MOTOROLA

MC2902

HIGH-SPEED LOOK-AHEAD CARRY GENERATOR

The MC2902 is a high-speed, look-ahead carry generator which accepts up to four pairs of carry propagate and carry generate signals and a carry input and provides anticipated carries across four groups of binary ALUs. The device also has carry propagate and carry generate outputs which may be used for further levels of look-ahead.

The MC2902 is generally used with the bipolar microprocessor unit to provide look-ahead over word lengths of more than four bits. The look-ahead carry generator can be used with binary ALUs in an active LOW or active HIGH input operand mode by reinterpreting the carry functions. The connections to and from the ALU to the look-ahead carry generator are identical in both cases.

The logic equations provided at the outputs are:

$$C_{n+x} = G_0 + P_0C_n$$
$$C_{n+y} = G_1 + P_1G_0 + P_1P_0C_n$$
$$C_{n+z} = G_2 + P_2G_1 + P_2P_1G_0 + P_2P_1P_0C_n$$
$$G = G_3 + P_3G_2 + P_3P_2G_1 + P_3P_2P_1G_0$$
$$P = P_3P_2P_1P_0$$

FEATURES

- Provides look-ahead carries across a group of four MC2901 microprocessor ALUs.
- Capability of multi-level look-ahead for high-speed arithmetic operation over large word lengths.
- Typical carry propagation delay of 6.0 ns.

TTL

HIGH-SPEED LOOK-AHEAD CARRY GENERATOR

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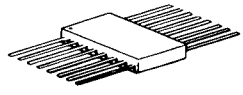
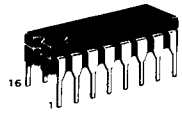
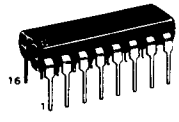


F SUFFIX
CERAMIC PACKAGE
CASE 650

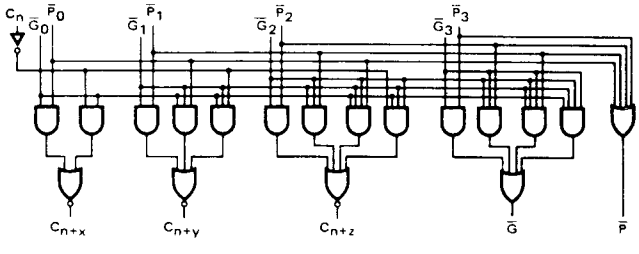


L SUFFIX
CERAMIC PACKAGE
CASE 620

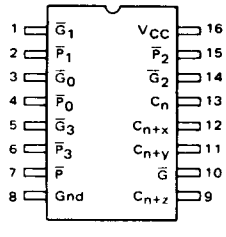


P SUFFIX
PLASTIC PACKAGE
CASE 648

LOGIC DIAGRAM



PIN ASSIGNMENT



ORDERING INFORMATION

Package Type	Temperature Range	Order Number
Molded DIP	0°C to +70°C	MC2902PC
Hermetic DIP	0°C to +70°C	MC2902LC
Hermetic DIP	-55°C to +125°C	MC2902LM
Hermetic Flat Pack	-55°C to +125°C	MC2902FM

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MAXIMUM RATINGS (Above which the useful life may be impaired)

Storage Temperature	−65°C to +150°C
Temperature (Ambient) Under Bias	−55°C to +125°C
Supply Voltage to Ground Potential	−0.5V to +7.0V
DC Voltage Applied to Outputs for HIGH Output State	−0.5V to +V_{CC} max.
DC Input Voltage	−0.5V to +5.5V
DC Output Current, Into Outputs	30 mA
DC Input Current	−30 mA to +5.0 mA

ELECTRICAL CHARACTERISTICS OVER OPERATING TEMPERATURE RANGE (Unless Otherwise Noted)

MC2902XC T_A = 0°C to +70°C V_{CC} = 5.0V ±5% (COM'L) MIN. = 4.75V MAX. = 5.25V
MC2902XM T_A = −55°C to +125°C V_{CC} = 5.0V ±10% (MIL) MIN. = 4.50V MAX. = 5.50V

Parameters	Description	Test Conditions (Note 1)		Min.	Typ. (Note 2)	Max.	Units
V_{OH}	Output HIGH Voltage	V_{CC} = MIN., I_{OH} = −0.8mA, V_{IN} = V_{IH} or V_{IL}		2.4	3.0		Volts
V_{OL}	Output LOW Voltage	V_{CC} = MIN., I_{OL} = 16mA, V_{IN} = V_{IH} or V_{IL}			0.2	0.4	Volts
V_{IH}	Input HIGH Level	Guaranteed input logical HIGH voltage for all inputs		2.0			Volts
V_{IL}	Input LOW Level	Guaranteed input logical LOW voltage for all inputs				0.8	Volts
V_I	Input Clamp Voltage	V_{CC} = MIN., I_{IN} = −12mA				−1.5	Volts
I_{IL} (Note 3)	Input LOW Current	V_{CC} = MAX., V_{IN} = 0.4V	C_n			−3.2	mA
			$\overline{P}_3$			−4.8	
			$\overline{P}_2$			−6.4	
			$\overline{P}_0$, $\overline{P}_1$, $\overline{G}_3$			−8.0	
			$\overline{G}_0$, $\overline{G}_2$			−14.4	
			$\overline{G}_1$			−16	
I_{IH} (Note 3)	Input HIGH Current	V_{CC} = MAX., V_{IN} = 2.4V	C_n'			80	µA
			$\overline{P}_3$			120	
			$\overline{P}_2$			160	
			$\overline{P}_0$, $\overline{P}_1$, $\overline{G}_3$			200	
			$\overline{G}_0$, $\overline{G}_2$			360	
			$\overline{G}_1$			400	
I_I	Input HIGH Current	V_{CC} = MAX., V_{IN} = 5.5V				1.0	mA
I_{SC}	Output Short Circuit (Note 4)	V_{CC} = MAX., V_{OUT} = 0.0V		−40		−100	mA
I_{CC}	Power Supply Current	V_{CC} = MAX., All Outputs LOW	MIL		62	99	mA
			COM'L		58	94	
		V_{CC} = MAX., All Ouputs HIGH	MIL		37		mA
			COM'L		35		

Notes 1. For conditions shown as MIN. or MAX., use the appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical limits are at V_{CC} = 5.0V, 25°C ambient and maximum loading.
3. Actual input currents = Unit Load Current X Input Load Factor (see Loading Rules).
4. Not more than one output should be shorted at a time. Duration of the short circuit test should not exceed one second.

SWITCHING CHARACTERISTICS V_{CC} = 5.0V, T_A = 25°C, C_L = 15pF, R_L = 400Ω

Parameter	From (Input)	To (Output)	Test Figure	Test Conditions	Min	Typ	Max	Units
t_{PLH}	C_n	C_{n+j}	2	$\overline{P}_0 = \overline{P}_1 = \overline{P}_2 = 0$ V, $\overline{G}_0 = \overline{G}_1 = \overline{G}_2 = 4.5$ V		11	14	ns
t_{PHL}						11	14	
t_{PLH}	$\overline{P}_i$	C_{n+j}	3	$\overline{P}_i = 0$ V (j ≥ i), $C_n = \overline{G}_0 = \overline{G}_1 = \overline{G}_2 = 4.5$ V		6.0	8.0	ns
t_{PHL}						6.0	8.0	
t_{PLH}	$\overline{G}_i$	C_{n+j}	3	$\overline{G}_i = 0$ V (j > i), $C_n = \overline{P}_0 = \overline{P}_1 = \overline{P}_2 = 4.5$ V		8.0	10	ns
t_{PHL}						8.0	10	
t_{PLH}	$\overline{P}_i$	$\overline{G}$ or $\overline{P}$	2	$\overline{P}_i = 0$ V (j ≥ i), $C_n = \overline{G}_0 = \overline{G}_1 = \overline{G}_2 = 4.5$ V		11	14	ns
t_{PHL}						11	14	
t_{PLH}	$\overline{G}_i$	$\overline{G}$ or $\overline{P}$	2	$\overline{G}_i = 0$ V (j > i), $C_n = \overline{P}_0 = \overline{P}_1 = \overline{P}_2 = 4.5$ V		12	14	ns
t_{PHL}						12	14	

DEFINITION OF FUNCTIONAL TERMS

C_n Carry-in. The carry-in input to the look-ahead generator. Also the carry-in input to the nth MC2901 microprocessor ALU input.

C_{n+j} Carry-out. (j = x, y, z). The carry-out output to be used at the carry-in inputs of the n+1, n+2, and n+3 microprocessor ALU slices.

G_i P_i Generate and propagate inputs, respectively (i = 0, 1, 2, 3). The carry generate and carry propagate inputs from the n, n+1, n+2 and n+3 microprocessor ALU slices.

G, P Generate and propagate outputs, respectively. The carry generate and carry propagate outputs that can be used with the next higher level of carry look-ahead if used.

LOADING RULES (In Unit Loads)

Input/Output	Pin No.	Input Unit Load	Fan-out Output HIGH	Fan-out Output LOW
$\overline{G}_1$	1	8.0	–	–
$\overline{P}_1$	2	4.0	–	–
$\overline{G}_0$	3	7.2	–	–
$\overline{P}_0$	4	4.0	–	–
$\overline{G}_3$	5	4.0	–	–
$\overline{P}_3$	6	2.4	–	–
$\overline{P}$	7	–	16	8
GND	8	–	–	–
C_{n+z}	9	–	16	8
$\overline{G}$	10	–	16	8
C_{n+y}	11	–	16	8
C_{n+x}	12	–	16	8
C_n	13	1.6	–	–
$\overline{G}_2$	14	7.2	–	–
$\overline{P}_2$	15	3.2	–	–
V_{CC}	16	–	–	–

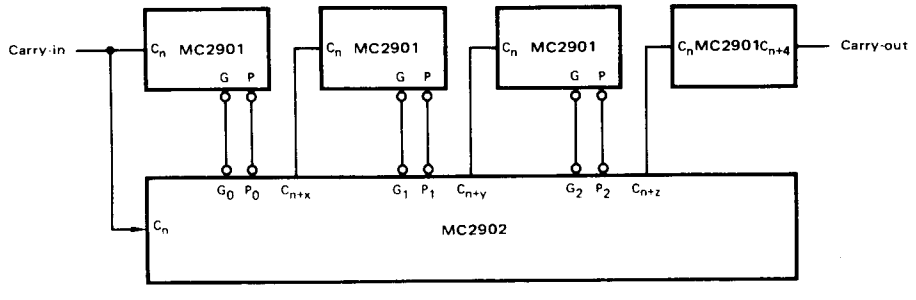
A Schottky TTL Unit Load is defined as 50μA measured at 2.7V HIGH and −2.0mA measured at 0.5V LOW.

TRUTH TABLE

Inputs								Outputs				
C_n	$\overline{G}_0$	$\overline{P}_0$	$\overline{G}_1$	$\overline{P}_1$	$\overline{G}_2$	$\overline{P}_2$	$\overline{G}_3$	$\overline{P}_3$	C_{n+z}	C_{n+y}	C_{n+x}	$\overline{G}$	$\overline{P}$
X	H	H							L				
L	H	X							L				
X	L	X							H				
H	X	L							H				
X	X	X	H	H						L			
X	H	H	H	X						L			
L	H	X	H	X						L			
X	X	X	L	X						H			
X	L	X	X	L						H			
H	X	L	X	L						H			
X	X	X	X	X	H	H					L		
X	X	X	H	H	X	X					L		
X	H	X	H	X	H	X					L		
L	H	X	H	X	X	L					L		
X	X	X	X	L	X	L					H		
X	X	X	L	X	L	L					H		
X	L	X	X	L	L	L					H		
H	X	L	X	L	L	L					H		
X			X	X	X	H	H	X				H	
X			X	X	H	H	H	X				H	
X			H	H	H	X	H	X				H	
H			H	X	H	X	H	X				H	
X			X	X	X	X	L	X				L	
X			X	X	L	X	X	L				L	
X			L	X	X	L	X	L				L	
L			X	L	X	L	X	L				L	
	H		X		X		X						H
	X		H		X		X						H
	X		X		H		X						H
	X		X		X		H						H
	L		X		L		L						L

H = HIGH Voltage Level
L = LOW Voltage Level
X = Don't Care

APPLICATIONS



16-BIT CARRY LOOK-AHEAD CONNECTION.

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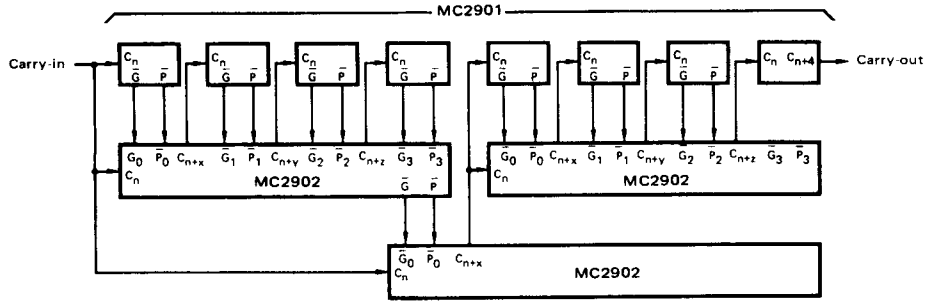
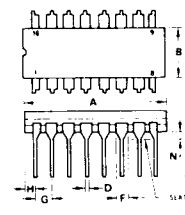
APPLICATIONS (Cont'd.)



32-BIT ALU, THREE LEVEL CARRY LOOK-AHEAD.

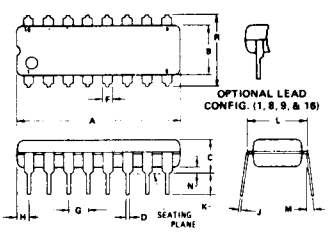
PACKAGE DIMENSIONS



1. LEADS WITHIN 0.13 mm (0.005) RADIUS OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION
2. PACKAGE INDEX NOTCH IN LEAD NOTCH IN CERAMIC OR INK DOT
3. DIM "A" AND "B" (620 06) DO NOT INCLUDE GLASS RUN OUT
4. DIM "L" TO INSIDE OF LEADS (MEASURED 0.51 mm (0.020) BELOW BODY)

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	19.05	19.94	0.750	0.785
B	6.10	7.49	0.240	0.295
C	–	5.08	–	0.200
D	0.38	0.53	0.015	0.021
F	1.40	1.78	0.055	0.070
G	2.54 BSC		0.100 BSC	
H	0.51	1.14	0.020	0.045
J	0.20	0.30	0.008	0.012
K	3.18	5.08	0.125	0.200
L	7.49	8.89	0.295	0.350
M	–	15°	–	15°
N	0.51	1.02	0.020	0.040

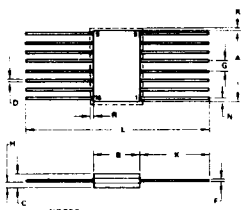
CASE 620



NOTES
1. LEADS WITHIN 0.13 mm (0.005) RADIUS OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION
2. DIMENSION "L" TO CENTER OF LEADS WHEN FORMED PARALLEL
3. DIMENSION "B" DOES NOT INCLUDE MOLD FLASH
4. "F" DIMENSION IS FOR FULL LEADS. "HALF" LEADS ARE OPTIONAL AT LEAD POSITIONS 1, 8, 9, and 16)
5. DIMENSION "R" TO BE MEASURED AT THE TOP OF THE LEADS (NOT AT THE TIPS)

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A		22.10		0.870
B	6.10	6.60	0.240	0.260
C	–	5.08	–	0.200
D	0.38	0.53	0.015	0.021
F	–	1.78		0.070
G	2.54 BSC		0.100 BSC	
H	0.38	2.41	0.015	0.095
J	0.20	0.38	0.008	0.015
K	2.92	–	0.115	–
L	7.62 BSC		0.300 BSC	
M	0°	15°	0°	15°
N	0.51	–	0.020	–
R	–	8.26	–	0.325

CASE 648



NOTES
1. LEAD NO. 1 IDENTIFIED BY TAB ON LEAD OR DOT ON COVER
2. LEADS WITHIN 0.13 mm (0.005) TOTAL OF TRUE POSITION AT MAXIMUM MATERIAL CONDITION

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	9.40	10.16	0.370	0.400
B	6.22	7.24	0.245	0.285
C	1.52	2.03	0.060	0.080
D	0.41	0.48	0.016	0.019
F	0.08	0.15	0.003	0.006
G	1.27 BSC		0.050 BSC	
H	0.64	0.89	0.025	0.035
K	6.35	9.40	0.250	0.370
L	18.92		0.745	
N		0.51		0.020
R		0.38		0.015

CASE 650