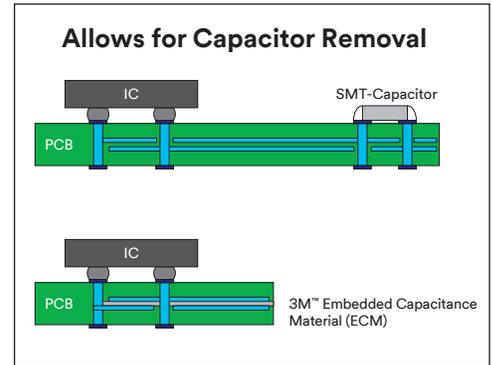


# 3M™ Embedded Capacitance Material (ECM)

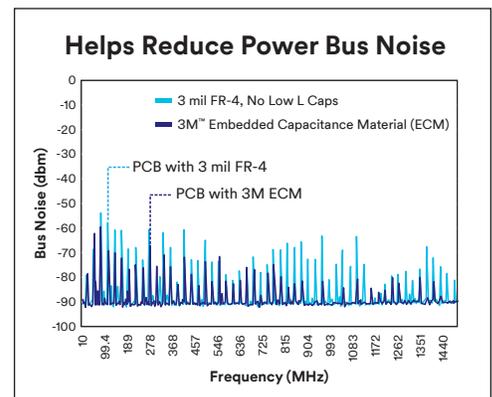
## Utilize a proven solution

- Laminate is a UL Recognized Component that's RoHS<sup>2</sup> compliant and Halogen free<sup>3</sup> with high capacitance density that can be embedded into PCBs and chip packages as either a power ground plane or a discrete capacitor
- Consists of a very thin layer of ceramic-filled epoxy sandwiched between two layers of copper foil
- Compatible with a large range of PCB material sets and with standard PCB fabrication and assembly processes, including lead-free
- A variety of custom panel sizes and copper thicknesses available
- In production in telecom, computer, test and measurement, military/aerospace, medical and consumer electronics applications



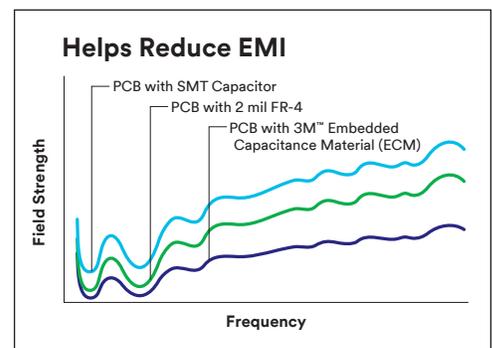
## Simplify design while amplifying performance

- Helps increase usable board area by allowing for the removal of many, if not all, capacitors equal to or below 0.1  $\mu$ F and their associated solder joints and vias
- Helps improve power integrity by reducing power bus noise and PCB impedance
- Helps reduce EMI by decreasing resonance that causes EMI
- Dissipates heat better than thin FR-4 due to high thermal conductivity and low thermal impedance



## Enable product roadmaps

- Simplify board layout and routing
- Reduce PCB size, thickness and weight
- Add functionality on fixed form factors
- Lower spreading inductance
- Decrease need for EMC measures such as metal shells, tapes, etc.
- Helps reduce interference from digital circuits to analog/RF circuits in mixed signal applications
- Add PCB layers while maintaining similar PCB thickness
- Helps reduce design spins by solving noise issues early in the design cycle
- Helps improve PCB panel utilization
- Helps improve assembly yields and board reliability due to fewer components



## 3M™ Embedded Capacitance Material (ECM)

**CXXXX**

	<b>Nominal dielectric thickness (µm)</b>
<b>Capacitance per area</b>	19 = 19 µm
06 = 6.4 nF/in <sup>2</sup>	12 = 12 µm
10 = 10 nF/in <sup>2</sup>	06 = 6 µm
20 = 20 nF/in <sup>2</sup>	03 = 3 µm
40 = 40 nF/in <sup>2</sup>	

Property	Test Method	3M™ Embedded Capacitance Material (ECM)			
		C0619	C1012	C2006	C4003
<b>Capacitance/Unit Area (1 kHz)</b>	Supplier Method	6.4 nF/in <sup>2</sup> (1.0 nF/cm <sup>2</sup> )	10.0 nF/in <sup>2</sup> (1.6 nF/cm <sup>2</sup> )	20.0 nF/in <sup>2</sup> (3.1 nF/cm <sup>2</sup> )	40.0 nF/in <sup>2</sup> (6.2 nF/cm <sup>2</sup> )
<b>Electrical Test Coupon Size</b>	Supplier Method	approx 350 sq inches	approx 350 sq inches	approx 20 sq inches	approx 12 sq inches
<b>Electrical Test Frequency</b>	see Note #7	Audit or 100% e-test	Audit or 100% e-test	Audit e-test only	Audit e-test only
<b>Dielectric Thickness</b>	Ref Only (see Note #5)	19 µm (0.75 mils)	12 µm (0.47 mils)	6 µm (0.24 mils)	3 µm (0.12 mils)
<b>Copper Thickness</b>	Cross-section #6	18 µm, 25 µm, & 35 µm	18 µm, 25 µm, & 35 µm	18 µm, 25 µm, & 35 µm	25 µm & 35 µm
<b>Thickness Tolerance</b>	Ref Only (see Note #6)	+/-10%	+/-10%	+/-10%	+/-10%
<b>Capacitance Tolerance</b>	Supplier Method	+/- 10%	+/- 10%	+/- 10%	+/- 10%
<b>Dielectric Constant (1 kHz)</b>	Supplier Method	22			
<b>Dissipation Factor (1 kHz)</b>	Supplier Method	0.010			
<b>Temperature Coefficient of Capacitance (TCC)</b>	Supplier Method	Meets X7R requirements			
<b>Dielectric Strength (Volts/Mil)</b>	ASTM D149	3000			
<b>HiPOT Voltage +/- 10% (note #7)</b>	IPC-TM-650 2.5.7.2	100 V	100 V	50 V	10 V
<b>UL Flammability Rating</b>	UL 94	94 V-0			

## 3M™ Embedded Capacitance Material (ECM)

Property	Test Method	3M™ Embedded Capacitance Material (ECM)			
		C0619	C1012	C2006	C4003
UL Relative Thermal Index (RTI)	UL 796	90°C <sup>4</sup>			
UL Solderability Limits	UL 796	288°C/20 sec.			
Glass Transition Temperature	Supplier Method (DSC)	120°C			
Moisture Absorption (wt %)	ASTM D570	0.10			
CTE (ppm/C)	Supplier Method (TMA)	31 (x,y,z)			
Degradation Temperature	IPC-TM-650 2.3.40	375°C			
Peel Strength (pli)	IPC-TM-650 2.4.9 modified	6.0	6.0	3.0	3.0
Thermal Conductivity (W/m*K)	ASTM F433 modified	0.5			
Halogen Content (ppm)	BS EN 14582:2007	None Detected			

1) All test data provided are typical values and not intended to be specification values.

2) “RoHS 2011/65/EU” means that the product or part does not contain any of the substances in excess of the maximum concentration values (“MCVs”) in EU RoHS Directive 2011/65/EU. The MCVs are by weight in homogeneous materials. This information represents 3M’s knowledge and belief, which may be based in whole or in part on information provided by third party suppliers to 3M.

In the event any product is proven not to conform with 3M’s Regulatory Information Appendix, then 3M’s entire liability and Buyer’s exclusive remedy will be in accordance with the Warranty stated below.

3) Halogen Free is defined as both 1) no halogen compounds that are intentionally added to the product or used in the manufacturing process for the product and 2) any impurities present are less than 900 ppm bromine, less than 900 ppm chlorine and/or less than 1500ppm total bromine and chlorine. The latter are the levels set forth in certain industry standards for printed circuit boards, such as the International Electrotechnical Commission (IEC) 61249-2-21 standard. This information represents 3M/s knowledge and belief which may be based in whole or in part on information provided by 3rd party suppliers to 3M.

4) Epoxy default RTI temperature.

5) Dielectric thickness is provided for reference only since it correlates to the Capacitance density. Capacitance density is the product parameter that is measured and controlled, and used to calculate the approx dielectric thickness reported on the Certificate of Conformance.

6) Copper thickness is not measured directly, but is determined by a “weight per area” factor to calculate thickness.

7) 100% electrical test is suggested for PCB applications larger than 2 square inches in area.

For more information, please visit our website to learn more: [www.3Mcapacitance.com](http://www.3Mcapacitance.com)

3M has a number of patents in the United States and other countries that relate to a variety of structural and functional aspects of the 3M ECM product such as high peel strength, low leakage current at high temperature and humidity, and thermally stable capacitance. Exemplary patents include US Patent Nos. 6,274,224 and 6,577,492, and Korean Patent No. 100597978.

# 3M™ Embedded Capacitance Material (ECM)

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**Technical Information:** The technical information, recommendations and other statements contained in this document are based upon tests or experience that 3M believes are reliable, but the accuracy or completeness of such information is not guaranteed.

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