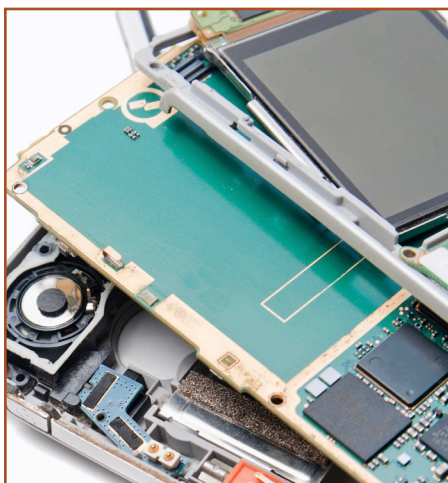


## Key Performance Advantages

- Provide customizable functionality for a variety of exacting demands
- Perform as chelating agents for metals
- Deliver tunable buffering capability



Electronic Chemicals

# VOLTAN™ SPECIALTY ELECTRONICS-GRADE ADDITIVES

For Customizable Functionality in Cleaning and Stripping Solutions Used in Semiconductor and Electronic Display Manufacturing.

Advanced semiconductors and electronic displays are manufactured with highly sensitive materials that can be easily damaged during the manufacturing process. Manufacturers require cleaning and stripping solutions that can be effectively used on fragile electronics components and during precision fabrication steps. ANGUS provides an array of specialty chemical additives that deliver the unique functionality that formulators need—without the harsh effects of existing chemical solutions.

## Benefits of developmental VOLTAN specialty electronics-grade additives from ANGUS:

- Reliable supply of consistently high-quality amino alcohols
- Thoroughly clean semiconductor wafers after etching, chemical-mechanical planarization (CMP) and photoresist stripping
- Effective in cleaners and strippers with lower copper corrosion for ultra-high-definition large-screen flat panel displays
- Remove unwanted debris during manufacturing, while preserving end-product functionality
- Multiple options available for water- and solvent-based systems
- A broad range of chemical structures with varied polarity, basicity and solvency characteristics

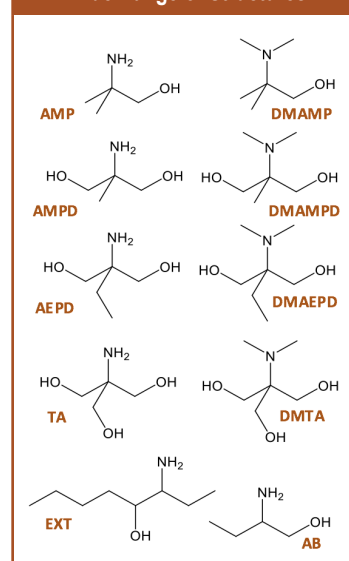
# ANGUS' Wide Range of Solutions and Properties in Electronics-Grade Chemicals

ANGUS amino alcohols can be used in a variety of processes during electronics manufacturing. Our products cover a range of pKa, solubility and other physical-chemical properties. We also have a demonstrated ability to meet demands with new molecules providing discrete changes in chemical properties allowing the formulation of a broad spectrum of effective cleaning and stripping solutions. Common applications of amino alcohols include CMP, post-CMP cleaning, photoresist stripping and removal of organic and organometallic etch residues.

ANGUS Electronics Chemicals Product Chart

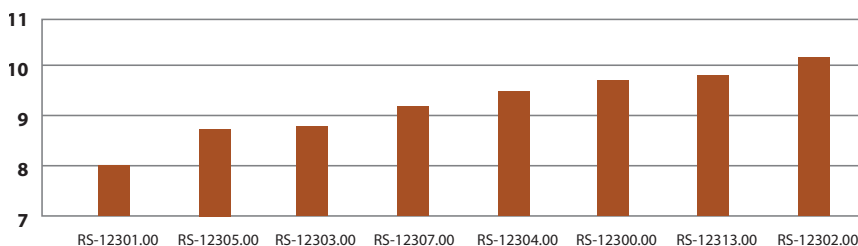
Product	Chemistry	Molecular Wt. (calc.)	Freeze/Melting Point, °C	pKa	Log P(ow)	Dipole Moment <sup>b</sup> (Debye)	Boiling point at 760mm <sup>e</sup> Hg, °C
RS-12300 <sup>a</sup>	AMP	89.1	-2	9.7	-0.63	1.09	165
RS-12301	TA	121.1	171-172	8.0	-2.31	2.03	219-220 <sup>d</sup>
RS-12302 <sup>a</sup>	DMAMP	117.0	-20	10.2	0.09	1.59	160
RS-12303 <sup>a</sup>	AEPD	119.2	-24	8.8	-1.02	3.21	152-153 <sup>d</sup>
RS-12304 <sup>a</sup>	AB	89.1	-2	9.5	-0.45	1.3	178
RS-12305	AMPD	105.1	109-111	8.8	-1.75 <sup>b</sup>	3.22	151-152 <sup>e</sup>
RS-12307 <sup>a</sup>	DMTA	149.1	<25	9.2	-0.81	2.57	305
RS-12313 <sup>a</sup>	EXT	145	-3	9.8	1.3	<sup>c</sup>	218

Wide Range of Structures



<sup>a</sup>Typically supplied as concentrated aqueous solution | <sup>b</sup>Calculated | <sup>c</sup>To be determined | <sup>d</sup>at 10 mmHg | <sup>e</sup>For anhydrous active ingredient

## pKa of ANGUS Amines for Electronics



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CHEMICAL COMPANY

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