

RICOH

EK-044-9004

RICOH CORP/ ELECTRONIC

**CMOS Gate Array
5GV Series**

The RICOH gate array 5GV series complies with the CMOS 1.5 μ rule, and offers high speed operation with a gate delay time of 1.0 ns.

The 5GV series inherits the rich library of 5GF gate array series. The cell library is compatible with standard cell RSC-15 series and enables LSI development to suit any system and production scale.

■ FEATURES

1. Gate count

6 types, from 4180 to 16140 gates.

2. High speed operation (CMOS 1.2 μ design rule)

Gate delay time 0.8 ns (Typ.)

I/O cell delay time 3.0 ns (Typ.)

* Typ. : F.O. = 2, wiring length = 2 mm

3. Extensive cell library

Macro cell 151

Macro function cell 251

Total 402

The library is perfectly compatible with the cell library of the conventional gate array 5GH, 5GF series and the standard cell RSC-15 series. It is easy to convert from the gate array to the standard cell.

4. Test cell

10 types of scan-path format test cells are prepared.

5. Design tool

- RICOH originally developed R-CAD design system based on SUN work station.
- MENTOR, DAISY EWS

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■ ABSOLUTE MAXIMUM RATINGS

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Symbol	Parameter	Condition	Rating	Unit
Vcc	Power Supply Voltage	with respect to GND	-0.3~7	V
VI	Input Voltage		-0.3~Vcc+0.3	V
VO	Output Voltage		-0.3~Vcc+0.3	V
Topr	Operating Temperature		-40~85	°C
Tstg	Storage Temperature		-55~125	°C

■ RECOMMENDED OPERATING CONDITION

Symbol	Parameter	Min.	Typ.	Max.	Unit
Vcc	Power Supply Voltage	4.75	5.00	5.25	V
Ta	Operating Temperature	0	25	70	°C

■ DC ELECTRICAL CHARACTERISTICS

(Ta=0~70°C, Vcc=5V±10%)

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
VIH	"H" Input voltage (TTL)		2.2		Vcc+0.3	V
VIL	"L" Input voltage (TTL)		-0.3		0.8	V
VIH	"H" Input voltage (CMOS)		Vcc×0.7		Vcc+0.3	V
VIL	"L" Input voltage (CMOS)		-0.3		Vcc×0.3	V
VOH	"H" Output voltage	IOH=-4mA	2.4			V
VOL	"L" Output voltage	IOL= 4mA			0.4	V
ILI	Input Current	VI =0~Vcc	-10		10	μA
IOZ	Output Current for off state	VO =0~Vcc	-10		10	μA
Icc	Power Supply Current			*		mA

* The power supply current depends on gate count, clock frequency, etc.

■ AC ELECTRICAL CHARACTERISTICS

(Ta=0~70°C, Vcc=5V±10%)

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
Tpdo	I/O Output delay time	CL =15pF		1.7		ns
Tpdi	I/O Input delay time	F.O.=2, wiring length=2mm		3.0		ns
Tpd	Inner gate delay time	F.O.=2, wiring length=2mm		0.8		ns

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■ 5GV SERIES LINE-UP

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Series		5GV041	5GV053	5GV073	5GV094	5GV124	5GV161
Gate count		4,180	5,330	7,370	9,450	12,490	16,140
Number of I/O* ¹		106	118	136	154	178	204
Package	DIP	24, 28, 40	24, 28, 40	24, 28, 40	24, 28, 40		
	SDIP	64	42, 64	42, 64	42, 64	42, 64	42, 64
	FLAT	60, 64, 80	60, 64, 80	60, 64, 80	64, 80, 100	64, 80, 100	80, 100* ²
		100	100, 128	100, 128, 144	128, 144	128, 144, 160	128, 144* ² , 160
	PLCC	44, 68, 84	44, 68, 84	44, 68, 84	44, 68, 84	44, 68, 84	44, 68, 84

*¹ Eight of I/O pads are dedicated to VCC and GND*² Under Development

■ DEVELOPMENT TOOL (CAD Interface)

Hardware

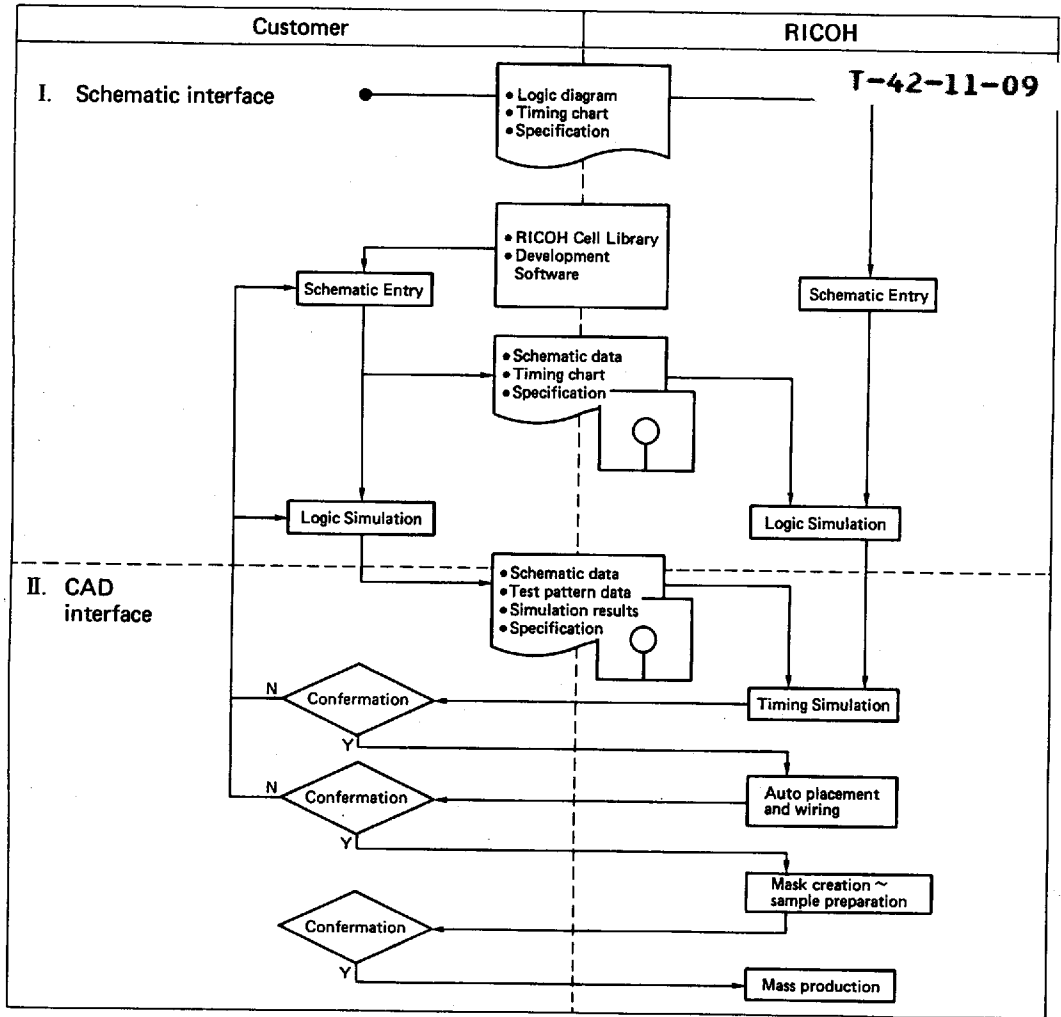
- EWS R-CAD (SUN3, SUN4)
- LOGICIAN (Daisy)
- IDEA1000 (Mentor)

Software

- RICOH Library
- RICOH Development Software
- R-CAD (C-CAD : Schematic Entry, Simulation)
- (KBSC : Logic Synthesis)

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■ 5GV DEVELOPMENT FLOW

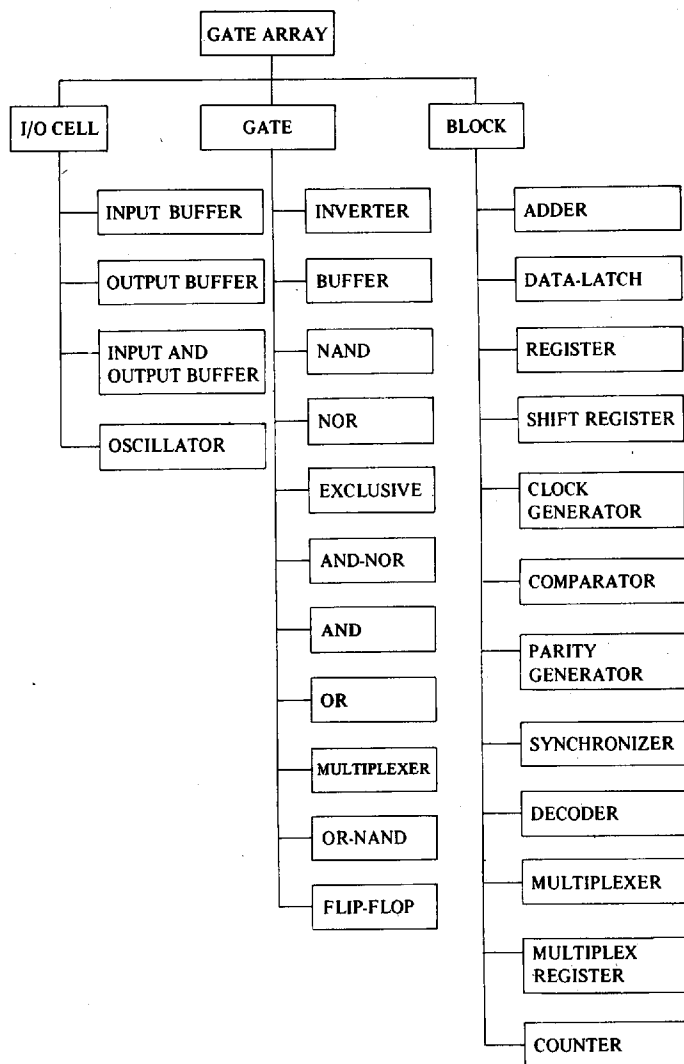


CMOS GATE ARRAY 5GV series

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Cell List

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GATE ARRAY 5GV CELL LIST

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I/O CELL

INPUT BUFFER

STANDARD

CELL FUNCTION

INT01	TTL Compatible	Inverter
INT02	TTL	Buffer
INTSCH	TTL	Schmitt Trigger
INC01	CMOS Compatible	Inverter
INC02	CMOS	Buffer
INCSCH	CMOS	Schmitt Trigger

with Resistance
for pull-up

INT1U1	TTL Compatible	Inverter
INT2U1	TTL	Buffer
INTSU1	TTL	Schmitt Trigger
INC1U1	CMOS Compatible	Inverter
INC2U1	CMOS	Buffer
INCSU1	CMOS	Schmitt Trigger

with Resistance
for pull-down

INT1D1	TTL Compatible	Inverter
INT2D1	TTL	Buffer
INTSD1	TTL	Schmitt Trigger
INC1D1	CMOS Compatible	Inverter
INC2D1	CMOS	Buffer
INCSU1	CMOS	Schmitt Trigger

OUTPUT BUFFER

OUTINV	Inverter
OUTTRI	3-State Output
OUTOPN	Open Drain Output

OUTPUT AND
INPUT BUFFER

STANDARD

IOT01	TTL Compatible	Inverter & 3-State Output
IOT1		
IOT02	TTL Compatible	Buffer & 3-State Output
IOT2		
IOTSCH	TTL Compatible	Schmitt Trigger & 3-State Output
IOTSH		
IOC01	CMOS Compatible	Inverter & 3-State Output
IOC1		
IOC02	CMOS Compatible	Buffer & 3-State Output
IOC2		
IOCSCH	CMOS Compatible	Schmitt Trigger & 3-State Output
IOCSH		

with Resistance
for pull-up

IOT1U1	TTL Compatible	Inverter & 3-State Output
IOTU1		
IOT2U1	TTL Compatible	Buffer & 3-State Output
IOC1U1	CMOS Compatible	Inverter & 3-State Output
IOCU1		
IOC2U1	CMOS Compatible	Buffer & 3-State Output

with Resistance
for pull-down

IOT1D1	TTL Compatible	Inverter & 3-State Output
IOTD1		
IOC1D1	CMOS Compatible	Inverter & 3-State Output
IOD1		

OSCILLATOR

XIN01	Input
XOUT	Oscillator Output
XIO	Oscillator

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GATE

INVERTER	STANDARD	INV01 Inverter
	POWER Type	NBUF02 Power Inverter(X2), NBUF06 Power Inverter(X6) NBUF03 Power Inverter(X3), NBUF10 Power Inverter(X10) NBUF04 Power Inverter(X4), NBUF16 Power Inverter(X16)
	3-STATE	TINVB3 3-State Inverter TINVB3 3-State Inverter (X3) TBF368 Quad 3-State Inverter M368C Quad 3-State Inverter M240C Octal 3-State Inverter (74LS240) M540C Octal 3-State Inverter (74LS540)
BUFFER	STANDARD	BUF11 Buffer
	POWER Type	BUF12 Power Buffer (X2), BUF06 Power Buffer (X6) BUF13 Power Buffer (X3), BUF010 Power Buffer (X10) BUF26 Power Buffer (X6), BUF015 Power Buffer (X15)
	3-STATE	3BUF02 3-State Buffer Driver M125C 3-State Buffer, M125-D 3-State Buffer (X3) M367C Quad 3-State Buffer M244C Octal 3-State Buffer (74LS244) M245C Octal 3-State Bus Transceiver (74LS245) M541C Octal 3-State Buffer (74LS541) M640C Octal 3-State Bus Transceiver (74LS640)
NAND	STANDARD	NAND02 2-Input NAND03 3-Input NAND04 4-Input NAND05 5-Input NAND06 6-Input NAND08 8-Input
	POWER Type	DNAND2 Power 2-Input
NOR	STANDARD	NOR02 2-Input NOR03 3-Input NOR04 4-Input NOR05 5-Input NOR06 6-Input NOR08 8-Input
	POWER Type	DNOR02 Power 2-Input
EXCLUSIVE		XOR02 2-Input Exclusive OR XNOR02 2-Input Exclusive NOR
AND-NOR		AOI21 2-AND-NOR AOI31 3-AND-NOR AOI41 4-AND-NOR AOI22 2-Input, 2-Wide AOI32 3-Input, 2-Wide AOI23 2-Input, 3-Wide AOI33 3-Input, 3-Wide AOI24 2-Input, 4-Wide AOI211 2-AND Into 3-NOR AOOI22 2-AND, 2-NOR Into 2-NOR MAJ23 Inverting 2 of 3 Majority

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AND

AND02 2-Input
 AND03 3-Input
 AND04 4-Input

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OR

OR02 2-Input
 OR03 3-Input
 OR04 4-Input

MULTIPLEXER

MUX21H 2 bit non Inverting MUX

OR-NAND

OAI21 2-OR-NAND
 OAI31 3-OR-NAND
 OAI41 4-OR-NAND
 OAI22 2-Input, 2-Wide
 OAI32 3-Input, 2-Wide
 OAI23 2-Input, 3-Wide
 OAI33 3-Input, 3-Wide
 OAI24 2-Input, 4-Wide
 OAI211 2-OR Into 3-NAND
 OAAI22 2-OR, 2-NAND Into 2-NAND

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BLOCK

ADDER

HA1	Half Adder
FA1	Full Adder
M80C	Gated Full Adder (7480)
FA2	2 Bit Binary Full Adder
FAS2	2 Bit Binary 2's Complement Full Adder, or Subtractor
M82C	2 Bit Binary Full Adder (7482)
FA4	4 Bit Binary Full Adder
M83C	4 Bit Binary Full Adder with Fast Carry (74LS83)
CLA1	Carry Look Ahead for 4 Bit Adder (Least Significant Nibble)
CLA2	Carry Look Ahead for 4 Bit Adder
FA16	16 Bit Fast Adder

DATA LATCH

L4	4 Bit Data Latch
L8	8 Bit Data Latch

REGISTER

R41	4 Bit Data Register
R42	4 Bit Data Register, Clear Direct
R81	8 Bit Data Register
R82	8 Bit Data Register, Clear Direct

SHIFT REGISTER

SR41	4 Bit Shift Register
SR42	4 Bit Shift Register, Clear Direct
M95C	4 Bit Shift Register (74LS95)
SR43	4 Bit Shift Register, Set Direct
SR44	4 Bit Shift Register, Synchronous Parallel Load
SR45	4 Bit Shift Register, Synchronous Parallel Load and Clear
SR46	4 Bit Shift Register, Asynchronous Parallel Load
SR47	4 Bit Shift Register, Sync Clear
M94C	4 Bit Shift Register (7494)
M179C	4 Bit Parallel Access Shift Register (74179)
M195C	4 Bit Parallel-Access Shift Register (74LS195)
M96C	5 Bit Shift Register (74LS96)
M91C	8 Bit Shift Register (74LS91)
M164C	8 Bit Parallel Output Serial Shift Register (74LS164)
M165C	Parallel Load 8 Bit Shift Register (74LS165)
M166C	8 Bit Shift Register (74LS166)
M198C	8 Bit Bidirectional Universal Shift Register (74198)
M199C	8 Bit Bidirectional Universal Shift Register (74199)

CLOCK GENERATOR

CPG1	Two Phase Clock Generator, Unbuffered, Hi Underlap, Lo Drive
CPG2	Two Phase Clock Generator, Unbuffered, Lo Underlap, Lo Drive
CPG3	Two Phase Clock Generator, Unbuffered, Hi Underlap, Hi Drive
CPG4	Two Phase Clock Generator, Unbuffered, Lo Underlap, Hi Drive

COMPARATOR

MAG2H	2 Bit Magnitude Comparator
MAG2	2 Bit Extendable Magnitude Comparator
MAG4	4 Bit Extendable Magnitude Comparator
CMP4	4 Bit Equality Comparator
M85C	4 Bit Magnitude Comparator Expandable
CMP8	8 Bit Equality Comparator

PARITY GENERATOR

PAR8	8 Bit Odd Parity Detector
PAR9	9 Bit Odd Parity Detector
M180C	9 Bit Odd/Even Parity Generator (74180)

SYNCHRONIZER

SYNC01	Synchronizer for Asynchronous 0 to 1 Event
SYNC10	Synchronizer for Asynchronous 1 to 0 Event

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FLIP-FLOP	LATCH	
		DLT00 D-LATCH DLTOR Reset DLTOS Set DLTSR Set & Reset NDLTOR Reset B NDLTOS Set B NDLTSR Set B & Reset B DLG00 Gated DLNG00 Gated (Active L) NDLGOR Gated, With Reset B NLNGOR Gated (Active L), With Reset B
	RS-LATCH	RSLT RS-Latch NRSLT RS-Latch B NRSLCT Common Gate N2RSLT Separate Gate
	T-FF	TFF0R Reset TFF0S Set TFFSR Set & Reset NTFF0R Reset B NTFF0S Set B NTFFSR Set B & Reset B
	D-FF	DFF00 D-FF DFF0R Reset DFF0S Set DFFSR Set & Reset NDFF0R Reset B NDFF0S Set B NDFFSR Set B & Reset B DFFC00 Clocked NDCOR Clocked, With Reset B NDCOS Clocked, With Set B NDCSR Clocked, With Set B & Reset B N2CSR Set B & Reset B M273C Octal D-Type Flip-Flop (74LS273)
	JK-FF	JK0R Reset JK0S Set JKSR Reset & Set NJK0R Reset B NJK0S Set B NJKSR Reset B & Set B NJKCOR Clocked, with Reset B NJKCOS Clocked, with Set B NJKCSR Clocked, with Set B & Reset B NJ2CSR Set B & Reset B No Spbufs and No SdBufs M112C Clocked (Active L), with Set B & Reset B
	SCAN	DLT00T D-Latch SCAN DLTMS D-Latch into D-Latch SCAN NDORT D-FF with Reset B SCAN NDOST D-FF with Set B SCAN NDSRT D-FF with Set B & Reset B SCAN DC00T D-FF SCAN NDCORT D-FF with Reset B SCAN NDCSRT D-FF with Set B & Reset B SCAN NJCORT JK-FF with Reset B SCAN NJCSRT JK-FF with Set B & Reset B SCAN

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GATE ARRAY 5GV CELL LIST

DECODER

M4555C Binary to 1 of 4 Decoder
 M139C 2 to 4 Decoder (74LS139)
 M155C Dual 2 to 4 Decoders
 D24H 2 to 4 Decoder, Output Active Hi
 D24L 2 to 4 Decoder, Output Active Lo
 D24GH 2 to 4 Decoder, Gated Output Active Hi
 D24GL 2 to 4 Decoder, Gated Output Active Lo
 D38H 3 to 8 Decoder, Output Active Hi
 D38L 3 to 8 Decoder, Output Active Lo
 D38GH 3 to 8 Decoder, Gated Output Active Hi
 D38GL 3 to 8 Decoder, Gated Output Active Lo
 M138C Gated 3 to 8 Decoder (74LS138)
 M138D Gated 3 to 8 Decoder (74LS138)
 D410H 4 to 10 Decoder, Output Active Hi
 D410L 4 to 10 Decoder, Output Active Lo
 M154C 4 to 16 Decoder (74LS154)

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DM6JH Spike Free Decoder for MOD 6 Johnson Counter, Active Hi
 DM6JL Spike Free Decoder for MOD 6 Johnson Counter, Active Lo
 DM8JH Spike Free Decoder for MOD 8 Johnson Counter, Active Hi
 DM8JL Spike Free Decoder for MOD 8 Johnson Counter, Active Lo
 DM10JH Spike Free Decoder for MOD 10 Johnson Counter, Active Hi
 DM10JL Spike Free Decoder for MOD 10 Johnson Counter, Active Lo
 DM12JH Spike Free Decoder for MOD 12 Johnson Counter, Active Hi
 DM12JL Spike Free Decoder for MOD 12 Johnson Counter, Active Lo
 DM14JH Spike Free Decoder for MOD 14 Johnson Counter, Active Hi
 DM14JL Spike Free Decoder for MOD 14 Johnson Counter, Active Lo
 DM16JH Spike Free Decoder for MOD 16 Johnson Counter, Active Hi
 DM16JL Spike Free Decoder for MOD 16 Johnson Counter, Active Lo

M43C Excess-3 to Decimal Decoder (7443)
 M44C Excess-3 Gray to Decimal Decoder (74LS44)
 M47C Bcd to 7 Segment Decoders/Drivers (74LS47)
 M49C Bcd to 7 Segment Decoders/Drivers (74LS49)
 M42C Bcd to Decimal Decoder (7442)
 M145C Bcd to Decimal Decoder (74LS145)
 M4028C Bcd to Decimal Decoder (4028)

MULTIPLEXER

M298C Quad 2-Input Multiplexer with Storage (74LS298)
 M157C Quad 2 Bit Gated Non Inverting Mux
 M158C Quad 2 Bit Gated Inverting Mux
 M257C Quad 2 Bit Gated Non Inverting Mux with 3-State Output
 M258C Quad 2 Bit Gated Inverting Mux with 3-State Output
 M153C Dual 4 Bit Gated Non Inverting Mux
 M353C Dual 4 Bit Gated Inverting Mux with 3-State Output
 M253C Dual 4 Bit Gated Non Inverting Mux with 3-State Output (74LS253)
 M251C 8 Bit Gated Mux with 3-State Output (74LS251)
 M151C 8 Bit Gated Mux
 M152C 8 Bit Inverting Mux
 M150C 16 Bit Gated Inverting Mux (74LS150)

MUX31H 3 Bit Non Inverting Mux
 MUX31L 3 Bit Inverting Mux
 MUX41H 4 Bit Non Inverting Mux
 MUX41GH 4 Bit Gated Non Inverting Mux
 MUX41L 4 Bit Inverting Mux
 MUX51H 5 Bit Non Inverting Mux
 MUX51L 5 Bit Inverting Mux
 MUX61H 6 Bit Non Inverting Mux
 MUX61L 6 Bit Inverting Mux
 MUX71H 7 Bit Non Inverting Mux
 MUX71L 7 Bit Inverting Mux
 MUX81H 8 Bit Non Inverting Mux

MUX22H Dual 2 Bit Non Inverting Mux
 MUX32H Dual 3 Bit Non Inverting Mux
 MUX42H Dual 4 Bit Non Inverting Mux
 MUX52H Dual 5 Bit Non Inverting Mux
 MUX62H Dual 6 Bit Non Inverting Mux
 MUX72H Dual 7 Bit Non Inverting Mux
 MUX82H Dual 8 Bit Non Inverting Mux

MUX24H Quad 2 Bit Non Inverting Mux
 MUX24L Quad 2 Bit Inverting Mux
 MUX34H Quad 3 Bit Non Inverting Mux
 MUX44H Quad 4 Bit Non Inverting Mux
 MUX54H Quad 5 Bit Non Inverting Mux
 MUX64H Quad 6 Bit Non Inverting Mux
 MUX74H Quad 7 Bit Non Inverting Mux
 MUX84H Quad 8 Bit Non Inverting Mux

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GATE ARRAY 5GV CELL LIST

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MULTIPLEX
REGISTER

MR41	4 Bit Register with 2 Bit Multiplexed Input
MR42	4 Bit Register with 2 Bit Multiplexed Input, Clear Direct
MR43	4 Bit Register with 2 Bit Multiplexed Input, Sync Clear
MR44	4 Bit Register with 2 Bit Multiplexed Input, Sync Clear Reset B
MR81	8 Bit Register with 2 Bit Multiplexed Input
MR82	8 Bit Register with 2 Bit Multiplexed Input, Clear Direct

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COUNTER

MODULO
JOHNSON
COUNTER

CM4J	Modulo 4, Johnson Counter, Clear Direct
CM6J	Modulo 6, Johnson Counter, Clear Direct
CM8J	Modulo 8, Johnson Counter, Clear Direct
CM10J	Modulo 10, Johnson Counter, Clear Direct
CM12J	Modulo 12, Johnson Counter, Clear Direct
CM14J	Modulo 14, Johnson Counter, Clear Direct
CM16J	Modulo 16, Johnson Counter, Clear Direct

MODULO
GRAY
COUNTER

C2G	Modulo 4, Gray Counter, Clear Direct
C3G	Modulo 8, Gray Counter, Clear Direct
C4G	Modulo 16, Gray Counter, Clear Direct
C5G	Modulo 32, Gray Counter, Clear Direct
C6G	Modulo 64, Gray Counter, Clear Direct, Prescaled
C7G	Modulo 128, Gray Counter, Clear Direct, Prescaled
C8G	Modulo 256, Gray Counter, Clear Direct, Prescaled

MODULO
BINARY
COUNTER

CM3B	Modulo 3, Binary Counter, Clear Direct
CM4B	Modulo 4, Binary Counter, Clear Direct
CM5B	Modulo 5, Binary Counter, Clear Direct
CM6B	Modulo 6, Binary Counter, Clear Direct
CM7B	Modulo 7, Binary Counter, Clear Direct
CM8B	Modulo 8, Binary Counter, Clear Direct
CM9B	Modulo 9, Binary Counter, Clear Direct
CM10B	Modulo 10, Binary Counter, Clear Direct
CM11B	Modulo 11, Binary Counter, Clear Direct
CM12B	Modulo 12, Binary Counter, Clear Direct
CM13B	Modulo 13, Binary Counter, Clear Direct
CM14B	Modulo 14, Binary Counter, Clear Direct
CM15B	Modulo 15, Binary Counter, Clear Direct
CM16B	Modulo 16, Binary Counter, Clear Direct
CM17B	Modulo 17, Binary Counter, Clear Direct

MODULO
BINARY
RIPPLE
COUNTER

CM8BR	Modulo 8, Binary Ripple Counter, Clear Direct
CM9BR	Modulo 9, Binary Ripple Counter, Clear Direct
CM10BR	Modulo 10, Binary Ripple Counter, Clear Direct
CM11BR	Modulo 11, Binary Ripple Counter, Clear Direct
CM12BR	Modulo 12, Binary Ripple Counter, Clear Direct
CM13BR	Modulo 13, Binary Ripple Counter, Clear Direct
CM14BR	Modulo 14, Binary Ripple Counter, Clear Direct
CM15BR	Modulo 15, Binary Ripple Counter, Clear Direct
CM16BR	Modulo 16, Binary Ripple Counter, Clear Direct
CM17BR	Modulo 17, Binary Ripple Counter, Clear Direct
CM18BR	Modulo 18, Binary Ripple Counter, Clear Direct
CM19BR	Modulo 19, Binary Ripple Counter, Clear Direct
CM20BR	Modulo 20, Binary Ripple Counter, Clear Direct
CM21BR	Modulo 21, Binary Ripple Counter, Clear Direct
CM22BR	Modulo 22, Binary Ripple Counter, Clear Direct
CM23BR	Modulo 23, Binary Ripple Counter, Clear Direct
CM24BR	Modulo 24, Binary Ripple Counter, Clear Direct
CM25BR	Modulo 25, Binary Ripple Counter, Clear Direct
CM26BR	Modulo 26, Binary Ripple Counter, Clear Direct
CM27BR	Modulo 27, Binary Ripple Counter, Clear Direct
CM28BR	Modulo 28, Binary Ripple Counter, Clear Direct
CM29BR	Modulo 29, Binary Ripple Counter, Clear Direct
CM30BR	Modulo 30, Binary Ripple Counter, Clear Direct
CM31BR	Modulo 31, Binary Ripple Counter, Clear Direct
CM32BR	Modulo 32, Binary Ripple Counter, Clear Direct

MODULO
SHIFT
COUNTER

CM5SR	Modulo 5, Shift Counter, Clear Direct
CM8SR	Modulo 8, Shift Counter, Clear Direct
CM9SR	Modulo 9, Shift Counter, Clear Direct
CM10SR	Modulo 10, Shift Counter, Clear Direct
CM12SR	Modulo 12, Shift Counter, Clear Direct

MODULO BINARY UP COUNTER	CB41	Modulo 16, Binary Up Counter, Expandable Enable Clear Direct
	CB42	Modulo 16, Binary Up Counter, Expandable Enable Sync Clear
	CB4C	Modulo 16, Binary Up Counter Fast, Sync Clear
	CB5C	Modulo 32, Binary Up Counter Fast, Sync Clear
	CB6C	Modulo 64, Binary Up Counter Fast, Sync Clear
	CB7C	Modulo 128, Binary Up Counter Fast, Sync Clear
	CB8C	Modulo 256, Binary Up Counter Fast, Sync Clear
	CB4F	Modulo 16, Binary Up Counter Fast, Individual Reset B & Set B
	CB5F	Modulo 32, Binary Up Counter Fast, Individual Reset B & Set B
	CB6F	Modulo 64, Binary Up Counter Fast, Individual Reset B & Set B
	CB7F	Modulo 128, Binary Up Counter Fast, Individual Reset B & Set B
	CB8F	Modulo 256, Binary Up Counter Fast, Individual Reset B & Set B
MODULO UP/DOWN COUNTER	CUD41	Modulo 16, Up/Down Counter, Expandable Enable Clear Direct
	CUD42	Modulo 16, Up/Down Counter, Expandable with Asynchronous Load and Clear
SYNCHRONOUS COUNTER	M161C	Synchronous 4 Bit Binary Counter (74LS161)
	M161D	Synchronous 4 Bit Binary Counter (74LS161)
	M163C	Synchronous 4 Bit Binary Counter (74LS163)
	M163D	Synchronous 4 Bit Binary Counter (74LS163)
	M163F	Synchronous 4 Bit Binary Counter, Optimized for Max Clock Freq
	M160C	Synchronous 4 Bit Bcd Counter (74LS160)
	M160D	Synchronous 4 Bit Bcd Counter (74LS160)
	M162C	Synchronous 4 Bit Bcd Counter (74LS162)
	M162D	Synchronous 4 Bit Bcd Counter (74LS162)
MODULO LINEAR FEEDBACK SHIFT REGISTER	C3LSR	Modulo 7, Linear Feedback Shift Register
	C4LSR	Modulo 15, Linear Feedback Shift Register
	C5LSR	Modulo 31, Linear Feedback Shift Register
	C6LSR	Modulo 63, Linear Feedback Shift Register
	C7LSR	Modulo 127, Linear Feedback Shift Register
	C8LSR	Modulo 255, Linear Feedback Shift Register
CLOCK PRESCALER	PS2	Divide by 2 External Clock Prescaler with No Input Protection
	PS3	Divide by 3 External Clock Prescaler with No Input Protection
	PS4	Divide by 4 External Clock Prescaler with No Input Protection
TTL/CMOS MSI	M90C	Decade Counter (74LS90)
	M92C	Divided by Twelve Counter (74LS92)
	M93C	4 Bit Binary Counter (74LS93)
	M197C	Presetable 4 Bit Binary Counter (74LS197)
	M390C	Decade Counter (74LS390)
	M393C	4 Bit Binary Counter
	M4017C	Decade Counter/Driver (4017)
	M4520C	Dual Binary Up Counter

GATEARRY 5GV CELL LIST

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TTL/RICOH CELL CORRESPONDENCE TABLE

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TTL Name	RICOH Cell	TTL Name	RICOH Cell	TTL Name	RICOH Cell
74LS00	NAND02	74LS138	M138C	74LS244	M244C F
74LS02	NOR02		M138D	74LS245	M245C F
74LS04	INV01	74LS139	M139C	74LS251	M251C F
74LS10	NAND03	74LS145	M145C	74LS253	M253C F
74LS20	NAND04	74150	M150C	74LS257C	M257C F
7425	NOR04*1	74LS151	M151C	74LS258	M258C F
74LS27	NOR03	74LS152	M152C	74S260	NOR05
74LS30	NAND08	74LS153	M153C	74LS273	M273C
7442	D410L	74LS154	M154C		R82
	M42C	74LS155	M155C	74LS279	NRSLT*10
74LS43	M43C	74LS157	M157C	74LS298	M298C
74LS44	M44C	74LS158	M158C	74LS353	M353C F
74LS47	M47C	74LS160	M160C*6	74LS367A	M367C F
74LS49	M49C		M160D	74LS368A	M368C F
74LS51	AOI22	74LS161	M161C*7		TINVBF F
74LS54	AOI24		M161D		TBF368 F
74LS73	NJKCOR*2 F	74LS162	M162C*8	74LS390	M390C
7474	NDCSR		M162D	74LS393	M393C
7476	NJKCSR*3	74LS163	M163C*9		CM16BR*11
74LS80	M80C*4		M163D	74LS399	MR41
7482	M82C		M163F	74LS540	M540C F
	FA2	74LS164	M164C	74LS541	M541C F
74LS83	M83C	74LS165	M165C	74LS640	M640C F
74LS85	M85C	74LS166	M166C	4017	M4017C
74LS86	XOR02	74LS169	M169C	4028	M4028C
74LS90	M90C	74LS171	R42	4520	M4520C
74LS91	M91C	74LS174	R82	4555	M4555C
74LS92	M92C	74LS175	R42		
74LS93	M93C	74LS179	M179C		
74LS94	M94C	74LS180	M180C		
74LS95	M95C	74LS195	M195C		
74LS96	M96C	74LS197	M197C		
74100	L4	74LS198	M198C		
74LS113A	NJKCOS*5	74LS199	M199C		
74LS125	M125C F	74LS240	M240C F		

F: 5GF, 5GV Series

*1: NOR04 has no strobe terminal.

*2 *3 and *5: 7473, 7476, and 74LS113A are negative edge triggers, but NJKCOR, NJKCSR and NJKCOS are positive edge triggers.

4: M80C has no 74LS80 A or B* terminals.

*6, *7, *8 and *9: M160C, M161C, M162C and M163C have inverted outputs.

*10: NRSLT has a QB terminal.

*11: 74LS393 is a negative edge trigger, but CM16BR is a positive edge trigger.