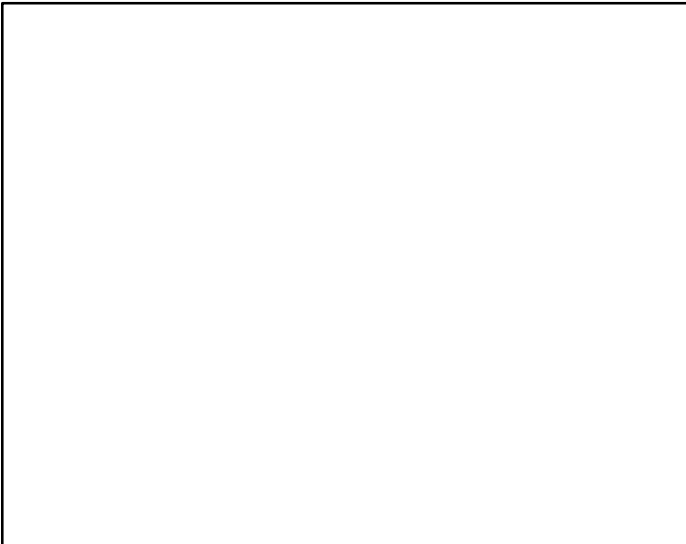


# Selection Information

## FAST/LS TTL

1

**FAST AND LS TTL**



# GENERAL INFORMATION

## TTL in Perspective

Since its introduction, TTL has become the most popular form of digital logic. It has evolved from the original gold-doped saturated 7400 logic, to Schottky-Clamped logic, and finally to the modern advanced families of TTL logic. The popularity of these TTL families stem from their ease of use, low cost, medium-to-high speed operation, and good output drive capability.

Motorola offers two modern TTL logic families — LS and FAST™. They are pin and functionally compatible and can easily be combined in a system to achieve maximum performance at minimum cost.

LS (Low Power Schottky) is currently the more popular and commands by far the largest share of the total TTL logic market. It is low-cost and provides moderate performance at low power.

FAST, the state-of-the-art, high-performance TTL family, is growing rapidly and gaining a significant share of the total TTL logic market. FAST offers a 20–30 percent improvement in performance over the older Standard Schottky family (74S) with a 75–80 percent reduction in power. When compared with the Advanced Schottky family (74AS), FAST offers nearly equal performance at a 25–50 percent savings in power.

FAST is manufactured on Motorola's MOSAIC (oxide-isolated) process. This process provides FAST with inherent speed/power advantages over the older junction-isolated 74S and 74LS families, allowing the FAST family to be designed and specified with improved noise margins, reduced input currents, and superior line driving capabilities in comparison to these earlier families. Additionally, FAST designs incorporate power-down circuitry on all three-state outputs, and buffered outputs on all storage devices.

Two further advantages of FAST are the load specifications and power supply specifications. FAST ac characteristics are specified at a heavier capacitive load than the earlier families (50 pF versus 15 pF) to more accurately reflect actual in-circuit performance. Motorola's dc and ac characteristics for FAST are specified over a full 10% supply voltage range — a significant improvement over the industry standard specifications for the earlier families (5% for dc, 0% for ac).

These design and specification improvements offered by the Motorola FAST family provide the user with better system performance, enhanced design flexibility, and more reliable system operation.

## TTL Family Comparisons

### General Characteristics for Schottky TTL Logic

(ALL MAXIMUM RATINGS)		LS		FAST		
Characteristic	Symbol	54LSxxx	74LSxxx	54Fxxx	74Fxxx	Unit
Operating Voltage Range	V <sub>CC</sub>	5 ± 10%	5 ± 5%	5 ± 10%	5 ± 10%	Vdc
Operating Temperature Range	T <sub>A</sub>	–55 to 125	0 to 70	–55 to 125	0 to 70	°C
Input Current	I <sub>IN</sub> I <sub>IH</sub>	20	20	20	20	μA
	I <sub>IL</sub>	–400	–400	–600	–600	
Output Drive Standard Output	I <sub>OH</sub>	–0.4	–0.4	–1.0	–1.0	mA
	I <sub>OL</sub>	4.0	8.0	20	20	mA
	I <sub>SC</sub>	–20 to –100	–20 to –100	–60 to –150	–60 to –150	mA
Buffer Output	I <sub>OH</sub>	–12	–15	–12	–15	mA
	I <sub>OL</sub>	12	24	48	64	mA
	I <sub>SC</sub>	–40 to –225	–40 to –225	–100 to –225	–100 to –225	mA

### Speed/Power Characteristics for Schottky TTL Logic(1)

#### (ALL TYPICAL RATINGS)

Characteristic	Symbol	LS	FAST	Unit
Quiescent Supply Current/Gate	I <sub>G</sub>	0.4	1.1	mA
Power/Gate (Quiescent)	P <sub>G</sub>	2.0	5.5	mW
Propagation Delay	t <sub>p</sub>	9.0	3.7	ns
Speed Power Product	—	18	19.2	pJ
Clock Frequency (D-F/F)	f <sub>max</sub>	33	125	MHz
Clock Frequency (Counter)	f <sub>max</sub>	40	125	MHz

NOTES: 1. Specifications are shown for the following conditions:

- a) V<sub>CC</sub> = 5.0 Vdc (AC);
- b) T<sub>A</sub> = 25°C
- c) C<sub>L</sub> = 50 pF for FAST; 15 pF for LS

## Functional Selection

### Abbreviations

**S** = Synchronous

**A** = Asynchronous

**B** = Both Synchronous and Asynchronous

**2S** = 2-State Output

**3S** = 3-State Output

**OC** = Open-Collector Output

**P** = Planned (See FAST/LS Selector Guide, SG-60 for latest availability status)

**X** = Available

### Inverters

Description	Type of Output	No.	LS	FAST
Hex	2S	04	X	X
	OC	05	X	

### AND Gates

Description	Type of Output	No.	LS	FAST
Quad 2-Input	2S	08	X	X
	OC	09	X	
Triple 3-Input	2S	11	X	X
	OC	15	X	
Dual 4-Input	2S	21	X	X

### NAND Gates

Description	Type of Output	No.	LS	FAST
Quad 2-Input	2S	00	X	X
	OC	01	X	
	OC	03	X	
Quad 2-Input, High Voltage	OC	26	X	
	2S	10	X	X
Triple 3-Input	OC	12	X	
	2S	20	X	X
Dual 4-Input	OC	22	X	
	2S	30	X	
8-Input	2S	30	X	
13-Input	2S	133	X	

### OR Gates

Description	Type of Output	No.	LS	FAST
Quad 2-Input	2S	32	X	X

### NOR Gates

Description	Type of Output	No.	LS	FAST
Quad 2-Input	2S	02	X	X
Triple 3-Input	2S	27	X	
Dual 5-Input	2S	260	X	

### Exclusive OR Gates

Description	Type of Output	No.	LS	FAST
Quad 2-Input	2S	86	X	X
	OC	136	X	
	2S	386	X	

### Exclusive NOR Gates

Description	Type of Output	No.	LS	FAST
Quad 2-Input	OC	266	X	

### AND-OR-INVERT Gates

Description	Type of Output	No.	LS	FAST
Dual 2-Wide, 2-Input 3-Input	2S	51	X	X
4-Wide, 2-3-2-3-Input	2S	54	X	
2-Wide, 4-Input	2S	55	X	
4-Wide, 4-2-2-3-Input	2S	64		X

### Schmitt Triggers

Description	Type of Output	No.	LS	FAST
Dual 4-Input NAND Gate	2S	13	X	X
Hex, Inverting	2S	14	X	X
Quad 2-Input NAND Gate	2S	132	X	X

### SSI Flip-Flops

Description	Clock Edge	No.	LS	FAST
Dual D w/Set & Clear	Pos	74		X
Dual D w/Set & Clear	Pos	74A	X	
Dual JK w/Set	Neg	113A	X	
Dual JK w/Clear	Neg	73A	X	
Same as 73A with Different Pinout	Neg	107A	X	
Dual JK w/Set & Clear Individual J, K, $\overline{C_P}$ , $\overline{S_D}$ , $\overline{C_D}$ Inputs	Neg	76A	X	
Same as 76 with Different Pinout	Neg	112		X
Same as 76A with Different Pinout	Neg	112A	X	
Same as 112 with Different Pinout	Neg	114A	X	
Dual JK w/Set & Clear	Pos	109		X
Dual JK w/Set & Clear	Pos	109A	X	

### Multiplexers

Description	Type of Output	No.	LS	FAST
Quad 2-to-1, Non-Inverting	2S	157	X	
	2S	157A		X
	3S	257A		X
Quad 2-to-1, Inverting	3S	257B	X	
	2S	158	X	
	2S	158A		X
Dual 4-to-1, Non-Inverting	3S	258A		X
	3S	258B	X	
	2S	153	X	X
Dual 4-to-1, Inverting	3S	253	X	X
	2S	352	X	X
8-to-1	3S	353	X	X
	2S	151	X	X
Quad 2-to-1 with Output Register	3S	251	X	X
	2S	298	X	
	2S	298	X	
398 — Positive edge triggered, Q/ $\bar{Q}$ Outputs	2S	398	X	X
399 — Positive edge triggered, Q Output Only	2S	399	X	X

### Encoders

Description	Type of Output	No.	LS	FAST
10-to-4-Line BCD	2S	147	X	
8-to-3-Line Priority Encoder	2S	148	X	X
	3S	348	X	
	2S	748	X	
	3S	848	X	

### Register Files

Description	Type of Output	No.	LS	FAST
4 x 4	OC	170	X	
	3S	670	X	

### Shift Registers

Description	No. of Bits	Type of Output	Mode*				No.	LS	FAST
			SR	SL	Hold	Reset			
Serial In-Parallel Out	8	2S	X			A	164	X	X
Parallel In-Serial Out	8	2S	X			X	165	X	
	8	2S	X			X	166	X	
Parallel In-Parallel Out	4	2S	X			A	95B	X	
	4	2S	X	X	X	A	194		X
	4	2S	X	X	X	A	194A	X	
	4	2S	X			A	195		X
	4	2S	X			A	195A	X	
	4	3S	X			A	395	X	
Parallel In-Parallel Out, Bidirectional	8	3S	X	X	X	A	299	X	X
	8	3S	X	X	X	S	323	X	X
Sign Extended Bidirectional	8	3S	X		X	A	322A	X	

\* SR = Shift Right  
SL = Shift Left

### Decoders/Demultiplexers

Description	Type of Output	No.	LS	FAST
Dual 1-of-4	2S	139	X	X
	2S	155	X	
	OC	156	X	
1-of-8	3S	539		X
	2S	138	X	X
1-of-8 with Latch	3S	538		X
	2S	137	X	
1-of-10	2S	42	X	
	3S	537		X

### Latches

Description	No. of Bits	Type of Output	No.	LS	FAST
Transparent, Non-Inverting	4	2S	77	X	
	8	3S	373	X	X
Octal, Non-Inverting	8	3S	573		
Transparent, Inverting	8	3S	533		X
Transparent, Q and $\bar{Q}$ Outputs	4	2S	75	X	
	4	2S	375	X	
Quad Set-Reset Latch	4	2S	279	X	
Addressable	8	2S	259	X	X
Dual 4-Bit Addressable	4	2S	256	X	X

### Asynchronous Counters — Negative Edge-Triggered

Description	Load	Set	Reset	No.	LS	FAST
Decade (2/5)	X	X	X	90	X	
			X	196	X	
		X	X	290	X	
Dual Decade (2/5)			X	390	X	
Dual Decade		X	X	490	X	
Modulo 12 (2/6)			X	92	X	
4-Bit Binary (2/8)	X		X	93	X	
			X	197	X	
Dual 4-Bit Binary			X	293	X	
			X	393	X	

\* The 716 and 718 are positive edge-triggered.

### Display Decoders/Drivers with Open-Collector Outputs

Description	No.	LS	FAST
1-of-10	145	X	
BCD-to-7 Segment	47	X	
	48*	X	
	247	X	
	248*	X	
	249	X	

\* The 48 and 248 have internal pull up resistors to  $V_{CC}$  on their outputs.

### Cascadable Synchronous Counters — Positive Edge-Triggered

Description	Type of Output	Load	Reset	No.	LS	FAST
Decade	2S	S	A	160A	X	X
	2S	S	S	162A	X	X
Decade, Up/Down	2S	S		168	X	X
	2S	A		190	X	
	2S	A	A	192*	X	
	3S	S	B	568		X
4-Bit Binary	2S	S	A	161A	X	X
	2S	S	S	163A	X	X
4-Bit Binary, Up/Down	2S	S		169	X	X
	2S	A		191	X	
	2S	A	A	193*	X	
	3S	S	B	569		X
8 Bit Binary, Up/Down	3S	S	B	569A	X	
	2S	S		669	X	
	3S	S	S	579		X
	3S	S		779		X
	3S	S		269		X

\* The 192 and 193 do not provide a clock enable for synchronous cascading.

### MSI Flip-Flops/Registers

Description	No. of Bits	Type of Output	Set or Reset	Clock Enable	No.	LS	FAST
D-Type, Non-Inverting	4	3S	A	X	173A	X	
	4	2S		X	377	X	X
	6	2S	A		174	X	X
	6	2S		X	378	X	X
	8	2S	A		273	X	
	8	3S			374	X	X
	8	3S			574		X
	Quad 2-Port	4	2S	A	X	398	X
D-Type, Inverting	4	2S	A	X	399	X	X
	8	3S			534		X
D-Type, Q and $\bar{Q}$ Outputs	8	3S			564		
	4	2S	A		175	X	X
	4	2S		X	379	X	X

### Arithmetic Operators

Description	No.	LS	FAST
4-Bit Adder	83	X	
	283	X	X
4-Bit ALU	181	X	X
	381		X
	382		X
Look-Ahead Carry Generator	182		X
4-Bit Barrel Shifter	350		X

### Magnitude Comparators

Description	Type of Output	P = Q	P > Q	P < Q	No.	LS	FAST
4-Bit	2S	X	X	X	85	X	X
8-Bit	2S	X	X		682	X	
	2S	X	X		684	X	
	2S	X			521		X
8-Bit with Output Enable	2S	X			688	X	

### Parity Generators/Checkers

Description	No.	LS	FAST
9-Bit Odd Even Parity Generator Checker	280	X	X

### VCOs and Multivibrators

Description	No.	LS	FAST
Retriggerable Monostable Multivibrator	122	X	
Dual 122	123	X	
Precision Non-Retriggerable Monostable Multivibrator	221	X	

### Buffers/Line Drivers

Description	Type of Output	No.	LS	FAST
Quad 2-Input NOR	2S	28	X	
	OC	33	X	
Quad 2-Input NAND	2S	37	X	X
	OC	38	X	X
Dual 4-Input NAND	2S	40	X	X
Quad, Non-Inverting	3S	125		X
		125A	X	
	3S	126		X
		126A	X	
Hex, Non-Inverting	3S	365		X
		365A	X	
	3S	367		X
		367A	X	
Hex, Inverting	3S	366		X
		366A	X	
	3S	368		X
		368A	X	
Octal, Non-Inverting	3S	241	X	X
	3S	244	X	X
Bus Pinout	3S	541	X	
	3S	795	X	
	3S	797	X	
Octal, Inverting	3S	240	X	X
Bus Pinout	3S	540	X	
	3S	796	X	
	3S	798	X	
10-Bit	3S	827		X
		828		X

### Transceivers

Description	Type of Output	No.	LS	FAST
Quad, Non-Inverting	3S	243	X	X
Quad, FutureBus	3S	3893A		X
Quad, Inverting	3S	242	X	X
Octal, Non-Inverting	3S	245	X	X
	3S	645	X	
	3S	623	X	X
	OC	641	X	
	3S	1245		X
Octal, Inverting	3S	620		X
	3S	640	X	X
	OC	642	X	
Octal, Non-Inverting Register	3S	646		X
Latch	3S	543		X
Octal, Inverting Register	3S	544		X
Octal w/ Parity Gen/Checker	3S	657A		X
		657B		X

### Clock Drivers

Description	No.	LS	FAST
Quad Matched Propagation Delays	803		X
Clock Driver	1803		X