (10) BULLET licenses.
2. You are not allowed to distribute non-executable code containing BULLET code. This means that you are not allowed to redistribute BULLET code as another .LIB, for example. Also, if BULLET code is to be contained in a Dynamic Link Library (DLL) then it must be part of a stand-alone product. This means that you cannot provide a .DLL containing BULLET code if that .DLL is to be used as a programming library for other programmers. If you wish to distribute non-executable code containing BULLET code you must obtain written permission from the author.
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This agreement is governed by the laws of the state of Texas.

**See:** [Product Support](#)

## Product support

Support is available at my BBS, The 40th Floor, 7 days a week. Hours are 5pm to 9am, Central Time (USA, -500/600 GMT). Weekend BBS hours are 24 hours (5pm Friday to 9am Monday). Hours other than during above periods are voice.

BBS tele#: 1-210-684-8065 (times listed above)  
N81, 300 to 14.4k bps (at least)

Latest releases of BULLET are available for free download by registered users. Also available are other shareware products by me such as the Ruckus soundcard toolkit, and the LP, the linear programming optimizer. Bullet OS/2 support is coming!

My E-mail address:

Fidonet: 1:387/800.8  
Internet: cornel.huth@LChance.sat.tx.us  
cornel@alamo.net

To order Bullet, use the supplied !ORDER.FRM file (!ORDER.CC for credit cards), or send check/money order, in US Dollars/US bank to:

Cornel Huth 6402 Ingram Rd San Antonio, Texas 78238-3915	Funds must be in US Dollars and must be drawn on a US bank (complete with bank routing numbers). If sending currency, USA
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For credit card orders (Visa, MC, Amex, Discover), call (800)242-4775 (outside US, call (713)524-6394), or fax to (713)524-6398, or via CompuServe e-mail to 71355,470, requesting Bullet for Windows (item# 11185). This is for ORDERING Bullet. Do NOT use these numbers for any other purpose! Be sure to specify "Bullet for Windows".

Price is \$89 plus \$1 AirMail shipping to all destinations (anywhere in the world). For fastest delivery, add \$15 for USA/Canada-only Next-Day Express Mail, or \$20 for International Express Mail. Standard AirMail is 3-5 days for US destinations, and 5-14 days for international destinations. Disk media is 3.5-inch, 1.44M unless requested otherwise. Bullet for Windows includes Bullet for DOS.

**See:** [Troubleshooting](#)



## Troubleshooting

Common problems encountered by new users of Bullet are:

P: Data fields are skewed, with some fields containing parts of other fields' data.

S: Most of these problems relate to the way C strings are 0-terminated, while dBASE DBF fields are fixed-length, and so need not have the \0. If you are going to use strcpy, or any other C run-time library that requires null-terminated strings, then be sure to provide for this when you define your DBF record. For example, if you want two fields, LASTN and FIRSTN, to each have 15 characters, but will be using C strings, define the fields as 16. This will allow room for the \0 on your strings, and give 15 true character places.

Often, the case is such that all appears normal when the DBF file is accessed (i.e., the data fields don't appear to be skewed), but indexed access is not correct. This is because your program code has templated the data record consistent with what was written (and is read) at the DBF level. However, it is not consistent with the DBF header specifications (written in CreateDXB) and so any external access to the DBF (including Bullet keyed access) will not be correct.

Skewed data also results when you change either your program's data structure template of the DBF record, or your DBF field list definitions, but don't do the same to both. The physical record buffer in your program must exactly match that of the DBF record. Off the subject a bit, but possibly on your mind: yes, you can create all this on the fly (i.e., not hard-coded fieldnames, etc.), but it does require that you manage all offsets yourself, rather than have the compiler do it for you. A job for a C++ wrapper, I suppose. Certainly do'able as I've done it using a BASIC compiler (see IDEMO.\*)

Another reason for skewed fields is that the compiler is modifying the alignment of your program's DBF record structure. It is imperative that you instruct your compiler to not modify any Bullet-used structure: #pragma pack() is used by many compilers. Consult your compiler documentation. For non-Bullet structures, alignment doesn't matter to Bullet. Bullet structures are any of the Bullet packs, and any DBF record template/buffer/structure that your program uses to communicate with Bullet.

The main point is to ensure that your physical data record (structure) you use in your C/C++ program exactly matches, field for field, that of the DBF record on disk.

P: Error 240 occurs when attempting to index or reindex when all else seems to be right.

S: dBASE specifications require that fieldnames of the DBF be 0-filled. Some programs create DBF files that do adhere to this specification, but instead just null-terminate the fieldname. These files must be fixed before they can be used by Bullet. When creating Bullet DBF files, you must 0-fill the fieldnames (11 bytes, 10 bytes data -- byte 11 always=0). Memset() can be used to quickly 0-fill the entire fieldlist.

P: Find an exact match on a GetEqualXB.

S: The problem usually stems from index files created to allow non-unique keys. Personally, I don't create index files where the primary key is not unique, but the demand was there and so Bullet provides for this. However, since there's no real way to offer indexing on physically identical keys, Bullet adds an enumerator word at the end of each key (only if

the index file is not using unique keys). This two enumerator is in high byte/low byte order, and is incremented for each duplicate key in the index file. For example, if KINGM is added as a key, and is found to be the first such key by Bullet, the actual physical key is KINGM\0\0, where the enumerator is the last two bytes (in Motorola-word order for proper collating). Upon the next insert of a "KINGM" key, Bullet uses KINGM\0\1. And so on.

To search for this key, which by the way is 7 bytes long, and so reported by StatKXB, though logically it is only the 5 bytes (as in `strcpy(keyExp,"SUBSTR(LASTN,1,5)")` with non-unique keys permitted), you must account for this in your keybuffer. For example, in your global scratch keybuffer (or you can use a separate buffer for each index file, up to you) you must specify all 7 bytes, not just the first 5. This because the data at bytes 6/7 may not equal \0\0 or \0\1, and so these keys will not be found (error 201). In this particular case, where duplicate keys exist, and you want to locate a KINGM record, you really have no choice but to start with `strcpy(keybuff,"KINGM\0\0"`, be aware of the "extra" \0 put by the `strcpy` function) and `GetEqualXB`, check the data record returned, and if not the one wanted, do `GetNextXB` until the desired record is located (or not). Alternatively, you could specify "KINGM\255\255" and use `GetEqualXB` followed immediately by `GetPrevXB` (enumerator \255\255 is the very last possible, and so will never be found, but will setup the internal gears so that the `GetPrevXB` will locate the very last existing "KINGM??").

All this is really only a concern if you permit duplicate keys. The above could be made unique by adding expanding the key expression. For example, a key based on `SUBSTR(LNAME,1,5)+SUBSTR(SSN,6,4)` would be pretty unique (first 5 characters of last name followed by last 4 SSN numbers (used as characters)).

Q: How do I specify the key I want to find?

A: The keybuffer (`AP.keybuffptr` locating it) is filled with whatever data type you want to locate (hence, keybuffer is of void type). If you want to locate a character key, simply specify the key, such as `strcpy(keybuffer,"whatever")` (see "Find an exact match on `GetEqualXB`", above). If you are locating a binary key value, place the binary value, with the appropriate cast, into the keybuffer: e.g., `*((long *)keybuffer) = 5L;`

These problems are the most frequently expressed to me. If you are having other problems related to getting Bullet going, feel free to contact me at the locations listed under Product Support. My ability to quickly respond to your requests is directly related to how thorough you are in expressing the exact circumstances of any problem.

Complete sample programs are in short supply. Experienced C or C++ programmers that would like their "Bullet wrappers" possibly included in future releases are requested to contact me. Additional samples will be made available on the BBS, available to all. Of course, registered Bullet users will have access to the best of the best, and always have free access to the current versions of Bullet.

When you've done everything and it's still not working, it's time to read the documentation!

## **What is BULLET?**

BULLET is a program module that handles the details of putting information to and getting information from your hard disk using a standard data file format called the Xbase DBF format with very fast and efficient index file routines. It can be used as-is by most DOS compilers.

BULLET is written in 100% assembly language. Why? Two reasons. First, control. There's no compiler code or run-time library code in between BULLET and your data. Second, efficiency. BULLET knows exactly what it requires from the operating system and when. Result: fast, small, and robust applications.

**See:** [What is a database?](#)

## What is a database?

A database is a collection of data arranged so that it can be accessed as useful information. For example, let's say we have two files. Each consists of two fields. The first file has codenumber and score. The second file has a codenumber and name. Separately, the files are merely a collection of data. Together, however, they tie the name to the score:

<b>score</b>	<b>codenumber</b>	<b>codenumber</b>	<b>name</b>
99	100	100	John
87	155	105	Paul
66	125	110	George
:	:	:	:

Codenumber 100 is John, who scored 99. The other members' scores are not in the abbreviated data file listing.

A database can be a single data file but more often it is a group of related data files and usually these data files are indexed by keys (in the index file, also called key file) so that very fast, direct access is possible.

Ringo.

**See:** [What is DBF?](#)

## What is DBF?

DBF is the file extension of dBASE III-compatible data files (filename.DBF). The file format is used by dBASE IV, FoxPro and many other database programs. Many programs can also use the file format to import/export data using it. The DBF format is the most common data file format used on PCs.

A DBF-compatible data file consists 3 distinct areas. First is the data header. This contains information such as the number of records in the file. Second is the field descriptors. These descriptors define the makeup of each field in the record. The third is the record area. Each record is a logical unit of data.

For example, a record, all of which are made up of the same fields but with different data, could (conceptually) look like this:

	<b>field 1</b>	<b>field 2</b>	<b>field 3</b>	<b>field n</b>
<b>record 1</b>	Johnson	Larry	465310555	...
<b>record 2</b>	Aberdeen	Zara	465230555	...
<b>record n</b>	...	...	...	...

**See:** [What is a Btree?](#), [DBF Specs](#)

## What is a Btree?

A b-tree is a sorting method ideally suited to data structures maintained on a hard disk. It is very fast on retrieval and is inherently self-balancing during inserts and deletes. Self-balancing ensures performance remains consistent.

The reason the b-tree is ideally suited to hard disks is that, when looking for a particular key, most of the time involved in accessing the key is spent by the hard drive moving to various locations on the disk. The task of a good access method is to reduce the number of seeks that the disk must perform. The b-tree accomplishes this by maintaining several keys (perhaps 50) on each node, with the necessary pointers to previous and following nodes. A b-tree of order 20 (19 keys per node) can find a key in a file of 1,000,000 keys in a MAXIMUM of 5 disk accesses, where each disk access visits a node.

```
'BASIC program to find *max* seeks needed/avg time
Keys& = 1000000: KeysPerNode = 19: AvgSR = 25
Order = KeysPerNode + 1
max = (LOG((Keys& + 1) / 2) / LOG(Order / 2))
PRINT "Max nodes accessed for"; Keys; "keys & b-tree of order"; Order;
PRINT "is"; max; "nodes"
PRINT "Max disk time based on avg seek+read of"; AvgSR;
PRINT "ms is"; AvgSR / 1000 * max; "seconds"
```

**See:** [What is a network?](#), [Index specs](#)

## What is a network?

A network is a group of computers able to communicate with one another. Often called a LAN (local area network), a network allows resources to be shared. Sharing resources can lead to problems if steps are not taken to ensure that two computers don't try to share the same resource at the same time. For example, say two computers try to change the same record in a file on a network drive. Let's say both users are accessing the number of widgets in inventory. The first user gets there a micro-second before the second and allocates the last widget in stock. The second user comes in right after and, since the first user has not yet updated the inventory, allocates the very same widget. One widget, two users. When the first user updates the inventory, widgets in inventory is changed to 0 (previous - 1). The second updates the inventory in the same manner and sets widgets to 1 less what it was when it started, or 0 also. You see the problem.

In order to successfully share a file on a network, the file must first be locked to a single user. Once that user has locked the file, he has sole access to the data within it and he will not experience the scenario above. When the user has completed the changes, he unlocks the file so that others may use it.

**See:** [What is file locking?](#)

## What is file locking?

File locking is a means to obtain exclusive access to a file. This is needed in cases of multiple programs or users accessing a shared file at the same time.

There are several methods to ensure only one process or user has access to a file. The first method is to open the file so that while the file is open only your program can access any part of it. This is simple to implement and the operating system handles the details of this. However, it requires your program to open/close files all the time since no other process may access the file while it is open.

Another method is to use byte-level locks. Also managed by the OS, this method allows for restricting access to any particular region within the file. Which regions are to be locked is to be determined by your program, however, and it can be complex to perform multiple locks at the byte, field, or record level.

Another use of the byte-level lock is to specify that all bytes within the file are to be locked. This greatly simplifies the process of obtaining a lock and has the advantage over a file access lock of not needing to open/close the file for each lock. It is very fast and easy to implement. BULLET offers all three lock types.



## **What is NLS?**

NLS stands for National Language Support. This feature is available in DOS 3.3 and later. BULLET makes use of NLS by getting from DOS the current DOS country collate-sequence table. The collate table is used to properly sort mixed-case character strings and also foreign (or non-USA) language character strings according to that country's alphabet. This is an option but is recommended.

In addition, BULLET provides for a programmer-supplied collate-sequence table.

## How to design a DB

To design a database, above all else, know what information you require from it. Having established what you need to know, collect the data that lets you formulate this into useful information.

For example, you want to track a class of students and determine how well they achieve on tests. The criterion you use is the test score. You determine that your data is 1) students, 2) tests, and 3) test scores. To simplify, you use a single 20-character field for student, a numeric field for test number (1 to the n tests), and a numeric field for test scores (0 to 100).

Since the objective is to track students' scores, arrange the data so that output consists of each student's score in test order. Do this by specifying an index file containing an index based on the student's name and test number:

```
char keyexpression[136];  
strcpy (keyexpression,"STUDENT+TEST");          /* use two-field key */
```

By using the routines of the database language, you can easily create the data and index files, add data, list student's scores, or make changes to the database. Note: these *How to* examples are meant only to show the basis behind an operation.

**See:** [How to create a DB](#), [CreateKXB](#)

## How to create a DB

Having defined the database, create it. First, create the datafile based on the 3 fields you defined in your design. To do this, allocate an array for the field descriptors for the number of fields (see also [CreateDataPack](#)):

```
struct fielddesctype fieldlist[3];
strcpy(fieldlist[0].fieldname, "STUDENT\0\0\0"); /* or use memset() to clear fieldlist[] */
strcpy(fieldlist[0].fieldtype, "C"); /* this will initially write a 0 to .fieldlen ! */
fieldlist[0].fieldlen = 20;
fieldlist[0].fielddc = 0;
strcpy(fieldlist[1].fieldname, "TEST\0\0\0\0\0"); /* this result in TEST plus 6 nulls + \0 */
strcpy(fieldlist[1].fieldtype, "N");
fieldlist[1].fieldlen = 1;
fieldlist[1].fielddc = 0;
strcpy(fieldlist[2].fieldname, "SCORE\0\0\0\0");
strcpy(fieldlist[2].fieldtype, "N");
fieldlist[2].fieldlen = 3;
fieldlist[2].fielddc = 0;
```

The fieldlist is a struct member in CDP (CreateDataPack) as in  
CDP.func = CREATEDXB;  
CDP.fieldlistptr=fieldlist;

Call [CreateDXB](#) to create the data file. To create the index file, first open the data file just created, then call [CreateKXB](#) to create the index file. Open the index file so we can use it (data file is already open).

**See:** [How to add to the DB](#)

## How to add to the DB

Once you have the database designed and the data and key files created and open you can start putting the student's test data into it. Note that the DBF-format requires that all data in a data file be in ASCII format. This means that we must convert the numeric test score into its ASCII form. C has the itoa() function to do this. In addition, numbers generally should be right-justified in their field.

Note that BULLET does not require that you use only ASCII field data. If you want to forgo dBASE compatibility, binary data can be used directly in the fields.

**See:** [How to query the DB](#), [InsertXB](#)

## How to query the DB

Now that you have data in the database you want to see what's in there. Since the index file is in "STUDENT+TEST" order, the information we'll be getting out of the database is in Student name order, with each student's scores in test number order.

If we want to look at all the students, we can use GetFirstXB to retrieve the first student's score for the first test. GetNextXB retrieves the next record (the first student's score for the second test), and so on. When all records have been retrieve GetNextXB returns an End Of File error code.

If we want to look at a particular student's score only, we can use GetEqualXB to go directly to a student's first test score. GetNextXB get his next and so on until GetNextXB retrieves the next student's first test score. You can stop at this point (student names no longer match).

We might also want to find all students who scored less than 65 on any test. To do this we can GetFirstXB, check SR.score for < 65 and if so print that record. Continue by using GetNextXB, printing each record that has a score < 65.

**See:** [How to update the DB](#)

## How to update the DB

To update a particular record in the database we must first locate and identify it using one of the get routines such as GetEqualXB. The Get() routine return the record data, and also the physical record number of the record accessed, into the AccessPack RecNo. Having used one of the Get() routines to read the data record from disk to memory, you can make any changes to the data record in memory. E.g., if a student's score needs to be changed from a 69 to a 96, first find the record (and its RecNo), then update the score field.

Note that any change to a key field will initiate a key file update automatically.

**See:** How to delete a record

## How to delete a record

To delete a particular record in the database we must first locate it using one of the get routines such as GetEqualXB. These Get() routines return the actual record number of the data record accessed by Get() into the AccessPack RecNo. Having used one of the Get() routines to find the data record, make a call to the delete function.

The DeleteRecordXB routine does not physically remove the record from the data file but instead tags it as being "deleted".

## How to call BULLET

BULLET is called through a single entry point. The only argument passed to it is a far pointer to the control pack using the Pascal calling convention. The first two entries in this pack are the function to be performed and the function return status. BULLET is a function call returning an integer status value. See [BULLET.H](#) for more.

Each function (or routine) uses a prescribed pack format. For example, some routines need only know the handle of the file, along with the function number itself. So, to flush a data file, for example, you would do the following:

```
struct handlepack HP;  
HP.func = FLUSHDHXB;           /* defined as a CONST in BULLET.H*/  
HP.handle = file2flushhandle;  /* handle returned from Open() routine */  
rstat = BULLET(&HP); /* do the actual call to BULLET */
```

The value of rstat is set to the completion code as returned by the [FlushDHXB](#) routine. It is the same as the value returned in HP.stat **IN ALL BUT A FEW** cases: [InsertXB](#), [UpdateXB](#), [ReindexXB](#), and [LockXB](#). These routines return not the actual error code, but rather a transaction index number of the access that failed. See those routines for more information.

**Note:** This help file (and the original CZ help file) use upper and lower case in order to make the routine names and packs more readable. However, the [BULLET.H](#) file defines all the routines (constants) in upper case, and the pack names in lower case.



## Overall specs

BULLET is dBASE III/III+/IV .DBF-compatible. This format is compatible with a large base of software programs including the latest database packages such as dBASE IV and FoxPro. Spreadsheet packages such as Excel and 1-2-3 can directly import BULLET DBF data files, too. And because of BULLET's versatility, it can also create very non-standard data files. This may be a useful feature if data secrecy is of concern.

BULLET requires MS-DOS 3.30 or above. It uses 19K of code/static data space and requires at least 40K of workspace. 140K of workspace is ideal.

Overall Specifications:

<b>DBF</b>		<b>INDEX</b>	
Max records:	16,777,215	Max nodes:	65,535
Record length:	2-4000 (8192)	Max keys:	4M
Max fields:	128 (255)	Key length:	1-64
Field length:	1-254 (255)	Max key fields:	16

Total open index plus data files can be up to 255. Numbers in () indicate extended specifications.

**See:** [DBF specs](#)

## DBF specs

To remain compatible with other dBASE III .DBF platforms you should restrict your data files to the following specifications:

- File ID byte: 3 (83hex if .DBF has memo field, not currently supported)
- Max record size: 4000 bytes Max fields/rec: 128 Max field size: 254 bytes
- Allowable field name characters: A-Z and the \_ (upper-case), 0-filled
- Allowable field types:
  - C** character, 1-254 bytes
  - D** date, 8 bytes, in the format YYYYMMDD (19920531)
  - L** logical, 1 byte, either space, "T" or "Y", "F" or "N"
  - M** memo, 10 bytes, used as pointer into .DBT file (currently not supported)
  - N** numeric, 1-19 bytes, ASCII format, uses explicit decimal if needed...  
...decimal places may be 0, or 2 to (field size - 3) but no more than 15

Restrict all data in .DBF fields to ASCII. This means you should convert binary data to the equivalent ASCII representation, e.g., if you have the binary value 22154, it must first be converted to the string "22154" before you can store it to the .DBF data file. So, while your in-program code deals with binary data, your I/O code must convert it to/from ASCII. This is a dBASE-compatibility issue only. If you can forgo these requirements you can use binary fields, any-character field names, record sizes to 8192 bytes, and up to 255 fields.

A dBASE III .DBF is composed of 3 sections: the header, the field descriptors, and the data area.

### The header structure (first 32 bytes of file):

Name	Type	Offset	Meaning
FileID	byte	0	data file type id, 03 standard (43,63,83,88h)
LastYR	byte	1	last update year, binary
LastMo	byte	2	last update month, binary
LastDA	byte	3	last update day, binary
NoRecs	long	4	number of records in file
HdrLen	word	8	length of header, including field descriptors, +1
RecLen	word	10	length of data record including delete tag
internal	byte	12-31	reserved

The last update values are updated to the current date whenever the .DBF file is flushed or closed. Likewise, the NoRecs value is updated whenever a record is added to the .DBF. The FileID is specified when you create the file, HdrLen and RecLen are computed and stored when the file is created, too.

### The field descriptor format (follows header, one per field):

Name	Type	Offset	Meaning
FieldName	char	0	field name 10 ASCII characters, A-Z or _ (0-filled)
OT	byte	10	field name zero-terminator (must be 0)
FieldType	char	11	field type (C D L M N)
internal	long	12	reserved
FieldLen	byte	16	length of this field
FieldDC	byte	17	decimal count
internal	byte	18-31	reserved

The unused bytes in the FieldName must be set to zeroes (CHR\$(0)).

Each field is described by a 32-byte descriptor. The first field's descriptor starts right after the header proper, at offset +32. After the last field descriptor is data byte ASCII 13. (Note: the original dBASE III has a 0 byte following this ASCII 13.) Immediately following this is the actual record data.

### **The data record format:**

The first record is located at offset HdrLen (from the header). The first byte of each record is a delete tag. This tag is maintained by the BULLET routines. A space, ASCII 32, means the record is not deleted; an asterisk, ASCII 42, means the record has been deleted (marked as deleted, often this is used as a method to temporarily tag records, for whatever purpose).

Following the tag is the data for each field, not delimited (i.e., the fields run together without anything separating them). The second record is at offset HdrLen+reclen. The start offset of any record in the file can be computed as  $(\text{recordnumber} - 1) * \text{reclen} + \text{HdrLen}$ . All data is in ASCII form.

An EOF marker (ASCII 26) is placed at the end of the last record.

**See:** [Index specs](#)

## Index specs

BULLETT uses a proprietary, modified b-tree index method to manage the index files. The supported key types are:

Type	Length	Meaning
Character	1-64	ASCII, NLS, or user-supplied sort table
Integer	2	signed or unsigned 16-bit value
Long Int	4	signed or unsigned 32-bit value

In addition to the above types, BULLETT allows for unique or duplicate keys in the index file. If duplicates are allowed, BULLETT enumerates each key with an enumerator word (see [FirstKeyXB](#)).

The key may be composed of up to 16 character fields or substrings within those fields. Numeric fields are considered character fields by BULLETT unless the key is set to binary (see KeyFlags below). Integer or LongInt binary keys can be composed of a single field only. The key expression is specified in text (e.g., "LNAME+SUBSTR(FNAME,1,1)+MI") and is fully evaluated when the index file is created.

A BULLETT index file is composed of 3 sections: the header, the collate-sequence table, and the node/key entry area.

The header structure:

Name	Type	Offset	Meaning
FileID	byte	0	index file type id, 20
RootNode	word	1	root node number
Keys	24bit	3	number of keys in index file
AvalNode	word	6	node number available for reuse
FreeNode	word	8	next free node number
KeyLen	byte	10	key length
NodeKeys	byte	11	number of keys that fit on a node
CodePage	word	12	code page ID
CtryCode	word	14	country code
internal	byte	16-21	reserved
KeyFlags	word	22	key flags
KeyExprn	byte	24-159	key expression
internal	byte	160	reserved
KeyXFids	byte	161	number of fields used by key (1-16)
KeyXlate	byte	162-225	translated key expression
internal	byte	226-253	reserved
CTsize	word	254	collate-sequence table size

The collate-sequence table structure:

table          byte 256-511    sort weight table of ASCII character 0-255

Node/key entry structure (first entry is in node #1, file offset 512):

```
2A 0A 00 KEY123 7B 00 00 12 00 KEY178 B2 00 00 0C 00 ...
1. 2.    3.    4.    5.    6.    7.    8. 9.
```

1. Key count for that node (first byte of each node)
2. 16-bit node back pointer (for non-leaf nodes, 0 if leaf node)

3. First key value, "KEY123" in this case
4. 24-bit data record pointer (low word/hi byte) 7Bh = DBF record number 123
5. 16-bit node forward ptr/back ptr (for non-leaf nodes, 0 if leaf node)
  - in this case, it indicates that the key following KEY123 is in node #12h
  - and also that the key before KEY178 is in that node as well
6. Second key (here "KEY178")
7. 24-bit data pointer (record number in DBF)
8. 16-bit forward node pointer (for non-leaf nodes, 0 if leaf node)
9. Repeat 6 to 8 for each key on node. (node size is 512 bytes)

As in many b-tree implementations, BULLET's index files maintain an average load percentage of approximately 66%. This means that in any given node, 66% of the available space is in use. The free space in the node is attributable to the constant reshaping of the file as keys are inserted or deleted, causing the nodes to be split and merged. A split will occur when an insert needs to add a key to an already full node; a merge will occur when a neighboring node is small enough to be merged into a just split node. This constant prune-and-graft of the b-tree results in a node load of about 66% (50% in degenerate cases such as with already sorted data). It's this aspect of the b-tree that makes it a consistent performer and a widely-used method of managing index files.

The following formula can be used to determine the number of keys that an index file can hold:

$$\text{MaxKeys} = \text{MaxNodes} * \text{MaxKeysPerNode} * \text{LoadFactor}$$

$$\text{MaxKeys} = 65535 * 509 / (\text{keylen} + 5) * .66$$

The load factor can be increased to ~95% by using the ReindexXB routine. This load factor results in superior retrieval speeds since there are more keys on each node. Insertion speed will be decreased, however, since splitting will occur more frequently, though perhaps not noticeably.

## Memory specs

BULLETT allocates memory on an as-needed basis. When linked to an executable program, BULLETT makes use of 17.5K of code space and about 1.5K of static DGROUPE data space. To accommodate the wide variety of compilers, BULLETT's API structure will have the linker included all of the library into your final EXE program.

All runtime memory allocations are obtained from the operating system (the far heap).

The amount of memory that BULLETT requires is based on which routines are used. See the next screen for a list of the routines that make malloc calls to the operating system and how much memory they require.

Routines making dynamic memory allocations and amount (within  $\pm 16$  bytes):

<b>Routine</b>	<b>Bytes</b>	<b>Basis</b>
InitXB (JFTmode=1)	272	permanent, released when program ends
BackupFileXB	32K	temp, released when routine exits
CreateDXB	48+(NF*32)	temp, released when routine exits (NF=NoFields)
CreateKXB	544	temp, released when routine exits
OpenDXB	144+((1+NF)*32)	semi-permanent, released when file closed
OpenKXB	1264	semi-permanent, released when file closed
PackRecordsXB	RL to 64K	temp, released when routine exits (RL=RecLength)
ReindexXB	32K to 128K	temp, released when routine exits
UpdateXB	2K+RL	temp, released when routine exits (RL=RecLength)

For example, when BackupFileXB is called it attempts to allocate 32K from the OS. If 32K is not available, BackupFileXB returns with an error code of 8 (DOS error #8, not enough memory). If you won't be using Backup or Reindex, BULLETT can make do with much less memory (use table above).

Needed stack space is 4K (max) for ReindexXB. Other routines can operate with less than 1K of stack space. In other words, stack use is minimal.

## OS calls specs

BULLETT makes use of the following operating system calls:

INT21/25	DOS_setvector	INT21/44/0B	DOS_setsharingretrycount
INT21/2A	DOS_getdate	INT21/48	DOS_malloc (*)
INT21/30	DOS_version	INT21/49	DOS_free (*)
INT21/35	DOS_getvector	INT21/51	DOS_getpsp
INT21/39	DOS_makedir	INT21/56	DOS_renamefile
INT21/3D	DOS_openfile	INT21/59	DOS_getextendederror
INT21/3E	DOS_closefile	INT21/5A	DOS_createtempfile
INT21/3F	DOS_readfile	INT21/5B	DOS_createnewfile
INT21/40	DOS_writefile	INT21/5C	DOS_lockunlockfile
INT21/41	DOS_deletefile	INT21/65/01	DOS_getextendedcountryinfo
INT21/42	DOS_movefileptr	INT21/65/06	DOS_getcollatetable (+)
INT21/44/09	DOS_isdriveremote	INT21/67	DOS_sethandlecount
INT21/44/0A	DOS_isfileremote	INT2F/10/00	DOS_isshareinstalled

No other operating system calls are made. No BIOS calls are made.

(\*) **Note:** In the Windows version, BULLETT calls the GlobalAlloc/GlobalLock and GlobalUnlock/GlobalFree functions for memory allocation. Furthermore, all calls to INT21 are done via the DOS3Call interface, which according to the SDK documentation is somewhat faster than calling INT21.

(+) **Note:** In the Windows version, BULLETT makes a call to DPMI (INT31/2) to obtain a valid selector for the pointer to the collate table returned by function INT21/6506 (a DOS service emulated by Windows -- the real INT21/6506 is not issued by Windows). Since this emulation is flawed in standard mode, Bullet requires that Windows be in enhanced mode before attempting this DPMI call. Therefore, your program must be running under enhanced mode when calling CreateKeyXB or an error is returned. You are permitted, however, to call CreateKeyXB in standard mode provided that you supply a collate table pointer for Bullet to use (meaning you can run a Bullet program from standard mode provided that you supply a collate table for Bullet, since only here is enhanced mode required).

## OS specs

BULLET is currently available only for MS-DOS and compatible operating systems, and Microsoft Windows. It requires DOS 3.3 or higher, or Windows 3.x or higher.

To provide efficient memory use, BULLET uses a single-buffer cache per index file. The single-buffer cache also provides for very quick network access since a minimum amount of memory needs to be flushed when releasing control of BULLET files. For maximum speed, however, an external high-performance disk cache can be used. Hyperdisk is a good choice (shareware, \$50+). A properly configured cache can increase BULLET's performance from 10 to 300%. The most improvement is with the InsertXB routine. The least is with ReindexXB and PackRecordsXB, which do most of their work in temporarily allocated memory. Hyperdisk is about the best designed disk cache available for PCs. SmartDRV 4.x is also good.

If you do not use a disk cache then it's recommended that you set your BUFFERS= statement in CONFIG.SYS to at least 20 or 30. Even without a disk cache, BULLET is still very fast. Also, be sure to set your FILES= to the number of files that you'll be opening at any one time. If you set FILES=20 you can have BULLET open 14 files (CZ.COM uses 1 and DOS reserves 5 more). You can set FILES=255 allowing BULLET to open up to 249 files at one time.

**DO NOT set FILES= to a value greater than 255.**



## Network specs

BULLET currently operates on all DOS-compatible network platforms.

Be sure to install SHARE.EXE (or VSHARE, or compatible) on the server and, if you are multitasking or using the locking functions, on your local machine, also. If you'll be opening many files you should extend the default SHARE file-sharing information space and the number of locks that can be performed at one time. The DOS 5.0 default is /F:2048 and /L:20. This allocates 2K for file-sharing info space and allows 20 consecutive locks to be active. If the F: value is too low, error 5 (extended error 32) is returned on an open attempt. If you extend the JFT in InitXB and plan to use many files, say more than 50, be sure to extend /F: by 2K for every 50 additional files and set the /L: to the number of files you plan on having open. If L: is too low, error 1 (ext err 36) is returned on a lock attempt.

As an example, if you'll be using 100 files, set FILES=106 in CONFIG.SYS, set SHARE /F:4096 /L:106, and IPJFTmode=1 for InitXB. These values are a minimum. If you have more than one process active, you need to account for other apps.

Note that Windows always returns a "SHARE is installed" using the DOS detection routines used by BULLET. To determine if SHARE is actually installed, attempt to perform a lock using one of the LockXB routines. An error code indicates that SHARE (or compatible) is not installed.

## InitXB

**Pack:** InitPack

**Src:** InitXBsrc

**Func:** 0/System

Before using any routine you must initialize the BULLET file system.

If you want more than the standard number of file handles, set InitPack.JFTmode to 1. This expands the current process's Job File Table to allow 255 open files maximum.

On return the DOS version (INT21/30h) is in InitPack.DOSver. Major version in the high byte. Minor in the low. The BULLET version (\*100) is returned as is the address of the ExitXB routine. You can use this address to register ExitXB with your own \_atexit function if your runtime library does not provide \_atexit already.

The osversion field defines whether the library being used is the DOS version (in which case it will be 0) or the Windows version (the field will be set to 1).

Note: \_atexit is a routine available in most DOS, OS/2, and ANSI runtime library code and is called just prior to the program ending. See AtExitXB for information on what to do if your library does not have \_atexit.

## ExitXB

**Pack:** [ExitPack](#)

**Src:** [ExitXBsrc](#)

**Func:** 1/System

Before ending your program you should call ExitXB to close any open BULLET files. This also will release any memory still allocated to those files. This restores the default keyboard break handlers if they were changed.

In normal operation you would see to closing all files yourself. However, if your program fails to reach the programmed end, it's very possible that files may still be left open. It is essential that you properly close all BULLET files before ending. There are two methods to achieve this:

1. Direct your startup code so that on fatal errors, your program executes ExitXB before returning to DOS.
2. Use [AtExitXB](#) to automatically register ExitXB to be executed in the normal shut-down code of the compiler. This method is preferred.

**See:** [InitXB](#)

## AtExitXB

**Pack:** ExitPack

**Src:** AtExitXBsrc

**Func:** 2/System

Used to automatically close all BULLET files, release allocated memory, and restore the default Break handlers when your program ends. Your compiler generates specific code to be executed in the course of ending your program. AtExitXB registers the ExitXB routine to be performed in this compiler-generated code.

This routine is standard in most DOS, OS/2, and ANSI runtime libraries. If yours does not have \_atexit, then you must link with the supplied NOATEXIT.OBJ file:

```
C>link YOURPRG + NOATEXIT, ...
```

You can tell if your compiler doesn't supply \_atexit at link time. LINK reports '\_atexit' : unresolved external. Add NOATEXIT.OBJ as described above.

Be sure that your \_atexit routine is for the medium, large, or huge memory models since BULLET uses multiple code segments and far calls.

**See:** BreakXB

## MemoryXB

**Pack:** MemoryPack

**Src:** MemoryXBsrc

**Func:** 3/System

This is the only BULLET routine that can be used before InitXB. It reports the largest free block of memory available from Windows, but reports available memory greater than 960K as 960K (i.e., the memory available may be 10MB but this routine will never indicate more than 983,040 bytes). This routine is essentially of no use in Windows.

**See:** OpenDXB, OpenKXB

## BreakXB

**Pack:** BreakPack

**Src:** BreakXBsrc

**Func:** 4/System

Disables system response to Control-C and Control-Break keys preventing users from inadvertently exiting the program without first doing a BULLET shutdown.

It's REQUIRED that you reinstate the default break handlers with this routine before ending your program. <u>ExitXB</u> automatically reinstates the default break handlers.
--

This routine will not disable Control-Alt-Delete (a warm-boot). If the user is at this point, he may prefer to exit via a warm-boot rather than reset the machine.

This routine will not surpress the ^C displayed by DOS. If you don't want the ^C to be displayed move the cursor to a location off-screen, say, row 26.

## BackupFileXB

**Pack:** CopyPack

**Src:** BackupFileXBsrc

**Func:** 5/System

Copy an open BULLET key or data file. BULLET repacks and reindexes files in place, requiring less disk space to perform the function. BackupFileXB allows you to safely copy a file before doing this.

<p>This function is recommended prior to packing a data file with <u>PackRecordsXB</u> since the data is very valuable. There is probably little need to do so when reindexing an index file since index files can be constructed very easily from the data file but a <u>CopyKHXB</u> to preserve the key expression is quick and recommended.</p>
---

**See:** ReindexXB

## StatHandleXB

**Pack:** StatHandlePack      **Src:** StatHandleXBsrc      **Func:** 6/System

Get information on a DOS file handle number to determine if it is a BULLET file and if so, if that file is a BULLET key or data file.

If the returned ID value is 0, the handle is to a BULLET index file. ID=1 then the handle is a BULLET .DBF file. ID= -1 then the handle is not a BULLET file.

**See:** CreateDXB, StatDXB, StatKXB



## GetExtErrorXB

**Pack:** XErrorPack

**Src:** GetExtErrorXBsrc

**Func:** 7/System

Get the extended error information for the last operation. This information includes the extended error code, the error class, the recommended action, and the location of the error. See DOS errors for the extended error meaning and for the class, action, and locus code meanings.

Note that on fatal DOS errors, such as an open floppy drive door, the extended error code returned is 83 - fail on INT24. This indicates that the INT24 handler was invoked by DOS and that the INT24 handler told DOS to ignore the error. (BULLET invokes its own INT24 handler each time it accesses the DOS file system and restores it promptly after the access.) In such cases, this extended error code is less informative than the standard return code and, the other 'extended' information should be disregarded. (In fatal DOS errors the standard return code IS the extended error code.)

This routine returns the extended error information for the LAST DOS system error. This information remains the same until the next DOS system error.
---

## DVmonCXB

**Pack:** DVmonPack

**Src:** DVmonCXBsrc

**Func:** 9/DEBUG

Control BULLET debug monitor.

This routine is available only in the debug engine.

The monitor displays in realtime the state of a data file handle, or an index and data file handle pair if an index handle is specified. DVmonCXB is best used on dual-display systems in which the video output is sent to the secondary video monitor. In any case, a 4000-byte screen image is updated in real-time.

To use the monitor, set mode=1, handle=file to monitor, and VideoSeg=segment address of 4000-byte area. The typical VideoSeg would be to video memory. If you have a color system as the main monitor and a mono as the secondary, set VideoSeg=0xB000. Detailed system stats are continually updated to the secondary monitor. If you have a single monitor with at least 2 video pages, set VideoSeg to your base address plus the page size\16, typically 0xB800+(4096\16). If you have only a single-page video system, you can allocate a 4000-byte memory area and update the video manually by moving it to your video display (80x25).

## CreateDXB

**Pack:** CreateDataPack      **Src:** CreateDXBsrc      **Func:** 10/Mid-level

Create a new BULLET .DBF data file. Before using this routine allocate a field description array of TYPE FieldDescTYPE for at least as many fields as are in the record. It's recommended that this allocation be zeroed before use since the fieldnames must be 0-filled.

Conventional dBASE .DBF files have a FileID=3. Other possible FileIDs that you may come across are (in hex):

43h \\_ are special-use Xbase IV DBF files, BULLET can process these file IDs  
63h / since they are similar to ID type 3  
83h --- this DBF file has an Xbase III/III+ memo field/file  
88h --- this DBF file has an Xbase IV memo field/file

In creating your .DBF files, specify FileID=3 to ensure compatibility across Xbase versions.

BULLET makes no special use of the FileID byte.

**See:** OpenDXB, CreateKXB

## OpenDXB

**Pack:** OpenPack

**Src:** OpenDXBsrc

**Func:** 11/Mid-level

Open an existing .DBF data file for use. You need to specify two things, the filename and the DOS file access mode. If the open succeeds, the DOS file handle is returned. Use this handle for all further access to this file.

Each .DBF data file you open allocates  $144 + ((1 + \text{number of fields}) * 32)$  bytes for internal use. This memory is not deallocated until you close the file with CloseDXB or execute ExitXB.

You must open the data file before you can open (or create) any of its index files.

**See:** OpenKXB

## CloseDXB

**Pack:** [HandlePack](#)

**Src:** [CloseDXBsrc](#)

**Func:** 12/Mid-level

Close an existing .DBF data file for use. Closing the file updates the file header and deallocates the memory used by this file.

You MUST close all BULLET files before ending your program or file corruption may occur. To ensure that all files are closed in the event of an unscheduled program termination, use [AtExitXB](#).

**See:** [StatDXB](#), [ExitXB](#), [CloseKXB](#)

## StatDXB

**Pack:** StatDataPack

**Src:** StatDXBsrc

**Func:** 13/Mid-level

Get basic information on the BULLET .DBF data file handle specified. Information returned includes the number of records in the file, the record length, number of fields per record, and the date the file was last updated.

Typically, your program will keep track of whether a particular handle belongs to a data file or a key file. In cases where this is not possible, call the StatHandleXB routine to determine what file type a handle is.

Note that a just-created data file will have the LastUpdate date set to 0/0/0.

**See:** StatKXB

## ReadDHXB

**Pack:** HandlePack

**Src:** ReadDHXBsrc

**Func:** 14/Mid-level

Reload the disk copy of the data header for the opened .DBF data file handle to the internal copy.

In single-user, single-tasking systems this routine is not needed. However, in a multi-user or multi-tasking system it's possible, and desirable, for two or more programs to use the same data file. Consider this scenario: A data file has 100 records. Two programs access this data file, both opening it. Program 1 locks the file, adds a new record, then flushes and unlocks the file. Program 1 knows that there are now 101 records in the file. However, Program 2 is not aware of the changes that Program 1 made--it thinks that there are still 100 records in the file. This out-of-sync situation is easily remedied by having Program 2 reload the data header from the file on disk.

How does Program 2 know that it needs to reload the header? It doesn't. Instead BULLET uses a simple yet effective approach when dealing with such problems. Whenever your program locks a file, BULLET automatically reloads the header. Whenever you unlock a file, BULLET automatically flushes the header.

**See:** ReadKHXB, LockXB

## FlushDHXB

**Pack:** HandlePack

**Src:** FlushDHXBsrc

**Func:** 15/Mid-level

Write the internal copy of the data header for the opened .DBF data file handle to disk. The actual write occurs only if the header has been changed.

This is to ensure that the data header on disk matches exactly the data header that is being maintained by BULLET. Also, this routine updates the operating system's directory entry for this file.

Assume the following: A data file with 100 records. Your program opens the data file and adds 1 record. Physically, there are 101 records on disk. However, the header image of the data file on disk still reads 100 records. This isn't a problem, BULLET uses its internal copy of the data header and the internal copy does read 101 records. BUT, if there were a system failure now, the disk image would not get updated. After the system restart, BULLET opens the file, reads the header and thinks that there are 100 records. You lost a record. Now, if after that add above, your program issued a FlushDHXB, the header on disk is refreshed with the internal copy, keeping the two in-sync. Also, the routine updates the DOS directory entry, keeping things neat there as well. Still, it doesn't come without cost: flushing will take additional time, therefore, you may elect to flush periodically, or whenever the system is idle.

**See:** ReadDHXB, FlushKHXB, LockXB



## CopyDHXB

**Pack:** CopyPack

**Src:** CopyDHXBsrc

**Func:** 16/Mid-level

Copy the .DBF file structure of an open data file to another DOS file.

This routine makes it easy for you to duplicate the structure of an existing .DBF file without having to specify all the information needed by CreateDXB.

The resultant .DBF will be exactly like the source, including number of fields and field descriptions. It will contain 0 records.

**See:** ZapDHXB

## ZapDHXB

**Pack:** HandlePack

**Src:** ZapDHXBsrc

**Func:** 17/Mid-level

Delete all records for a .DBF data file.

This routine is similar to CopyDHXB except for one major difference: ALL DATA RECORDS IN THE \*SOURCE\* FILE ARE PHYSICALLY DELETED, so be \*careful\*.

If you have a .DBF file with 100 records and use ZapDHXB on it, all 100 records will be physically deleted and the file truncated to 0 records. There is no return from this routine. All data is gone.

<b>CAUTION</b>
----------------

**See:** ZapKHXB

## CreateKXB

**Pack:** CreateKeyPack**Src:** CreateKXBsrc **Func:** 20/Mid-level

Create a new BULLET key file. Before you can create a key file, you must first have opened (and have created if necessary) the BULLET .DBF data file that it is to index. (BULLET couples index and data files tightly.)

To create the key file, you need to provide the key expression, key flags, .DBF file link handle, and optionally, the code page ID, country code, and collate table.

### Key Expression

The key expression is an ASCII character string composed of the elements that are to make up this index file's key. The key can be composed of any or all of the fields in the .DBF data record or sub-strings within any of those fields. Two functions are supported in evaluating a key expression. These are **SUBSTR()** and **UPPER()**. SUBSTR() extracts part of a string starting at a particular position for x number of characters. UPPER() converts all lower-case letters to their upper-case equivalent. Since BULLET supports NLS, UPPER() conversion is not required for proper sorting of mixed-case text strings.

All names used in the key expression must be a valid field name in the DBF data file. Some sample key expressions given that the .DBF has the following fields:

<b>Fields...</b>	<b>Valid key expressions</b>
FNAME C 25 0	"LNAME"
LNAME C 25 0	"LNAME+FNAME"
SSN C 9 0	"SUBSTR(LNAME,1,4)+SUBSTR(FNAME,1,1)+SUBSTR(SSN,6,4)"
DEPT N 5 0	"UPPER(LNAME+FNAME)" (for non-NLS index files)
: :	"DEPT+SSN" (N- + C-type is valid for non-binary keys)

The key expression is given to Bullet in the form of a text string, pointed to by AP.keyexpptr, during CreateKXB.

### Key Flags

The key expression is used in conjunction with the key flags to determine the type of key generated.

First, if your index file is to disallow duplicate keys, add 1 to KeyFlag.

If you have a key composed of a character field(s) or portions thereof, you specify a KeyFlag = 2. This instructs BULLET that the sort order is left-to-right (proper mixed-case sorting is available, see code page ID).

If you have a key composed of a numeric field(s) or portions thereof, you can also specify a KeyFlag = 2. This instructs BULLET to treat the numeric field as a regular character field for sorting. To ensure proper sorting, you must decimal-align the +numeric strings in the .DBF data field, i.e., right-justify the numeric strings (dBASE .DBF numeric strings are stored as ASCII strings). These non-binary numeric fields are just like character fields to BULLET.

In addition, if you have a key composed of a SINGLE numeric field (fld type N) and the field is an integer (NO DECIMAL POINT), you can specify a KeyFlag of 16 or 32. KeyFlag=16 is for a field known to be in word/integer range; KeyFlag=32 if the field is known to be in LongInt range. These KeyFlag values instruct BULLET to sort the key as a 16/32-bit BINARY value. It

also stores the key as a 16- or 32-bit value (only 2 or 4 bytes) in the index, even though the data field is in ASCII (keyflag=16 or 32).

Although not dBASE compatible, you may use BINARY FIELDS in your data records. dBASE always has ASCII data in the data fields, even if the field is numeric. For example, an N type field of 8.2 is stored as an ASCII text string in the data record, say, a string like " 1100.55". If you want dBASE compatibility your field data must also be ASCII. However, if you can forgo this requirement, you can use binary values in the fields.

To do this you must specify a field type of "B" (actually, anything but a "N") and, IF IT IS TO BE USED AS A KEY FIELD, also set the 16- or 32-bit KeyFlag. Unique and signed may also be flagged. The field length for a "B" field type is 2 or 4. Make sure the key flags match (2 if cINTEGER, 4 if cLONG).

If you specify a binary key flag (for either N or B field types), you must also specify whether the field is to be treated as a signed or unsigned value. If values less than 0 are possible, add to KeyFlag the hex number 0x8000.

```
KeyFlag = cUNIQUE|cCHAR;           /* unique character key (NLS sort) */
KeyFlag = cINTEGER|cUNIQUE;       /* unique unsigned integer (binary sort) */
KeyFlag = cUNIQUE|cSIGNED|cLONG;  /* unique signed long */
KeyFlag = cCHAR;                  /* character key with duplicates allowed */
KeyFlag = cCHAR|cINTEGER;         /* THIS IS AN INVALID KEY FLAG! */
```

Click [here](#) to see the values defined in [BULLET.H](#).

StatKXB is used to query KeyFlags.

The key expression you specify may be up to 136 characters, and evaluate out to 64 bytes (62 bytes if unique key is not specified). I.e, "SUBSTR(..." can be up to 136 characters, and that the actual key built from this expression can be no longer than 64 bytes, or 62 if you did not specify UNIQUE. In general, shorter keys (the key itself, not the expression) offer better performance.

## **DBF File Link Handle (XBlink)**

Since BULLET evaluates the key expression at CreateKXB, it must have access to the DBF file to verify that the key expression is valid. You must therefore supply CreateKXB with the OS file handle of the opened DBF data file.

## **National Language Support (NLS)**

With DOS 3.3 and later, NLS is available. BULLET uses NLS to build the collate sequence table that it uses to ensure proper sorting of mixed-case keys as well as the sorting of foreign language alphabets. In order for BULLET to use the proper collate table, it must know what code page ID and country code to use. This table is made part of the index file so that all subsequent access to the index file maintains the original sort order, even if the MIS shop is moved to another location/computer system using another country code/code page.

## **Code Page ID**

To use the default code page ID of the computer in use, specify a code page ID of -1. This instructs BULLET to use the collate-sequence table as provided by MS-DOS running on the machine. You may also specify the code page ID for BULLET to use, but only if support for the code page ID is available on your machine. Look in your DOS manual under

CUSTOMIZING FOR INTERNATIONAL USE for specific code page IDs and country codes. See also the COUNTRY and NLSFUNC commands. You may also specify a code page ID = 0 in which case no collate table is used.

## Country Code

To use the default country code of the computer in use, specify a country code of -1. This instructs BULLET to use the collate-sequence table as provided by MS-DOS running on the machine. You may also specify the country code for BULLET to use, but only if support for the country code is available on your machine. Look in your DOS manual under CUSTOMIZING FOR INTERNATIONAL USE for specific code page IDs and country codes. See also the COUNTRY and NLSFUNC commands. You may also specify a country code = 0 in which case no collate table is used.

Typically, you set CodePageID = -1, CountryCode = -1 and CollatePtr = 0.

## User-specified Collate Table

If you are to use a MS-DOS supplied collate table (BOTH codepage ID and country codes are non-zero) then you do not need to specify a collate table--DOS will. The option to allow a user-specified collate table is to work around some DOS versions supplying incorrect collate tables. If you find that the DOS-supplied collate table is not valid (it's stored in the second sector of the file) for your country, you can supply the table to be used by pointing the CollatePtr variables to your in-memory version of a valid collate table. If you want to use the DOS-supplied collate table, you MUST set the CollatePtr variables = 0.

Note: The collate table is a 256-byte table that contains the sort value of each character (0-255). For example, the first byte would be 0, second would be 1, and so on. Values for characters up to the lower-case letters (ASCII 97) are usually as you would expect: "A" has a value of 65. However, the lower-case letters have the same value as their upper-case counterparts: "a" also has a value of 65. BULLET uses this collate table to ensure proper sorting.

If you specify EITHER code page ID OR country code = 0 then no collate table is used or built. Instead, sorting is done by standard ASCII sort. This is somewhat faster but less versatile. Use UPPER() for mixed-case sort if needed.

## OpenKXB

**Pack:** OpenPack

**Src:** OpenKXBsrc

**Func:** 21/Mid-level

Open an existing key file for use.

Each key file that you open allocates 1264 bytes for internal use. This memory is not deallocated until you close the file with CloseKXB or execute ExitXB.

You must open the data file before you can open its related index file because you must supply the handle of the data file that this index files indexes.

**See:** OpenDXB

## CloseKXB

**Pack:** HandlePack

**Src:** CloseKXBsrc

**Func:** 22/Mid-level

Close an open key file. Closing the file updates the file header and deallocates the memory used by this file.

You MUST close all BULLET files before ending your program or file corruption may occur. To ensure that all files are closed on the event of an unscheduled program termination, use AtExitXB.

**See:** CloseDXB

## StatKXB

**Pack:** StatKeyPack

**Src:** StatKXBsrc

**Func:** 23/Mid-level

Get basic information on a BULLET key file handle specified. Information returned includes the number of keys in the file, the key length, the data file handle for this key, the last accessed record number of that data file, NLS information, and the key flags.

Typically, your program will keep track of whether a particular handle belongs to a key file or a data file. In cases where this is not possible, call the StatHandleXB routine to determine what file type a handle is.

**See:** StatDXB



## ReadKHXB

**Pack:** HandlePack

**Src:** ReadKHXBsrc

**Func:** 24/Mid-level

Reload the disk copy of the key header for the opened key file handle to the internal copy.

In single-user, single-tasking systems this routine is not needed. However, in a multi-user or multi-tasking system it's possible, and desirable, for two or more programs to use the same data file. Consider this scenario: A key file has 100 keys. Two programs access this key file, both opening it. Program 1 locks the file, adds a new key, then flushes and unlocks the file. Program 1 knows that there are now 101 keys in the file. However, Program 2 is not aware of the changes that Program 1 made--it thinks that there are still 100 keys in the file. This out-of-sync situation is easily remedied by having Program 2 reload the key header from the file on disk.

How does Program 2 know that it needs to reload the header? It doesn't. Instead BULLET uses a simple yet effective approach when dealing with such problems. Whenever your program locks a file, BULLET automatically reloads the header. Whenever you unlock a file, BULLET automatically flushes the header.

**See:** FlushKHXB, ReadDHXB, LockXB

## FlushKHXB

**Pack:** HandlePack

**Src:** FlushKHXBsrc

**Func:** 25/Mid-level

Write the internal copy of the key header for the opened key file handle to disk. The actual write occurs only if the header has been changed.

This is to ensure that the key header on disk matches exactly the key header that is being maintained by BULLET. Also, this routine updates the operating system's directory entry for this file.

Assume the following: A data file with 100 keys. Your program opens the key file and adds 1 key. Physically, there are 101 keys on disk. However, the header image of the data file on disk still reads 100 keys. This isn't a problem, BULLET uses its internal copy of the key header and the internal copy does read 101 keys. BUT, if there were a system failure now, the disk image would not get updated. After the system restart, BULLET opens the file, reads the header and thinks that there are 100 keys. You lost a key. Now, if after that add above, your program issued a FlushKHXB, the header on disk is refreshed with the internal copy, keeping the two in-sync. Also, the routine updates the DOS directory entry, keeping things neat there as well. Still, it doesn't come without cost: flushing will take additional time, therefore, you may elect to flush periodically, or whenever the system is idle.

**See:** ReadKHXB, LockXB

## CopyKHXB

**Pack:** CopyPack

**Src:** CopyKHXBsrc

**Func:** 26/Mid-level

Copy the key file structure of an open key file to another DOS file.

This routine makes it easy for you to duplicate the structure of an existing key file without having to specify all the information needed by CreateKXB.

The resultant key file will be exactly like the source, including key flags and key expression. It will contain 0 keys.

## ZapKHXB

**Pack:** HandlePack

**Src:** ZapKHXBsrc

**Func:** 27/Mid-level

Delete all keys for a key file.

This routine is similar to CopyKHXB except for one major difference: ALL KEYS IN THE \*SOURCE\* FILE ARE PHYSICALLY DELETED, so be \*careful\*.

If you have a key file with 100 keys and use ZapKHXB on it, all 100 keys will be physically deleted and the file truncated to 0 keys. There is no return from this routine. All data is gone.

<b>CAUTION</b>
----------------

**See:** CopyKHXB, ZapDHXB

## GetDescriptorXB

**Pack:** DescriptorPack      **Src:** GetDescriptorXBsrc      **Func:** 30/Mid-level

Get the field descriptor information for a field.

You can specify either the fieldname or the field number (position of the field within the record where the first field is #1) to get info on.

The field descriptor contains the following information:

- FIELDNAME** 10 upper-case characters, A-Z and \_ allowed, unused space is 0-filled and is 0-terminated (11 bytes, ASCII, byte 11 always=0)
- FIELDTYPE** single ASCII character where C=character, N=numeric, D=date, L=logical, and M=memo field (1 byte, ASCII)
- FIELDLEN** length of field: C=1-254, N=1-19, D=8 (yyyymmdd), L=1 (T/F/space), M=10, this is total field length (1 byte, binary)
- FIELDDC** places right of decimal point if N field type, minimum if not 0 is 2, can be up to 6 or 8, non-N fields always 0 (1 byte, binary)

## GetRecordXB

**Pack:** AccessPack

**Src:** GetRecordXBsrc

**Func:** 31/Mid-level

Get the physical record from the data file into a data buffer by record number.

The data buffer is typically a struct variable defined as the DBF record itself is defined. For example, if the DBF record has 2 fields, LNAME and FNAME, then variable would be struct'ed as:

```
struct rectype {
    char tag;          /* The Xbase DBF delete flag (must be included) */
    char lastname[25]; /* same field length
as the .DBF LNAME field */
    char firstname[25]; /* same field length
as the .DBF FNAME field */
}; /* 51 */
struct rectype recbuff;
```

This method of accessing the data file does not use any indexing. Therefore, it typically is not used except for special purposes. The preferred method to access the data is by one of the keyed Get() routines.

**See:** GetEqualXB

## AddRecordXB

**Pack:** AccessPack

**Src:** AddRecordXBsrc

**Func:** 32/Mid-level

Append the record in the data buffer to the end of the DBF file.

This method of adding a record does not involve any indexing. It is typically used to build a data file en masse and do the indexing after the entire .DBF file(s) has been built.
--

If you have several thousand data records to be added at once, this method of building the DBF first and then using the ReindexXB routine is often faster than using the InsertXB routine for each record to add.

The AddRecordXB is very fast. 400 recs/sec on an AT machine is typical. Over 2000 recs/sec can be added on a fast 486 machine--that's 120,000 records added per minute.

The record number used is determined by BULLET and it is returned in AP.RecNo.

**See:** UpdateRecordXB

## UpdateRecordXB

**Pack:** AccessPack

**Src:** UpdateRecordXBsrc

**Func:** 33/Mid-level

Write the updated data record to the the physical record number.

This method of writing the updated record must not be used if any field(s) in the record is used as a key field(s) and has been changed.

This method of updating a record is very fast if you know that that update is not going to alter any field used as a key in any index file that uses it. You must, of course, first get the data record into the record buffer. Then you can change it and write the update out to disk with this routine.

If you need to change a field(s) that is used as a key field or part of one, use the UpdateXB routine. UpdateXB not only dynamically updates all related index files if you change a key field, it also will undo any and all changes if an error occurs in the transaction.

**See:** GetRecordXB, UpdateXB



## DeleteRecordXB

**Pack:** AccessPack

**Src:** DeleteRecordXBsrc

**Func:** 34/Mid-level

Tag the record at the physical record number as being deleted.

This does not tag any in-memory copies of the record so be sure to mark any such copies as being deleted yourself.
--

The first byte of every .DBF record is reserved for the delete tag. This tag is a space (ASCII 32) if the record is normal, or a \* (ASCII 42) if it's marked as being deleted. This delete tag is a reserved field in the DBF record and as such is not defined as a formal field with a descriptor, etc. Make sure that you define your in-memory buffers to reserve the first byte for the delete tag.

The Xbase DBF standard doesn't physically remove records marked as deleted from the data file. It doesn't mark them as available/reusable either. To physically remove records marked as deleted use PackRecordsXB.

Records can be temporarily marked as deleted then recalled to normal status. The Key/Get routines (GetFirstXB, etc.) return the record number needed for this routine after each access in AP.RecNo.

See: UndeleteRecordXB

## UndeleteRecordXB

**Pack:** AccessPack

**Src:** UndeleteRecordsrc

**Func:** 35/Mid-level

Tag the record at the physical record number as being normal (not deleted).

This does not tag any in-memory copies of the record so be sure to mark any such copies as being normal yourself.
---

The first byte of every .DBF record is reserved for the delete tag. This tag is a space (ASCII 32) if the record is normal, or a \* (ASCII 42) if it's marked as being deleted. This delete tag is a reserved field in the DBF record and as such is not defined as a formal field with a descriptor, etc. Make sure that you define your in-memory buffers to reserve the first byte for the delete tag.

The Xbase DBF standard does not physically remove records marked as deleted from the data file so you can "recall" them back to normal status as easily as you marked them deleted.

**See:** DeleteRecordXB

## PackRecordsXB

**Pack:** AccessPack

**Src:** PackRecordsXBsrc

**Func:** 36/Mid-level

Rebuild the open DBF file by physically removing all records marked as deleted.

Packing occurs in place using the existing file. It's recommended that you use BackupFileXB to copy the current DBF file before using this routine in case of a failure during the pack process.

The newly packed file is truncated to reflect the current, actual size.

If there are index files for this .DBF file, they MUST all be reindexed after the pack process by using ReindexXB.

This routine dynamically allocates at least as many bytes as the length of the record. More if available.

**See:** DeleteRecordXB

## FirstKeyXB

**Pack:** AccessPack

**Src:** FirstKeyXBsrc

**Func:** 40/Mid-level

Retrieve the first key in index order from the index file.

This routine does not access the .DBF file and so does not retrieve the data record. What it does do is locate the first key of the index, returning it, and also returning the record number within the .DBF that the key indexes.

To retrieve the data record you can use the GetRecordXB routine. The preferred method, however, is to use the GetFirstXB.

The key returned includes an enumerator if a non-unique index file is involved.

The enumerator is a little-endian 16-bit value that serves to differentiate up to 65535 "identical", non-unique keys. It is attached to all keys of non-unique index files and occupies the last two bytes of the key.

This routine is typically used to position the index file to the first key so as to allow forward in-order access to the keys by using NextKeyXB.

**See:** LastKeyXB

## EqualKeyXB

**Pack:** AccessPack

**Src:** EqualKeyXBsrc

**Func:** 41/Mid-level

Search for the exact key in the index file.

This routine does not access the .DBF file and so does not retrieve the data record. What it does do is search for the key in the index, and if found, returns the record number within the .DBF that the key indexes. The key must be an exact match, including enumerator word if a non-unique index file.

To retrieve the data record you can use the GetRecordXB routine. The preferred method, however, is to use the GetEqualXB.

This routine will only find EXACT matches to the specified key (including the enumerator if applicable). However, even if the exact key is not found in the index file, the index file is positioned so that the next NextKeyXB retrieves the key that would have followed the unmatched specified key. For example, if the key to match was "KINGS" (a partial key in this case), EqualKeyXB would return a key not found error. If you were to now do a NextKeyXB, the next key would be returned, let's say it is "KINGSTON".

## NextKeyXB

**Pack:** AccessPack

**Src:** NextKeyXBsrc

**Func:** 42/Mid-level

Retrieve the next key in index order from the index file.

This routine does not access the .DBF file and so does not retrieve the data record. What it does do is retrieve the next key of the index, returning it, and also returning the record number within the .DBF that the key indexes.
--

To retrieve the data record you can use the GetRecordXB routine. The preferred method, however, is to use the GetNextXB.

The key returned includes an enumerator if a non-unique index file is involved.

This routine is typically called after the index file has first been positioned to a known key using either FirstKeyXB or EqualKeyXB, or after a previous NextKeyXB or even PrevKeyXB. What it basically does is get the key following the current key, and then make that key the new current key.

## PrevKeyXB

**Pack:** AccessPack

**Src:** PrevKeyXBsrc

**Func:** 43/Mid-level

Retrieve the previous key in index order from the index file.

This routine does not access the .DBF file and so does not retrieve the data record. What it does do is retrieve the previous key of the index, returning it and also returning the record number within the .DBF that the key indexes.

To retrieve the data record you can use the GetRecordXB routine. The preferred method, however, is to use the GetPrevXB.

The key returned includes an enumerator if a non-unique index file is involved.

This routine is typically called after the index file has first been positioned to a known key using either LastKeyXB or EqualKeyXB, or after a previous PrevKeyXB or even NextKeyXB. What it basically does is to get the key previous the current key, and then make that key the new current key.

## LastKeyXB

**Pack:** AccessPack

**Src:** LastKeyXBsrc

**Func:** 44/Mid-level

Retrieve the last key in index order from the index file.

This routine does not access the .DBF file and so does not retrieve the data record. What it does do is locate the last key of the index, returning it, and also returning the record number within the .DBF that the key indexes.
--

To retrieve the data record you can use the GetRecordXB routine. The preferred method, however, is to use the GetLastXB.

This routine is typically used to position the index file to the last key so as to allow reverse in-order access to the keys by using PrevKeyXB.



## StoreKeyXB

**Pack:** AccessPack

**Src:** StoreKeyXBsrc

**Func:** 45/Mid-level

Insert the key into the index file in proper key order.

This routine does not add the data record to the .DBF file. It only inserts the key and record number into the index file. Use <u>InsertXB</u> instead.
---

To do a complete data record and key insert, you could use AddRecordXB to add the data record to the .DBF, BuildKeyXB to construct the key, then StoreKeyXB to insert the key and record number information into the index file. If that key already exists and the file allows duplicate keys, you need to attach the proper enumerator word and retry StoreKeyXB.

This is much too much to do. Instead, just use InsertXB. All these details including adding the data record and multi-key inserts are performed automatically with just the single call.

## DeleteKeyXB

**Pack:** AccessPack

**Src:** DeleteKeyXBsrc

**Func:** 46/Mid-level

Physically remove the specified key from the index file.

This routine requires an EXACT key match for all bytes of the key, including the enumerator word if a non-unique index file is involved.
--

This routine would seldom be used, typically, since deleted dBASE data records are only physically deleted during a PackRecordsXB and the index file is rebuilt afterward using ReindexXB.

**See:** CurrentKeyXB

## BuildKeyXB

**Pack:** [AccessPack](#)

**Src:** [BuildKeyXBsrc](#)

**Func:** 47/Mid-level

Build the key for the specified data record based on the key expression for the index file. If the index file is non-unique, a 0-value enumerator is attached.

The enumerator is a little-endian 16-bit value that serves to differentiate up to 65535 "identical", non-unique keys. It is attached to all keys of non-unique index files and occupies the last two bytes of the key.
--

This routine, like most of the mid-level routines, typically would not be used since the high-level access routines take care of this detail automatically.

**See:** [StoreKeyXB](#)

## CurrentKeyXB

**Pack:** AccessPack

**Src:** CurrentKeyXBsrc

**Func:** 48/Mid-level

Retrieve the current key value for the specified key file handle and also the data record number that it indexes.

This routine is useful in that it retrieves on demand the actual key value of the last accessed key in the index file (and the data record number). Most often you don't need this information so it would be a waste of time and space for your program to explicitly track each current key for each index file that you have open.

**See:** ReindexXB, DeleteKeyXB

## GetFirstXB

**Pack:** AccessPack

**Src:** GetFirstXBsrc

**Func:** 60/High-level

Retrieve the first indexed key and data record.

The key returned includes an enumerator if a non-unique index file is involved.

This routine is typically used to process a database in index order starting at the first ordered key (and its data record). After processing this first entry, subsequent in-order access of the database is achieved by using GetNextXB until the end of the database is reached.

This routine, like all the high-level Get routines, fills in the AP.RecNo of the record accessed. In GetFirstXB's case, it fills AP.RecNo with the record number pointed to by the first key. Since this is so, the AP pack is primed for an UpdateXB after each high-level Get. Other methods to get the record number are to use CurrentKeyXB or any of the Key routines (FirstKeyXB, etc.).

**See:** GetEqualXB, GetLastXB

## GetEqualXB

**Pack:** AccessPack

**Src:** GetEqualXBsrc

**Func:** 61/High-level

Search for the exact key in the index file and return its data record.

This routine will only find EXACT matches to the specified key (including the enumerator if applicable). However, even if the exact key is not found in the index file, the index file is positioned so that the next GetNextXB retrieves the key that would have followed the unmatched specified key. For example, if the key to match was "KINGS" (a partial key in this case), GetEqualXB would return a key not found error. If you were to now do a GetNextXB, the next key and data record would be returned, let's say the key is "KINGSTON" and its data record is the data record for that key. Another GetNextXB would retrieve the key and record after that. (GetPrevXB can be used in this fashion too.)

This routine, like all the high-level Get routines, fills in the AP.RecNo of the record accessed. In GetEqualXB's case, it fills AP.RecNo with the record number pointed to by the matched key. Since this is so, the AP pack is primed for an UpdateXB after each high-level Get. Other methods to get the record number are to use CurrentKeyXB or any of the Key routines (EqualKeyXB, etc.).

## GetNextXB

**Pack:** AccessPack

**Src:** GetNextXBsrc

**Func:** 62/High-level

Retrieve the next indexed key and its data record.

The key returned includes an enumerator if a non-unique index file is involved.

This routine is typically called after the index file has first been positioned to a known key using either GetFirstXB or GetEqualXB, or after a previous GetNextXB or even GetPrevXB. What it basically does is get the key and data record following the current key, and then make that key the new current key.

This routine, like all the high-level Get routines, fills in the AP.RecNo of the record accessed. In GetNextXB's case, it fills AP.RecNo with the record number pointed to by the next key. Since this is so, the AP pack is primed for an UpdateXB after each high-level Get. Other methods to get the record number are to use CurrentKeyXB or any of the Key routines (NextKeyXB, etc.).

## GetPrevXB

**Pack:** AccessPack

**Src:** GetPrevXBsrc

**Func:** 63/High-level

Retrieve the previous indexed key and record.

The key returned includes an enumerator if a non-unique index file is involved.

This routine is typically called after the index file has first been positioned to a known key using either GetLastXB or GetEqualXB, or after a previous GetPrevXB or even GetNextXB. What it basically does is to get the key and data record previous the current key, and then make that key the new current key.

This routine, like all the high-level Get routines, fills in the AP.RecNo of the record accessed. In GetPrevXB's case, it fills AP.RecNo with the record number pointed to by the previous key. Since this is so, the AP pack is primed for an UpdateXB after each high-level Get. Other methods to get the record number are to use CurrentKeyXB or any of the Key routines (PrevKeyXB, etc.).



## GetLastXB

**Pack:** AccessPack

**Src:** GetLastXBsrc

**Func:** 64/High-level

Retrieve the last indexed key and record.

This routine is typically used to process a database in reverse index order starting at the last ordered key (and its data record). After processing this last entry, subsequent reverse-order access of the database is achieved by using GetPrevXB until the top of the database is reached.

This routine, like all the high-level Get routines, fills in the AP.RecNo of the record accessed. In GetLastXB's case, it fills AP.RecNo with the record number pointed to by the last key. Since this is so, the AP pack is primed for an UpdateXB after each high-level Get. Other methods to get the record number are to use CurrentKeyXB or any of the Key routines (LastKeyXB, etc.).

**See:** GetEqualXB, GetFirstXB

## InsertXB

**Pack:** AccessPack

**Src:** InsertXBsrc

**Func:** 65/High-level

Add the data record to data file and insert the related key(s) into the linked index file(s).

This routine is used to add new entries into a database, one at a time. The data record is first added to the data file, then for each related index file, a key is inserted into the appropriate index file. Up to 32 index files can be automatically maintained for each data file.

This and several other routines are transaction-based. If a failure occurs prior to the routine's completion, all changes made to the database by the routine will be backed-out and the database (data and related index file(s)) effectively restored to its original state.

If the routine failed to complete, the function return value is the number of the pack that caused the failure. The pack's Stat is checked to determine the error code. If the function return value is 0, YOU MUST STILL check the first pack's Stat. If it's non-zero, then the failure occurred with the data record.
--

**See:** UpdateXB, StoreKeyXB

## UpdateXB

**Pack:** AccessPack

**Src:** UpdateXBsrc

**Func:** 66/High-level

Modify an existing data record (identified by record number) and automatically perform any index file updates needed to keep the index file(s) in sync.

If any key fields changed between the original record and the new one, this routine updates the appropriate index file(s) by replacing the original key(s) with new the key(s) based on the updated data record. Up to 32 index files can be automatically maintained for each data file. Get routines (GetFirstXB, etc.) set the AP.RecNo of the record that UpdateXB uses.

This and several other routines are transaction-based. If a failure occurs prior to the routine's completion, all changes made to the database by the routine will be backed-out and the database (data and related index file(s)) effectively restored to its original state.

If the routine failed to complete, the function return value is the number of the pack that caused the failure. The pack's Stat is checked to determine the error code. If the function return value is 0, YOU MUST STILL check the first pack's Stat. If it's non-zero, then the failure occurred with the data record.
--

**See:** UpdateRecordXB

## ReindexXB

**Pack:** AccessPack

**Src:** ReindexXBsrc

**Func:** 67/High-level

Reindex all related index files for a data file.

The index file(s) must already exist and be open. Any existing key data is overwritten by the new key data. In other words, if you have a 10MB index file, ReindexXB uses the same file space building the new keys over the old. This results in a less fragmented disk and also minimizes disk space needed. You can also create a new, empty index file and reindex to that. This would be useful, for instance, if you needed to create a temporary index file-- something that you'd use for a report, say, then delete after the report.

This routine creates a TEMPORARY work file in either the current directory or, if the DOS environment variable TMP is defined, in the TMP= directory. The size of this file is approx. bytes = (RECORDS \* (KEYLEN+6)). ReindexXB can operate in as little as 32K of available memory and can use up to 128K. The resultant index file(s) are optimized for minimum size AND maximum retrieval speed.

If the routine failed to complete, the function return value is the number of the pack that caused the failure. The pack's Stat is checked to determine the error code. A return value of zero indicates no error occurred.

**See:** PackRecordsXB

## LockXB

**Pack:** AccessPack

**Src:** LockXBsrc

**Func:** 80/Network

Lock all bytes in the index file handle(s) for exclusive use by the current process and reload the index file header(s) from disk. Also lock all bytes in the related data file and reload the data file header from disk.

The files must have been opened with the appropriate share attribute and not in compatibility mode. SHARE.EXE MUST be installed or DOS error 1 is issued.
---

This routine is transaction-based and will lock all index files specified in AccessPack and the data file. If any lock fails, all previous locks by this routine are released. The return value indicates which access pack failed, if any. This value is used as the index into the AccessPack group for you to identify the error code. See LockXBsrc for determining this exactly.

Use the DriveRemoteXB and/or FileRemoteXB to determine if locking is necessary. If the files are on a remote drive then it is best to use locking. Locking may also be necessary on multitasking local machines accessing shared files.

This routine is a combination of LockKeyXB and LockDataXB.

## UnlockXB

**Pack:** AccessPack

**Src:** UnlockXBsrc

**Func:** 81/Network

Unlock all bytes in the specified file handle(s) (previously locked) and flush the file header(s) to disk (flush done before lock(s) released). Also unlock all bytes in the related data file and flush the data file header to disk.

The files must have been opened with the appropriate share attribute and not in compatibility mode. SHARE.EXE MUST be installed or DOS error 1 is issued.
---

This routine is transaction-based and will unlock all index files specified in AccessPack and the data file. If an unlock fails the routine exits with a return value indicating which access pack failed. This value is used as the index into the AccessPack group for you to identify the error code. Note that this routine does not attempt to re-lock those files unlocked successfully if an error occurs in the transaction. If an error does occur (unlikely) you will need to provide for unlocking the remaining files manually with the UnlockKeyXB and UnlockDataXB routines. You should not rely on the operating system to automatically unlock files when they're closed.

This routine is a combination of UnlockKeyXB and UnlockDataXB.

## LockKeyXB

**Pack:** AccessPack

**Src:** LockKeyXBsrc

**Func:** 82/Network

Lock all bytes in the index file handle(s) for exclusive use by the current process and reload the index file header(s) from disk.

The files must have been opened with the appropriate share attribute and not in compatibility mode. SHARE.EXE MUST be installed or DOS error 1 is issued.
---

This routine is transaction-based and will lock all index files specified in AccessPack. If any lock fails, all previous locks by this routine are released. The return value indicates which access pack failed, if any. This value is used as the index into the AccessPack group for you to identify the error code.

The advantage of using region locks (LockKeyXB locks the entire file region) to control file access is that the file does not need to be opened/closed using the Deny Read/Write sharing attribute. Opening the file for Deny None, and controlling subsequent access with region locks, allows for faster processing since files do not need to be constantly opened and closed, as they would if access were controlled by opening with Deny Read/Write.

**See:** UnlockKeyXB, LockXB

## UnlockKeyXB

**Pack:** AccessPack

**Src:** UnlockKeyXBsrc

**Func:** 83/Network

Unlock all bytes in the specified file handle(s) (previously locked) and flush the file header(s) to disk (flush done before lock(s) released).

The files must have been opened with the appropriate share attribute and not in compatibility mode. SHARE.EXE MUST be installed or DOS error 1 is issued.
---

This routine is transaction-based and will unlock all index files specified in AccessPack. If an unlock fails the routine exits with a return value indicating which access pack failed. This value is used as the index into the AccessPack group for you to identify the error code.

All file locks should be released when exclusive access is no longer needed.
--

It is not recommended that you end your program without having released active file locks. This is especially a valid concern for DOS versions prior to 5.0. DOS 5 releases locks on files that are closed.

**See:** LockKeyXB, LockDataXB, UnlockXB



## LockDataXB

**Pack:** AccessPack

**Src:** LockDataXBsrc

**Func:** 84/Network

Lock all bytes in the file handle's data file for exclusive use by the current process and reload the data file header from disk. You must set AP.RecNo=0 to do this. To lock a single record, set AP.RecNo=record# to lock.

The files must have been opened with the appropriate share attribute and not in compatibility mode. SHARE.EXE MUST be installed or DOS error 1 is issued.
---

This routine locks the specified data file. If the handle specified is that of an index file, that index file's related data file handle is used. For single-record locks, AP.Handle must have a data file handle specified. Header loading is not performed if locking a single record.

The advantage of using region locks (LockDataXB locks the entire file region) to control file access is that the file does not need to be opened/closed using the Deny Read/Write sharing attribute. Opening the file for Deny None, and controlling subsequent access with region locks, allows for faster processing since files do not need to be constantly opened and closed, as they would if access were controlled by opening with Deny Read/Write.

**See:** UnlockDataXB, LockKeyXB, LockXB

## UnlockDataXB

**Pack:** AccessPack

**Src:** UnlockDataXBsrc

**Func:** 85/Network

Unlock all bytes in the specified file handle (previously locked) and flush the data file header to disk (flush done before lock released). To do this you must set AP.RecNo=0. To unlock a single record, set AP.RecNo=record# to unlock.

The files must have been opened with the appropriate share attribute and not in compatibility mode. SHARE.EXE MUST be installed or DOS error 1 is issued.
---

This routine unlocks the specified data file. If the handle specified is that of an index file that index file's related datafile handle is used. For single-record unlocks, AP.Handle must have a data file handle specified. Flushing is not performed if unlocking a single record.

All file locks should be released when exclusive access is no longer needed.
--

It is not recommended that you end your program without having released active file locks. This is especially a valid concern for DOS versions prior to 5.0. DOS 5 releases locks on files that are closed.

**See:** LockDataXB, UnlockXB

## DriveRemoteXB

**Pack:** RemotePack      **Src:** DriveRemoteXBsrc      **Func:** 86/Network

Determine if specified drive is remote (default drive=0, A:=1, B=2, C=3...).

This routine uses INT21/44/sub function 09.

In addition to returning the IsRemote state, this routine sends back the result of the DX register and also the install state of SHARE.EXE.

The meaning of the bitflags in Flags are (where IsRemote=0):

<b>Bit</b>	<b>Meaning drive...</b>
1	1=uses 32-bit sectoring
6	1=accepts Generic IOCTL (for INT21/44/0D,0E,0Fh)
7	1=accepts Query IOCTL Device (INT21/44/11h)
9	1=is local but shared by other computers in the network
11	1=accepts Does-Device-Use-Removable-Media (INT21/44/08)
13	1=requires media descriptor in FAT
14	1=accepts Receive/Send Control Data from Block Device (INT21/44/04,05)
15	1=is Substitution drive (set by the DOS SUBST command) (all other bits=0)

**See:** FileRemoteXB, LockXB

## FileRemoteXB

**Pack:** RemotePack

**Src:** FileRemoteXBsrc

**Func:** 87/Network

Determine if specified handle of file or device is remote.

This routine uses INT21/44/sub function 0Ah.

In addition to returning the IsRemote state, this routine sends back the result of the DX register and also the install state of SHARE.EXE.

Flags bit 7=1 then handle is device, =0 then handle is file.

Bit	Meaning DEVICE...
0	1=is console input device
1	1=is console output device
2	1=is null device
3	1=is clock device
4	1=is special device
5	1=is in binary mode, 0=in ASCII
6	0=returns EOF if device is read
11	1=is network spooler
12	1=is NoInherit

**Bit**      **Meaning DEVICE...(cont)**

13	1=is named pipe
15	1=is remote, 0=is local (all other bits=0)

**Bit**      **Meaning FILE...**

0-5	xxxxxx=drive number (0=A...)
6	1=has not been written to
12	1=is NoInherit
14	1=date/time not set at close
15	1=is remote, 0=is local (all other bits=0)

**See:** DriveRemoteXB, LockXB

## SetRetriesXB

**Pack:** SetRetriesPack

**Src:** SetRetriesXBsrc

**Func:** 88/Network

Set the number of times DOS retries disk operations after a failure due to file-sharing operations (locked file regions from LockXB routines).

This routine uses INT21/44/sub function 0Bh.

By default DOS retries an operation 3 times (without pausing between attempts) before returning an error to the application.

If you change the default values it's recommended that the default state be restored before your application ends (Retries=3, Pause=1).
---

These values are pretty much determined by trial-and-error. You may find that adding a delay between retries returns fewer access-denied errors.

**See:** LockXB

## DeleteFileDOS

**Pack:** DOSFilePack

**Src:** DeleteFileDOSsrc

**Func:** 00/DOS

Delete the specified file.

This routine uses DOS INT21/41 (interrupt 21h function 41h).

## RenameFileDOS

**Pack:** DOSFilePack

**Src:** RenameFileDOSsrc

**Func:** 101/DOS

Rename a file. May also be used to move the file to a new directory within the partition.

This routine uses DOS INT21/56.

If the specified directory differs from the file's directory, the file's directory entry is moved to the new directory.
---

For example, if the FilenamePtr filename is C:\LP100\PROJ94A.INF and the NewFilenamePtr filename is C:\ARCH\PROJ93A.INA, the file is essentially renamed and also moved to the \ARCH directory.

## CreateFileDOS

**Pack:** DOSFilePack

**Src:** CreateFileDOSsrc

**Func:** 102/DOS

Create a new file.

This routine uses INT21/3C.

The specified filename/pathname must NOT already exist.

The file created is not left open. You must OpenFileDOS to use it.

The attribute used during the create can be:

<b>Attribute</b>	<b>Value</b>	<b>Meaning</b>
Normal	0	normal access permitted to file
Read-Only	1	read-only access permitted to file
Hidden	2	file does not appear in directory listing
System	4	file is a system file
Volume	8	FILENAME used as volume label if no current label
Archive	20h	file is marked for archiving

**See:** OpenFileDOS



## AccessFileDOS

**Pack:** DOSFilePack

**Src:** AccessFileDOSsrc

**Func:** 103/DOS

Determine if the specified file can be accessed with the specified access/sharing mode.

This routine uses INT21/3D and INT21/3E.

Basically, a Does-File-Exist routine. It uses the specified access/sharing attributes when trying to open the file. For example, if you specify DFP.Attr = &H42 (R/W access + Deny None sharing) and use AccessFileDOS on a Read-Only DOS file, the return value would be DOS error 5, Access Denied.

## OpenFileDOS

**Pack:** DOSFilePack

**Src:** OpenFileDOSsrc

**Func:** 104/DOS

Open the specified file with the specified access/sharing mode.

This routine uses INT21/3D.

<b>Access</b>	<b>Value</b>	<b>Meaning</b>
Read-only	0	open for read-only access
Write-only	1	open for write-only access
Read/Write	2	open for read/write access
<b>Share</b>		
Compatibility	0	any process may share file (not recommended)
Deny Read/Write	10h	no other process may share file
Deny Write	20h	no other process may share file for write
Deny Read	30h	no other process may share file for read
Deny None	40h	any process may share file except in Compatibility mode
<b>Inherit</b>		
NonInheritFlag	80h	if set child processes do not inherit file handles (child process cannot inherit handle > 20)

The file access mode is a combination of ACCESS + SHARE + INHERIT.

**See:** OpenPack, CloseFileDOS

## SeekFileDOS

**Pack:** DOSFilePack

**Src:** SeekFileDOSsrc

**Func:** 105/DOS

Position the DOS file pointer of the specified file to the specified position.

This routine uses INT21/42.

The position is a 32-bit value and is relative to either the start of the file, the current file pointer position, or the end of the file.

<b>Method</b>	<b>Meaning</b>
0	start move from the start of file (offset is a 32-bit unsigned value)
1	start move at the current position (offset a signed value)
2	start move at the end of file (offset a signed value)

For example, to move to the 511th byte of a file (byte 0 being the first), set the offset value to 511 and use Method 0. On return, the absolute offset value of the new position is returned. This is useful with Method 2 since you can specify an offset of 0 and have the file length returned.

Never position the file pointer to before the start of file.
--

## ReadFileDOS

**Pack:** [DOSFilePack](#) **Src:** [ReadFileDOSsrc](#) **Func:** 106/DOS

Read from the file or device the specified number of bytes into a buffer.

This routine uses INT21/3F.

On block devices (such as disks) input starts at the current file position and the file pointer is repositioned to the last byte read +1.

<p>It is possible to read less than the bytes specified without an error being generated. Compare the bytes to read with the returned bytes read value. If less then end of file was reached during the read, if 0 then file was at EOF.</p>
--

By using DOS's predefined handles you can read from the keyboard (STDIN) by using the STDIN handle, 0. The input will terminate after all specified bytes have been read or after a CR (ASCII 0Dh). If more bytes are entered than were requested, the next read will retrieve those excess bytes. Therefore, it's suggested that you specify 129 bytes to input (DOS will process 127+CR/LF bytes maximum when reading the STDIN device). Post-process the entered data by scanning for the CR/LF.

**See:** [WriteFileDOS](#)

## ExpandFileDOS

**Pack:** DOSFilePack

**Src:** ExpandFileDOSsrc

**Func:** 107/DOS

Expands the specified file by the specified number of bytes.

This routine uses INT21/42 and INT21/40.

This routine is useful in pre-allocating disk space. By reserving disk space in advance you can guarantee that enough disk space will be available for a future operation (especially if more than 1 process is running). You'll also be able ensure that the disk space that a file does use is as contiguous as possible.

Database systems are dynamic and their files typically allocate new space on an as-needed basis. This dynamic allocation can cause parts of a file to be located throughout the disk system, possibly affecting performance drastically. By pre-allocating the disk space you can be assured of consistent throughput performance since the file is contiguous.

## WriteFileDOS

**Pack:** DOSFilePack

**Src:** WriteFileDOSsrc

**Func:** 108/DOS

Write to the file or device the specified number of bytes from a buffer.

This routine uses INT21/40.

If the number of bytes written is less than the specified bytes, this routine returns a -2 error code (or 65554 unsigned).
--

On block devices (such as disk) output starts at the current file position, and the file pointer is repositioned to the last byte written +1.

If the specified bytes to write is 0, the file is truncated at the current file pointer position.
---

By using DOS's predefined handles you can write to the screen (STDOUT) by using the STDOUT handle, 1.

**See:** ReadFileDOS

## CloseFileDOS

**Pack:** DOSFilePack

**Src:** CloseFileDOSsrc

**Func:** 109/DOS

Close the file flushing any internal buffers, releasing any locked regions, and update the directory entry to the correct size, date, and time.

This routine uses INT21/3E.

If you have opened a file using the DOS open routine you should close it when you no longer need it.

<p>This routine can be used to close the predefined DOS handles (0-4) and make those handles available for reuse. Typically handles 0 and 1 should not be closed by an application since they are the STDIN and STDOUT that DOS uses for the current application (keyboard and screen).</p>
---

Since BULLET provides for up to 250 user file handles for your applications it isn't necessary for you to seek 3 more file handles by closing handles 2-4.

**See:** OpenFileDOS

## MakeDirDOS

**Pack:** DOSFilePack

**Src:** MakeDirDOSsrc

**Func:** 110/DOS

Create a new subdirectory.

This routine uses INT21/39.



## AccessPack

**Src:** InsertXBsrc

**Func:** InsertXB and many more

```
struct accesspack {
    unsigned    func;          /* varies */
    unsigned    stat;         /* ret:completion status */
    unsigned    handle;       /* OS handle */
    long        recno;        /* in:rec# to get/delete/update if applicable */
                                /* in:single rec# to lock or 0=lock all */
                                /* ret:record number of data record */
    void far    *recptr;      /* far pointer to record storage buffer */
    void far    *keyptr;      /* far pointer to search key buffer */
    void far    *nextptr;     /* far pointer to next key access pack */
                                /* or 0:0 if end of link or if N/A */
};
```

The NextPtr variables are only used by InsertXB, UpdateXB, ReindexXB, and the LockXB routines. NextPtr is used as a link to the next related access pack, if any. Not all entries are used by all routines. Generally, any routine that gets/puts user data to the database uses this pack.

## BreakPack

**Src:** BreakXSrc

**Func:** BreakXB

```
struct breakpack {  
    unsigned func;          /* 4 */  
    unsigned stat;         /* ret:completion status */  
    unsigned mode;        /* =0 disable Ctrl-C/Ctrl-Brk, 1=restore */  
};
```

A simple pack.

## CopyPack

**Src:** BackupFileXBsrc

**Func:** BackupFileXB, CopyDHXB, CopyKHXB

```
struct copypack {
    unsigned    func;           /*5=BackupFileXB,16=CopyDHXB,26=CopyKHXB */
    unsigned    stat;          /* ret:completion status */
    unsigned    handle;        /* handle of BULLET file */
    char far    *filenameptr;  /* far pointer to filenameZ */
};
```

## CreateDataPack

**Src:** CreateDXBsrc

**Func:** CreateDXB

```
struct createdatapack {
    unsigned    func;           /* 10          */
    unsigned    stat;          /* ret:completion status */
    char far    *filenameptr;  /* far pointer to filenameZ to create */
    unsigned    nofields;      /* number of fields per record */
    void far    *fieldlistptr; /* far pointer to field list */
    unsigned    fileid;        /* file signature byte, usually=3 */
};
```

The FieldListPtr variables point to an array of struct fielddescType. This array is dimensioned for as many fields as there are in the record and contains the field descriptors, one for each field.

**See:** FieldDescType

## CreateKeyPack

**Src:** CreateKXBsrc

**Func:** CreateKXB

```
struct createkeypack {
    unsigned    func;           /* 20 */
    unsigned    stat;          /* ret:completion status */
    char far    *filenameptr;  /* far pointer to filenameZ */
    char far    *keyexptr;     /* far pointer to key expressionZ */
    unsigned    xblink;        /* BULLET XB data handle this file indexes */
    unsigned    keyflags;      /* bit 0=unique,1=char,4=int,5=lng,F=signed */
    int         codepageid;    /* codepage for NLS, -1 use system default */
    int         countrycode;   /* country code for NLS, -1 to use default */
    char far    *collateptr;   /* far ptr to prg-supplied collate table */
                                /* or 0:0 if using sys-determined NLS table */
};
```

Bit 14 in KeyFlags (0Eh) is set by BULLET during CreateKXB if a collate table is present.

**Note:** In the Windows version, if requested to use the system default collate table, BULLET makes a call to DPAPI (INT31) function2 in order to obtain a valid selector for the pointer returned by DOS.

**See:** What is NLS

## DescriptorPack

**Src:** [GetDescriptorXBsrc](#)    **Func:** [GetDescriptorXB](#)

```
struct descriptorpack {
    unsigned    func;           /* 30          */
    unsigned    stat;          /* ret:completion status */
    unsigned    handle;        /* data file handle to get info on */
    unsigned    fieldnumber;    /* field number to get info on; if 0... */
    struct fielddescstype    fd; /* ...search for DP.FD.FieldName */
};
```

GetDescriptorXB allows you to get the field descriptor info for a particular field number (as in the first field, or the 10th field, etc.) or, if you don't know the physical field number, the routine can also get the info for a field by field name.

To get the info for field number, say 5, set DP.FieldNumber = 5. The DP.FD structure element is filled in with field 5's information.

To get the info for a field by fieldname, say LASTNAME, set dp.fieldnumber=0 & strcpy(dp.fd.fieldname, "LASTNAME\0\0") - the fieldname must be zero-filled and zero-terminated.

**See:** [FieldDescType](#)

## DOSFilePack

**Src:** AccessFileDOSsrc

**Func:** AccessFileDOS  
(all routines ending with DOS)

```
struct dosfilepack {
    unsigned    func;          /* varies, see DeleteFileDOS for first */
    unsigned    stat;         /* ret:completion status */
    char far    *filenameptr; /* far pointer to filenameZ */
    unsigned    handle;      /* in: handle to access */
                                /* ret: handle opened */
    unsigned    asmode;      /* open access/sharing mode */
    unsigned    bytes;       /* in: bytes to read  ret: bytes read */
    long        seekoffset;  /* seek to file position */
    unsigned    method;     /* seek method */
    void far    *bufferptr;  /* far pointer to read/write buffer */
    unsigned    attr;       /* file create directory entry attribute */
    char far    *newnameptr; /* pointer to new filenameZ for rename */
};
```

All of the xDOS routines use this pack. Often only a few of the structure member elements are used by any one of the routines. Set only those needed.

## DVmonPack

**Src:** DVmonCXBsrc

**Func:** DVmonCXB

```
struct dvmonpack { /* AVAILABLE ONLY IN THE DEBUG ENGINE */
    unsigned func; /* 9 */
    unsigned stat; /* ret:completion status */
    unsigned mode; /* =0 disable monitoring, =1 enable */
    unsigned handle; /* file handle to monitor */
    unsigned vs; /* segment for screen image (eg, 0xB800) */
};
```

This routine is supplied only in the BULLET debug engine. It displays real-time monitoring information of a .DBF file or index and .DBF file pair including searches, seeks, hits, current record number, current key, key node contents, key node pointers, stack state, key and record counts, and other info.



## ExitPack

**Src:** InitXBsrc

**Func:** ExitXB, AtExitXB

```
struct exitpack {  
    unsigned func;          /* 1=ExitXB, 2=AtExitXB */  
    unsigned stat;         /* ret:completion status */  
};
```

## FieldDescType

**Src:** [CreateDXBsrc](#)

**Func:** [CreateDXB](#)

```
struct fielddescstype { /* used by CreateDataPack ONLY */
    char          fieldname[11]; /* 0-filled (use only ASCII 65-90,95) */
    char          fieldtype[1]; /* Char,Numeric,Date,Logical,Memo */
    unsigned long fieldda;      /* =0,reserved */
    unsigned char fieldlen;     /* C=1-254,N=1-19(varies),D=8,L=1,M=10 */
    unsigned char fielddc;     /* dec places for FieldType=N (0,2-15) */
    long          fieldrez;     /* =0,reserved */
    char          filler[10];   /* =0,reserved */
};
```

If you can can forgo dBASE compatibility you can use the B field type. This type is for fields that contain binary data (all dBASE fields contain ASCII text or numeric strings). If you specify a FieldType = "B" for, say an integer field, use a FieldLen = 2. If the field is a long integer, use FieldLen = 4. You can also use this non-standard field type for indexing. See [CreateKXB](#) for more.

**See:** [CreateDataPack](#)

## HandlePack

**Src:** CloseDXBsrc

**Func:** CloseDXB, ReadDHXB, FlushDHXB, ZapDHXB  
CloseKXB, ReadKHXB, FlushKHXB, ZapKHXB

```
struct handlepack {
    unsigned    func;          /* 12=CloseDXB,14=ReadDHXB,15=FlushDHXB */
                                /* 17=ZapDHXB, 22=CloseDXB,24=ReadKHXB */
                                /* 25=FlushKHXB,27=ZapKHXB */
    unsigned    stat;         /* ret:completion status */
    unsigned    handle;       /* handle of BULLET file */
};
```

## InitPack

**Src:** InitXBsrc

**Func:** InitXB

```
struct initpack {
    unsigned    func;           /* 0 */
    unsigned    stat;          /* ret:completion status */
    unsigned    jftmode;       /* expand JFT if non-zero */
    unsigned    dosver;        /* ret:DOS version */
    unsigned    version;       /* ret:BULLET version * 100 */
    unsigned    osversion;     /* ret:0=real mode DOS; 1=prot mode Windows */
    unsigned long exitptr;     /* ret:far pointer to ExitXB routine */
};
```

## MemoryPack

**Src:** MemoryXBsrc

**Func:** MemoryXB

```
struct memorypack {
    unsigned    func;           /* 3 */
    unsigned    stat;          /* ret:completion status */
    unsigned long memory;      /* ret:largest free OS memory block */
};
```

## OpenPack

**Src:** OpenDXBsrcCTX\_OPENDXB SRC  
OpenKXBCTX\_FN\_OPENKXB

**Func:** OpenDXBCTX\_FN\_OPENDXB,

```
struct openpack {
    unsigned    func;          /* 11=OpenDXB,21=OpenKXB          */
    unsigned    stat;         /* ret:completion status          */
    unsigned    handle;       /* ret:OS handle of file opened   */
    char far    *filenameptr; /* far pointer to filenameZ to open */
    unsigned    asmode;       /* sharing mode(see OpenFileDOS) */
    unsigned    xblink;       /* if opening index,related data file */
                                     /* (if opening data file, not used) */
};
```

**Note:** you must supply xbHandle on index file opens

## RemotePack

**Src:** DriveRemoteXBsrcCTX\_DRIVEREMOTESRC **Func:**  
DriveRemoteXBCTX\_FN\_DRIVEREMOTEXB, FileRemoteXBCTX\_FN\_FILEREMOTEXB

```
struct remotepack {
    unsigned func;          /* 86=DriveRemoteXB,87=FileRemoteXB */
    unsigned stat;         /* ret:completion status */
    unsigned handle;       /* handle/drive depending on routine */
    unsigned isremote;     /* ret:0=local,1=remote */
    unsigned flags;        /* ret:dx register returned by DOS */
    unsigned isshare;      /* ret:0=SHARE.EXE not loaded */
};
```

## SetRetriesPack

**Src:** SetRetriesXBsrc

**Func:** SetRetriesXB

```
struct setretriespack {
    unsigned    func;          /* 88          */
    unsigned    stat;         /* ret:completion status */
    unsigned    mode;         /* 0=set DOS default else Pauses */
                                /* Retries below          */
    unsigned    pause;        /* 0-65535 loops between retries */
    unsigned    retries;     /* 0-65535 retries to access file */
};
```

The default values for Retries is 3 and Pause is 1.

The Pause value is used as a simple loop counter used to waste time. This loop IS dependent on CPU power so values are not portable across different machines.

Do not use unrealistic values. For example, don't set Retries to 30,000 unless you really want to wait for DOS to try 30,000 times before returning an error!



## StatDataPack

**Src:** [StatDXBsrc](#)      **Func:** [StatDXB](#)

```
struct statdatapack {
    unsigned    func;           /* 13 */
    unsigned    stat;          /* ret:completion status */
    unsigned    handle;        /* BULLET data file to get status on */
    unsigned char filetype;    /* ret:1=BULLET XB data file */
    unsigned char dirty;       /* ret:0=not changed */
    unsigned long recs;        /* ret:records in file */
    unsigned    reclen;       /* ret:record length */
    unsigned    fields;       /* ret:fields per record () */
    char        f1;           /* reserved (1=update DVmon) */
    unsigned char luyear;      /* ret:binary, year file last updated */
    unsigned char lumonth;    /* ret:month */
                                /* LUs are 0 if DBF newly created */
    unsigned char luday;       /* ret:day */
    unsigned    hereseg;      /* ret:this file's control segment */
    char        filler[10];    /* reserved */
};
```

**See:** [StatKeyPack](#)

## StatKeyPack

**Src:** [StatKXBsrc](#)

**Func:** [StatKXB](#)

```
struct statkeypack {
    unsigned    func;           /* 23 */
    unsigned    stat;          /* ret:completion status */
    unsigned    handle;        /* BULLET key file to get status on */
    unsigned char filetype;    /* ret:0=BULLET XB key file */
    unsigned char dirty;       /* ret:0=not changed */
    unsigned long keys;        /* ret:keys in file */
    unsigned    keylen;        /* ret:key length */
    unsigned    xblink;        /* ret:related BULLET XB data handle */
    unsigned long xbrecono;    /* ret:recono attached to current key */
    unsigned    hereseg;       /* ret:this file's control segment */
    unsigned    codepageid;    /* ret:codepage of key file sort */
    unsigned    countrycode;   /* ret:countrycode of key file sort */
    unsigned    collatetablesiz; /* ret:size of collate table, 0 or 256 */
    unsigned    keyflags;      /* ret:bit 0=unique,1=char,4=int,
    char         filler[2];     /* 5=long,E=NLS,F=signed */
};
```

**See:** [StatDataPack](#)

## StatHandlePack

**Src:** StatHandleXBsrc

**Func:** StatHandleXB

```
struct stathandlepack {
    unsigned    func;           /* 6 */
    unsigned    stat;          /* ret:completion status */
    unsigned    handle;        /* file handle to get information on */
    unsigned    id;            /* ret:0=index,1=data,-1=not BULLET handle */
    char far    *filenameptr;  /* pointer to filename of handle */
};
```

## XErrorPack

**Src:** GetExtErrorXBsrc

**Func:** GetExtErrorXB

```
struct xerrorpack {
    unsigned    func;           /* 7 */
    unsigned    stat;          /* ret:extended error */
    unsigned    class;         /* ret:error class */
    unsigned    action;        /* ret:suggested action */
    unsigned    location;      /* ret:error location */
};
```

**See:** DOS errors

## BULLET errors

<b>200 key not found</b>	The search key for Equal was not matched exactly (including enumerator word attached to non-unique keys -- see docs). Next/Prev routines can be used to continue search from point of mismatch.
<b>201 key already exists</b>	Attempted to add a key that already exists in the index file created to allow only unique keys.
<b>202 end of file</b>	A Next routine is past the last key of the index file.
<b>203 top of file</b>	A Prev routine is before the first key of the index file.
<b>204 key file empty</b>	A key access was attempted with no keys in the index file.
<b>205 key type unknown</b>	Generally indicates a corrupt index header (key flags unknown at key insert).  reserved,206-207
<b>208 no more nodes</b>	The index file has reached full capacity (32MB). <u>ReindexXB</u> can often shrink an index file by 30 to 50%.
<b>209 key file corrupt</b>	The index file is corrupt (write attempt to node 0).
<b>210 key file corrupt</b>	The index file is corrupt (internal overflow).  reserved,211-219
<b>220 incorrect DOS version</b>	BULLET requires DOS 3.3 or later.
<b>221 invalid key length</b>	The key is > 62 bytes (or 64 if unique specified).
<b>222 file not open</b>	The specified handle is not an open BULLET file.  reserved,223
<b>224 invalid record number</b>	The specified record number is < 0, past the last record number in the .DBF, or is > 16,777,215.  reserved,225-227
<b>228 invalid file type</b>	The specified handle is not the correct type for the operation (i.e., specifying a data file handle for a key file operation).  reserved,229-232
<b>233 init not active</b>	<u>InitXB</u> must be called before all others except <u>MemoryXB</u> .
<b>234 init already active</b>	InitXB has already been called. Use <u>ExitXB</u> first to call InitXB more than once per process. (Make sure the xxP.Func <> 0.)
<b>235 too many indexes</b>	BULLET can handle up to 32 index files per transaction

record with the InsertXB and UpdateXB routines. Contact the author if you need to allow for more than 32 index files/transaction record.

- 236 null record pointer** The supplied pointer to the record buffer is null (e.g., AP.recptr = NULL;) and must not be for the operation to continue.
- 237 null key pointer** The supplied pointer to the key buffer is null (e.g., AP.keyptr = NULL;) and must not be for the operation to continue.  
reserved,238-239
- 240 invalid key expression** The CreateKXB key expression could not be evaluated.  
reserved,241
- 242 field not found** The fieldname was not found in the descriptor area.
- 243 invalid field count** Too many fields were specified or the specified field number is past the last field.  
reserved,244-249
- 250 invalid country info** The specified country code or code page ID is not valid or not installed (according to DOS).
- 251 invalid collate table size** The specified country code/code page ID uses a collate-sequence table > 256 bytes (2-byte characters as with Kanji).
- 252 invalid key flags** The specified keyflags are invalid.
- 253 enhanced mode required for operation** CreateKeyXB requires Windows enhanced mode unless a programmer-supplied collate table pointer is provided (and appropriate code page/country code values -- i.e., non-zero).  
reserved,254
- 255 evaluation mode shutdown** BULLET evaluation period has completed. You can reinstall to continue evaluation, though you may want to consider your motives for reinstalling since the original evaluation period has expired. This error occurs only after the evaluation period has expired. It is not recommended that you continue to use BULLET after the evaluation period. It is possible for no 255 error to be generated for quite some time since it occurs only under certain load conditions and then only when certain routine sequences are performed. The specified evaluation period of 21 days should be adhered to.

**See:** DOS errors

## DOS errors

- 3 unexpected end of file
- 2 disk full
- 1 bad filename
- 0 no error
- 1 function not supported
- 2 file not found
- 3 path not found
- 4 too many open files
- 5 access denied (see [Network specs](#))
- 6 handle invalid
- 7 MCBs destroyed
- 8 not enough memory
- 9 memory block address invalid
- 10 environment invalid
- 11 format invalid
- 12 access code invalid
- 13 data invalid
- reserved-0Eh
- 15 disk drive invalid
- 16 cannot remove current directory
- 17 not same device
- 18 no more files
- 19 disk write protected
- 20 unknown unit
- 21 drive not ready
- 22 unknown command
- 23 data error (CRC)
- 24 bad request structure length
- 25 seek error
- 26 unknown medium type
- 27 sector not found
- 28 printer out of paper
- 29 write fault
- 30 read fault
- 31 general failure
- 32 sharing violation
- 33 lock violation
- 34 disk change invalid/wrong disk
- 35 FCB unavailable
- 36 sharing buffer overflow
- 37 code page mismatched
- 38 handle EOF
- 39 handle disk full
- reserved-28h
- reserved-29h
- reserved-2Ah
- reserved-2Bh
- reserved-2Ch
- reserved-2Dh
- reserved-2Eh
- reserved-2Fh
- reserved-30h
- reserved-31h

50 network request not supported  
 51 remote computer not listening  
 52 duplicate name on network  
 53 network pathname not found  
 54 network busy  
 55 network device no longer exists  
 56 NETBIOS command limit exceeded  
 57 network adapter hardware error  
 58 incorrect response from network  
 59 unexpected network error  
 60 incompatible remote adapter  
 61 print queue full  
 62 no spool space  
 63 not enough space to print file  
 64 network name deleted  
 65 network access denied  
 66 network device type incorrect  
 67 network name not found  
 68 network name limit exceeded  
 69 NETBIOS session limit exceeded  
 70 sharing temporarily paused  
 71 network request not accepted  
 72 print/disk redirection paused  
 reserved-49h  
 reserved-4Ah  
 reserved-4Bh  
 reserved-4Ch  
 reserved-4Dh  
 reserved-4Eh  
 reserved-4Fh  
 80 file exists  
 81 duplicate FCB  
 82 cannot make  
 83 fail on INT24  
 84 out of structures  
 85 already assigned  
 86 invalid password  
 87 invalid parameter  
 88 network write fault  
 reserved-59h  
 90 sys comp not loaded

### DOS Class Codes

1	out of resources	7	application error
2	temporary situation	8	not found
3	authorization	9	bad format
4	internal error	10	locked
5	hardware failure	11	media failure
6	system failure	12	already exists
		13	unknown

### DOS Action Codes

1 retry immediately  
 2 delay and retry

### DOS Locus Codes

1 unknown  
 2 block device



3 reenter input  
4 abort ASAP  
5 abort immediately  
6 ignore error  
7 user intervention

3 network  
4 serial device  
5 memory

**See:** BULLET errors

## InitXBsrc

**Func:** InitXB

**Pack:** InitPack

**Func:** 0/System

```
struct initpack IP;
struct exitpack EP;

IP.func = INITXB;
IP.jftmode = 1;
stat = BULLET(&IP);
if (stat == 0) {
    EP.func = ATEXTXB;
    stat = BULLET(&EP);
}
if (stat != 0) ...

/* InitXB defined in BULLET.H*/
/* expand JFT to 255 handles */

/* register ExitXB with _atexit routine */

/* error */
```

**Note:** When compiling for Windows, it is advisable to verify that the Windows version of BULLET is linked by testing IP.osversion (Fab thinks so).

## ExitXBsrc

**Func:** ExitXB

**Pack:** ExitPack

**Func:** 1/System

```
struct exitpack EP;
```

```
    EP.func = EXITXB  
    stat = BULLET(&EP)
```

```
/* ExitXB defined in BULLET.H*/
```

The return value from ExitXB is currently always 0.

## AtExitXSrc

**Func:** AtExitXB

**Pack:** ExitPack

**Func:** 2/System

```
struct initpack IP;
struct exitpack EP;

IP.func = INITXB;
IP.jftmode = 1;
stat = BULLET(&IP);
if (stat == 0) {
    EP.func = ATEXITXB;
    stat = BULLET(&EP);
}
if (stat != 0) ...

/* InitXB defined in BULLET.H*/
/* expand JFT to 255 handles */

/* register ExitXB with _atexit routine */

/* error */
```

## MemoryXBsrc

**Func:** MemoryXB

**Pack:** MemoryPack

**Func:** 3/System

```
struct memoryPack MP;
```

```
MP.func = MEMORYXB;  
stat = BULLET(&MP);
```

```
/* MP.memory = amount of far heap available */
```

MP.memory does not reflect memory available through DOS in the UMB area. It's possible that all memory requests can be satisfied by UMB RAM. Consult a DOS 5+ programmer reference for more information on this (see DOS INT21/58 for more).

Borland C/C++ compiler users must install the BCFIX.ZIP files. See it for more.

## BreakXBsrc

**Func:** BreakXB

**Pack:** BreakPack

**Func:** 4/System

```
struct breakpack BP;

BP.func = BREAKXB;          /* BreakXB defined in BULLET.H*/
BP.mode = 0;               /* disable Ctrl-C/Ctrl-BREAK
                           (do nothing on those keys) */
stat = BULLET(&BP);        /* stat=0 always */
```

If BreakXB is called multiple times with the same BP.mode each time, only the first is acted on. You can set BP.mode = 1 to restore the default handlers (those installed originally) and then again set BP.Mode = 0 to disable them.

ExitXB calls this routine automatically as part of the BULLET shutdown to restore the original default break handlers.

## BackupFileXBsrc

**Func:** BackupFileXB

**Pack:** CopyPack

**Func:** 5/System

```
struct accesspack AP;
struct copenpack CP;

CP.func = BACKUPFILEXB;          /* defined in BULLET.H*/
CP.handle = datahandle;         /* handle of data file to backup */
CP.filenameptr = newfilename;  /* filename to save to */
stat = BULLET(&CP);
if (stat == 0) {
    AP.func = PACKRECORDSXB;
    AP.handle = datahandle;
    stat = BULLET(&AP);
}
if (stat != 0) ...              /* error */
```

## StatHandleXSrc

**Func:** StatHandleXB

**Pack:** StatHandlePack

**Func:** 6/System

```
struct stathandlepack SHP;
struct statkeypack SKP;
struct statdatapack SDP;

SHP.func = STATHANDLEXB;           /* defined in BULLET.H*/
SHP.handle = thehandlenumber;
stat = BULLET(&SHP);
if (SHP.ID == 0) {                 /* handle belongs to index file (index/key)*/
    SKP.func = STATKXB;           /* get key stats - see StatKXB/StatDXB for more*/
    SKP.handle = passedhandlenumber; /* on the SKP structure*/
    stat = BULLET(&SKP);
}
elseif (SHP.ID == 1) {           /*.DBF data file */
    /* get DBF stats */
}
else
    /* error not a BULLET file type */
}
```



## GetExtErrorXBsrc

**Func:** GetExtErrorXB

**Pack:** XErrorPack

**Func:** 7/System

```
/* an error just occurred in the range 1 to 199 as returned in one of the
   pack.stat variables (current max DOS error is 90 (5Ah)) */
```

```
/* remember, transaction-based routines return a bad pack index in the
   return stat value, which you use to check the appropriate pack.Stat
   variable */
```

```
struct xerrorpack XEP;
```

```
XEP.func = GETEXTERRORXB;
```

```
stat = BULLET(&XEP);
```

```
if (rstat != 0) {
```

```
/* defined in BULLET.H */
```

```
/* error=XEP.rstat
```

```
   error class=XEP.class
```

```
   recommended action=XEP.action
```

```
   location=XEP.location*/
```

```
}
```

## DVmonCXBsrc

**Func:** DVmonCXB

**Pack:** DVmonPack

**Func:** 9/DEBUG

```
/* at this point a data file and a key file have been opened.  
   kf is that key file's DOS handle      */
```

```
struct dvmonpack DVP;
```

```
DV.func = DVMONCXB;          /* defined in BULLET.H*/  
DV.mode = 1;                /* enable monitoring */  
DV.handle = kf;              /* monitor key handle (and its Xblink file) */  
DV.videoseg = 0xB800+(4096/16); /* output to color screen, pg 1 (pg 0 to ?) */  
stat = BULLET(&DV);         /* stat=0 always even if not DEBUG ENGINE */
```

For two-monitor systems (with a color monitor as the main system) output should be directed to 0xB000, the mono monitor's video memory.

DVmonCXB stands for Dual Video Monitor Control XB. This module is available on the BBS in the BULLET conference files. It is not included in the distribution, nor is a Windows version currently available.

## CreateDXBsrc

**Func:** CreateDXB

**Pack:** CreateDataPack

**Func:** 10/Mid-level

```
struct createdatapack CDP;
struct fielddescstype fieldlist[2];          /* fld descriptions for each field
                                             in the record (record has 2 fields) */

/* build FD first for each of the fields in the record */

strcpy(fieldlist[0].fieldname, "STUDENT\0\0\0"); /* 0-fill! */
/* strcpy(fieldlist[0].fieldtype, "C"); */
fieldlist[0].fieldtype = 'C';                /* this is preferred since single byte */
fieldlist[0].fieldlen = 20;
fieldlist[0].fielddc = 0;
strcpy(fieldlist[1].fieldname, "SCORE\0\0\0\0\0");
/* strcpy(fieldlist[1].fieldtype, "N"); */
fieldlist[1].fieldtype = 'N';
fieldlist[1].fieldlen = 3;
fieldlist[1].fielddc = 0;
/* build the CDP */
CDP.func = CREATEDXB;                        /* defined in BULLET.H */
CDP.filenameptr = filename;                  /* filenameZ (Z=0-terminated str) */
CDP.nofields = 2;                            /* this example has 2 fields */
CDP.fieldlistptr = fieldlist                 /* point to the first field decription...*/
CDP.fileid = 3;                              /* standard dBASE file ID */
stat = BULLET(&CDP);                          /* create the DBF data file */
if (stat !=0) ...                             /* error */
```

Normally this code would be written as a generalized FUNCTION. The CDP could be a global allocation and the fieldlist would also.

BULLET can be customized very easily and with very little overhead. If you don't like the default API, just develop your own using your own parameter order, etc.

Rather than adding the \0 to 0-fill the fieldname, you can memset() the entire fieldlist[]. In any case, the fieldname must be 0-filled.

Since the .fieldtype member is a single byte, it's preferred that the value be directly assigned, rather than using the strcpy function. A good compiler will disregard the \0 since it will not fit, but I've seen them overwrite the following byte, too. Assigning is more efficient.

(for BINARY FieldType="B" see FieldDescType)

## OpenDXBsrc

**Func:** OpenDXB

**Pack:** OpenPack

**Func:** 11/Mid-level

```
struct openpack OP;

OP.func = OPENDXB;          /* defined in BULLET.H */
OP.filenameptr = filename; /* file to open (must already exist) */
OP.asmode = ReadWrite | DenyNone; /* defined in BULLET.H */
stat = BULLET(&OP);
if (stat !=0) ...          /* error */
```

The ASmode (access/sharing mode) determines how the operating system controls access to the file. See OpenFileDOS for the meanings of the various ASmodes.

## CloseDXBsrc

**Func:** CloseDXB

**Pack:** HandlePack

**Func:** 12/Mid-level

```
struct handlepack HP;
```

```
HP.func = CLOSEDXB;  
HP.handle = datahandle;  
stat = BULLET(&HP);  
if (stat !=0) ...
```

```
/* defined in BULLET.H*/  
/* handle of the file to close */  
  
/* error */
```

## StatDXBsrc

**Func:** StatDXB

**Pack:** StatDataPack

**Func:** 13/Mid-level

```
struct statdatapack SDP;

SDP.func = STATDXB;
SDP.handle = datahandle;
stat = BULLET(&SDP);

if (stat == 0) {
    /* defined in BULLET.H*/
    /* data handle to get stats on */
    /* must be data handle, use StatHandleXB */
    /* if you don't know the type of file */
    /* SDP.filetype is set to 1
       SDP.dirty is set to 1 if the file has
       ...changed (0=not changed)
       SDP.recs = number records in DBF file
       SDP.recLen = record length
       SDP.fields = number fields in record
       SDP.f1 is reserved
       SDP.luyear = year file last updated,
       ...binary (year = ASC(SDP.LUyear))
       SDP.lumonth = month, binary
       SDP.luday = day, binary
       SDP.hereseg is set to this handle's
       control segment (location in memory)
    */
}
}
```

## ReadDHXBsrc

**Func:** ReadDHXB

**Pack:** HandlePack

**Func:** 14/Mid-level

```
struct handlepack HP;

HP.func = READDHXB;          /* defined in BULLET.H*/
HP.handle = datahandle;     /* handle of file whose header to reload */
stat = BULLET(&HP);
if (stat != 0) ...          /* error */
```

This routine is automatically called by the network lock routines.

## FlushDHXBsrc

**Func:** FlushDHXB

**Pack:** HandlePack

**Func:** 15/Mid-level

```
struct handlepack HP;
```

```
HP.func = FLUSHDHXB;  
HP.handle = datahandle;  
stat = BULLET(&HP);  
if (stat != 0) ...
```

```
/* defined in BULLET.H */  
/* handle of file you want to flush */  
  
/* error */
```

Note that the physical write to disk is performed only if the file has changed since the open or last flush.

This routine is automatically called by the network unlock routines.

**See:** UnlockDataXB



## CopyDHXBsrc

**Func:** CopyDHXBsrc

**Pack:** CopyPack

**Func:** 16/Mid-level

```
struct copypack CP;
```

```
CP.func = COPYDHXB;
```

```
CP.handle = datahandle;
```

```
CP.filenameptr = filename;
```

```
stat = BULLET(&CP);
```

```
if (stat !=0) ...
```

```
/* defined in BULLET.H */
```

```
/* handle of file to copy from (source) */
```

```
/* pointer to filenameZ for copy (dest) */
```

```
/* error */
```

## ZapDHXBsrc

**Func:** ZapDHXB

**Pack:** HandlePack

**Func:** 17/Mid-level

```
struct handlepack HP;
```

```
HP.func = ZAPDHXB;
```

```
HP.handle = datahandle;
```

```
stat = BULLET(&HP);
```

```
if (stat !=0)...
```

```
/* defined in BULLET.H */
```

```
/* handle of file you want to !ZAP! */
```

```
/* error */
```

Note that this removes ALL data records from the data file.

## CreateKXBsrc

**Func:** CreateKXB

**Pack:** CreateKeyPack

**Func:** 20/Mid-level

```
/* This code assumes that the datafile was created as in CreateDXBsrc,  
   and that the datafile was opened as in OpenDXBsrc.  
*/
```

```
strcpy(keyexpression,"SUBSTR(STUDENT,1,5)");          /* a non-unique, char key*/  
struct createkeypack CKP;
```

```
CKP.func = CREATEKXB;                                /* defined in BULLET.H*/  
CKP.filenameptr = filename;                          /* far pointer to filenameZ */  
CKP.keyexpptr = keyexpression;                       /* far pointer to key expressionZ */  
CKP.XBlink = datahandle;                            /* the datafile handle returned from OpenDXB */  
CKP.KeyFlags = cCHAR;                               /* -KEYFLAGS- are defined in BULLET.H*/  
CKP.CodePageID = -1;                                /* use DOS default code page ID */  
CKP.CountryCode = -1;                              /* use DOS default country code */  
CKP.CollatePtrOff = 0;                              /* no user-supplied collate table...*/  
CKP.CollatePtrSeg = 0;                              /* ...*/  
stat = BULLET(&CKP);  
IF (stat !=0) ...                                  /* error */
```

Normally this code would be written as a generalized FUNCTION.

## OpenKXBsrc

**Func:** OpenKXB

**Pack:** OpenPack

**Func:** 21/Mid-level

```
struct openpack OP;

OP.func = OPENKXB;          /* defined in BULLET.H */
OP.filenamePtr = filename; /* point to filenameZ (Z=0-terminated str) */
OP.asmode = ReadWrite | DenyNone; /* defined in BULLET.H */
OP.xblink = datafilehandle; /* Needs to know the data file handle */
stat = BULLET(&OP);
if (stat !=0) ...          /* error */
```

The ASmode (access/sharing mode) determines how the operating system controls access to the file. See OpenFileDOS for the meanings of the various ASmodes.

Before you can open an index file you must first open its associated data file.

**See:** OpenFileDOS

## CloseKXBsrc

**Func:** CloseKXB

**Pack:** HandlePack

**Func:** 22/Mid-level

```
struct handlepack HP;
```

```
HP.func = CLOSEDXB;  
HP.handle = indexhandle;  
stat = BULLET(&HP);  
if (stat !=0) ...
```

```
/* defined in BULLET.H*/  
/* handle of the file to close */  
  
/* error */
```

## StatKXBsrc

**Func:** StatKXB

**Pack:** StatKeyPack

**Func:** 23/Mid-level

```
struct statkeypack SKP;

SKP.func = STATKXB;          /* defined in BULLET.H*/
SKP.handle = indexhandle;    /* handle to get stats on */
stat = BULLET(&SKP);        /* must be index handle, use StatHandleXB
                             if you don't know the type of file a
                             handle's for */

if (stat == 0) {
    /* SKP.filetype is set to 0
     SKP.dirty is set to 1 if the file has changed (0=not changed)
     SKP.keys = number of key in the index file (index file=key file)
     SKP.keyLen = physical key length (1-64 bytes)
     SKP.xblink = datafile handle that this index file is associated with
     SKP.xbrecno is set to record number associated with last accessed key
     SKP.hereseg is set to this handle's control segment (location in memory)
     SKP.codepageid returns this index file's permanent code page ID
     SKP.countrycode returns this index file's permanent country code
     SKP.collatetablesize = 0 (no collate table present) or 256 (table present)
     SKP.keyflags= key flags specifed at CreateKXB (except NLS flag may be set)
     (NLS flag is bit 14, 0x4000) */
}
else
    /* error */
```

## ReadKHXBsrc

**Func:** ReadKHXB

**Pack:** HandlePack

**Func:** 24/Mid-level

```
struct handlepack HP;  
  
HP.func = READKHXB;          /* defined in BULLET.H*/  
HP.handle = indexhandle;    /* handle of file whose header to reload */  
stat = BULLET(&HP);  
if (stat !=0) ...          /* error */
```

This routine is automatically called by the network lock routines.

**See:** LockKeyXB

## FlushKHXBsrc

**Func:** FlushKHXB

**Pack:** HandlePack

**Func:** 25/Mid-level

```
struct handlepack HP;

HP.func = FLUSHKHXB;          /* defined in BULLET.H*/
HP.handle = indexhandle;     /* handle of file you want to flush */
stat = BULLET(&HP);
if (stat !=0) ...           /* error */
```

Note that the physical write to disk is performed only if the file has changed since the open or last flush.

This routine is automatically called by the network unlock routines.

**See:** UnlockKeyXB



## CopyKHXBsrc

**Func:** CopyKHXB

**Pack:** CopyPack

**Func:** 26/Mid-level

```
struct copypack CP;
```

```
CP.func = COPYKHXB;
```

```
CP.handle = indexhandle;
```

```
CP.filenameptr = filename;
```

```
stat = BULLET(&CP);
```

```
if (stat !=0) ...
```

```
/* defined in BULLET.H*/
```

```
/* handle of file to copy from (source) */
```

```
/* far pointer to filenameZ for copy */
```

```
/* error */
```

## ZapKHXBsrc

**Func:** ZapKHXB

**Pack:** HandlePack

**Func:** 27/Mid-level

```
struct handlepack HP;
```

```
HP.func = ZAPKHXB;
```

```
HP.handle = indexhandle;
```

```
stat = BULLET(&HP);
```

```
if (stat !=0) ...
```

```
/* defined in BULLET.H*/
```

```
/* handle of file you want to !ZAP! */
```

```
/* error */
```

Note that this removes ALL keys from the index file.

## GetDescriptorXBsrc

**Func:** GetDescriptorXB

**Pack:** DescriptorPack

**Func:** 30/Mid-level

```
struct descriptorpack DP;

DP.func = GETDESCRIPTORXB;          /* defined in BULLET.H*/
DP.handle = datahandle;             /* handle of file
if (fieldnumber > 0) {
    DP.fieldnumber = fieldnumber;    /* field number to get info on */
}
else {                               /* or, if 0, then */
    DP.fieldnumber = 0;
    strcpy(DP.FD.fieldname,fieldname); /* fieldname to get info on */
}
stat = BULLET(&DP);
if stat == 0 {
    /* DP.FD.fieldname is set to field name
    DP.FD.fieldtype is set to field type
    DP.FD.fieldlen is set to field length
    DP.FD.fielddc is set to field DC */

}
else
    /* error */
```

## GetRecordXBsrc

**Func:** GetRecordXB

**Pack:** AccessPack

**Func:** 31/Mid-level

```
struct rectype {
    /*
    char tag;
    char code[4];
    char bday[8];
};
struct rectype recbuff;
struct accesspack AP;

AP.func = GETRECORDXB;
AP.handle = datahandle;
AP.recno = recnotoget;
AP.recptr = recbuff;
stat = BULLET(&AP);
if (stat == 0) {
    /* recbuff.code and .bday set to contents of record (recnotoget) */
} else
    /* error */
```

/\* simple DBF record layout

**/\* THE FIRST BYTE OF YOUR RECORD TYPES MUST BE TAG!** (a single byte) \*/

/\* while 4 bytes, if you use C strings \*/

/\* the DBF record must be 5 to hold \0 \*/

/\* 2 fields: code/C/5.0, bday/D/9.0 \*/

/\* defined in BULLET.H\*/

/\* handle to get record from \*/

/\* record number to get \*/

/\* read record from disk into recbuff \*/

## AddRecordXBsrc

**Func:** AddRecordXB

**Pack:** AccessPack

**Func:** 32/Mid-level

```
struct rectype {
    /*
    char tag;
    char code[4];
    char bday[8];
};
struct rectype recbuff;
struct accesspack AP;

/* be sure to init the tag field to a space (ASCII 32) */
recbuff.tag = ' ';
strcpy(recbuff.code,"1234");
strcpy(recbuff.bday,"19331122");

AP.func = ADDRECORDXB;
AP.handle = datahandle;
AP.recptr = recbuff;
stat = BULLET(&AP);
if (stat == 0) {
    /* AP.recno set to record number to used by just written record */
}
```

/\* simple DBF record layout

**/\* THE FIRST BYTE OF YOUR RECORD TYPES  
MUST BE TAG!** (a single byte) \*/

/\* 4 characters + implicit byte=5 \*/

/\* and so DBF field is actually 5 \*/

/\* 2 fields: code/C/5.0, bday/D/9.0 \*/

/\* not a string " ", just single byte " " \*/

/\* if using C strings, actual string size \*/

/\* is the size +1 byte for the \0 \*/

/\* defined in BULLET.H\*/

/\* handle to put record to \*/

/\* write recbuff to disk \*/

## UpdateRecordXBsrc

**Func:** UpdateRecordXB

**Pack:** AccessPack

**Func:** 33/Mid-level

/\* see GetRecordXBsrc for this source example's preliminary code  
\*/

```
AP.func = GETRECORDXB;          /* first get the record to update */
AP.handle = datahandle;
AP.recno = recno;
AP.recptr = recbuff;
stat = BULLET(&AP);
if (stat==0) {
    strcpy(recbuff.dbay,"19591122");
    AP.func = UPDATERECORDXB;    /* Do NOT use UpdateRecordXB to change */
                                /* any field(s) used in a key expression. */
                                /* Instead use UpdateXB. */
                                /* change only non-key portions of record */
                                /* defined in BULLET.H */
                                /* other AP. values are already set by Get */
}
if (stat !=0) ...               /* error */
```

See: UpdateXB

## DeleteRecordXBsrc

**Func:** DeleteRecordXB      **Pack:** AccessPack      **Func:** 34/Mid-level

```
struct accesspack AP;
```

```
AP.func = DELETERECORDXB;  
AP.handle = datahandle;  
AP.recno = recnotodelete;  
stat = BULLET(&AP);  
if (stat !=0) ...
```

```
/* defined in BULLET.H*/  
/* handle of record to delete */  
/* to determine which record number any record */  
/* is, use one of the keyed access routines */  
/* error */
```

## UndeleteRecordsrc

**Func:** UndeleteRecordXB

**Pack:** AccessPack

**Func:** 35/Mid-level

```
struct accesspack AP;
```

```
AP.func = UNDELETERECORDXB;
```

```
AP.handle = datahandle;
```

```
AP.recno = recnotoundelete;
```

```
stat = BULLET(&AP);
```

```
if (stat !=0) ...
```

```
/* defined in BULLET.H */
```

```
/* handle of record to undelete */
```

```
/* to determine which record number any record */
```

```
/* is, use one of the keyed access routines */
```

```
/* error */
```



## PackRecordsXBsrc

**Func:** PackRecordsXB

**Pack:** AccessPack

**Func:** 36/Mid-level

```
struct accesspack AP;
```

```
AP.func = PACKRECORDSXB;
```

```
AP.handle = datahandle;
```

```
stat = BULLET(&AP);
```

```
if (stat !=0) ...
```

```
/* defined in BULLET.H*/
```

```
/* handle of data file to pack */
```

```
/* error */
```

## FirstKeyXBsrc

**Func:** FirstKeyXB

**Pack:** AccessPack

**Func:** 40/Mid-level

```
struct accesspack AP;

AP.func = FIRSTKEYXB;           /* defined in BULLET.H*/
AP.handle = indexhandle;       /* handle to index file to access key from */
AP.keyptr = keybuffer;         /* far pointer to key buffer */
stat = BULLET(&AP);
if (stat==0) {
    /* keybuff is filled in with the key (for as many bytes as the key length)
       When using the key returned, be aware that if UNIQUE was NOT specified
       then the enumerator word is attached to the end of the key (the right
       two bytes).
       Also, AP.recno is set to record number of the first key in index. */
}
else
    /* error */
```

## EqualKeyXBsrc

**Func:** EqualKeyXB

**Pack:** AccessPack

**Func:** 41/Mid-level

```
struct accesspack AP;

AP.func = EQUALKEYXB;           /* defined in BULLET.H */
AP.handle = indexhandle;       /* handle to index file to find key from */
AP.keyptr = keybuffer;        /* far pointer to key buffer (include enumerator */
stat = BULLET(&AP);           /* if non-UNQIUE key) (double NULL good start) */
if (stat==0) {
    /* the key matched exactly (including enumerator, if present)
       keybuff is NOT ALTERED
       AP.recno is set to the record number of that key */
else
    if (stat == 200) {
        AP.func = NEXTKEYXB           /* if not found, get following key and check the */
        stat = BULLET(&AP)           /* key proper (key less the enumerator bytes) */
        if (stat==0) {               /* (i.e., it may be proper key but enumerator=1) */
/* see NextKeyXBsrc for continuation */
```

## NextKeyXBsrc

**Func:** NextKeyXB

**Pack:** AccessPack

**Func:** 42/Mid-level

```
/* see EqualKeyXBsrc for preliminary code */
```

```
AP.func = NEXTKEYXB;           /* defined in BULLET.H*/  
rstat = BULLET(&AP);         /* KEYLEN assumed to equal actual key length  
*/  
if (stat==0) {                /* ...as returned by StatKXB */  
    if (IndexFileIsNotUnique) {  
        if (KeyProperMatchesKeyToFind) {  
            /* found a match to the key proper
```

This code example follows up on the EqualKeyXBsrc example. See EqualKeyXB for more information on finding partial keys.

## PrevKeyXBsrc

**Func:** PrevKeyXB

**Pack:** AccessPack

**Func:** 43/Mid-level

```
struct accesspack AP;

/* assume code has already executed to locate a key--this code then gets
   the key before that one */

AP.func = PREVKEYXB;           /* defined in BULLET.H*/
AP.handle = indexhandle;      /* handle to index file to access key from */
AP.keyptr = keybuff;         /* far pointer to key buffer */
stat = BULLET(&AP);
if (stat==0) {
    /* keybuff is filled in with the key (for as many bytes as the key length).
       Also, AP.recno is set to the record number of the key. */
}
else
    /* error */
```

## LastKeyXBsrc

**Func:** LastKeyXB

**Pack:** AccessPack

**Func:** 44/Mid-level

```
struct accesspack AP;

AP.func = LASTKEYXB;           /* defined in BULLET.H*/
AP.handle = indexhandle;      /* handle to index file to access key from */
AP.keyptr = keybuff;         /* far pointer to key buffer */
stat = BULLET(&AP);
if (stat==0) {
    /* keybuff is filled in with the key (for as many bytes as the key length).
       Also, AP.recno is set to the record number of the last key. */
}
else
    /* error */
```

## StoreKeyXBsrc

**Func:** StoreKeyXB

**Pack:** AccessPack

**Func:** 45/Mid-level

```
struct accesspack AP;

/* Assume record has been added to data file (AddRecordXB, returning
   recno2use) and key has been built (BuildKeyXB returning keytoadd[]). */

AP.func = STOREKEYXB;           /* defined in BULLET.H*/
AP.handle = indexhandle;       /* handle to index file to insert key into */
AP.recno = recno2use;          /* associate this record number with key */
AP.keyptr = keytoadd;          /* far pointer to key buffer */
stat = BULLET(&AP);
if (stat==0)
    /* key added */
else
    if (rstat==201) {
        /* key already exists, you need to construct a unique enumerator -
           provided file wasn't created for UNIQUE keys...INSTEAD USE InsertXB! */
    }
else
    /* other error */
```

## DeleteKeyXBsrc

**Func:** DeleteKeyXB

**Pack:** AccessPack

**Func:** 46/Mid-level

```
struct accesspack AP;

AP.func = DELETEKEYXB;           /* defined in BULLET.H */
AP.handle = indexhandle;        /* handle to index file of key to delete */
AP.keyptr = keybuffer;          /* far pointer to key buffer (incl enum) */
                                /* (this key is searched for exactly) */
stat = BULLET(&AP);             /* if exact match found the key is deleted! */
if (stat==0)
    /* key deleted permanently */
else
    if (rstat==200) {
        /* key as stated was not in the index file--if the index is not UNQIUE
           then you must supply the exact enumerator along with the key proper
           to delete - you can use the CurrentKeyXB routine to obtain the exact
           current key */
    }
else
    /* other error */
```



## BuildKeyXBsrc

**Func:** BuildKeyXB

**Pack:** AccessPack

**Func:** 47/Mid-level

```
struct accesspack AP;
```

```
/* Assume record has been built and is ready to be added to the data file.  
   The record is in the variable recbuff. */
```

```
AP.func = BUILDKEYXB;           /* defined in BULLET.H*/  
AP.handle = indexhandle;       /* handle to index file key is to be built for  
   */  
AP.recptr = recbuff;          /* far pointer to data record buffer */  
AP.keyptr = keybuff;         /* far pointer to key buffer */  
stat = BULLET(&AP)  
if (stat==0) {  
    /* key built okay so can do a AddRecordXB followed by a StoreKeyXB  
       but, again, InsertXB takes care of all this detail and then some-use it */  
}  
else  
    /* error */
```

## CurrentKeyXBsrc

**Func:** CurrentKeyXB

**Pack:** AccessPack

**Func:** 48/Mid-level

```
struct accesspack AP;

AP.func = CURRENTKEYXB;           /* defined in BULLET.H*/
AP.handle = indexhandle;         /* handle to index file */
AP.keyptr = keybuff;            /* far pointer to key buffer */
stat = BULLET(&AP);
if (stat==0) {
    /* keybuff set to current key (valid only for KeyLen bytes)
       Also, AP.recno is set to the record number of the key. */
}
else
    /* error */
```

## GetFirstXBsrc

**Func:** GetFirstXB

**Pack:** AccessPack

**Func:** 60/High-level

```
struct accesspack AP;

AP.func = GETFIRSTXB;           /* defined in BULLET.H*/
AP.handle = indexhandle;       /* handle to index file to access key from */
AP.recptr = recbuff;          /* far pointer to record buffer */
AP.keyptr = keybuff;          /* far pointer to key buffer */
stat = BULLET(&AP);
if (stat==0) {
    /* keybuff is filled in with the key (for as many bytes as the key length)
       recbuff is filled in with the data record
       AP.recno is set to the record number of the first key in the index. */
}
else
    /* error */
```

## GetEqualXBsrc

**Func:** GetEqualXB

**Pack:** AccessPack

**Func:** 61/High-level

```
struct accesspack AP;

AP.func = GETEQUALXB;           /* defined in BULLET.H*/
AP.handle = indexhandle;       /* handle to index file to access key from */
AP.recptr = recbuff;           /* far pointer to record buffer */
AP.keyptr = keybuff;           /* far pointer to key buffer */
stat = BULLET(&AP);
if (stat==0)
    /* recbuff and AP.recno filled as expected (keybuff remains the same) */
else
    if (rstat==200) {
        AP.func = GETNEXTXB; /* if not found, can get following key--the next */
        stat = BULLET(&AP); /* key would logically follow the key not found */
    }
    else
        /* error */
```

## GetNextXBsrc

**Func:** GetNextXB

**Pack:** AccessPack

**Func:** 62/High-level

```
struct accesspack AP;

AP.func = GETNEXTXB;           /* defined in BULLET.H */
AP.handle = indexhandle;      /* handle to index file to access key from */
AP.recptr = recbuff;         /* far pointer to record buffer */
AP.keyptr = keybuff;         /* far pointer to key buffer */
stat = BULLET(&AP);
if (stat==0) {
    /* keybuff is filled in with the next key (as many bytes as the key length)
       recbuff is filled in with the data record
       AP.recno is set to the record number of the next key in the index
       This key is made the current key so GETNEXTXB again gets next, and so on */
}
else
    /* error */
```

## GetPrevXBsrc

**Func:** GetPrevXB

**Pack:** AccessPack

**Func:** 3/High-level

```
struct accesspack AP;

AP.func = GETPREVXB;           /* defined in BULLET.H */
AP.handle = indexhandle;      /* handle to index file to access key from */
AP.recptr = recbuff;         /* far pointer to record buffer */
AP.keyptr = keybuff;         /* far pointer to key buffer */
stat = BULLET(&AP);
if (stat==0) {
    /* keybuff is filled in with the prev key (as many bytes as the key length)
       recbuff is filled in with the data record
       AP.recno is set to the record number of the prev key in the index
       This key is made the current key so GETPREVXB again gets prev, and so on */
}
else
    /* error */
```

## GetLastXBsrc

**Func:** GetLastXB

**Pack:** AccessPack

**Func:** 64/High-level

```
struct accesspack AP;

AP.func = GETLASTXB;           /* defined in BULLET.H*/
AP.handle = indexhandle;      /* handle to index file to access key from */
AP.recptr = recbuff;         /* far pointer to record buffer */
AP.keyptr = keybuff;         /* far pointer to key buffer */
stat = BULLET(&AP);
if (stat==0) {
    /* keybuff is filled in with the key (for as many bytes as the key length)
       recbuff is filled in with the data record
       AP.recno is set to the record number of the last key in the index. */
}
else
    /* error */
```







## ReindexXBsrc

**Func:** ReindexXB

**Pack:** AccessPack

**Func:** 67/High-level

```
struct accesspack AP[3];           /* array of 3 access packs, 1 for each index
                                   file; keybuff / recbuff previously defined */
for (i=0,i<3,i++) {              /* 3=number of related indexes to maintain */
    AP[i].func = REINDEXB;
    AP[i].handle = indexhandle[i]; /* each index file's handle */
    AP[i].nextptr = &AP[i+1];     /* point to NEXT access pack */
}
AP[2].nextptr = NULL;            /* reset last access pack to end-link value
    */
stat = BULLET(&AP);
if (stat !=0) {
    trueerror = AP[stat-1].stat;  /* returned rstat is array index of bad pack
    */
}
/* -1 since C packs are 0 based. */
```

## LockXBsrc

**Func:** LockXB

**Pack:** AccessPack

**Func:** 80/Network

```
struct accesspack AP[3];           /* array of 3 access packs, 1 per index file */

for (i=0,i<3,i++) {               /* 3=number of related indexes to maintain */
    AP[i].func = LOCKXB;
    AP[i].handle = indexhandle[i]; /* each index file's handle */
    AP[i].nextptr = &AP[i+1];     /* point to NEXT access pack */
}
AP[2].nextptr = NULL;             /* reset last access pack to end-link value */
stat = BULLET(&AP);
if (stat > 3) {                   /* if stat > 3 (> number of packs) then the... */
    trueerror = AP[2].stat;       /* ...lock failed on the data file */
}
else                               /* and the error code is in the last pack */
    if (rstat !=0) {
        trueerror = AP[rstat-1].stat /* ...lock failed on index file # stat
                                     -1 since C packs are 0 based. */
    }
}
```

The Lock routines use a different method to identify the bad pack when the failure was caused by the data file. See above.

**See:** UnlockXBsrc

## UnlockXBsrc

**Func:** UnlockXB

**Pack:** AccessPack

**Func:** 81/Network

```
struct accesspack AP[3];           /* array of 3 access packs, 1 per index file */

for (i=0,i<3,i++) {               /* 3=number of related indexes to maintain */
    AP[i].func = UNLOCKXB;
    AP[i].handle = indexhandle[i]; /* each index file's handle */
    AP[i].nextptr = &AP[i+1];     /* point to NEXT access pack */
}
AP[2].nextptr = NULL;             /* reset last access pack to end-link value */
stat = BULLET(&AP);
if (stat > 3) {                    /* if stat > 3 (> number of packs) then the...*/
    trueerror = AP[2].stat;        /* ...unlock failed on the data file */
}
else                               /* and the error code is in the last pack */
    if (rstat !=0) {
        trueerror = AP[stat-1].stat /* ...unlock failed on index file # stat
                                     -1 since C packs are 0 based. */
    }
}
```

The Lock routines use a different method to identify the bad pack when the failure was caused by the data file. See above.

**See:** LockXBsrc

## LockKeyXBsrc

**Func:** LockKeyXB

**Pack:** AccessPack

**Func:** 82/Network

```
struct accesspack AP[3];          /* array of 3 access packs, 1 per index file */
for (i=0,i<3,i++) {             /* 3=number of related indexes to maintain */
    AP[i].func = LOCKKEYXB;
    AP[i].handle = indexhandle[i]; /* each index file's handle */
    AP[i].nextptr = &AP[i+1];    /* point to NEXT access pack */
}
AP[2].nextptr = NULL;          /* reset last access pack to end-link value */
stat = BULLET(&AP);
if (stat !=0) {
    trueerror = AP[stat-1].stat /* ...lock failed on index file # stat
                                -1 since C packs are 0 based. */
    /* if stat > packs (3) then failed on last
       internal ReadKHXB. This is EXTREMELY unlikely. */
}
}
```

**See:** UnlockKeyXBsrc

## UnlockKeyXBsrc

**Func:** UnlockKeyXB

**Pack:** AccessPack

**Func:** 83/Network

```
struct accesspack AP[3];          /* array of 3 access packs, 1 per index file
                                  keybuff and recbuff previously defined */
for (i=0,i<3,i++) {             /* 3=number of related indexes to maintain */
    AP[i].func = UNLOCKKEYXB;    /* each index file's handle */
    AP[i].handle = indexhandle[i]; /* point to NEXT access pack */
    AP[i].nextptr = &AP[i+1];
}
AP[2].nextptr = NULL;          /* reset last access pack to end-link value */
stat = BULLET(&AP);
if (stat !=0) {
    trueerror = AP[stat-1].stat; /* ...lock failed on index file # stat
                                  -1 since C packs are 0 based.
}
}
```

**See:** LockKeyXBsrc

## LockDataXBsrc

**Func:** LockDataXB

**Pack:** AccessPack

**Func:** 84/Network

```
struct accesspack AP;
```

```
AP.func = LOCKDATAXB;  
AP.handle = datahandle;  
AP.recno = 0L;  
stat = BULLET(&AP);  
if (stat !=0) ...
```

```
/* defined in BULLET.H */  
/* handle of data file to lock */  
/* =0 to lock all or, set to actual record */  
/* num to lock, as in AP.recno = lockthisrec */  
/* error */
```

**See:** UnlockDataXBsrc

## UnlockDataXSrc

**Func:** UnlockDataXB

**Pack:** AccessPack

**Func:** 85/Network

```
struct accesspack AP;
```

```
AP.func = UNLOCKDATAXB;
```

```
AP.handle = datahandle;
```

```
AP.recno = 0L;
```

```
stat = BULLET(&AP);
```

```
if (stat !=0) ...
```

```
/* defined in BULLET.H*/
```

```
/* handle of data file to unlock */
```

```
/* =0 to unlock all or, set to actual record */
```

```
/* num to unlock as in AP.recno = lockthisrec */
```

```
/* error */
```

Note: you cannot unlock parts of a file with 1 single unlock (where AP.recno=0). Instead, you must unlock each record individually - that is, if you made any single-record locks

**See:** LockDataXSrc



## DriveRemoteXBsrc

**Func:** DriveRemoteXB

**Pack:** RemotePack

**Func:** 86/Network

```
struct remotepack RP;

RP.func = DRIVEREMOTEXB;          /* defined in BULLET.H */
RP.handle = drive2check;         /* drive (0=default, 1=A:,2=B:,3=C:...) */
stat = BULLET(&RP);
if (stat==0) {
    /* RP.isremote set to 0 if drive local, 1 if remote
       RP.flags set to DX register as returned by DOS
       RP.isshare set to 0 if SHARE.EXE is not loaded, non-zero SHARE installed */
}
else
    /* error (like invalid drive) */
```

**See:** FileRemoteXBsrc

## FileRemoteXBsrc

**Func:** FileRemoteXB

**Pack:** RemotePack

**Func:** 87/Network

```
struct remotepack RP;

RP.func = FILEREMOTEXB;          /* defined in BULLET.H */
RP.handle = filehandle;         /* file handle to check */
stat = BULLET(&RP);
if (stat==0) {
    /* RP.isremote set to 0 if file local, 1 if remote
       RP.flags set to DX register as returned by DOS
       RP.isshare set to 0 if SHARE.EXE is not loaded, non-zero SHARE installed */
}
else
    /* error (like invalid handle) */
```

**See:** DriveRemoteXBsrc

## SetRetriesXBsrc

**Func:** SetRetriesXB

**Pack:** SetRetriesPack

**Func:** 88/Network

```
struct setretriespack SRP;
```

```
SRP.func = SETRETRIESXB;
```

```
SRP.mode = 1;
```

```
SRP.pause = 5000;
```

```
SRP.retries = 5;
```

```
stat = BULLET(&SRP);
```

```
if (stat !=0) ...
```

```
/* 1=set to user values, 0=set DOS default */
```

```
/* do 5,000 loops between retries */
```

```
/* try 5 times before giving up with error */
```

```
/* error */
```

## DeleteFileDOSsrc

**Func:** DeleteFileDOS

**Pack:** DOSFilePack

**Func:** 100/DOS

```
struct dosfilepack DFP;
```

```
DFP.func = DELETEFILEDOS;
```

```
DFP.filenameptr = filename;
```

```
stat = BULLET(&DFP);
```

```
if (stat !=0) ...
```

```
/* defined in BULLET.H */
```

```
/* error */
```

## RenameFileDOSsrc

**Func:** RenameFileDOS

**Pack:** DOSFilePack

**Func:** 101/DOS

```
struct dosfilepack DFP;
```

```
DFP.func = RENAMEFILEDOS;          /* defined in BULLET.H */  
DFP.filenameptr = orgfilename;  
DFP.newnameptr = newfilename;  
stat = BULLET(&DFP);  
if (stat !=0) ...                  /* error */
```

## CreateFileDOSsrc

**Func:** CreateFileDOS

**Pack:** DOSFilePack

**Func:** 102/DOS

```
struct dosfilepack DFP;
```

```
DFP.func = CREATEFILEDOS;
```

```
/* defined in BULLET.H*/
```

```
DFP.filenameptr = filename;
```

```
DFP.attr = 0;
```

```
/* normal file directory attribute */
```

```
stat = BULLET(&DFP);
```

```
if (stat !=0) ...
```

```
/* error */
```

## AccessFileDOSsrc

**Func:** AccessFileDOS

**Pack:** DOSFilePack

**Func:** 103/DOS

```
struct dosfilepack DFP;
```

```
DFP.func = ACCESSFILEDOS;
```

```
/* defined in BULLET.H*/
```

```
DFP.filenameptr = filename;
```

```
/* attempt R/W DENY NONE access */
```

```
DFP.asmode = 0x42;
```

```
stat = BULLET(&DFP);
```

```
if (stat !=0) ...
```

```
/* error */
```

## OpenFileDOSsrc

**Func:** OpenFileDOS

**Pack:** DOSFilePack

**Func:** 104/DOS

```
struct dosfilepack DFP;
```

```
DFP.func = OPENFILEDOS;  
DFP.filenameptr = filename;  
DFP.ASmode = 0x42;  
stat = BULLET(&DFP);  
if (stat !=0) ...
```

```
/* defined in BULLET.H */
```

```
/* open in R/W DENY NONE access */
```

```
/* error  
else DFP.handle set to handle of open file */
```

**See:** CloseFileDOSsrc



## SeekFileDOSsrc

**Func:** SeekFileDOS

**Pack:** DOSFilePack

**Func:** 105/DOS

```
struct dosfilepack DFP;

DFP.func = SEEKFILEDOS;          /* defined in BULLET.H*/
DFP.handle = handle;
DFP.seekoffset = 0L;            /* position 0 relative EOF (get length of file) */
DFP.method = 2;                /* seek from END of file */
stat = BULLET(&DFP);
if (stat==0) {
    /* DFP.SeekOffset set to absolute current offset
       in this case, the DFP.seekoffset equals then length of the file */
}
else
    /* error */
```

## ReadFileDOSsrc

**Func:** ReadFileDOS

**Pack:** DOSFilePack

**Func:** 106/DOS

```
struct dosfilepack DFP;

DFP.func = READFILEDOS;          /* defined in BULLET.H */
DFP.handle = handle;
DFP.bytes = bytes2read;         /* 16-bit value, in this case 512 since that's */
DFP.bufferptr = dosbuff;       /* the size of dosbuff */
stat = BULLET(&DFP);
if (stat==0) {
    if (DFP.bytes != bytes2read) { /* check if EOF processed */
        /* hit EOF before reading all 512 bytes */
    }
    else {
        /* ReadBuff filled with 512 bytes of data read from the current disk pos
        disk position moved to the last byte read + 1 */
    }
}
else
    /* error */
```

**See:** WriteFileDOSsrc

## ExpandFileDOSsrc

**Func:** ExpandFileDOS

**Pack:** DOSFilePack

**Func:** 107/DOS

```
struct dosfilepack DFP;

DFP.func = EXPANDFILEDOS;          /* defined in BULLET.H */
DFP.handle = handle;
DFP.seekoffset = bytes2expandby;
stat = BULLET(&DFP);
if (stat==0) {
    /* file expanded by number of bytes specified */
else
    /* error */
```

## WriteFileDOSsrc

**Func:** WriteFileDOS

**Pack:** DOSFilePack

**Func:** 108/DOS

```
struct dosfilepack DFP;

DFP.func = WRITEFILEDOS;           /* defined in BULLET.H */
DFP.handle = handle;
DFP.bytes = bytes2write;          /* 16-bit value, in this case 512 since that's */
DFP.buffptr = dosbuff;           /* the size of dosbuff */
stat = BULLET(&DFP);
if (stat=0xFFFE)                  /* -2 that is */
    /* disk full */
else
    if (rstat !=0) ...            /* error */
```

Unlike ReadFileDOS, if the number of bytes actually written does not equal bytes2write, the WriteFileDOS routine returns a DISK FULL error code (-2).

**See:** ReadFileDOSsrc

## CloseFileDOSsrc

**Func:** CloseFileDOS

**Pack:** DOSFilePack

**Func:** 109/DOS

```
struct dosfilepack DFP;
```

```
DFP.func = CLOSEFILEDOS;
```

```
DFP.handle =handle2close;
```

```
stat = BULLET(&DFP);
```

```
if (stat !=0) ... /* error
```

```
/* defined in BULLET.H */
```

**See:** OpenFileDOSsrc

## MakeDirDOSsrc

**Func:** MakeDirDOS

**Pack:** DOSFilePack

**Func:** 110/DOS

```
struct dosfilepack DFP;
```

```
DFP.func = MAKEDIRDOS; /* defined in BULLET.H*/
```

```
DFP.filenameptr = newdirectoryname;
```

```
stat = BULLET(&DFP);
```

```
if (stat !=0) ... /* error */
```

The predefined key flags are:

cUNIQUE	1	
cCHAR	2	
cINTEGER	16	
cLONG	32	
cNLS	0x4000	note: cNLS is set by BULLET
cSIGNED	0x8000	

**Credits:**

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