

# **BOM-EX**

## **v1.56**

### **Enhanced Bill of Materials for Eagle**

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**Document Version 1.09**

**October 11, 2013**

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# Introduction

This documentation describes the process of integrating **BOM-EX** as a new enhanced BOM management system for Cadsoft Eagle. The **BOM-EX** utility is an Eagle based ULP program derived from the original BOM system provided with Eagle. However, **BOM-EX** takes advantage of the new **ATTRIBUTES** feature available in Eagle 5.0 for additional flexibility and greatly enhances the BOM system functionality. Note that **BOM-EX** also includes options to generate part order upload files and edit part number attributes. Many suppliers allow uploading part order files to directly a website to automate the part ordering process and automatically pre-fill part order numbers.

The BOM-EX package consists of several components and, like the original BOM system, requires a text formatted parts database file to fully implement a complete BOM management system. The details of the database record structure are described in the next section of this document and should be followed carefully. The database is not required to view a basic BOM, but the database is required to generate order upload files and take advantage of the enhanced reporting and export features. The screenshots below show the basic BOM viewer interface with and without the database loaded.

Figure 1 - Viewer without database loaded

Part	Value	Attributes	Package	Description	Part Num	XREF
BOM-ENTRY1	1SWHT	*		SWITCH CAP WHITE	1SWHT	*
BOM-ENTRY2	1SRED	*		SWITCH CAP RED	1SRED	*
C1	120u		CE-035X080	POLARIZED CAP	EEU-FC1V121	*
C2	470p		C025-025X046	NON-POLARIZED CAP	C315C471J1G5TA7301	*
C3	100p		C025-025X046	NON-POLARIZED CAP	C315C101K2G5TA	*
C4	470p		C025-025X046	NON-POLARIZED CAP	C315C471J1G5TA7301	*
C5	100p		C025-025X046	NON-POLARIZED CAP	C315C101K2G5TA	*
C6	100p		C025-025X046	NON-POLARIZED CAP	C315C101K2G5TA	*
C7	100n		C050-025X072	NON-POLARIZED CAP	MKS2C031001A00KSSD	*
C8	220u		CE-035X080	POLARIZED CAP	EEU-FC1C221	*
C9	120u		CE-035X080	POLARIZED CAP	EEU-FC1V121	*
C10	120u		CE-035X080	POLARIZED CAP	EEU-FC1V121	*
C11	100n		C050-025X072	NON-POLARIZED CAP	MKS2C031001A00KSSD	*
C12	470u		CE-035X080	POLARIZED CAP	EEU-FC1C471L	*
C13	10u/NP		CENP-020-050	BIPOLAR CAP	ECE-ALVN100U	*
C14	10u/NP		CENP-020-050	BIPOLAR CAP	ECE-ALVN100U	*
C15	120u		CE-035X080	POLARIZED CAP	EEU-FC1V121	*
C16	100n		C050-025X072	NON-POLARIZED CAP	MKS2C031001A00KSSD	*
C17	100n		C050-025X072	NON-POLARIZED CAP	MKS2C031001A00KSSD	*
C18	100n		C050-025X072	NON-POLARIZED CAP	MKS2C031001A00KSSD	*
C19	22p		C025-025X046	NON-POLARIZED CAP	C315C220K2G5TA	*
C20	33u		CE-020X050	POLARIZED CAP	EEU-FC1V330	*
C21	33u		CE-020X050	POLARIZED CAP	EEU-FC1V330	*
C22	100n		C050-025X072	NON-POLARIZED CAP	MKS2C031001A00KSSD	*
C23	100n		C050-025X072	NON-POLARIZED CAP	MKS2C031001A00KSSD	*
C24	33u		CE-020X050	POLARIZED CAP	EEU-FC1V330	*

Figure 2 - Viewer with database loaded

Part	Value	Attributes	Package	Description	Part Num	Mfg Name	VID	Vendor Part Num	Description	Customer Ref	XREF
BOM-ENT...	1SWHT	*		SWITCH CAP WHITE	1SWHT	E-Switch	ME	612-15-WHT	SWITCH CAP SQ WHITE PBH SERIES	REF87	REF86
BOM-ENT...	1SRED	*		SWITCH CAP RED	1SRED	E-Switch	ME	612-15-RED	SWITCH CAP SQ RED PBH SERIES	REF88	REF87
C1	120u		CE-035X080	POLARIZED CAP	EEU-FC1V121	Panasonic	ME	667-EEU-FC1V121	Electrolytic Capacitor - 120uF 35V LS=3.5mm (8mm Dia. x 15mm L)	REF28	REF27
C2	470p		C025-025X046	NON-POLARIZED CAP	C315C471J1G5TA73...	Kemet	ME	80-C315C471J1G73...	Multilayer Ceramic Capacitor (MLCC) - 100volts 470pF 5% COG	REF16	REF15
C3	100p		C025-025X046	NON-POLARIZED CAP	C315C101K2G5TA	Kemet	ME	80-C315C101K2G5TA	Multilayer Ceramic Capacitor (MLCC) - 200volts 100pF 10% COG	REF15	REF14
C4	470p		C025-025X046	NON-POLARIZED CAP	C315C471J1G5TA73...	Kemet	ME	80-C315C471J1G73...	Multilayer Ceramic Capacitor (MLCC) - 100volts 470pF 5% COG	REF16	REF15
C5	100p		C025-025X046	NON-POLARIZED CAP	C315C101K2G5TA	Kemet	ME	80-C315C101K2G5TA	Multilayer Ceramic Capacitor (MLCC) - 200volts 100pF 10% COG	REF15	REF14
C6	100p		C025-025X046	NON-POLARIZED CAP	C315C101K2G5TA	Kemet	ME	80-C315C101K2G5TA	Multilayer Ceramic Capacitor (MLCC) - 200volts 100pF 10% COG	REF15	REF14
C7	100n		C050-025X072	NON-POLARIZED CAP	MKS2C031001A00K...	WIMA	ME	505-MKS2.1/63/10	Polyester Film Capacitor 63V 1uF 10% LS=5mm (2.5 mm W x 7.2 mm L x 6.5 mm H)	REF4	REF3
C8	220u		CE-035X080	POLARIZED CAP	EEU-FC1C221	Panasonic	ME	667-EEU-FC1C221	Electrolytic Capacitor - 220uF 35V LS=3.5mm (8mm Dia. x 15mm L)	REF29	REF28
C9	120u		CE-035X080	POLARIZED CAP	EEU-FC1V121	Panasonic	ME	667-EEU-FC1V121	Electrolytic Capacitor - 120uF 35V LS=3.5mm (8mm Dia. x 15mm L)	REF28	REF27
C10	120u		CE-035X080	POLARIZED CAP	EEU-FC1V121	Panasonic	ME	667-EEU-FC1V121	Electrolytic Capacitor - 120uF 35V LS=3.5mm (8mm Dia. x 15mm L)	REF28	REF27
C11	100n		C050-025X072	NON-POLARIZED CAP	MKS2C031001A00K...	WIMA	ME	505-MKS2.1/63/10	Polyester Film Capacitor 63V 1uF 10% LS=5mm (2.5 mm W x 7.2 mm L x 6.5 mm H)	REF4	REF3
C12	470u		CE-035X080	POLARIZED CAP	EEU-FC1C471L	Panasonic	ME	667-EEU-FC1C471L	Electrolytic Capacitor - 470uF 16V LS=3.5mm (8mm Dia. x 15mm L)	REF30	REF29
C13	10u/NP		CENP-020-050	BIPOLAR CAP	ECE-ALVN100U	Panasonic	ME	667-ECE-ALVN100U	Electrolytic Capacitor - 10uF BP 50V LS=2.0mm (5mm Dia. x 11mm L)	REF21	REF20
C14	10u/NP		CENP-020-050	BIPOLAR CAP	ECE-ALVN100U	Panasonic	ME	667-ECE-ALVN100U	Electrolytic Capacitor - 10uF BP 50V LS=2.0mm (5mm Dia. x 11mm L)	REF21	REF20
C15	120u		CE-035X080	POLARIZED CAP	EEU-FC1V121	Panasonic	ME	667-EEU-FC1V121	Electrolytic Capacitor - 120uF 35V LS=3.5mm (8mm Dia. x 15mm L)	REF28	REF27
C16	100n		C050-025X072	NON-POLARIZED CAP	MKS2C031001A00K...	WIMA	ME	505-MKS2.1/63/10	Polyester Film Capacitor 63V 1uF 10% LS=5mm (2.5 mm W x 7.2 mm L x 6.5 mm H)	REF4	REF3
C17	100n		C050-025X072	NON-POLARIZED CAP	MKS2C031001A00K...	WIMA	ME	505-MKS2.1/63/10	Polyester Film Capacitor 63V 1uF 10% LS=5mm (2.5 mm W x 7.2 mm L x 6.5 mm H)	REF4	REF3
C18	100n		C050-025X072	NON-POLARIZED CAP	MKS2C031001A00K...	WIMA	ME	505-MKS2.1/63/10	Polyester Film Capacitor 63V 1uF 10% LS=5mm (2.5 mm W x 7.2 mm L x 6.5 mm H)	REF4	REF3
C19	22p		C025-025X046	NON-POLARIZED CAP	C315C220K2G5TA	Kemet	ME	80-C315C220K2G5TA	Multilayer Ceramic Capacitor (MLCC) - 200volts 22pF 10% COG	REF14	REF13
C20	33u		CE-020X050	POLARIZED CAP	EEU-FC1V330	Panasonic	ME	667-EEU-FC1V330	Electrolytic Capacitor - 33uF 35V LS=2.0mm (5 mm Dia. x 11 mm L)	REF25	REF24
C21	33u		CE-020X050	POLARIZED CAP	EEU-FC1V330	Panasonic	ME	667-EEU-FC1V330	Electrolytic Capacitor - 33uF 35V LS=2.0mm (5 mm Dia. x 11 mm L)	REF25	REF24
C22	100n		C050-025X072	NON-POLARIZED CAP	MKS2C031001A00K...	WIMA	ME	505-MKS2.1/63/10	Polyester Film Capacitor 63V 1uF 10% LS=5mm (2.5 mm W x 7.2 mm L x 6.5 mm H)	REF4	REF3
C23	100n		C050-025X072	NON-POLARIZED CAP	MKS2C031001A00K...	WIMA	ME	505-MKS2.1/63/10	Polyester Film Capacitor 63V 1uF 10% LS=5mm (2.5 mm W x 7.2 mm L x 6.5 mm H)	REF4	REF3
C24	33u		CE-020X050	POLARIZED CAP	EEU-FC1V330	Panasonic	ME	667-EEU-FC1V330	Electrolytic Capacitor - 33uF 35V LS=2.0mm (5 mm Dia. x 11 mm L)	REF25	REF24

## Creating a Parts Database File

Although **BOM-EX** will show basic part information by default, a parts database text file is required to fully implement the parts order export and part number assignment features. The database file must consist of lines of tabbed text record data, each line contains one record consisting of tabbed text delimiting the record fields and a single line feed line termination character. Thus, the parts database text file is simply a read-only database that contains a list of all part numbers used in a design, note these part numbers will be assigned to parts in the schematic using attributes by **BOM-EX**.

The very first line of your parts database file must contain a "header" record, which defines a unique field name for each column of the database. **All field names must exactly match the names as shown below or you will encounter problems with the order export operations.** Note the first column of each record must contain a unique and non-empty manufacturer part number key for each record. The following details the minimum database format required for the BOM order system, however some fields are optional as noted below.

**Figure 3 - Database Record Structure**

Column	Field Name	Description
0	"Mfg Part Num"	This field is the primary database key and contains the manufacture part number for a part.
1	"Mfg Name"	This field contains the manufacturer name and is required for exporting BOM orders. Some vendors, like Digi-Key, require this field for order upload files.
2	"VID"	This field contains a unique vendor ID name. The vendor ID codes are described in a following section.
3	"Vendor Part Num"	This field contains the supplier part number specific to the vendor and may be different from the manufacturer part number. In most cases, this field is used for exporting BOM order uploads.
4	"Description"	This field is not required, but is very useful for visually checking part values against component values in various listings or reports.
5	"Pkg Code"	This field is optional and is used to support the package verify feature. The should contain the package name or a substring to match against the library part package name (eg. 0805, 0603, etc).

Note that the record columns in the parts database file are separated by a tab character (you may optionally use a semicolon (;)). If you use the semicolon as a field delimiter, you must ensure no data item contains a semicolon. The TAB delimiter option is highly recommended as this character is unique and will not conflict with any normal part number ASCII character codes. You may also add additional columns of user defined record information for parts in the database.

The database record field "**Mfg Part Num**" serves as the primary key link to a part number in the parts database file. Each schematic part contains a **PARTNO** attributes that specifies the manufacturer part number in the parts database file. Thus, **PARTNO** attributes in a schematic serve as the primary key link to database records. The BOM viewer then displays any additional information from the database records based on the **PARTNO** key lookup.

The following example shows the header record and several record entries in a parts database file. Note that each record field, or column, is separated by tab character and serves as the field delimiter.

Mfg Part Num	Mfg Name	VID	Vendor Part Num	Description
ERJ-12SF48R7U	Panasonic - ECG	DK	P48.7ACCT-ND	RES 48.7 OHM 3/4W 1% 2010 SMD
ERJ-6ENF9312V	Panasonic - ECG	DK	P93.1KCCT-ND	RES 93.1K OHM 1/8W 1% 0805 SMD
C0805C101J5GACTU	Kemet	DK	399-1122-1-ND	CAP CERAMIC 100PF 50V NP0 0805
C0805C102K5RACTU	Kemet	DK	399-1147-1-ND	CAP 1000PF 50V CERAMIC X7R 0805

## Vendor ID Codes

The following Vendor ID codes are currently reserved for use by the BOM system to identify each vendor for a part during order export operations.

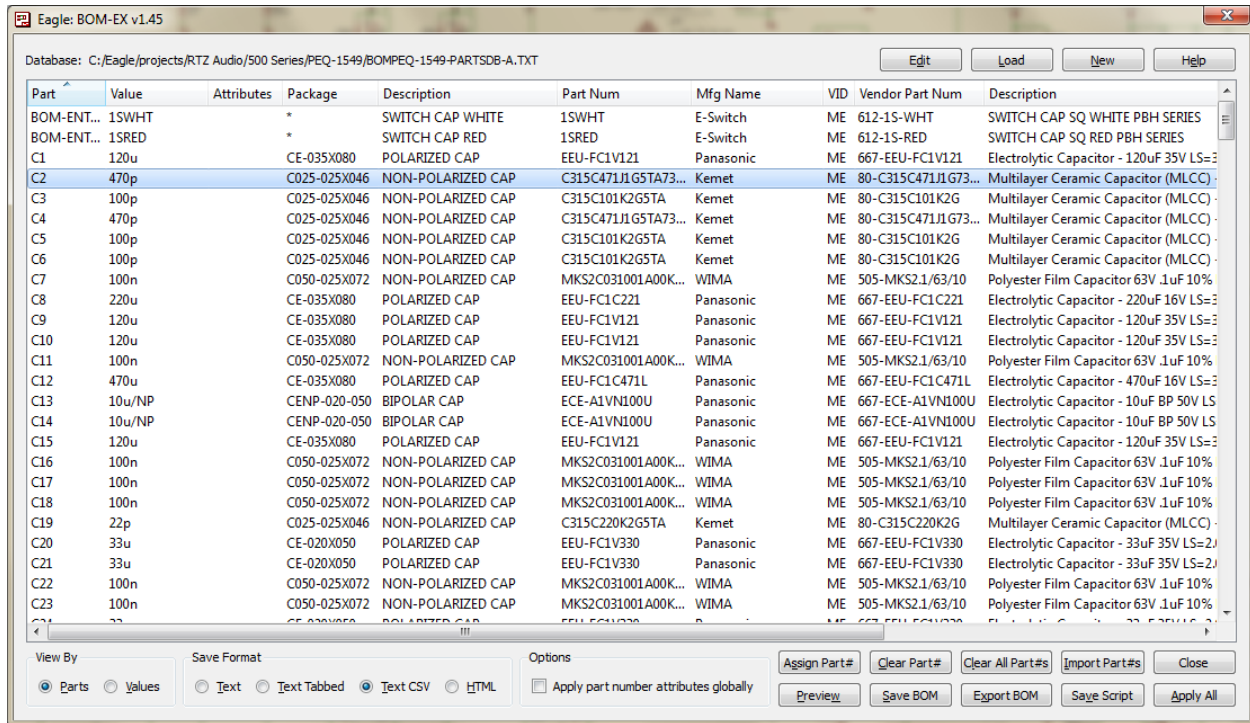
Vendor ID	Description
"*"	Generic – any vendor may supply
"NW"	Newark Corporation
"DK"	Digi-Key Corporation
"AE"	Allied Electronics
"ME"	Mouser Electronics

You may add as many new vendor type codes as needed or desired, but the above codes are reserved by the various order export generation routines. Note that an asterisk for the vendor ID indicates the part can be supplied by any of the vendors and will be generated in any of the parts order export files.

# Assigning and Applying Schematic Part Numbers

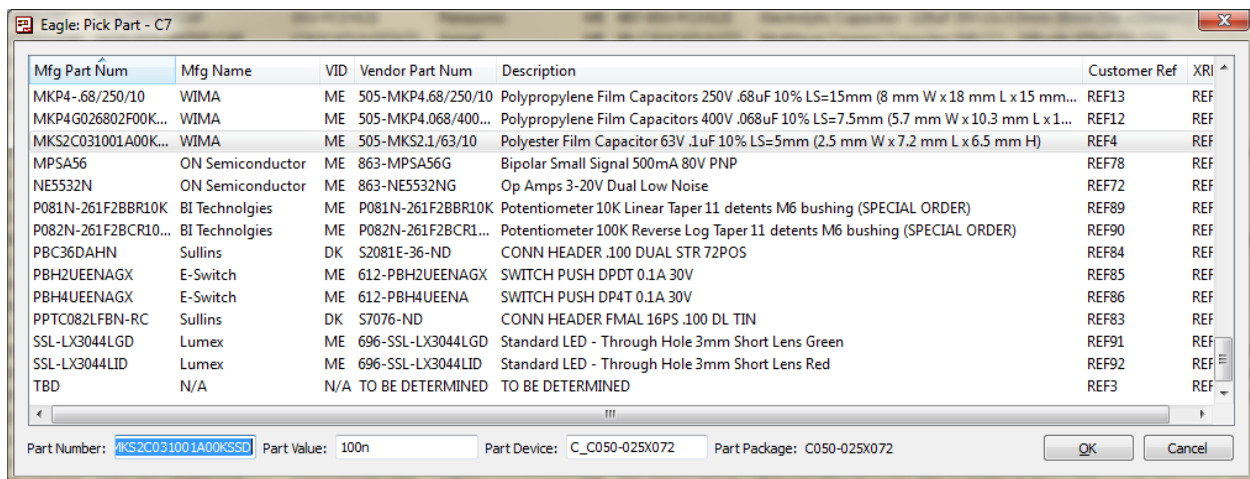
The BOM viewer allows you to assign any part number from parts in the database file by double clicking on any line item in the BOM viewer. If you make any part number changes in the BOM viewer, you must apply these updates or save the changes to a script file in order to update the part number attribute changes in the schematic. If you attempt to exit the program and any unsaved part number changes are present, you will be prompted and given the option to save the part number attributes to a script file that can be applied later.

Figure 4 - BOM Viewer Main Application Window



Click the **Apply All** button to exit the BOM viewer and apply all attribute changes to the schematic automatically. The **Save Script** button allows you to save the part number attributes to a script file at any time. You can execute a saved part number attribute script later from the schematic editor directly if desired to manually apply the part number attribute changes.

Figure 5 - Pick Part Dialog



You may also import Part ID's and Part Number data and then apply these to your schematic. Click the **Import** button to import part number information from a TAB text format file. This feature is handy if you have existing BOM data from a previous spreadsheet or other format and wish to import and assign part number information to your schematic automatically.

## Saving and Applying the Script

After assigning any part numbers to schematic parts in the BOM viewer, you can apply or save the part number assignment edit changes to a script file and/or apply these changes to your schematic by executing the generated script file within the schematic editor. Review the BOM report carefully after applying changes to ensure all part numbers are correct in your project and add/edit any new part number records to the master database file as needed.

The **Save Script** button allows you to save the generated script file. The script file can be executed later to apply all part number attribute updates in your design. This feature is useful if you wish to manually edit the script contents for some reason or review the results prior to applying updates.

The **Apply All** executes the script immediately and automatically applies all part number changes to the current design. Always review the BOM report after applying any changes to verify all parts are listed properly in the report.

## Importing Part Numbers

The BOM part number manager also allows you to import part number assignment data from an external import text file. This feature is useful if you already have BOM data available in a spreadsheet and wish to import and apply this information to an existing schematic that currently has no part number attribute data assigned. The import part number file must contain TAB delimited text data that specifies the component ID(s) and manufacturer part number associated with each component. The following table describes the import file header and data record structure.

Column	Field Name	Description
0	"Part Name"	This field is the primary database key and contains the manufacture part number for a part.
1	"Part Number"	This field contains the manufacturer name and is required for exporting BOM orders. Some vendors, like Digi-Key, require this field for order upload files.

The first line of the file must contain the header record field names followed by data records for each part number. A valid data file (with tab delimiters) might appear as follows:

```
Part Name  Part Number
R4  MCR10EZHJ000
R12      ERA-6YEB391V
"R3, R20"  ERJ-6ENF1001V
R1  ERJ-6ENF2211V
"R5, R7, R10, R15, R18, R26, R27, R28, R25 "  ERJ-6ENF4751V
```

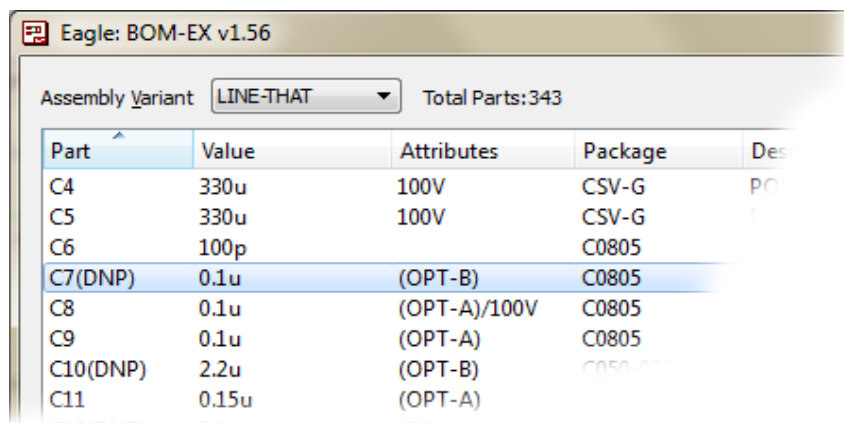
Note that a line may contain multiple part ID references for a single manufacturer part number. This allows you to assign the same manufacturer part number to many part ID's on a single line. Note that quotes are allowed for lines containing multiple part ID's with comma delimiters (standard Excel format). Once all part numbers have been imported, save the BOM manager script to a script filename and apply the script to your schematic.

## Assembly Variants in Eagle 6

Note that BOM-EX version 1.56 and above supports assembly variants. Assembly variants in Eagle 6 allow for multiple population and part value variations options for a given design. See the “*Edit->Assembly Variants...*” menu option in the schematic editor to create and manage assembly variants for your design.

BOM-EX generates all reports and data with respect to assembly variants and automatically displays DNP (do not place) suffixes on parts where appropriate. Thus, you can control all DNP features for parts using assembly variants if desired. However, parts may also still contain the “DNP” attribute which overrides any assembly variant value.

You can select the current variant of the BOM to view via the variant combo box in the upper left corner of the BOM-EX window as shown below:



Note that BOM-EX lists all variants of the assembly for the schematic design currently loaded. So, you must manage all variants in the schematic editor before invoking BOM-EX. All reports and order files are generated for the assembly variant currently selected by the Assembly Variant combo box.

## Part Number and Other Attributes

All schematic parts store the part number information using the **ATTRIBUTES** feature of Eagle. Specially, the BOM system uses the attributes **PARTNO** and **BOM**. The attribute **PARTNO** specifies a unique manufacturer part number for each component in a drawing. The **BOM** attribute allows you to exclude parts from the BOM listing. The exclude option is useful for components that don't require an actual part order, like SMD test points etc.

**Figure 6 – BOM Attributes**

Attribute Name	Value	Description
PARTNO	<i>{mfg-part-num}</i>	This attribute contains the actual manufacturer part number for a particular part. The value serves as the primary key in the part database for report listings and export order generation facilities. This value should be unique across all parts and vendors in the database.
BOM	EXCLUDE	This attribute is used to omit parts or items from the BOM report. Some parts, such as SMD test points, wire pads or other PCB features do not require an actual component and can be omitted from the BOM by adding this attribute and value to the part.
BOM	INCLUDE	The BOM reporting includes all parts by default, but this attribute/value can be used to indicate a part should be included in the BOM report. This may be useful for items that you need to temporarily exclude or include in a BOM when generating reports or exporting order files.
DNP	T	This attribute indicates a DO NOT PLACE part and the part ID will appear in the BOM report with "(DNP)" appended to indicate the part should not be placed.
DNP	F	Parts are assumed to require placement by default. Any value other than "T" indicates the part requires placement.

Note that **BOM-EX** will report all parts in a schematic regardless of whether or not the PARTNO attribute actually exists for a part. However, the PARTNO attribute is required if you wish to link schematic parts to a parts database to generate complete reports and export complete part order files. Therefore, it's important to consistently add and manage part numbers during the design stage of a project.

Keep in mind that the native part >VALUE (via CHANGE VALUE command) is used as a secondary comparison key for BOM listing also. If no PARTNO attributes are defined for a design, then the actual part value (e.g. 10uF for a capacitor) is used as the secondary key for sorting operations. The value field is also used when listing parts in list-by-value mode.

### Excluding BOM Entries

Any part can be excluded from the BOM report by adding the attribute **BOM[EXCLUDE]** to a part. The BOM processor assumes all parts will be included by default and the attribute BOM[INCLUDE] is treated the same as if no BOM attribute is present.



## Adding User Defined BOM Entries

The library **bom.lbr** is provided to allow adding ad-hoc BOM entries manually. Add the part **BOM\_ENTRY** to your drawing and assign it a **PARTNO** attribute as you would any other part. This is useful for adding additional parts to your BOM report that are not actually part of the schematic or board design itself (e.g. part enclosures, knobs, wall wart power supplies, etc).

## DNP (Do Not Place) Parts

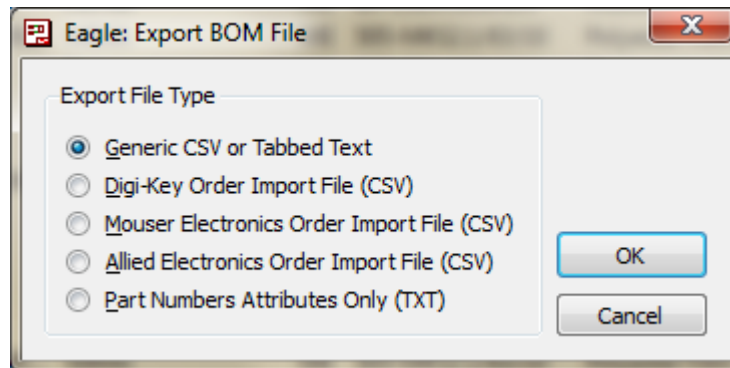
Parts can be flagged as DO NOT PLACE items by adding the attribute **DNP[T]** to a part. The BOM report processor will append the text "(DNP)" to the part ID name in the report indicating the part should not be placed.

You can also add optional place option description text with the attribute **PLACE[*text-string*]**. Any PLACE text will appear in the **Attributes** report column of the listing. This text should be kept short to avoid long text in the report. The report generator appends all known BOM attributes delimited by a slash in the attributes report column. Therefore, text should be kept brief to avoid wide strings of text in the attributes column.

Refer to the **ATTRIB-ADD** section of this document for complete information on the known BOM attributes recognized by the BOM processor. This utility allows you to quickly add BOM attributes to parts in your schematic.

## Exporting Order Files

**BOM-EX** supports a handy feature to generate part order upload files for several suppliers. Some supplier websites accept BOM order upload files that will pre-load part order data to simplify the ordering process for large part orders. Obviously the part database must contain valid part order data in order to use this feature. Once your part database contains complete part information, you can use the export feature to generate order upload file data. Click the Export button to export a BOM order upload file and a dialog similar to the following appears.



The "Generic" option exports all of the BOM data into a TAB or CSV delimited formatted file. You can then import this file into most any spreadsheet application for further manipulation, price analysis, etc. Other options allow exporting in various manufacturer specific order formats.

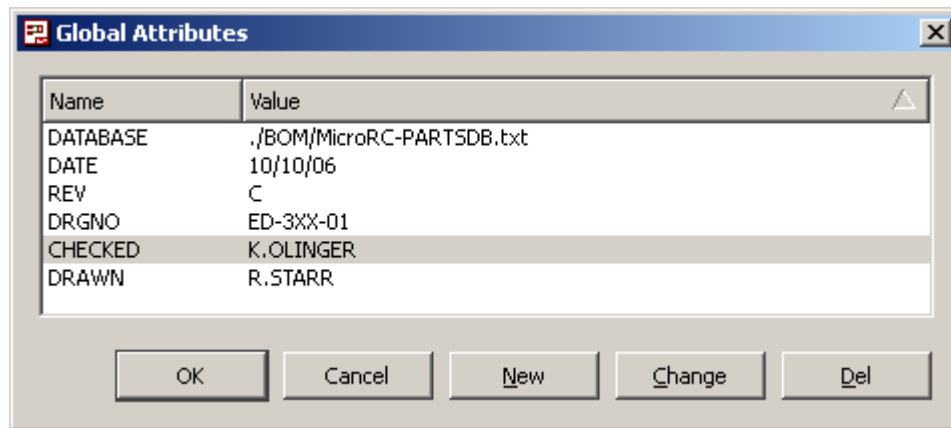
## Database Auto-Loading

You can have the database load automatically each time **BOM-EX** or **BOM-PARTNO-MGR** executes by defining the global variable “**DATABASE**” in your project schematic file. The database must reside in a subdirectory within your project directory if the pathname is prefixed with a period “.” character, otherwise the path name is assumed to specify a full working directory and path/file name.

### NOTE

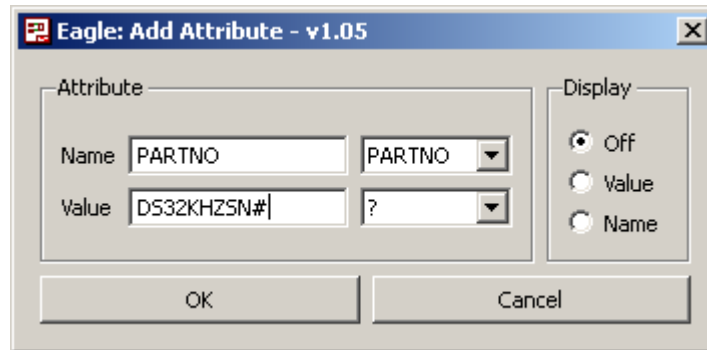
Use the forward slash character “/” for file and path names or the filename will not be display or be interpreted correctly under windows.

In the schematic editor, select the “Edit->Global Attributes” menu option and add a new global attribute with the name “DATABASE” and a the value set to your database subdirectory and filename. The example below shows a typical example for database auto-load filename.



## The ATTRIB-ADD Utility

The utility program **ATTRIB-ADD.ULP** provides a quick means to add a single part number and other component specific attributes to parts in a schematic. This utility works best by assigning the ULP to a keystroke or text menu so it's available quickly. Simply select a part, or group of parts, with the **GROUP** command and execute the **ATTRIB-ADD.ULP** program and the following dialog appears:



The combo boxes on the right hand side provide various default options for each field, or you can override these by typing the value in the edit fields in the left hand column. The example above shows a part number being adding to a resistor selected in the drawing. Note you can assign the same part number to several components at once by selecting a group of similar components with the group command prior to launching the ULP.

Note that **BOM-EX** recognizes all the “known” attributes available by the **ATTRIB-ADD** utility and these will appear in the attributes column of the BOM listing if defined for a part. The following list summarizes the attributes currently recognized by **BOM-EX**.

**Figure 7 - Known BOM Attributes**

Attribute Name	Description
PARTNO	Specifies the manufacture part number.
BOM	BOM listing control flags, see Figure 3 for options.
DNP	Do not place part flag (T or F Boolean)
PLACE	Generic place and stuff option descriptions.
TOL	Generic part tolerance field (1%, 5%, etc).
TC	Generic temperature field (X7R, NPO, etc).
VOLT	Generic voltage rating field (10V, 6.3V, etc)
RATE	Generic part rating field (1W, 5W, etc)
COLOR	Generic color field for LED's etc (RED, GRN, etc)
LABEL	Generic label text (for switch, controls, etc)
TYPE	Generic type field (POLY, TANT, FILM, etc)
SIZE	Generic size field (0805, etc)
LOAD	Generic load field (for xtals and such, 18pf, etc).
OPT	Generic option text (for any optional info)