

# Process C1221

## BiCMOS 1.2 $\mu$ m

### High Resistance Poly for Analog

#### Electrical Characteristics

T=25°C Unless otherwise noted

N-Channel Transistor	Symbol	Minimum	Typical	Maximum	Unit	Comments
Threshold Voltage	$V_{TN}$	0.55	0.75	0.95	V	100x1.2 $\mu$ m
Body Factor	$\gamma_N$		0.34		$V^{1/2}$	100x1.2 $\mu$ m
Conduction Factor	$\beta_N$	64	75	86	$\mu A/V^2$	100x100 $\mu$ m
Effective Channel Length	$L_{effN}$	0.8	1.0	1.2	$\mu$ m	100x1.2 $\mu$ m
Width Encroachment	$\Delta W_N$		0.6		$\mu$ m	Per side
Punch Through Voltage	$BVDSS_N$	9			V	
Poly Field Threshold Voltage	$VTF_{P(N)}$	10			V	

P-Channel Transistor	Symbol	Minimum	Typical	Maximum	Unit	Comments
Threshold Voltage	$V_{TP}$	-0.7	-0.9	-1.1	V	100x1.2 $\mu$ m
Body Factor	$\gamma_P$		0.38		$V^{1/2}$	100x1.2 $\mu$ m
Conduction Factor	$\beta_P$	21	25	29	$\mu A/V^2$	100x100 $\mu$ m
Effective Channel Length	$L_{effP}$	0.9	1.1	1.3	$\mu$ m	100x1.2 $\mu$ m
Width Encroachment	$\Delta W_P$		0.8		$\mu$ m	Per side
Punch Through Voltage	$BVDSS_P$	-9			V	
Poly Field Threshold Voltage	$VTF_{P(P)}$	-10			V	

Diffusion & Thin Films	Symbol	Minimum	Typical	Maximum	Unit	Comments
Base Resistor Sheet Resist.	$\rho_{RB}$	1.33	1.66	2.00	$K\Omega/\square$	
Base Resistor Effective Width Change	$\Delta W_{RB}$	-0.2	-0.6	-1.0	$\mu$ m	
Base Resistor Voltage Coefficient, Narrow Size	$VOLT_{CO\_N}$		11297		ppm/V	250x5 $\mu$ m
Base Resistor Voltage Coefficient, Wide Size	$VOLT_{CO\_W}$		15468		ppm/V	250x25 $\mu$ m
Base Resistor Voltage Coefficient, Narrow Size	$TEMP_{CO\_N}$		2761		ppm/C	250x5 $\mu$ m
High Resistance Poly	$\rho_{HI-POLY}$	1.5	2.0	2.5	$K\Omega/\square$	
Voltage Coefficient - High Resistance Poly	$VOLT_{CO\_HIPOLY}$	-200		0.0	ppm/V	For < 2V, 4 $\sigma$ 100 $\mu$ m
Temperature Coefficient - High Resistance Poly	$TEMP_{CO\_HIPOLY}$		-1969		ppm/C	
Base to Emitter Capacitance	$C_{BEO}$		33.8		fF/ $\mu$ m <sup>2</sup>	
Base to Collector Cap.	$C_{BCO}$		56.9		fF/ $\mu$ m <sup>2</sup>	
Base to Substrate Cap.	$C_{CS}$		35.1		fF/ $\mu$ m <sup>2</sup>	
Collector to Substrate Junction Capacitance	$C_{JS}$		0.1		fF/ $\mu$ m <sup>2</sup>	

Capacitance	Symbol	Minimum	Typical	Maximum	Unit	Comments
Gate Oxide	$C_{OX}$	1.28	1.38	1.58	fF/ $\mu$ m <sup>2</sup>	
Metal-1 to Poly-1	$C_{M1P}$		0.057		fF/ $\mu$ m <sup>2</sup>	
Metal-1 to Silicon	$C_{M1S}$		0.028		fF/ $\mu$ m <sup>2</sup>	
Metal-2 to Metal-1	$C_{MM}$		0.035		fF/ $\mu$ m <sup>2</sup>	
Poly-1 to Poly-2	$C_{P1P2}$	0.69	0.86	1.03	fF/ $\mu$ m <sup>2</sup>	

**Electrical Characteristics****NPN Bipolar Transistor Characteristics (Emitter size 4.5 x 4.5 $\mu$ m)**

	<b>Sym</b>	<b>Min</b>	<b>Typ</b>	<b>Max</b>	<b>Unit</b>	<b>Comments</b>
Current Gain	$h_{FE}$		118			@100 $\mu$ A
Early Voltage	$V_A$		22		V	
Cut - Off Frequency	$f_t$		6.2		GHz	
Collector-Emitter Saturation Voltage	$V_{CESAT}$		0.3		V	
Collector to Emitter Breakdown Voltage	$BV_{CEO}$		6.5		V	
Collector to Base Breakdown Voltage	$BV_{CBO}$		17		V	
Emitter to Base Breakdown Voltage	$BV_{EBO}$		6		V	
Emitter Resistance	$R_E$		40		$\Omega$	
Base Spreading Resistance	$R_B$		1000		$\Omega$	
Collector Saturation Resistance	$R_C$		100		$\Omega$	
Base to Emitter Capacitance	$C_{BEO}$				pF	
Base to Collector Capacitance	$C_{BCO}$				pF	
Base to Substrate Capacitance	$C_{CS}$				pF	

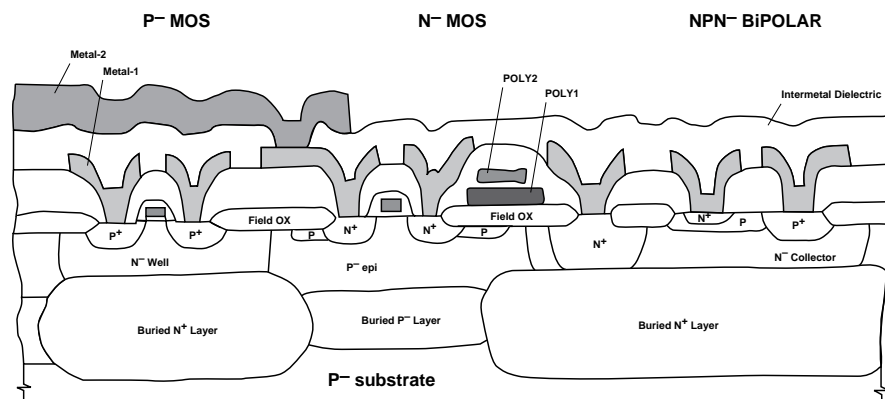
**NPN Bipolar Transistor Characteristics (Emitter size 31.5 x 4.5 $\mu$ m)**

	<b>Sym</b>	<b>Min</b>	<b>Typ</b>	<b>Max</b>	<b>Unit</b>	<b>Comments</b>
Current Gain	$h_{FE}$		110			@100 $\mu$ A
Early Voltage	$V_A$		22		V	
Cut - Off Frequency	$f_t$		6.4		GHz	
Collector-Emitter Saturation Voltage	$V_{CESAT}$		0.2		V	
Collector to Emitter Breakdown Voltage	$BV_{CEO}$		6.5		V	
Collector to Base Breakdown Voltage	$BV_{CBO}$		17		V	
Emitter to Base Breakdown Voltage	$BV_{EBO}$		6		V	
Emitter Resistance	$R_E$		6		$\Omega$	
Base Spreading Resistance	$R_B$		250		$\Omega$	
Collector Saturation Resistance	$R_C$		15		$\Omega$	

## Physical Characteristics

Starting Material	p <100>	N+/P+ Width/Space	2.5/1.2 $\mu$ m
Starting Mat. Resistivity	25 - 50 $\Omega$ -cm	N+ to P+ Space	9.0 $\mu$ m
Typ. Operating Voltage	5V	Contact to Poly Space	1.5 $\mu$ m
Well Type	N-well	Contact Overlap of Diffusion	1.0 $\mu$ m
Metal Layers	2	Contact Overlap of Poly	1.0 $\mu$ m
Poly Layers	2	Metal-1 Overlap of Contact	1.0 $\mu$ m
Contact Size	1.5x1.5 $\mu$ m	Metal-1 Overlap of Via	1.0 $\mu$ m
Via Size	1.5x1.5 $\mu$ m	Metal-2 Overlap of Via	1.0 $\mu$ m
Metal-1 Width/Space	2.5 / 1.5 $\mu$ m	Minimum Pad Opening	65x65 $\mu$ m
Metal-2 Width/Space	2.5 / 1.5 $\mu$ m	Minimum Pad-to-Pad Spacing	5.0 $\mu$ m
Gate Poly Width/Space	1.5 / 2.0 $\mu$ m	Minimum Pad Pitch	80.0 $\mu$ m

Special feature of C1206 Process: BiCMOS 1.2- $\mu$ m technology with a cutoff frequency of 6.4GHz.



Cross-sectional view of the BiCMOS 1.2 C1221 process

