MOS Industrial ICs

AD Converter

J6

Type No.	Resolution	Conversion Time	Conversion Mode	Input Channel	Output Format		Package
					Code	Format	
TC5090AP	8bit	2ms	Integration method	1	Binary	4-bit time sharing 3-State	DIP16PIN
TC5091AP	8bit	2ms	"	6			DIP28PIN
TC5092AP	13bit	8.2ms	"	8		8-bit parallel 3-State	DIP42PIN
TC5093AP	8bit	50μs	Successive approximation	8			DIP28PIN
TC35094P	8bit	19μs	"	1			DIP18PIN
TC35095AP/AF	8bit	35μs	"	8		Serial 3-State	DIP18PIN/SOP20PIN
TC35096AP/AF	8bit	32.5μs	"	4			DIP14PIN/SOP14PIN
TC35097AP	8bit	30μs	"	2			DIP8PIN
TC35098AP	8bit	27.5μs	"	1			DIP8PIN
TC35080P	10bit	11μs	"	8		10-bit serial 3-State	DIP20PIN
TC35081P/F	10bit	11μs	"	1		8-bit time sharing 3-State	DIP20PIN/SOP20PIN
TC35082P/F	10bit	11μs	"	1		10-bit parallel 3-State	DIP24PIN/SOP24PIN
TC35083P/F	10bit	11μs	"	2		10 bit parallel or 8-bit time sharing 3-State	DIP24PIN/SOP24PIN
**TC35084F/FS	10bit	7μs	"	2		8 bit time sharing 3-State	SOP20/SSOP20
TC35071P/F	8bit	20MHz	Half Flash	1		8-bit parallel	DIP20PIN/SOP20PIN
TC35072P/F	8bit	15MHz	"	1		8-bit parallel	DIP20PIN/SOP20PIN

**: Under development

DA Converter

J6

Type No.	Resolution	Conversion Time	DG (%)	DP (deg)	Output Channel	Package
TC35010P/F	8bit	20MHz	0.75 TYP	0.5 TYP	1	DIP16PIN/SOP16PIN

Communications

J6

Type No.	Function	Feature	Package
TC35129F	1 chip 9600 bps MODEM	G3 facsimile MODEM, HDLC, VOICE function, DTMF and TONE det. TONE gen.	QFP80PIN
TC35183F	Scanner image processor	Shading correction, Half tone (16 level), Built-in analog and line memory	QFP60PIN
TC35191F	Facsimile CODEC	Data compression and expansion of MH, MR and MMR	QFP100PIN
TC35167F	1 chip fascimile processor	Built-in 9600 bps MODEM, image processor, 8 bit CPU and peripheral control	QFP208PIN

Display-Use LSI

X44

Type No.	Outline	Features	Package
TC9525F	LCD display driver	LCD 1/2 duty. 1/2 bias dynamic driver. (44 x 2 segment). COMMON self exciting/forced exciting switchable	QFP60PIN
TC9533N	Car clock	Hour/minute (VFD display) 12-hour system, Reset terminal provided	SDIP42PIN
TC9534N	Car clock	Hour/minute (VFD display) 12-hour system, Provided with power on reset circuit. Dimming ratio 1/16	SDIP42PIN
*TC9538N/F	Car clock	Hour/minute (VFD display) 12/24-hour system, power on reset, variable Dimming ratio	SDIP42PIN/ QFP44PIN
TC9542/43P	Duty controller	6-bit resolution duty output. UP/DOWN contact type.	DIP8PIN

*: New Product

Clock LSI

Built-in LCD Driver

J1

Type No.	Outline	Features	Package	Power Supply
TC8215UF	Alarm clock	Clock, alarm, snooze, sleep timer, LCD 1/2 duty	FP44PIN	1.5V
TC8217SF	Timer	12-key input. Max. 100-minute measurement, LCD 1/2 duty	FP44PIN	1.5V
TC8234AF	Clock with thermometer	Clock, alarm, control terminal, display of max./min. temperature, LCD 1/2 duty	FP67PIN	1.5V
TC8244UF	Radio-cassette clock	Clock, alarm, sleep timer, time counter, LCD 1/2 duty	FP44PIN	1.5V
TC8260F	Clock with thermometer	Clock/temperature/alarm, LCD 1/2 duty	FP60PIN	1.5V
TC8270F	Sound clock	Clock/audio time signal in English/audio alarm, LCD 1/3 duty	FP80PIN	3.0V
TC8272UF	Alarm clock	Clock, alarm, snooze, LCD 1/3 duty	FP44PIN	1.5V/3.0V
JT9673-AS	Stop watch	Max. 9:59 59 99, 1/100 sec., CUM/SPLIT, LCD 1/3 duty	Chip 44 pads	1.5V

To ensure definite market competitiveness, you need continuously strive to upgrade your products toward more sophisticated, more technology-intensive and higher value-added models through a process of technological innovation and systematic marketing concept. Application-specific ICs (ASICs) will give you an edge well beyond your expectations. Toshiba prides itself on providing its customers with unique and complete ASIC products and services. Toshiba's ASIC offerings include Gate Arrays which feature quick production turnaround, high-density and high-performance Cell-Based ICs, and Embedded Arrays which combine the Gate Array advantage of a short turnaround time with the gate density and functional flexibility of Cell-Based ICs.

New CMOS ASIC Lines

Gate Arrays: TC180G Series/TC183G Series/TC170G Series
Cell-Based ICs: TC180C Series/TC183C Series/TC170C Series
Embedded Arrays: TC180E Series/TC183E Series

Series	Gate Array		Cell-Based IC		Embedded Array	
	TC180G	TC183G	TC180C	TC183C	TC180E	TC183E
Process technology	0.5μm CMOS Si-gate double- / triple- layer metal					
Gate delay	0.23ns (V_{DD}=3.3V, F/O=2+estimated wire loading)					
Gate complexity	340k	315k	323k	300k	340k	315k

Series	Gate Array	Cell-Based IC
	TC170G	TC170C
Process technology	0.7μm CMOS Si-gate double- / triple- layer metal	
Gate delay	0.25ns Gate delay (V_{DD}=5V, F/O=2+ estimated wire loading)	0.24ns (V_{DD}=5, F/O=2+ estimated wire loading)
Gate complexity	340k	323k

Features and Benefits

TC180/TC183

- Consumes about 1/3 the power of conventional 5V, 0.8μm ASICs.
- Enables you to move a design from more expensive ceramic packaging to lower cost plastic packaging.
- Achieves fast gate delays of just 0.23 ns, a 20% improvement over the conventional 5V ASICs.
- Minimizes electromagnetic interference (EMI) emissions.
- All existing ASICs, and the TC180/183 series are compatible, simplifying a mid-development switchover to a more advanced technology.

TC183

- Operates with 3.3V core and both 3.3V and 5V I/Os.
- Handles 5V full-swing signals using a dedicated power ring for 5V I/Os.
- Places no restrictions on 3.3V and 5V I/O placement.

TC170

- Using 0.7μm CMOS technology and handles designs with up to 340,000 gates.

CMOS Gate Arrays

A Gate Array is a matrix of uncommitted, potentially active transistors whose interconnect is "programmed" at the metal mask level. Gate Array wafers may be pre-fabricated in volume up to final processing steps, thus achieving manufacturing economies of scale. These wafers are customized at the metal masking stage by applying a unique interconnect pattern that implements the customer's logic design. Therefore, development cost is low and development time is short.

Series	Delay Time [1]	Supply voltage	Estimated Usable Gates (I/O pads)[2]
TC180G Series	0.23ns	Single 3.3V (3.0V)	21,000 (144) ~ 340,000 (416)
TC183G Series	0.23ns	Internal 3.3V (3.0V) (I/O 3.3V (3.0V)/5V Programmable)	17,000 (128) ~ 315,000 (400)
TC170G Series	0.25ns	Single 5V	21,000 (144) ~ 340,000 (416)
TC150G Series	0.3ns	Single 5V	4,000 (64) ~ 210,000 (416)
	0.4ns	Single 3.3V (3.0V)	
TC163G Series	0.4ns	Internal 3.3V (3.0V) (I/O 3.3V (3.0V)/5V Programmable)	2,500 (68) ~ 196,000 (400)
TC150G Series	0.4ns	Single 5V	1,700 (44) ~ 120,000 (360)
TC140G Series	0.4ns	Single 5V	1,000 (44) ~ 68,000 (360)
	0.6ns	Single 3.3V (3.0V)	
TC14L Series	0.4ns	Single 5V	1,000 (100) ~ 20,000 (208)
	0.6ns	Single 3.3V (3.0V)	
TC110G Series	0.6ns	Single 5V	1,400 (60) ~ 50,000 (360)
TC11L Series	0.6ns	Single 5V	300 (44) ~ 700 (44)

1) High-drive 2-input NAND gate, Fanout=2 plus typical interconnect load
2) The TC180G, TC183G, TC170G, TC160G, TC163G, and TC140G support TAB and TCP, which provide about 1.5 times as many I/O pads as wire bonding does.

- The TC180G and TC183G Series are 0.5μm gate arrays that combine low power consumption with high speeds.
- The TC183G and TC163G Series are designed for mixed 3V/5V systems. They operate with a 3.3V core and offer both 3.3V and 5V I/Os.
- The TC170G Series is processed using 0.7μm CMOS technology and handles designs with up to 340,000 gates.
- TC11L and TC14L feature high pin-to-gate ratio and are suitable for small and medium scale systems.

CMOS Cell-Based ICs

The cell-based technique assembles pre-designed and pre-optimized cells that users select, place, and interconnect on-chip to produce the required circuit functions with an optimum chip size. These cells include basic gates, as well as various memory blocks and analog functions. Because all of the mask set needs defining, the development times is longer than a gate array. However, the density of functions is greater than that achieved by gate arrays.

Series	Delay Time [1]	Supply voltage	Equivalent Gates (I/O pads)[2]
TC180C Series	0.23ns	Single 3.3V (3.0V)	5,000 (68) ~ 323,400 (416)
TC183C Series	0.23ns	Internal 3.3V (3.0V) (I/O 3.3V (3.0V)/5V Programmable)	2,800 (60) ~ 300,000 (408)
TC170C Series	0.25ns	Single 5V	5,000 (68) ~ 323,400 (416)
TC26SC Series	0.3ns		27,800 (144) ~ 200,000 (424)
TC25SC Series	0.33ns		700 (24) ~ 102,850 (360)
TC24SC Series	0.5ns		700 (30) ~ 70,000 (366)
TC23SC Series	0.8ns		700 (32) ~ 50,000 (332)

1) 2-input NAND gate, Fanout=2 plus typical interconnect load (High-drive 2-input NAND gate for the TC180C, TC183C, TC170C and TC26SC)
2) The TC180C, TC183C and TC170C support TAB and TCP, which provide about 1.5 times as many I/O pads as wire bonding does.

- The TC180C and TC183C Series are 0.5μm cell-based ICs that combine low power consumption with high speeds.
- The TC183C Series is designed for mixed 3V/5V systems, it operates with a 3.3V core and offers both 3.3V and 5V I/Os.
- The TC25SC and TC23SC Series can integrate high-performance analog functions such as A/D converters and D/A converters on the same chip, reducing the need for external support circuitry.
- For all cell-based IC series, extensive libraries of specialized functions are provided. Included in them are large-capacity RAMs and ROMs, CPU peripherals, multipliers, etc.

CMOS Embedded Arrays

The embedded array combines cell-based IC's extensive libraries of high-performance functions with the gate array advantage of a short production turn-on time.

Early in the design cycle the appropriate area of gates, embedded memory, core functions, and the number of I/O are agreed upon by you and Toshiba. After the items to be embedded in the customer specific base array are finalized, the base wafers are manufactured concurrently with the simulation of your design. Once the design is completed, the layout of the gate array portion of the design is performed on the inventoried customer specific base wafers. Post-layout simulation is then performed, similar to a standard gate array, confirming that performance requirements are achieved. Manufacturing of prototypes progresses in the same manner as standard gate arrays from this point.

A major advantage of using the embedded array is that changes to the logic design implemented in the gate array section can be easily made. Because only metal mask changes are required for changes in the gate array section, new prototypes are available in a fraction of the time required for cell-based ASIC technologies.

Series	Delay Time [1)]	Supply voltage	Estimated Usable Gates (I/O pads)[2)]
TC180E Series	0.23ns	Single 3.3V (3.0V)	5,000 (68) ~ 323,400 (416)
TC183E Series	0.23ns	Internal 3.3V (3.0V) (I/O 3.3V (3.0V)/5V Programmable)	3,000 (52) ~ 315,000 (400)
TC160E Series	0.3ns	Single 5V	13,000 (144) ~ 210,000 (416)

1) High-drive 2-input NAND gate, Fanout-2 plus typical interconnect load
2) The TC180E and TC183E support TAB and TCP, which provide about 1.5 times as many I/O pads as wire bonding does.

- The TC180E and TC183E Series are 0.5μm embedded arrays that combine low power consumption with high speeds.
- The TC183E Series is designed for mixed 3V/5V systems. It operates with a 3.3V core and offer both 3.3V and 5V I/Os.

For Quick Reference

X41

Function		LVQ (TC74LVQxxx Series) **	LVX (TC74LVXxxx Series) **
GATES BUFFERS	NAND	LVQ00	LVX00
	NOR	LVQ02	LVX02
	AND	LVQ08	LVX08
	OR	LVQ32	LVX32
	BUFFER		
	INVERTER	LVQ04	LVX04
	3-STATE BUFFER	LVQ240, LVQ241 LVQ244 LVQ245	LVX125 LVX240, LVX244 LVX245
	OPEN DRAIN		
	LEVEL SHIFTER		
	MULTIFUNCTION	LVQ86	LVX86
	SCHMITT TRIGGER	LVQ14	LVX14
FLIP-FLOPS		LVQ74 LVQ174 LVQ273, LVQ374	LVX74 LVX174 LVX273, LVX374
LATCHES		LVQ373, LVQ573	LVX373, LVX573
MULTIVIBRATORS			
DECODERS		LVQ138	LVX138
ENCODERS			
DRIVERS	LED		
	LCD		
	OTHERS		
REGISTERS	SHIFT		
	STORAGE		
COUNTERS	BINARY		
	DECADE		
	N-DIGIT DECADE		
	DIVIDER		
	PRESETTABLE		
MULTIPLEXERS	ANALOG		
	DIGITAL	LVQ151, LVQ157	LVX157
ARITHMETIC CIRCUITS	ADDER		
	COMPARATOR		
	PARITY TREE		
	RATE MULTIPLIER		
MEMORIES(RAM)	FIFO		
OTHERS	TIMER		
	BUS TERMINATOR		

**: Under Development

X41

Function		ACL (TC74AC/ACTxxx Series)	VHS (TC74VHC/VHCTxxx Series) **
GATES BUFFERS	NAND	AC00, ACT00, AC10, ACT10, AC20	VHC00, VHCT00, VHC10, VHC20, VHC132
	NOR	AC02, ACT02	VHC02, VHC27
	AND	AC08, ACT08, AC11	VHC08, VHCT08, VHC11, VHC21
	OR	AC32, ACT32	VHC32
	BUFFER		
	INVERTER	AC04, ACT04, AC05, AC14, ACT14	VHC04, VHCT04, VHCU04, VHC14
	3-STATE BUFFER	AC125, AC126, AC240, ACT240, AC241 AC244, ACT244, AC245, ACT245, AC367 AC368, AC540, ACT540, AC541, ACT541 AC623, AC640, ACT640	VHC125, VHC126 VHC240, VHCT240, VHC244, VHCT244 VHC367, VHC368 VHC540, VHCT540, VHC541, VHCT541 VHC245, VHCT245
	OPEN DRAIN	AC05	
	LEVEL SHIFTER		
	MULTI FUNCTION	AC86, ACT86	VHC86
	SCHMITT TRIGGER	AC14, ACT14	VHC14, VHC132
FLIP-FLOPS		AC74, ACT74, AC109, ACT109, AC112 ACT112, AC174, ACT174, AC175, ACT175 AC273, ACT273, AC374, ACT374, AC377 ACT377, AC534, AC564, ACT564 AC574, ACT574 AC821, ACT821, AC823, ACT823, AC825 ACT825	VHC74, VHCT74, VHC174 VHC175, VHC273 VHC374, VHCT374, VHC574, VHCT574
LATCHES		AC373, ACT373, ACT533, AC563 ACT563, AC573, ACT573, AC841, ACT841 AC843, ACT843	VHC373, VHCT373, VHC573, VHCT573
MULTIVIBRATORS			VHC123A, VHC221A
DECODERS		AC138, ACT138, AC139, ACT139	VHC138, VHCT138, VHC139 VHC238
ENCODERS			
DRIVERS	LED		
	LCD		
	OTHERS		
REGISTERS	SHIFT	AC164, ACT164, AC166, AC299, ACT299 AC670	VHC164, VHC165 VHC299, VHC595
	STORAGE		
COUNTERS	BINARY	AC161, ACT161, AC163, ACT163 AC169, AC393	VHC161, VHC163 VHC393 VHC4040
	DECADE	AC390	
	N-DIGIT DECADE		
	DIVIDER		
	PRESETTABLE		
MULTIPLEXERS	ANALOG		
	DIGITAL	AC151, ACT151, AC153, ACT153, AC157 ACT157, AC158, ACT158 AC257, ACT257, AC258	VHC153 VHC157, VHC257
ARITHMETIC CIRCUITS	ADDER	AC283, ACT283	
	COMPARATOR	AC521, ACT521	
	PARITY TREE	AC280, ACT280	
	RATE MULTIPLIER		
MEMORIES(RAM)	FIFO		
OTHERS	TIMER		
	BUS TERMINATOR		

**: Under Development

HS-C²MOS (TC74HC/HCTxxxA Series)	STANDARD C²MOS (TC4000/4500/5000 Series)
HC00A, HCT00A, HC03A, HC10A, HC20A, HC30A, HC132A, HC133A	4011B, 4011UB, 4012B, 4023B, 4068B, 4093B
HC02A, HCT02A, HC27A, HC4002A, HC4078A	4000B, 4001B, 4001UB, 4002B, 4025B, 4078B
HC08A, HCT08A, HC09A, HC11A, HC21A	4068B, 4073B, 4081B, 4082B
HC32A, HCT32A, HC4072A, HC4075A, HC4078A	4071B, 4072B, 4075B, 4078B
HC07A, HC4050A, HCT7007A	4009UB, 4010B, 4050B, 5064B, 5065B, 5066B 5067B
HC04A, HCT04A, HCU04A, HC05A, HC4049A	4007UB, 4049B, 4069UB, 4584B
HC125A, HC126A, HC240A, HCT240A, HC241A, HCT241A, HC242A, HC243A, HC244A, HCT244A, HC245A, HCT245A, HC365A, HC366A, HC367A, HC368A, HC540A, HCT540A, HC541A, HCT541A, HC623A, HC640A, HCT640A, HC7240A, HC7241A, HC7244A HC7645A	4502B, 4503B, 5012B, 5024B, 5025B
HC03A, HC05A,HC07A, HC09A, HC266A	40107B, 5029B, 5064B, 5065B, 5066B, 5067B
HC4049A, HC4050A	4009UB, 4010B, 4049B, 4050B, 5020B
HC51A, HC86A, HCT86A, HC266A, HC386A, HC7266A	4019B, 4030B, 4077B, 4085B, 4086B, 4519B 4572B
HC14A, HC132A	4093B, 4583B, 4584B
HC73A, HC74A, HCT74A, HC76A, HC107A, HC109A, HC112A, HC174A HCT174A, HC175A, HC273A, HCT273A, HC374A, HCT374A, HC377A, HC534A HC564A, HC574A, HCT574A, HC646A, HCT646A HC652A, HCT652A	4013B, 4027B, 40174B, 40175B
HC75A, HC77A, HC259A, HC279A, HC373A, HCT373A, HC375A, HC563A, HCT563A, HC573A, HCT573A	4042B, 4043B, 4044B, 4099B, 4508B
HC123A, HC221A, HC423A, HC4538A	4047B, 4528B, 4538B
HC42A, HC131A, HC137A, HC138A, HCT138A, HC139A, HCT139A, HC154A HC155A, HC237A, HC238A, HC4028A, HC4511A, HC4514A, HC4515A, HC4543A	4028B, 4514B, 4515B, 4555B, 4556B,
HC147A, HC148A	4532B
HC4511A	4511B, 5002B, 5022B
HC4543A	4056B, 4543B
	5068B, 5069B
HC164A, HCT164A, HC165A, HC166A, HC173A, HC194A, HC195A, HC299A, HC595A, HC597A, HC670A, HC4094A, HC40105A	4006B, 4014B, 4015B, 4021B, 4035B, 4094B 5050
	4076B
HC161A, HC163A, HC191A, HC193A, HC393A, HC590A, HC592A, HC691A, HC697A, HC4020A, HC4024A, HC4040A, HC4520A	4020B, 4024B, 4040B, 40161B, 40163B, 40193B 4520B, 4526B, 5027B
HC160A, HC162A, HC190A, HC192A, HC390A,	4029B, 4518B, 40192B, 4522B 5026B
	5032, 5037, 5051, 5052, 5053, 5054, 5070
HC4017A, HC4020A, HC4022A, HC4024A, HC4040A, HC4060A, HC40102A, HC40103A, HC7292A	4017B, 4020B, 4022B, 4024B, 4040B, 4521B, 40102B, 40103B, 5036A, 5048A
	4018B, 4029B, 4510B, 4516B
HC4051A, HC4052A, HC4053A, HC4066A, HC4316A, HC4351A, HC4352A HC4353A	4016B, 4051B, 4052B, 4053B, 4066B
HC151A, HC153A, HC157A, HCT157A, HC158A, HCT158A, HC251A, HC253A, HC257A, HCT257A, HC258A, HCT258A, HC298A, HC352A, HC353A	4512B, 4539B, 5023B
HC283A	4008B, 4560B
HC85A, HC688A, HCT688	4063B, 4585B
HC280A	4531B
	4527B
HC40105A	
	5043, 5071
	40117B