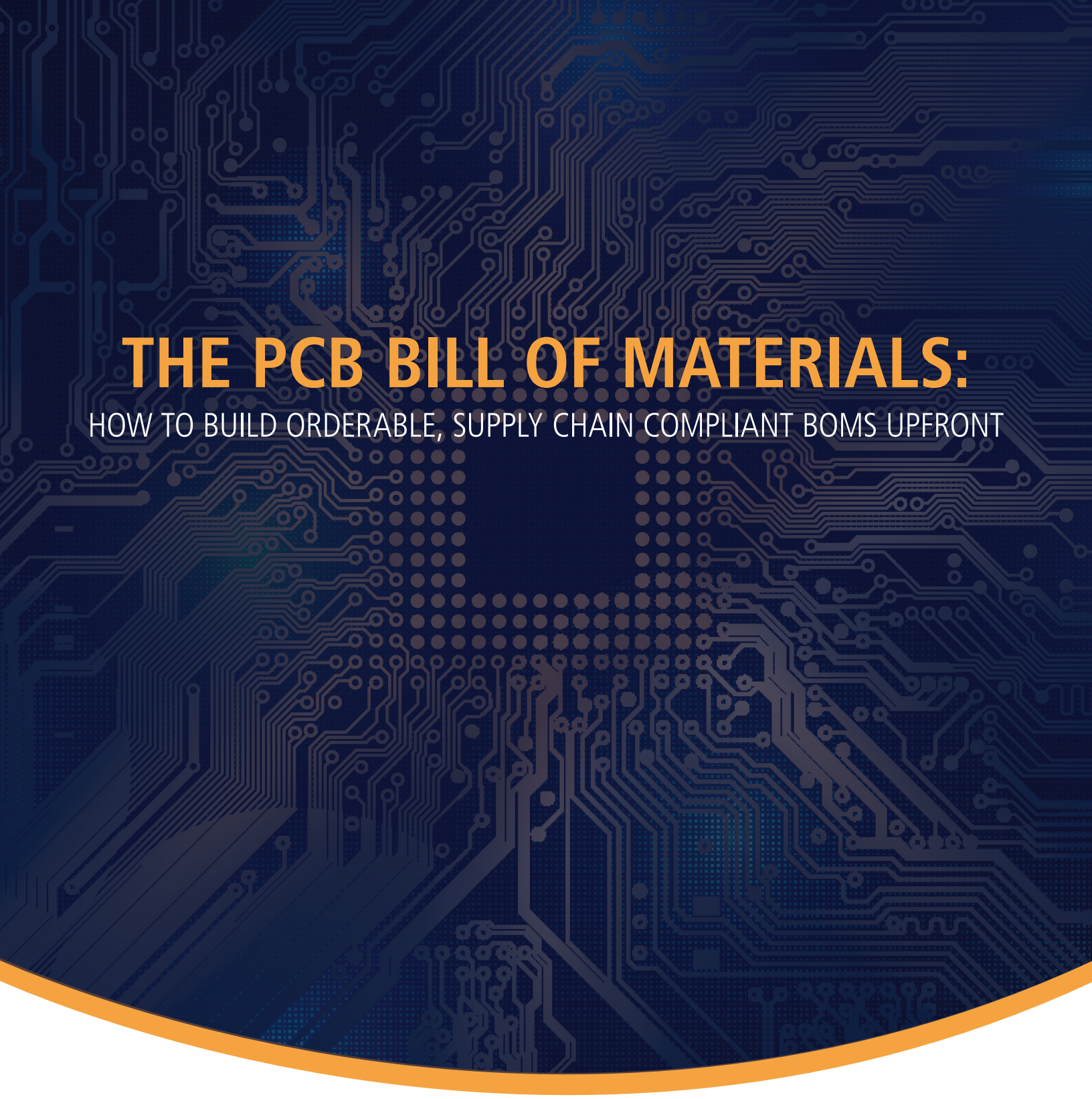

THE PCB BILL OF MATERIALS:

HOW TO BUILD ORDERABLE, SUPPLY CHAIN COMPLIANT BOMS UPFRONT

EMA Design Automation®

THE PCB BILL OF MATERIALS

HOW TO BUILD ORDERABLE, SUPPLY CHAIN COMPLIANT BOMS UPFRONT

At any given time, engineers face many typical design pressures:

- Function
- Performance
- Form Factor
- Signal & Power Integrity
- Quality
- Reliability
- DFM
- Test
- Cost
- Time

However, there is an often-hidden pressure: **sourcing components on time and on/ under budget.**

This e-book will discuss what to consider during component selection to consistently build orderable and complete BOMs — streamlining part procurement and getting your team on the fast track to design success.

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BILL OF MATERIALS
WHAT IS A BOM?

Unfortunately, almost every engineer has encountered project delays due to supply chain issues at some point in their careers; but it doesn't have to be this way. By learning about the common causes of BOM rejection and how to prevent them, you can create a supply chain compliant BOM quickly, streamline part procurement, and keep your designs on track. But first we must understand the BOM creation and approval process.

The Bill of Material or BOM is a list containing all the items needed to manufacture the PCB. The BOM communicates the parts required for the PCB design to both the purchasing team to source the components for production as well as the manufacturing team to provide helpful insights throughout the assembly process.

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Item Number	PART_NUMBER	Part Reference	Quantity	Value	Description	Manufacturer	Manufacturer PN	Distributor	Distributor PN	Price
1	EMA-00000454	C1 C2	2	1.0uF	CAP, Tantalum, SMD, 1.0 uF, 20 %, 20 V, 3216-18	AVX	TAJA105M020R	Digi-Key	TAJA105M020R-ND	0.38
						AVX	TAJA105M020R	Mouser	581-TAJA105M020R	0.35
2	EMA-00000399V22	C3 C4 C5 C6	4	0.1uF	CAP, Ceramic, SMD, 0.1 uF, 10 %, 16 V, 0603	AVX	0603YC104KA72A	Mouser	581-0603YC104KA72A	0.1
3	EMA-00000407V22	C7 C8 C9 C10	4	0.1uF	CAP, Ceramic, SMD, 0.1 uF, 5.0 %, 50 V, 0805	AVX	08055C104JA72A	Mouser	581-08055C104JA72A	0.1
4	EMA-00000403	C11 C12 C13 C14	4	0.1uF	CAP, Ceramic, SMD, 0.1 uF, 10 %, 25 V, 0805	AVX	08053C104KAT2A	Mouser	581-08053C104K	0.1
						AVX	08053C104KAT2A	Digi-Key	478-KGM21NR71E104KTTR-ND	0.1
						AVX	08053C104KAT4A	Digi-Key	478-KGM21NR71E104KMTR-ND	0.1
5	EMA-00005995	J2	1	15-24-7240	CONN, Header, 15-24-7240, 24, TH	Molex Inc	15-24-7240	Digi-Key	23-0015247240-ND	5.23
						Molex Inc	15-24-7240	Mouser	538-15-24-7240	3.66
6	EMA-00006083V22	P1	1	53261-0819	CONN, Header, 8, SMD	Molex Inc	532610871	Digi-Key	WM7626TR-ND	0.93
7	EMA-00002890V22	R1 R2 R3 R4	4	41.2kOhm	RES, Thin Film, 41.2 kOhm, 0.1 %, 1/16 W, SMD, 0603	Koa Speer	RN731JTTD4122B25	Digi-Key	2019-RN731JTTD4122B25TR-ND	0.2
8	EMA-00007179	U2	1	27C801	IC, Memory Devices, EEPROM, 27C801, DIP-32	STMicroelectronics	M27C801-100F1	Digi-Key	497-1688-5-ND	32.1
						STMicroelectronics	M27C801-100F1	Mouser	511-M27C801-10F	33.5
9	EMA-00007402	U3	1	XC18V01	IC, Memory Devices, PROM, XC18V01, SOIC-20	Xilinx	XC18V01SOG20C	SiliconExpert	122-1464-ND	71.25
10	EMA-00006523	U4	1	EPCS4	IC, Programmable Devices, Config Device, EPCS4, SOIC-8	Altera Corporation	EPCS4SI8N	Mouser	989-EPCS4SI8N	9.25
						Altera Corporation	EPCS4SI8N	Digi-Key	544-1379-5-ND	8.64
11	EMA-00006788V22	U5	1	LT1763	IC, Voltage Regulator, Linear-LDO, LT1763, SOIC-8	Linear Technology	LT1763CS8-3#TRPBF	Digi-Key	LT1763CS8-3#TRPBF-ND	3.78
						Linear Technology	LT1763CS8-3#PBF	Digi-Key	LT1763CS8-3#PBF-ND	6.83
						Linear Technology	LT1763CS8-3#PBF	Mouser	584-LT1763CS8-3#PBF	6.82

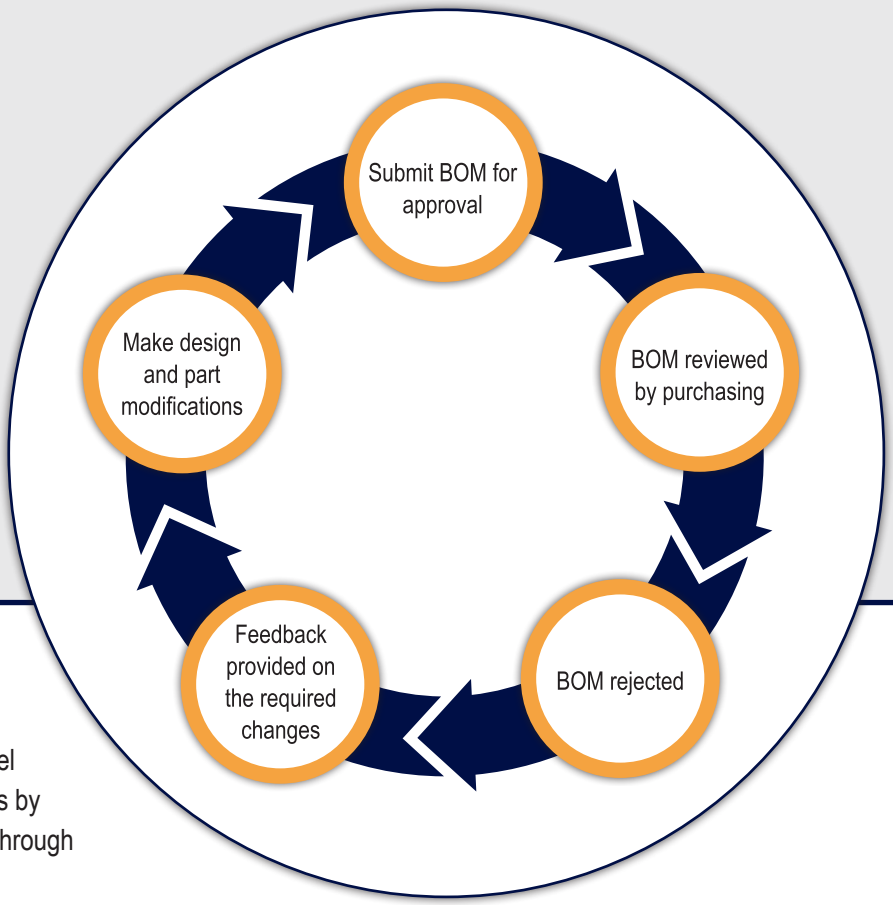
Therefore, the BOM should be in a shareable format, such as an excel file, and contain all the information required to purchase and assemble the components on the PCB such as:

- Reference Designators
- Part Values
- Part Descriptions
- Quantities
- Manufacturer
- Manufacturer Part Number
- Distributor Information
- Price

Defining this data upfront during the PCB design process will allow purchasing to procure the required components in time for production; however, this is where problems start to occur.

BILL OF MATERIALS
SUBMIT, REJECT, REPEAT

After the BOM is completed, it must be submitted for approval and purchasing. From here, we can look at a theoretical scenario not very far off from many engineers' experiences.



First, the supply chain or procurement personnel evaluate the ability to purchase the components by reviewing the following fields on the BOM and through part research:

- Part Quantity
- Availability
- Lead Time
- Cost
- Distributor Information
- Manufacturer Information
- Part Status
- Compliance

After review, the BOM is either accepted or rejected based on the purchasing criteria of the project or company. If the BOM is rejected, feedback is provided on the required changes and the design team must then scramble to rework the design before resubmitting. This circular process continues until the BOM is approved and production can begin. Through this process teams are losing not only valuable production time, but costly hours of manpower in redesign work and re-submittal. So why does this happen so much, and more importantly, how can you prevent it? To determine this, we need to look at the first step in the BOM creation process, part selection.

PART SELECTION
NOT JUST ANY PART WILL DO

Traditionally when selecting components, engineers focus on achieving the desired circuit functionality and performance. Their methods for part selection often include pulling from manufacturer or distributor websites, datasheets, or previous designs and consolidating basic parametrics (part number, values, and manufacturer). However, the main causes of BOM rejection are based on a completely different set of criteria. Therefore, it is ideal to include this data as part of the component selection process. This information is even more important as the electronics supply chain has become highly dynamic due to:

Technological Advancements

Industries such as automotive and medical must adapt to cutting-edge technological advancements. As a result, once optional systems are now standard — creating high demand on specific parts, while others become obsolete.

Mergers and Acquisitions

Once a company completes their merger, they re-assess their product lines, discontinue certain items, and create new ones. This results in an ever-changing marketplace with unpredictable conditions.

Increased Regulations

New and improved regulations are instated as the market moves toward a more sustainable, lead-free environment.

Component Shortages

The global pandemic had lasting effects on the electronic supply chain. While things are returning to normal component shortages are still prevalent.

These changes in the supply chain can lead to unsuccessful part purchasing and BOM rejection due to:

Part Status

Example: Part lifecycle is changed due to technological advancements meaning the part you selected may not be available for purchase for the lifecycle of your intended product.

Part Availability

Example: The required part, which was available at the start of the project, may not be available when the PCB is ready for production.

Adherence to Standards

Example: Selecting a component that contains lead when the project requires lead-free.

Counterfeit Parts

Example: Sometimes counterfeit parts won't be recognized until product assembly; however, risk can be mitigated to guarantee the quality and performance of your product.

By understanding these issues, critical supply chain information can be reviewed and analyzed during the part selection process to help you achieve an orderable BOM on the first pass.

SUPPLY CHAIN ANALYSIS

FILLING IN THE BLANKS

To properly understand what's going wrong with your BOM approval, it helps to look at the issue from a different perspective. Many times, it's not what's ***in*** the BOM that is contributing to component sourcing problems and delays, it's what's ***missing***. According to Vern Densler, a supply chain expert from SiliconExpert, there are some vital pieces of data you will need to fully understand your options:

Part Status **Lifecycle Risk** **Lead Time** **Counterfeit Risk** **Compliance Data**

Having this data can ensure your parts are the best possible solution for your product. Let's look at how this supply chain information correlates to the common sources of BOM rejection:

Part Status

Part status and lifecycle risk should be analyzed before committing a component to the design. If the component is listed as Active, there should be minimal purchasing issues; however, a new part should be selected if the component is listed as:

- Obsolete
- Not Recommended for New Designs (NRND)
- Last Time Buy (LTB)

Additionally, lifecycle risk should be analyzed to determine the probability of obsolescence of similar parts in the market.

Part Availability

Part quantities and availability are continuously changing until the time of purchase. While quantity is often analyzed during part selection, ensure component the lead time is aligned with your project timeline. This will guarantee parts can be sourced on-time if the required quantity is not immediately available.

Note: Defining alternate sources for component purchasing, also known as multi-sourcing, will provide multiple purchasing options. This will ensure successful procurement even if the component becomes unavailable from the primary distributor.

Counterfeit Parts

Due to the high demand for electronic components, counterfeit parts are on the rise. Is your manufacturer a target? Analyze the risk that your part may have a counterfeit in the open market. If counterfeit risk is high, be sure to source components directly from trusted, reliable manufacturers.

Adherence to Standards

What are the environmental and regulatory requirements for your design? These need to be reflected at the component level. If necessary, be sure to analyze compliance to Reach, RoHS, lead, conflict minerals, and more to adhere to your project specifications.

Taking the initiative to cover your bases and analyze the above information during part selection can mitigate the number of errors found in your BOM and vastly improve your time-to-market schedule.

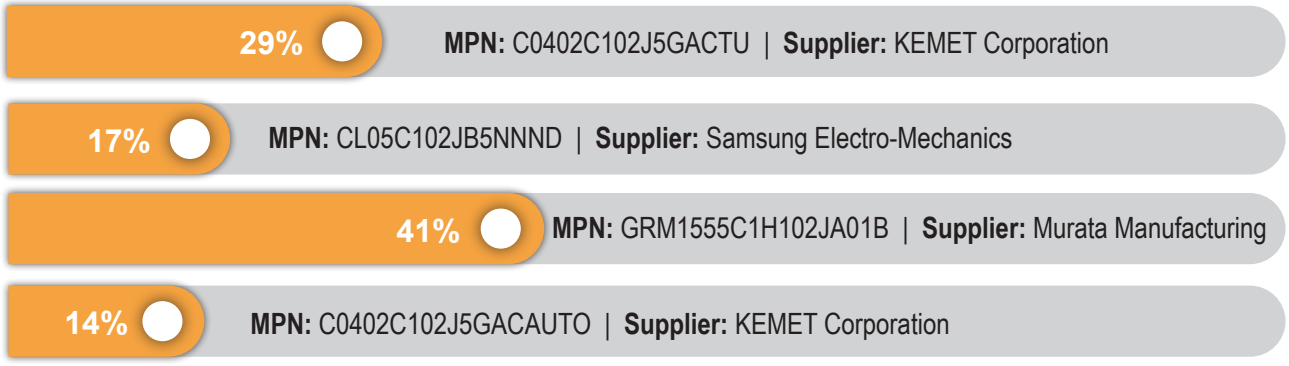
DATA-DRIVEN DECISION MAKING

WHICH WOULD YOU CHOOSE?

Let's look at an example to see the importance of analyzing supply chain data during part selection. In a recent survey, we polled engineers to choose between four SMD part options based on the following information:

	MPN	Supplier	Description	Average Price
1	C0402C102J5GACTU	KEMET Corporation	Cap Ceramic 0.001uF 50V C0G 5% Pad SMD 0402 125 °C T/R	$0.02
2	CL05C102JB5NNND	Samsung Electro-Mechanics	Cap Ceramic 0.001uF 50V C0G 5% Pad SMD 0402 125 °C T/R	$0.02
3	GRM1555C1H102JA01B	Murata Manufacturing	Cap Ceramic 0.001uF 50V C0G 5% Pad SMD 0402 125 °C Bulk	$0.01
4	C0402C102J5GACAUTO	KEMET Corporation	Cap Ceramic 0.001uF 50V C0G 5% Pad SMD 0402 125 °C Automotive T/R	$0.05

The results were typical, with 41% of answers choosing the Murata Manufacturing supplier with the cheapest price and therefore an increased chance of higher revenue.



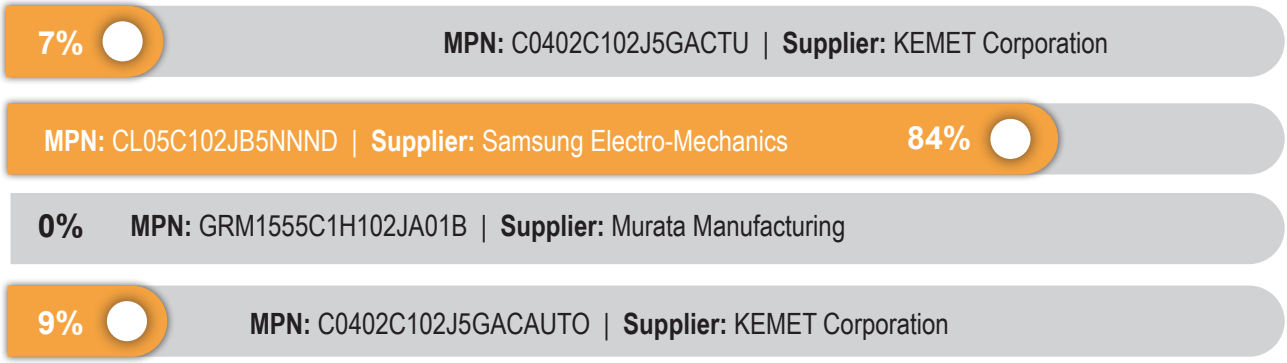
Given the same information, which would YOU have chosen?

DATA-DRIVEN DECISION MAKING
WHICH WOULD YOU CHOOSE?

We polled the group second time, after providing additional supply chain information:

	MPN	Supplier	Description	Average Price	Minimum Lead Time (weeks)	Maximum Lead Time (weeks)
1	C0402C102J5GACTU	KEMET Corporation	Cap Ceramic 0.001uF 50V C0G 5% Pad SMD 0402 125 °C T/R	$0.02	**54**	**54**
2	CL05C102JB5NNND	Samsung Electro-Mechanics	Cap Ceramic 0.001uF 50V C0G 5% Pad SMD 0402 125 °C T/R	$0.02	**24**	**24**
3	GRM1555C1H102JA01B	Murata Manufacturing	Cap Ceramic 0.001uF 50V C0G 5% Pad SMD 0402 125 °C Bulk	$0.01	**Obsolete**	**Obsolete**
4	C0402C102J5GACAUTO	KEMET Corporation	Cap Ceramic 0.001uF 50V C0G 5% Pad SMD 0402 125 °C Automotive T/R	$0.05	**33**	**33**

Reviewing the data, you can see the previously selected Murata part was obsolete and two of the other manufacturer's had lengthy lead times. With more information given, the Samsung Electro-Mechanics manufacturer won by far, with 84% of votes.



As seen in this example, often choices are made to save money now, rather than later; however, this decision may cost you when things start to go wrong. Rather than defaulting your selection to the lowest priced component, it is best practice to select a component with the lowest risk.

This exercise in data-driven decision making provides a clear illustration on the importance of obtaining supply chain information upfront to reduce a myriad of issues later. When engineers are armed with the information they need, they can quickly make the best component decision for their organization and designs.

RECIPE FOR DESIGN SUCCESS
SUPPLY CHAIN ASSISTED DESIGN

There are several key factors to ensuring the best possible outcome for BOM approval and part purchasing; but the most important is for the designer to have access to critical component data when they are designing, preferably within their design tool. With supply chain knowledge readily available, they can make the correct decisions at the beginning of their design cycle to ensure a lower risk of incurring unexpected costs and achieve a smoother product release schedule.

With OrCAD CIP, you can leverage supply chain and purchasing information from distributors and our partners at SiliconExpert directly in your ECAD environment. This integration enables designers to analyze critical data throughout their design process to create an orderable, supply chain compliant BOM upfront. OrCAD CIP analyzes the components in your OrCAD Capture schematics, BOMs, or your entire component database with:

- Integrated Part Research
- Automatic Database Updates
- Real-time supply chain and purchasing information
- Direct access in your ECAD environment
- Component Risk Analysis
- Alternate Components or Crosses
- Streamlined New Part Introduction Process

By creating a centralized repository of reliable components for all team members with OrCAD CIP, you can ensure any component selected for a design is purchasable and adheres to your company's requirements.

EMA Design Automation is a leading provider of the resources engineers rely on to accelerate innovation. Based on decades of engineering expertise, we provide solutions that include cutting-edge PCB design and analysis packages and customized integrations to optimize your electronic development workflow and create more efficiently.

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