VERGENT

PRODUCTS

Continually Elevating Return

CAD/CAM Interface

Computer Aided Design to Manufacturing Link

CAD/CAM for Product Designers

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INTRODUCTION

In order to reduce turn around times and to ensure precision placement of today's miniature surface mount devices, VERGENT PRODUCTS has adopted a Computer Aided Design (CAD) to Computer Aided Manufacturing (CAM) link.

This link enables Printed Circuit Board Assembly (PCBA) designers to use the coordinate information for component placement in the design tool to control the automated MYDATA brand pick and place equipment at VERGENT PRODUCTS with a proprietary CAD/CAM link.

Using the coordinates from the design tools eliminate time consuming and expensive manual training of the manufacturing equipment. It also eliminates potential for errors.

The aim of this guide is to help designers understand the process and data requirements to ensure a timely, error free, and efficient new product introduction into VERGENT PRODUCTS PCBA process.

REFERENCES

TERMS and DEFINITIONS

BOM: Bill of Materials.

ERP: Enterprise Resource Planning System

PCB: Printed Circuit Board. Refers to the raw board after fabrication and before assembly.

PCBA: Printed Circuit Board Assembly. Refers to a fully loaded printed circuit board.

PFC: Press Fit Connector. A type of connector that is press-fit into the board thereby eliminating the need to solder it.

PIP: Pin-In-Paste. Refers to a process where solder paste is applied to pin through hole components.

PTH: Pin Through Hole. A PCBA assembly process where the devices are connect by leads that protrude through the PCBA and are soldered on both sides.

SMT: Surface Mount Technology.   A PCBA assembly process where the devices a placed on the surface of the PCB and soldered to a pad.
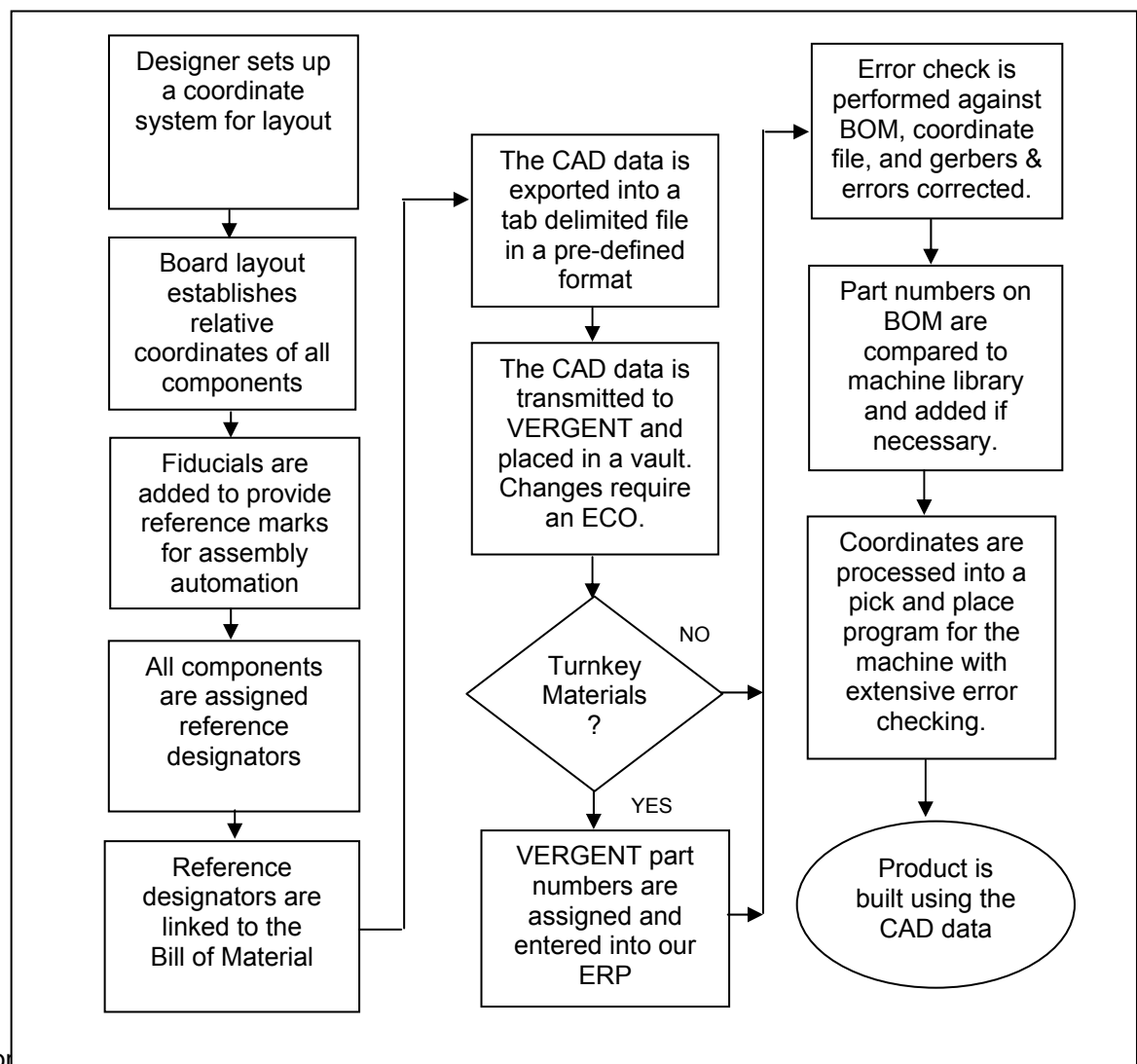
WHAT SHOULD I KNOW AND EXPECT?

Successful CAD/CAM data transfer depends on data integrity and continuity. Data may originate from multiple sources and be stored in a variety of places throughout the process. Very strict conventions and data definitions are required.

The pick and place CAD/CAM interface is relatively simple. It requires the designer to establish a useable coordinate system during the layout of the PCBA then merge the coordinates with the BOM and reference designators. Many of the popular layout tools have this feature built in.

CAM uses automated equipment to handle and align the PCBAs. This automated equipment requires the use of alignment marks or "fiducials". Some PCB fabricators will add the fiducials automatically, some will not. Therefore, it is always best for the designer to add the fiducial marks and export their coordinates along with the component coordinates.

The process looks like this:

```
┌─────────────────┐                                      ┌──────────────────┐
│ Designer sets up│                                      │  Error check is  │
│  a coordinate   │                                      │ performed against│
│system for layout│                                      │ BOM, coordinate  │
│                 │                                      │ file, and gerbers│
└────────┬────────┘         ┌─────────────────┐          │  & errors        │
         │                  │ The CAD data is │          │  corrected.      │
┌────────┴────────┐         │ exported into a │          └────────┬─────────┘
│  Board layout   │         │ tab delimited   │                   │
│   establishes   │         │ file in a       │          ┌────────┴─────────┐
│   relative      │         │ pre-defined     │          │ Part numbers on  │
│coordinates of all│        │ format          │          │     BOM are      │
│  components     │         └────────┬────────┘          │  compared to     │
└────────┬────────┘                  │                   │ machine library  │
         │                  ┌────────┴────────┐          │   and added if   │
┌────────┴────────┐         │ The CAD data is │          │   necessary.     │
│  Fiducials are  │         │ transmitted to  │          └────────┬─────────┘
│ added to provide│         │ VERGENT and     │                   │
│ reference marks │         │ placed in a     │          ┌────────┴─────────┐
│  for assembly   │         │ vault. Changes  │          │ Coordinates are  │
│   automation    │         │ require an ECO. │          │ processed into a │
└────────┬────────┘         └────────┬────────┘          │ pick and place   │
         │                           │                   │ program for the  │
┌────────┴────────┐              NO  │                   │ machine with     │
│ All components  │          ◇───────┘                   │ extensive error  │
│  are assigned   │        ◇ Turnkey ◇──── NO            │ checking.        │
│   reference     │        ◇Materials◇                   └────────┬─────────┘
│  designators    │          ◇  ?   ◇                             │
└────────┬────────┘            ◇───◇                     ┌────────┴─────────┐
         │                  YES │                        │   Product is     │
┌────────┴────────┐    ┌────────┴────────┐               │  built using the │
│   Reference     │    │  VERGENT part   │               │    CAD data      │
│  designators are│    │  numbers are    │               └──────────────────┘
│  linked to the  │    │  assigned and   │
│ Bill of Material│    │  entered into   │
└─────────────────┘    │   our ERP       │
                       └─────────────────┘
```

DATA REQUIREMENTS

Data fields

The following data fields must be exported in the following order into a single tab delimited file:

1) Reference Designator (ie: "R1", "R2", "C1", "U1", etc)
2) A unique part number. This is the VERGENT PRODUCTS part number for turnkey products.
3) Description of the unique part number (ie: "RES, 10K 1% 1/10W 0603")
4) Board side for the given reference designator. This will be one of two values:
   a) "T" for component side or top.
   b) "B" for circuit side or bottom.
5) X Coordinate in mills
6) Y Coordinate in mills
7) Orientation in degrees (ie: "0", "90", "180", "270")
8) Polarity flag. This will be one of two values:
   a) ""Y" for components that are polarity sensitive. (ie: Diodes, LED's, IC's)
   b) "N" for components that do not matter. (ie: Resistors, certain capacitors)

A sample file is given in Appendix A.

PCBA Fiducials

PCBA should be designed with at least two 50 mill round fiducials.

The fiducials should be spaced as far apart as possible but within .250" from board edges.

The solder mask must be clear over the top of the fiducial.

Fiducials should be identified using the part number "FIDUCIAL" and a unique reference designator.

Component labels

To ensure data integrity the labels on all part containers must match the BOM exactly. Abbreviations shall not be used.

SUGGESTED PRACTICES

Component presentation

The presentation of a component (reel, tube, tray, other) is critical to automation. If a component is presented in a different manner then the machine program must be changed each time. Where possible standardize on a particular presentation and enforce it in your BOM.

Cut tape

If components are inexpensive consider purchasing an entire reel as opposed to cut tape. While the cut tape may appear less expensive on the surface it can result in significant delays and costs overruns. Here is a real example for a 10K ohm 0603 resistor:

- ❑ Cut tape: 10 strips of 10 at \$.70 each.   Price: \$ 7.00.
- ❑ Reel: 5000 parts.   Price: \$15.60.

The reality is quite different because it takes time to handle and manage the cut tape:

- ❑ Cut tape cost: \$ 7.00 parts + \$17.00 handling + \$104.00 feeder setup = \$128.00
- ❑ Reel cost: \$ 15.60 parts + \$ 1.70 handling + \$ 10.40 Feeder setup = \$27.70

Sometimes the component cost makes purchasing a reel prohibitive. In that case VERGENT PRODUCTS recommends purchasing a minimum of 100 pieces or the quantity required plus 20% in a contiguous strip.

Silkscreen

Reference designators should be places on the silk screen along with very clear polarity markings using IPC industry standards.

"Do Not Load" (DNL)

Components that have reference designators or a place to be loaded but will not be loaded must be clearly identified on the BOM. The nomenclature used in the industry is "DNL" for the part number. VERGENT PRODUCTS strongly recommends that all reference designators have part numbers assigned including the DNL.

VERGENT PRODUCTS has assigned the part number 999-99-99999 as the dummy part number for DNL.

APPENDIX A - SAMPLE CAD/CAM FILE

Ref. Des.	Part Number	Part Description	Board Side T=Top; B= Bot	Position X (mills)	Position Y (mills)	Orientation (degrees)	Polarity Y = Yes; N = No
C1	000-02-09520	CAP_TANT_10UF_16V_SMT_3528	T	493.75	5100	90	N
C10	000-02-01560	CAP_CER_22PF_50V_0805	T	1950	3975	90	N
C11	000-99-00016	CAP_CER_0.1_50V_X7R_0805	T	850	3900	90	N
F1T	FIDUCIAL	Lower right fiducial	T	2344	2650	270	N
F2T	FIDUCIAL	Upper left fidicual	T	713	3569	270	N
F1B	FIDUCIAL	Lower right fiducial	B	167	472	270	N
F2B	FIDUCIAL	Upper left fidicual	B	3061	5394	270	N
Q1	000-99-00580	MOSFET-N_FDV301	T	2625	2125	270	Y
Q2	000-99-00580	MOSFET-N_FDV301	T	2625	1950	270	Y
Q3	000-02-09555	MOSFET-P_FDN302P	T	2600	475	90	Y
R1	000-02-01369	RES0805_0OHM_1/8W	T	900	5575	90	N
R10	000-99-00612	RES0805_1M_1/10W	T	2625	4275	90	N
R11	000-02-01369	RES0805_0OHM_1/8W	T	1200	4200	90	N
R12	000-02-00659	RES0805_100_1/10W	T	2625	4150	270	N
R13	000-99-00609	RES0805_5.1M_1/8W	T	1725	3975	270	N
U1	000-99-00607	IC_REG_PQ09RD21	T	700	4800	90	Y
U2	000-02-09549	IC_LMC7215	T	2075	4675	0	Y
U3	000-02-09550	IC_LT1521CST-3.3_REGULATOR_3.3V_300MA	T	1675	4575	180	Y
U4	000-99-00576	IC-TPS3836_SUPERVISORY_CIRCUIT	T	850	3625	180	Y
U5	000-99-00608	IC-MSP430X14X_UP	T	1750	3350	270	Y
Y1	000-02-09546	CRYSTAL_CSM_4MHZ	T	1750	3825	270	N