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Comparison of IC Logic Families

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Comparison of Logic Families

Logic Family (Silicon Technology)		Introduction		Features	Limitations
Transistor Logic Families (Bipolar Transistor Technology)	Saturated Logic Families (ON – Saturation Mode) (OFF – Cut Off Mode)	1. RTL (Resistor Transistor Logic)	- In common use before the development of ICs. Common Emitter Configuration. - Logic 1: 1-3.6 V and Logic 0: 0.2V	- First logic family, require minimum number of transistors.	- Low speed, high power dissipation - Low fan out, poor noise immunity - Operating speed <4MHz.
		2. DCTL (Direct Coupled Transistor Logic)	- Direct coupled transistors. - Base resistors of RTL are removed.	- Simpler than RTL, easy to fabricate. - Fewer components hence economical.	- Small logic swing, poor noise margin. - Current hogging
		3. DTL (Diode Transistor Logic)	- Use diodes and transistors. - Input is fed through diodes followed by transistor at the output side.	- First circuit configuration designed into IC. - Very small in size and high reliability at very low price. - Greater fan out and improved noise margins.	- No low and constant output impedance in both states.
		4. TTL (Transistor-Transistor Logic)	- Use all transistors totem pole output. - Function of diodes in DTL is performed by multi-emitter transistor at input	- Fast switching time, larger fan out. - Reduced silicon chip area. - Easy to interface with other logic families.	- Large current spike when switching from low to high. - Less noise immunity (0.4V)
		5. IIL (Integrated Injection Logic)	- Merged Transistor Logic (MTL). - Both PNP and NPN transistors are used. - Designed around multi-collector inverting transistors.	- High component density, less power dissipation. - Low metal interconnection. - Used in MSI and LSI designs.	- Poor noise immunity.
	Non-Saturated Logic (ON – Active Mode) (OFF – Cut Off Mode)	6.ECL (Emitter Coupled Logic)	- Non saturated logic/Current mode logic. - Compliment output/eliminates the need of inverter. - Logic 1: -0.8 and Logic 0: -1.7	- Fastest logic family - Used in very high frequency applications. - No noise spikes, large fan out.	- Require large silicon area, high power dissipation (high cost). - Inconvenient voltage levels. - Low noise margins.
MOS Logic Families (Unipolar Transistor Technology)		7.MOS Logic (Metal Oxide Semiconductor Logic)	- Use pMOS, nMOS or both with high packaging density. - Easy to design and fabricate - Less power drawn due to gate dielectric.	- Lower power dissipation. - Shorter rise and fall times. - Large fan-out.	- Larger propagation due to high output impedance. - Noise margin is around 1V.

Parameter	RTL	IIL	DTL	HTL	TTL	ECL	MOS	CMOS
Basic Gate	NOR	NOR	NAND	NAND	NAND	OR-NOR	NAND	NOR-NAND
Fan Out	5	Depends on Injector Current	8	10	10-20	25	20	20-50
Power Dissipation	12 mW	6 nW – 70 uW	8-12 mW	55 mW	10 mW	40-55 mW	0.2-10 mW	0.025-1.01 mW
Noise Immunity	Nominal	Poor	Good	Excellent	Very Good	Poor	Good	Very Good
Propagation Delay	12 nSec	25-30 nSec	30 nSec	4 nSec	10 nSec	1-2 nSec	300 nSec	70 nSec
Clock Rate	8 MHz	-	72 MHz	4 MHz	35 MHz	+60 MHz	2 MHz	10 MHz
Speed X Power	144	Less than 1	300	-	100	100	60	70

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