Four Channel ECL Delay Line

AD53020

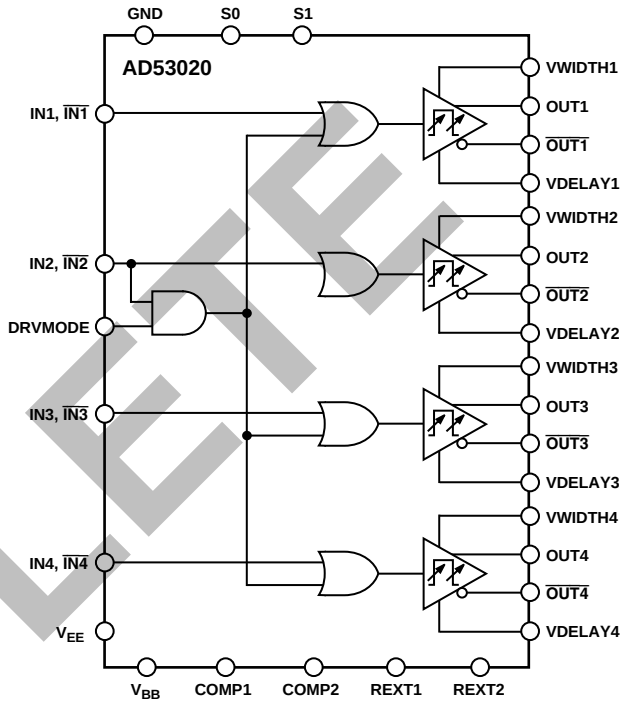
FEATURES

Four Delay Lines with the Ability to Independently Adjust All Edges
Pin Compatible and Functionally Equivalent with the BT624
Reduced Power Dissipation
44-Lead PLCC Package with Internal Heat Spreader

APPLICATIONS

Automatic Test Equipment
Semiconductor Test Systems
Board Test Systems
Clocked ECL Circuits

FUNCTIONAL BLOCK DIAGRAM



PRODUCT DESCRIPTION

The AD53020 is a four-channel delay line designed for use in automatic test equipment and digital logic systems. High speed bipolar transistors and a 44-lead plastic PLCC package with internal heat spreader provide high frequency performance at a minimum of space, cost and power dissipation.

Featuring full pin compatibility and functional equivalence to the BT624, the AD53020 offers independent analog control of positive and negative edges with five delay ranges. The AD53020 offers attractive performance with optimized power dissipation and linear delay vs. program voltage control. This device is also very stable over operating conditions and has very low jitter.

Digital inputs are ECL compatible. They can either be provided independently for each channel (IN1, $\overline{IN1}$ through IN4, $\overline{IN4}$), or fanned out to all channels from Channel 2 (IN2, $\overline{IN2}$). The choice of these two options is made by setting the DRVMODE input, with ECL Logic 0 providing four independent channels, and ECL Logic 1 enabling a logical OR function between each channel and the Channel Number 2.

For maximum timing accuracy, differential signals are recommended for use with the digital inputs. However, single-ended operation is also supported and it is facilitated through the use of the V_{BB} midpoint level generated on-chip. To make use of this feature, connect the V_{BB} output to the inverting input of each channel. It is also advisable, when using the V_{BB} output, to decouple this signal with a 0.1 µF ceramic capacitor to ground.

The outputs of the AD53020 are ECL compatible and should be terminated by 50 Ω to –2.0 V at the inputs of the gates they drive.

The delay is programmed through the VDELAY and VWIDTH pins for each channel. The acceptable range is –1.3 V to –0.1 V, representing the longest and the shortest delays provided by the device. An 0.01 µF ceramic capacitor to ground is recommended for each input. The bias current for each input is fixed by an internal current mirror. The value of the bias current is set by the external resistor at REXT1. A 1.3 kΩ resistor to ground at this pin establishes 1 mA bias in each input. The nominal voltage at the REXT1 pin is –1.3 V.

The VDELAY affects both the positive and negative edges in all modes. The VWIDTH is an additional delay adjustment that is active in Modes 2, 3 and 5. VWIDTH has no effect in Modes 0 and 1. For Modes 2 and 3, the effect of the VWIDTH adjustment is to increase or decrease the delay of the negative edge relative to the positive edge. In Mode 5, the total delay for both positive and negative edges is set by the combination of VDELAY and VWIDTH.

(continued on page 4)

REV. A

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AD53020–SPECIFICATIONS

AD53020-Test Conditions (Unless otherwise noted): Recommended Operating Conditions with all OUT and $\overline{OUT}$ outputs terminated through 50 Ω to –2.0 V, REXT1 = 1.3 kΩ, REXT2 = 2.94 kΩ. Typical values are based on nominal temperature, T_A = +25°C, and nominal supply voltage, V_{EE} = –5.2 V.

DC CHARACTERISTICS[1]

Parameter	Symbol	T(°C)	Min	Typ	Max	Units
DIGITAL INPUT HIGH VOLTAGE IN, $\overline{IN}$, DRVMODE, S0, S1	V_{IH}	70	–1.070		0.000	V
DIGITAL INPUT LOW VOLTAGE IN, $\overline{IN}$, DRVMODE, S0	V_{IL}	70	–1.950		–1.450	V
DIGITAL INPUT LOW VOLTAGE, S1	V_{IL}	70	V_{EE}		–1.450	V
S1 THIRD STATE (EXTENDED DELAY)		Full	V_{EE}		–3.2	V
DIGITAL OUTPUT HIGH VOLTAGE	V_{OH}	70	–1.000		–0.735	V
DIGITAL OUTPUT LOW VOLTAGE	V_{OL}	70	–1.950		–1.600	V
DIGITAL INPUT BIAS CURRENT IN, $\overline{IN}$, DRVMODE, S0, S1	I_{IN}			–100 to +100		µA
POWER SUPPLY REJECTION RATIO[2]	PSRR	Full		0.5		% Tpd/V
V_{EE} SUPPLY CURRENT						
Mode 0	I_{EE}	Full		174	200	mA
Modes 1, 2	I_{EE}	Full		225	250	mA
Modes 3, 5	I_{EE}	Full		267	290	mA

NOTES

[1]The specified limits shown can be met only after thermal equilibrium has been established. Thermal equilibrium is established by applying power for at least two minutes while maintaining a transverse air flow of 400 linear feet per minute over the device either mounted in the test socket or on the printed circuit board.

[2]This parameter is fully characterized, but not production tested.

Specifications subject to change without notice.

AC CHARACTERISTICS[1]

Parameter				Symbol	Min	Typ	Max	Units
MINIMUM PROPAGATION DELAYS[2]								
Mode	S1	S0	VDELAY					
0	0	0	–0.1 V	Tpd Min	3.6	4.5	5.4	ns
1	0	1	–0.1 V	Tpd Min	4.9	6.3	7.3	ns
2	1	0	–0.1 V	Tpd Min	3.9	5.3	6.8	ns
3	1	1	–0.1 V	Tpd Min	5.2	7.1	8.8	ns
5	V_{EE}	1	–0.1 V	Tpd Min	6.8	8.8	10.3	ns
DELAY ADJUSTMENT RANGES								
Mode	S1	S0						
0	0	0		Tpd Span	14.0	19.0	24.7	ns
1	0	1		Tpd Span	22.9	31.4	37.8	ns
2	1	0		Tpd Span	13.2	18.9	24.6	ns
3	1	1		Tpd Span	22.0	31.5	40.6	ns
5	V_{EE}	1		Tpd Span	29.3	44.5	52.0	ns
MINIMUM PULSEWIDTH[3]						1.9		ns
RISING EDGE DELAY VS. VWIDTH DELAY Change (Modes 2 and 3)[3]						30		ps
DELAY VS. DUTY CYCLE[3, 4]						50		ps
VWIDTH RANGE OF ADJUSTMENT (VDELAY = –0.6 V, MODES 2 AND 3, DELAY RELATIVE TO VWIDTH = –0.7 V)								
VWIDTH = –0.1 V						–5.5	–4.0	ns
VWIDTH = –1.1 V						+5.5		ns
VWIDTH = –1.3 V					+4.0	+6.5		ns

Parameter	Symbol	Min	Typ	Max	Units
RISING TO FALLING EDGE DELAY MATCHING (VDELAY = VFALL = –0.5 V)[3]					
Modes 0, 1, 5			0.1		ns
Modes 2, 3			1.0		ns
PROPAGATION DELAY TEMPERATURE COEFFICIENT[3, 5]			0.05		% Tpd/°C
OUTPUT RISE/FALL TIMES (20% to 80%)[3]			550		ps
DELAY LINEARITY[3]			MONOTONIC		

NOTES
[1]The specified limits shown can be met only after thermal equilibrium has been established. Thermal equilibrium is established by applying power for at least two minutes while maintaining a transverse air flow of 400 linear feet per minute over the device either mounted in the test socket or on the printed circuit board.
[2]All minimum propagation delay time measurements refer to both rising and falling edges for Modes 0, 1, 5; these measurements refer to rising edges for Modes 2 and 3 only. DRVMODE is logically low.
[3]This parameter is fully characterized, but not production tested.
[4]Delay on leading and trailing edges are measured by setting VDELAY = VWIDTH = –0.7 V. The variations for each delay are measured by changing the input duty cycle from 5% to 95% at a constant frequency of 10 MHz.
[5]Propagation delay temperature coefficient measured at VDELAY = VWIDTH = –0.7 V.

Specifications subject to change without notice.

ABSOLUTE MAXIMUM RATINGS[1]

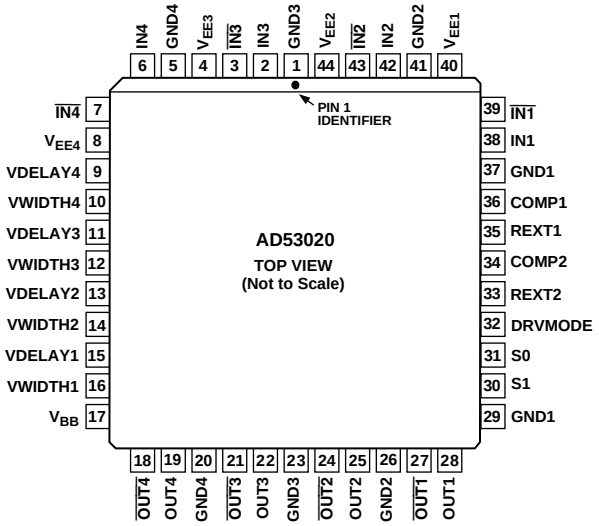
Parameter	Symbol	Min	Max	Units
V_{EE} (Relative to GND)		–6.0	0	V
Voltage on Any Digital Pin		V_{EE}		V
Output Current			50	mA
Ambient Operating Temperature	T_A	–55	+70	°C
Storage Temperature	T_S	–65	+150	°C
Junction Temperature	T_J		+150	°C
Soldering Temperature[2] (Soldering, 5 sec)	T_{SOL}		+260	°C

NOTES
[1]Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those listed in the operational sections of this specification is not implied. Absolute maximum limits apply individually, not in combination. Exposure to absolute maximum rating conditions for extended periods of time may affect device reliability.
[2]To ensure lead solderability, handling with bare hands should be avoided and the device should be stored in environments at 24°C ± 5°C (75°F ± 10°F) with relative humidity not to exceed 65%.

ORDERING GUIDE

Model	Package Description	Package Option
AD53020	44-Lead Plastic Leaded Chip Carrier (PLCC)	P-44A

PIN CONFIGURATION



CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although the AD53020 features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

A second bias current reference is employed to set the bias current of the delay cells. This current is set by the external resistor at REXT2. A 2.94 kΩ resistor sets the nominal bias current of 500 µA. The nominal voltage at the REXT2 pin is –1.47 V.

The current references require compensation capacitors of 0.1 µF to V_{EE} at each of the COMP1 and COMP2 pins. In addition, each V_{EE} supply pin should also have its own decoupling capacitor of 0.1 µF to ground.

All decoupling capacitors should be located as close as possible to the AD53020 chip.

The mode is set by the inputs S0 and S1. These pins use standard ECL levels, with the addition of a third level for the S1 Pin, which can also be connected to V_{EE}. Refer to Table I for the description of the modes and their respective settings.

For Modes 2 and 3, it is important to note that an internal flip-flop is used to provide the independent control of rising and falling edges. The state of this flip-flop is indeterminate upon power-up. The state becomes fixed once the first full pulse is provided to each channel, consisting of a positive edge followed by a negative edge.

Table I. Truth Table for Mode Determination

S1	S0	Mode	Typical Span	Independent Adjustment of Positive and Negative Edges?
0	0	0	19 ns	No
0	1	1	31 ns	No
1	0	2	19 ns	Yes
1	1	3	31 ns	Yes
V_{EE}	0	Not Valid		
V_{EE}	1	5	45 ns	No

S0 and S1 accept logical ECL levels. In the case of S1 only, a third state is also accepted, at the negative supply, V_{EE}.

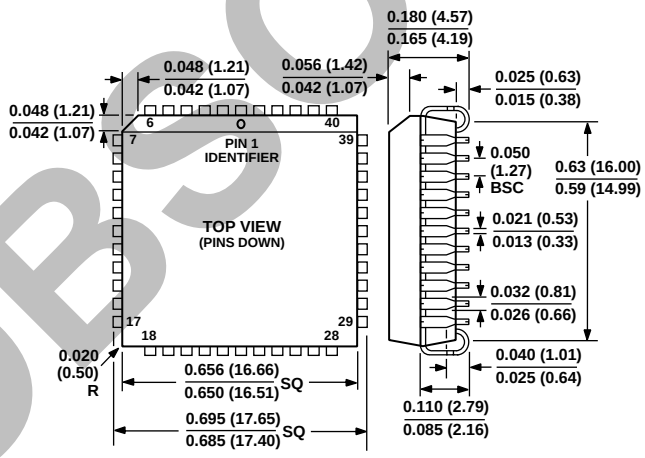
Table II. Package Thermal Characteristics

Air Flow, FM	θ_{JA}, °C/W
0	30.2
400	20.9

OUTLINE DIMENSIONS

Dimensions shown in inches and (mm).

44-Lead PLCC
(P-44A)



C3265a–0–2/99

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