

Concept to Commercialization

Topics

Product Development : A Bumpy Path

Developing Specifications

Prototype Iteration

Design for Manufacturability

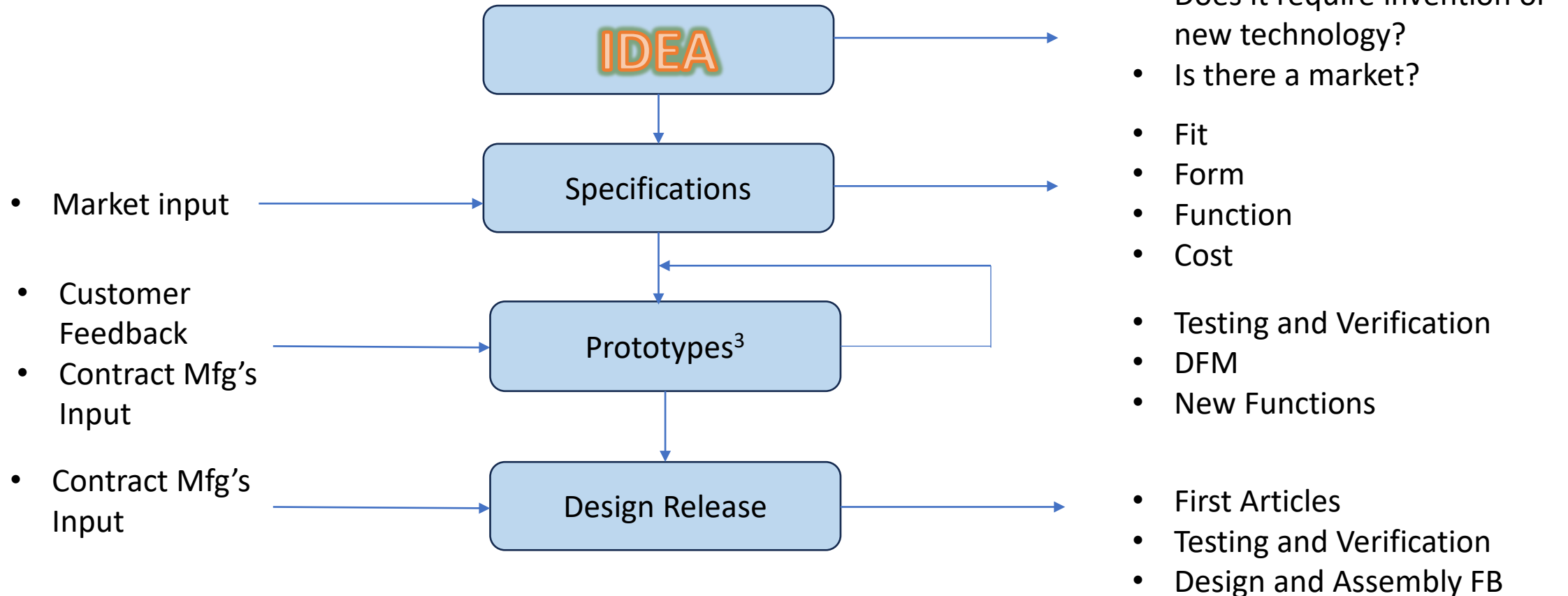
Drawing & Specification Packages

Product Certifications

IP Protection

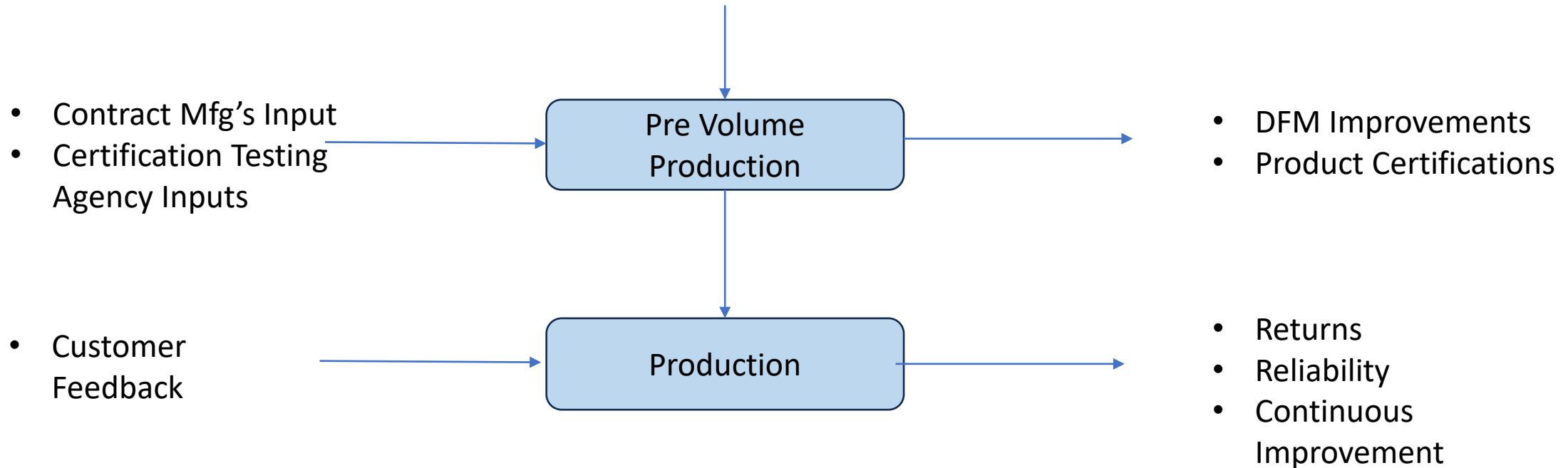
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Product Development



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Product Development



Developing Specifications

- Blue Print Outlining Product
- Business Case
- User Requirements
 - Who and Benefit
- Initial Drawings or Mockup
- Technical Specifications

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Developing Specifications

- Technical Specifications
 - Functionality
- User Interface
 - Controls
 - GUI or Displays
- Electrical Characteristics
 - Power Requirements
 - Operating Frequency
 - Connectivity
- Mechanical
 - Materials
 - Form and Dimensions

Developing Specifications

- Technical Specifications (cont.)
 - Software Requirements
 - Embedded
 - Application
 - Web Interface
 - Environmental
 - Temperature/Humidity
 - IP Rating
 - Disposal and Recycle
- Test and Verification
- Product Reliability
- Cost

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Prototype Realization

- Plan on Multi-Passes
 - Requirement Changes
 - Continuous Learning
 - DFM and Contract Mfg. Feedback
 - Customer Feedback
 - Mistakes
- Consider Potential Supply Chain Issues Early
 - Consider Defining Alternates Components
- Consider Cost/Performance Tradeoffs at Every Step

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Design for Manufacturability

- For Print Circuit Designs
 - Avoid use of minimum dimensions
 - PC land spacings and widths
 - Minimal sized components (0402, 0201)
 - Avoid thru-hole components (where possible)
 - Integrate Connectors, Switches, LED and displays on the board
 - Less Costly to place components on one side of board (where possible)
 - Minimize board wiring layers
 - Consistency in Meeting Requirements
 - Tolerances, Temperature ranges, Reliability

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Design for Manufacturability

- For Mechanical Designs
 - Avoid use of minimum dimensions and tolerances
 - Consider best material tradeoffs
 - Molding vs CNC
 - 3D print all prototypes (where practical)
 - Determine the IP rating which meets requirements
 - Electrical and Mechanical safety considerations

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Drawing and Specification Packages

- **Contact your Contract Manufacturer for Requirements and Formats**
- Printed Circuit Boards (Generated by PC CAD tool)
 - Bill of Materials (BOM)
 - Build Parameters (Generally Defined within the Design files or BOM)
 - Board Dimensions – Outline shape
 - Location of alignment fiducials (Mfg. dependent)
 - Base material, layers, color, thickness, copper weight, silkscreen color, surface finish.....

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Drawing and Specification Packages

BOM For PCB Example

Project Name:		Switchboard A002_1.PrjPcb				Blue Indicates changes from previous revision Pink indicates DNP and Do Not Order		
Current EC Level:		A002_1						
Date:		8/1/2023		Time:		1:39 PM		
Item #	Designator	Description	Manufacturer	PartNumber	Quantity	Generic	Assembly	EC Status
1	R20	Res 2.74Kohms SMD 0603 1/10 Watt 1% Tolerance	Panasonic - ECG	ERJ-3EKF2741V	1	Yes	PCB	A002_1
2	R19	Res 19.1Kohms SMD 0603 1/10 Watt 1% Tolerance	Panasonic - ECG	ERJ-3EKF1912V	1	Yes	PCB	A002_1
3	R7	Res 100 ohms SMD 0603 1/10 Watt 5% Tolerance	Panasonic - ECG	ERJ-3GEYJ101V	1	Yes	PCB	A000
4	R16, R21	Res 100K ohms SMD 0603 1/10 Watt 1% Tolerance	Panasonic - ECG	ERJ-3EKF1003V	2	Yes	PCB	A002_1
5	R1, R2, R3, R4, R5, R6, R17	Thick Film Resistors - SMD 0603 330ohms 1% AEC-Q200	Panasonic	ERJ-3EKF3300V	7	Yes	PCB	A000
6	R8, R9, R10, R11, R12, R13, R14	91 Ohms ±5% 0.5W, 1/2W Chip Resistor 1210 (3225 Metric) Automotive AEC-Q200 Thick Film	Panasonic Electronic Components	ERJ-14YJ910U	7	Yes	PCB	A000
7	C4, C5, C6, C11, C12, C13, C14, C19, C20, C21, C22, C24, C25	0.1µF -20%, +80% 25V Ceramic Capacitor Y5V (F) 0603 (1608 Metric)	AVX Corporation	C0603C104Z3VACTU	13	Yes	PCB	A000
8	C1, C3	CAP CER 100nf 50V SMD 0805	Kemet	C0805C104M5RACTU	2	Yes	PCB	A002_1
9	C9	CAP CER 1.0UF 16V SMD 0805	Kemet	C0805C105K4RACTU	1	Yes	PCB	A000
10	C17	CAP CER 10nf 50V SMD 0805	TDK	CGA4C2C0G1H103J060AA	1	Yes	PCB	A002_1
11	C16	CAP CER 200pf 50V SMD 0805	Samsung Electro-Mechanics	CL05C201JB5NNNC	1	Yes	PCB	A002_1
12	C10, C23	10µF Molded TantalumCapacitors 16V 1206 (3216 Metric) 30hm @ 100kHz	Taiyo Yuden	LMK316AB7106MLHT	2	Yes	PCB	A002_1
13	C7, C8, C15	Capacitors Ceramic 10V 1206 (3216 Metric)	MuRata	GRM31CR71A106KA01L	3	Yes	PCB	A002_1
14	C18	330µF 50V Aluminum Electrolytic Capacitors Radial, Can - SMD	Panasonic	EEETK1H331AQ	1	Yes	PCB	A002_1
15	C2	CAP TANT 10UF 10% 35V 2917	Vishay	593D106X9035D2TE3	1	Yes	PCB	A002_1
16	JS4(DNP)	Headers & Wire Housings FOB, THT, 8P	TE Connectivity	215079-8	1	No	JS4 DNP	A000
17	PCB1	FR4; 2 layer; 1.6mm Thickness; 1 oz Copper; Size 270mm by 50mm; Gold contacts; Plated vias; Board Color - Black; Overlay Color - White	Generic	MMM Main Board Rev A-000	1		PCB	A000

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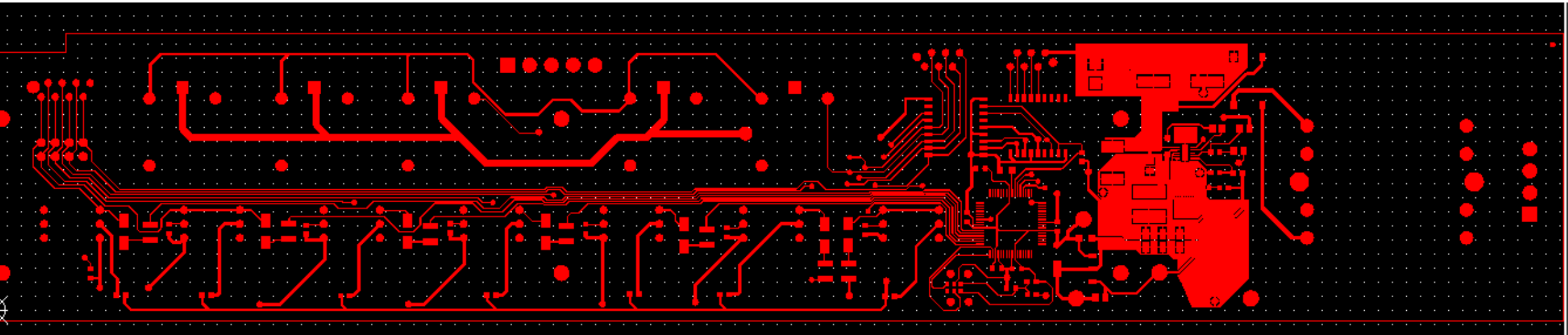
Drawing and Specification Packages

- Printed Circuit Boards (cont.)
 - Gerber files – Digital text files for each build layer
 - Drill Files – size and location of all holes
 - Pick and Place Files – Digital text file indicating location and orientation of each component
 - Board Test Requirements & Netlists
 - Schematics – Optional but useful for test and debug

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Drawing and Specification Packages

Gerber Design File



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Drawing and Specification Packages

- Printed Circuit Boards (Optional)
 - Functional Test specification
 - Embedded Software
- Popular PCB Design Tools
 - KiCAD – Free
 - AutoDesk Eagle
 - Fusion 360
 - Solid Works PCB
 - Cadence
 - Altium Designer
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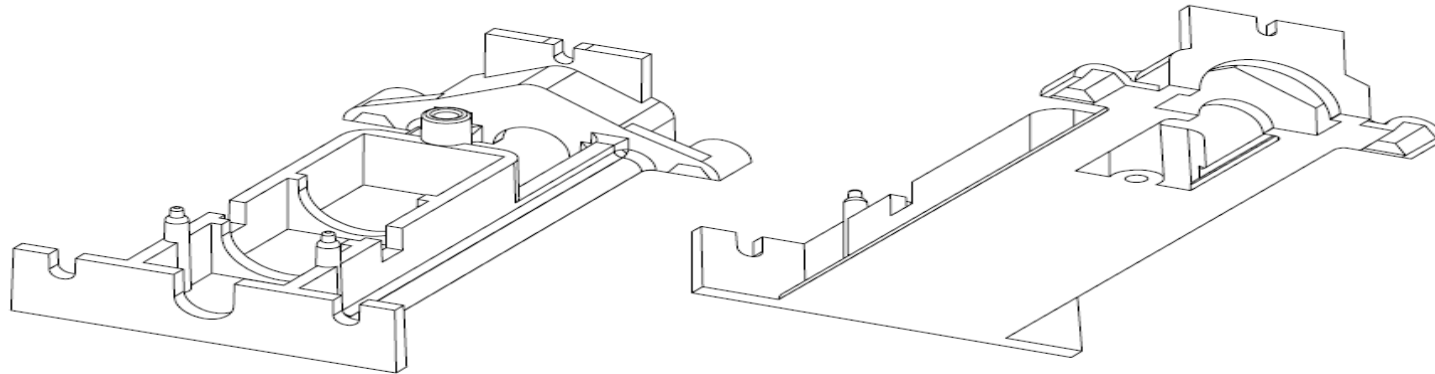
Drawing and Specification Packages

- Mechanical Designs
 - BOM – Include ALL components and material necessary for complete build and assembly
 - Identifier, Description, Supplier, Part Number, Material
 - Trimetric (3D) View
 - Orthographic View
 - Section views
 - Detail views
 - Show all necessary dimensions
 - Include critical tolerances
 - Avoid over dimensioning

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Drawing and Specification Packages

Trimetric Views



PROPRIETARY AND CONFIDENTIAL
THE INFORMATION CONTAINED IN THIS
DRAWING IS THE SOLE PROPERTY OF
<INSERT COMPANY NAME HERE>. ANY
REPRODUCTION IN PART OR AS A WHOLE
WITHOUT THE WRITTEN PERMISSION OF
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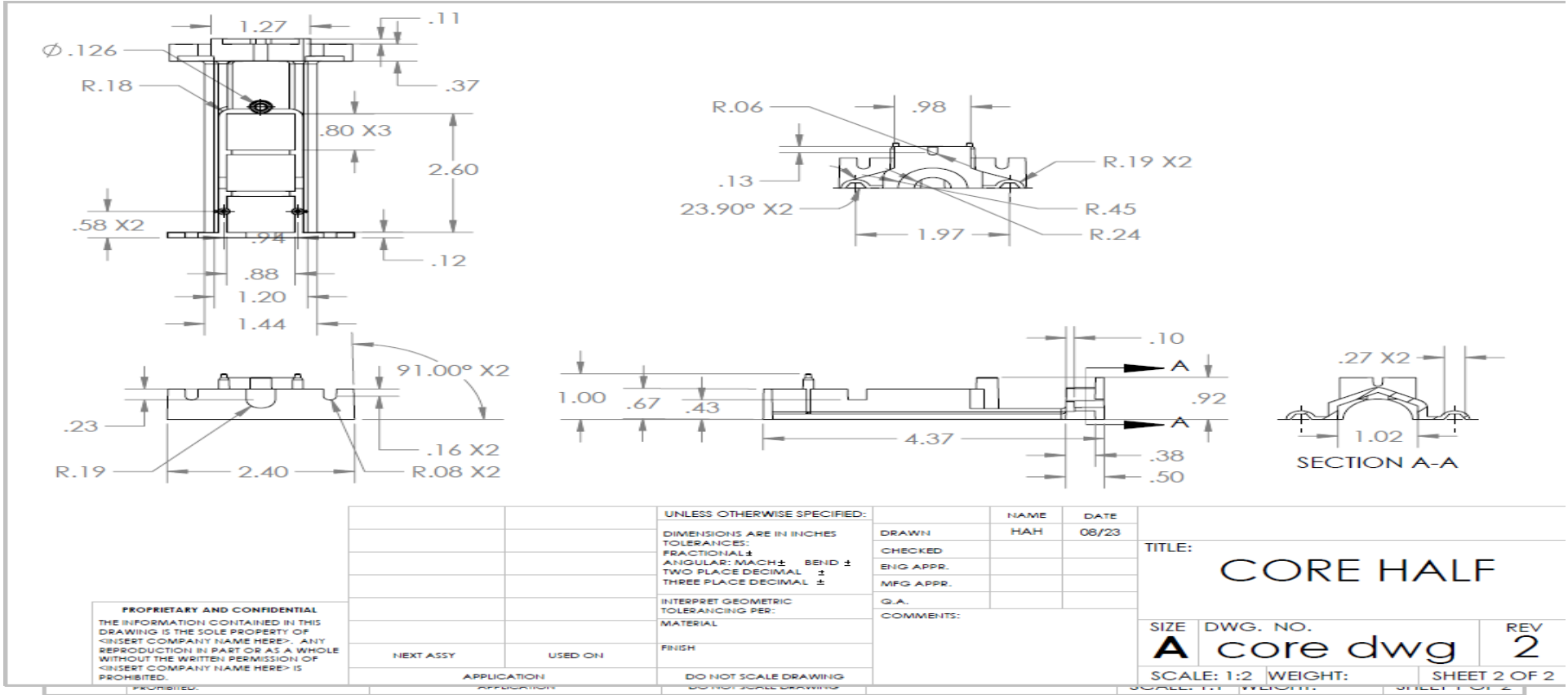
		UNLESS OTHERWISE SPECIFIED:	DRAWN	NAME	DATE
		DIMENSIONS ARE IN INCHES	CHECKED	HAH	08/23
		TOLERANCES:	ENG APPR.		
		FRACTIONAL ±	MFG APPR.		
		ANGULAR: MACH ± BEND ±	G.A.		
		TWO PLACE DECIMAL ±	COMMENTS:		
		THREE PLACE DECIMAL ±			
		INTERPRET GEOMETRIC TOLERANCING PER:			
		MATERIAL			
		FINISH			
NEXT ASSY	USED ON				
APPLICATION		DO NOT SCALE DRAWING			

TITLE:		
CORE HALF		
SIZE	DWG. NO.	REV
A	core dwg	2
SCALE: 1:1	WEIGHT:	SHEET 1 OF 2

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Drawing and Specification Packages

Orthographic View



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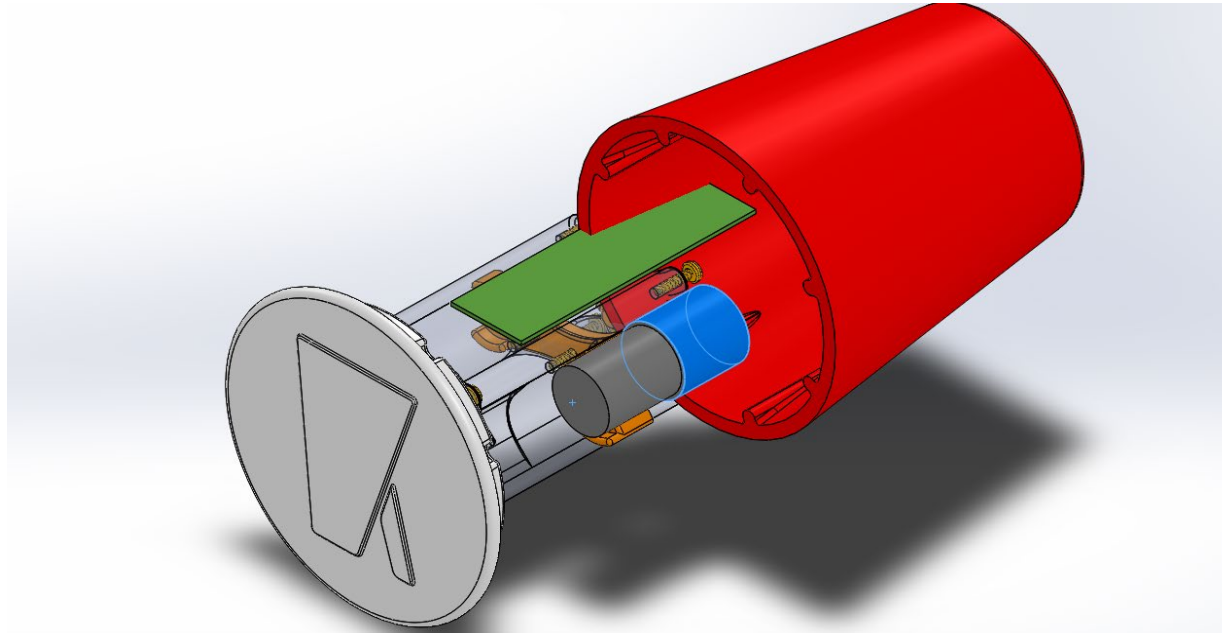
Drawing and Specification Packages

- Popular Mechanical CAD Tools
 - SolidWorks
 - AutoCAD
 - CATIA
 - Fusion 360
 - FreeCAD, NanoCAD, 3D Crafter – Free
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- Popular Interchange file formats
 - .STL - universal for 3D files basic forms
 - .STEP – widely used supporting part and assembly files
 - .DXF - 2D shapes
 - .PDF - Simple viewing
 -

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Drawing and Specification Packages

- Assembly Instructions
 - Basic how to steps
 - Develop details with contact manufacturer with photos
 - Exploded Renderings



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Drawing and Specification Packages

- Functional Test - Example for Electro-Mechanical Product
 - Develop with Contract Manufacturer
 - Schematics
 - Component
 - Voltage and Current requirements
 - Power Connections
 - Colling Requirements
 - Embedded Software Loading
 - Inputs stimulations
 - Functional Results
 - Output Loading and Responses
 - Display and Indicator Reponses
 - Wireless Connections
 - Package integrity
 -

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Certifications

- **Consider Up Front**
 - Where will this product be sold
 - What certifications are required
- Test must be preformed on products from the manufacturer of record
- Basic Areas to consider
 - Product Safety – Electrical, Mechanical, Material, Fire Hazard
 - Electrical Resilience (ElectroMagneticCompatibity, LowVoltageDirective)
 - Electrical Interference - FCC
 - Environmental
 - REACH – Restricted Chemicals
 - RoHS – Hazardous materials in electronic components
 - WEEE – Waste disposal and recovery
- CE Certification – European Conformity
 - Self Certification supported by reports from Recognized Test Agencies
- India and China developing new standards
- Testing Agencies - UL vs. TUV vs. Independent Test Labs

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IP Protection

- NDA – Non-Disclosure Agreement
 - Agreement to protect and not disseminate confidential information for a specific period of time or until product becomes public
 - Strongly recommend NDAs with all contract manufacturers and design resources
- Patents
 - Grant the legal right to exclude anyone else from manufacturing or marketing your unique tangible things.
 - **Utility - protects the function of a machine or process**
 - Provisional – less formal proves inventor was in possession of the invention with one year to file formal utility patent
 - Design - Ornamental design on a useful item
 - Plant – New types of plants
- Copyrights
 - Protects written or artistic expressions fixed in a tangible medium
- Trademarks
 - Names, phrases, sounds or symbols used in association with services or products

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Summary for Success

Identify your Market and Get Early Customer Input

Develop Detailed Specifications and Planned Path to Commercialization

Engage your Contract Manufacturer(s) Early

Be Prepared for Multiple Design Iterations with Customer and Contract
Manufacturer Feedback

Always Design for Manufacturability

Understand Product Certification Requirements