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C O R P O R A T I O N

BR1941 Dual Baud Rate Clock

1 Z0-10M0

FEBRUARY, 1981

FEATURES

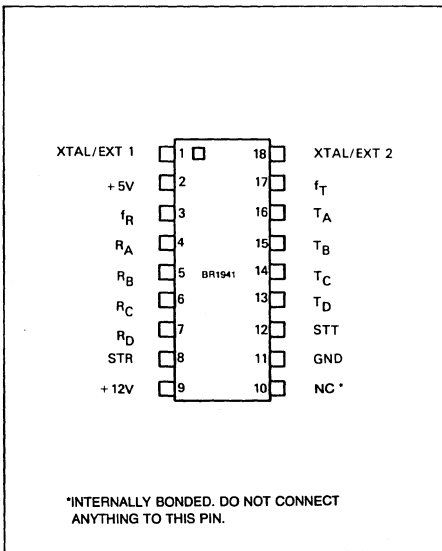
- 16 SELECTABLE BAUD RATE CLOCK FREQUENCIES
- DUAL SELECTABLE 16 X CLOCK OUTPUTS FOR FULL DUPLEX OPERATIONS
- OPERATES WITH CRYSTAL OSCILLATOR OR EXTERNALLY GENERATED FREQUENCY INPUT
- ROM MASKABLE FOR NON-STANDARD FREQUENCY SELECTIONS
- INTERFACES EASILY WITH MICRO-COMPUTERS
- OUTPUTS A 50% DUTY CYCLE CLOCK WITH 0.01% ACCURACY
- 18 PIN CERAMIC DIP PACKAGE
- 3 DIFFERENT FREQUENCY/DIVISOR PAIRS AVAILABLE

GENERAL DESCRIPTION

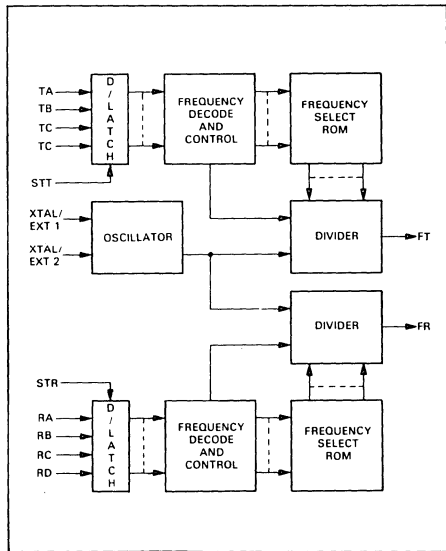
The BR1941 is a combination Baud Rate Clock Generator and Programmable Divider. It is manufactured in N-channel MOS using silicon gate technology. This device is capable of generating 16 externally selected clock rates whose frequency is determined by either a single crystal or an externally generated input clock. The BR1941 is a programmable counter capable of generating a division from 2 to $(2^{15}-1)$.

The BR1941 is available programmed with the most used frequencies in data communication. Each frequency is selectable by strobing or hard wiring each of the two sets of four Rate Select inputs. Other frequencies/division rates can be generated by reprogramming the internal ROM coding through a MOS mask change. Additionally, further clock division may be accomplished through cascading of devices. The frequency output is fed into the XTAL/EXT input on a subsequent device.

The BR1941 can be driven by an external crystal or by TTL logic.



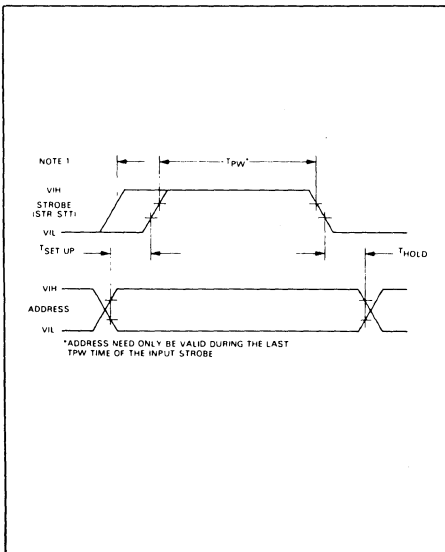
PIN CONNECTIONS



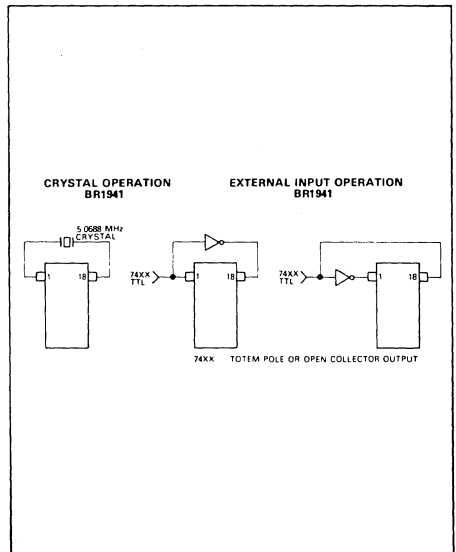
BR1941 BLOCK DIAGRAM

PIN DESCRIPTION

PIN NUMBER	SYMBOL	NAME	FUNCTION
1	XTAL/EXT 1	Crystal or External Input 1	This input receives one pin of the crystal package or one polarity of the external input.
2	V _{CC}	Power Supply	+5 volt Supply
3	f _R	Receiver Output Frequency	This output runs at a frequency selected by the Receiver Address inputs.
4-7	R _A , R _B , R _C , R _D	Receiver Address	The logic level on these inputs as shown in Table 1, selects the receiver output frequency, f _R .
8	STR	Strobe-Receiver Address	A high-level input strobe loads the receiver address (R _A , R _B , R _C , R _D) into the receiver address register. This input may be strobed or hard wired to +5V.
9	V _{DD}	Power Supply	+12 volt Supply
10	NC	No Connection	Internally bonded. Do not connect anything to this pin.
11	GND	Ground	Ground
12	STT	Strobe-Transmitter Address	A high-level input strobe loads the transmitter address (T _A , T _B , T _C , T _D) into the transmitter address register. This input may be strobed or hard wired to +5V.
13-16	T _D , T _C , T _B , T _A	Transmitter Address	The logic level on these inputs, as shown in Table 1, selects the transmitter output frequency, f _T .
17	f _T	Transmitter Output Frequency	This output runs at a frequency selected by the Transmitter Address inputs.
18	XTAL/EXT 2	Crystal or External Input 2	This input receives the other pin of the crystal package or the other polarity of the external input.



CONTROL TIMING



CRYSTAL/CLOCK OPTIONS

ABSOLUTE MAXIMUM RATINGS

Positive Voltage on any Pin, with respect to ground	+20.0V
Negative Voltage on any Pin, with respect to ground	-0.3V
Storage Temperature	(plastic "M" package) -65°C to +125°C (ceramic "L" package) -65°C to +150°C
Lead Temperature (Soldering, 10 sec.)	+325°C

*Stresses above those listed may cause permanent damage to the device. This is a stress rating only and Functional Operation of the device at these or at any other condition above those indicated in the operational sections of this specification are not implied.

ELECTRICAL CHARACTERISTICS

(T_A = 0°C to 70°C, V_{CC} = +5V ±5%, V_{DD} = +12V ± 5%, unless otherwise noted)

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
DC CHARACTERISTICS					
INPUT VOLTAGE LEVELS					
Low-level, V _{IL}			0.8	V	excluding XTAL inputs
High-level, V _{IH}	V _{CC} -1.5		V _{CC}	V	
OUTPUT VOLTAGE LEVELS					
Low-level, V _{OL}			0.4	V	I _{OL} = 3.2 mA I _{OH} = 100 μA
High-level, V _{OH}	V _{CC} -1.5	4.0		V	
INPUT CURRENT					
Low-level, I _{IL}			0.3	mA	V _{IN} = GND, excluding XTAL inputs
INPUT CAPACITANCE					
All inputs, C _{IN}		5	10	pf	V _{IN} = GND excluding XTAL inputs
POWER SUPPLY CURRENT					
I _{CC}		20		mA	
I _{DD}		20		mA	
AC CHARACTERISTICS					
T _A = +25°C					
CLOCK FREQUENCY		5.0688		MHz	XTAL/EXT inputs
PULSE WIDTH (T_{PW})					
Clock					50% Duty Cycle ± 10%
Receiver strobe	150		DC	ns	See Note 1
Transmitter strobe	150		DC	ns	See Note 1
INPUT SET-UP TIME (T_{SET-UP})					
Address	50			ns	See Note 1
OUTPUT HOLD TIME (T_{HOLD})					
Address	50			ns	

NOTE 1: Input set-up time can be decreased to >0 ns by increasing the minimum strobe width by 50 ns to a total of 200 ns.

All inputs except XTAL/EXT have internal pull-up resistors.

OPERATION

Standard Frequencies

Choose a Transmitter and receiver frequency from the table below. Program the corresponding address into TA-TD and RA-RD respectively using strobe pulses or by hard wiring the strobe and address inputs.

Non-Standard Frequencies

To accomplish non-standard frequencies do one of the following:

1. Choose a crystal that when divided by the BR1941 generates the desired frequency.
2. Cascade devices by using the frequency outputs as an input to the XTAL/EXT inputs of the subsequent BR1941.
3. Consult the factory for possible changes via ROM mask reprogramming.

FREQUENCY OPTIONS

TABLE 1 CRYSTAL FREQUENCY = 5.0688 MHZ

Transmit/Receive Address				Baud Rate	Theoretical Frequency 16X Clock	Actual Frequency 16X Clock	Percent Error	Duty Cycle %	Divisor
D	C	B	A						
0	0	0	0	50	0.8 KHz	0.8KHz	—	50/50	6336
0	0	0	1	75	1.2	1.2	—	50/50	4224
0	0	1	0	110	1.76	1.76	—	50/50	2880
0	0	1	1	134.5	2.152	2.1523	0.016	50/50	2355
0	1	0	0	150	2.4	2.4	—	50/50	2112
0	1	0	1	300	4.8	4.8	—	50/50	1056
0	1	1	0	600	9.6	9.6	—	50/50	528
0	1	1	1	1200	19.2	19.2	—	50/50	264
1	0	0	0	1800	28.8	28.8	—	50/50	176
1	0	0	1	2000	32.0	32.081	0.253	50/50	158
1	0	1	0	2400	38.4	38.4	—	50/50	132
1	0	1	1	3600	57.6	57.6	—	50/50	88
1	1	0	0	4800	76.8	76.83	—	50/50	66
1	1	0	1	7200	115.2	115.2	—	50/50	44
1	1	1	0	9600	153.6	153.6	—	48/52	33
1	1	1	1	19,200	307.2	316.8	3.125	50/50	16

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TABLE 2. CRYSTAL FREQUENCY = 4.9152 MHZ

Transmit/Receive Address				Baud Rate	Theoretical Frequency 16X Clock	Actual Frequency 16X Clock	Percent Error	Duty Cycle %	Divisor
D	C	B	A						
0	0	0	0	50	0.8 KHz	0.8 KHz	—	50/50	6144
0	0	0	1	75	1.2	1.2	—	50/50	4096
0	0	1	0	110	1.76	1.7598	-0.01	*	2793
0	0	1	1	134.5	2.152	2.152	—	50/50	2284
0	1	0	0	150	2.4	2.4	—	50/50	2048
0	1	0	1	300	4.8	4.8	—	50/50	1024
0	1	1	0	600	9.6	9.6	—	50/50	512
0	1	1	1	1200	19.2	19.2	—	50/50	256
1	0	0	0	1800	28.8	28.7438	-0.19	*	171
1	0	0	1	2000	32.0	31.9168	-0.26	50/50	154
1	0	1	0	2400	38.4	38.4	—	50/50	128
1	0	1	1	3600	57.6	57.8258	0.39	*	85
1	1	0	0	4800	76.8	76.8	—	50/50	64
1	1	0	1	7200	115.2	114.306	-0.77	*	43
1	1	1	0	9600	153.6	153.6	—	50/50	32
1	1	1	1	19,200	307.2	307.2	—	50/50	16

*When the duty cycle is not exactly 50% it is 50% ± 10%

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TABLE 3 CRYSTAL FREQUENCY = 5.0688 MHZ

Transmit/Receive Address				Baud Rate	Theoretical Frequency 32X Clock	Actual Frequency 32X Clock	Percent Error	Duty Cycle %	Divisor
D	C	B	A						
0	0	0	0	50	1.6 KHz	1.6 KHz	—	50/50	3168
0	0	0	1	75	2.4	2.4	—	50/50	2112
0	0	1	0	110	3.52	3.52	—	50/50	1440
0	0	1	1	134.5	4.304	4.303	.026	50/50	1178
0	1	0	0	150	4.8	4.8	—	50/50	1056
0	1	0	1	200	6.4	6.4	—	50/50	792
0	1	1	0	300	9.6	9.6	—	50/50	528
0	1	1	1	600	19.2	19.2	—	50/50	264
1	0	0	0	1200	38.4	38.4	—	50/50	132
1	0	0	1	1800	57.6	57.6	—	50/50	88
1	0	1	0	2400	76.8	76.8	—	50/50	66
1	0	1	1	3600	115.2	115.2	—	50/50	44
1	1	0	0	4800	153.6	153.6	—	*	33
1	1	0	1	7200	230.4	230.4	—	50/50	22
1	1	1	0	9600	307.2	298.16	2.941	*	17
1	1	1	1	19,200	614.4	633.6	3.125	50/50	8

*When the duty cycle is not exactly 50% it is 50% ± 10%

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APPLICATIONS INFORMATION

OPERATION WITH A CRYSTAL

The BR1941 Baud Rate Generator may be driven by either a crystal or TTL level clock. When using a crystal, the waveform that appears at pins 1 (XTAL/EXT 1) and 18 (XTAL/EXT 2) does not conform to the normal TTL limits of $V_{IL} \leq 0.8V$ and $V_{IH} \geq 2.0V$. Figure 1 illustrates a typical crystal waveform.

Since the D.C. level of the waveform causes the least positive point to typically be greater than 0.8V, the BR1941 is designed to look for an edge, as opposed to a TTL level. The XTAL/EXT logic triggers on a rising edge of typically 1V in magnitude. This allows the use of a crystal without any additional components.

OPERATION WITH TTL LEVEL CLOCK

With clock frequencies in the area of 5 MHz, significant overshoot and undershoot can appear at pins 1 and/or 18. The BR1941 may, at times, trigger on a rising edge of an overshoot or undershoot waveform, causing the device to effectively "double-trigger". This phenomenon may result as a twice expected baud rate, or as an apparent device failure. Figure 2 shows a typical waveform that exhibits the "ringing" problem.

The design methods required to minimize ringing include the following:

1. Minimize the P.C. trace length. At 5 MHz, each inch of trace can add significantly to overshoot and undershoot.

2. Match impedances at both ends of the trace. For example, a series resistor near the BR1941 may be helpful.
3. A uniform impedance is important. This can be accomplished through the use of:
 - a. parallel ground lines
 - b. evenly spaced ground lines crossing the trace on the opposite side of PC board
 - c. an inner plane of ground, e.g., as in a four layered PC board.

In the event that ringing exists on an already finished board, several techniques can be used to reduce it. These are:

1. Add a series resistor to match impedance as shown in Figure 3.
2. Add pull-up/pull-down resistor to match impedance, as shown in Figure 4.
3. Add a high speed diode to clamp undershoot, as shown in Figure 5.

The method that is easiest to implement in many systems is method 1, the series resistor. The series resistor will cause the D.C. level to shift up, but that does not cause a problem since the BR1941 is triggered by an edge, as opposed to a TTL level.

The BR1941 Baud Rate Generator can save both board space and cost in a communications system. By choosing either a crystal or a TTL level clock, the user can minimize the logic required to provide baud rate clocks in a given design.

CRYSTAL SPECIFICATIONS

User must specify termination (pin, wire, other)
Frequency—5.0688 MHz, or 4.9152 MHz
Temperature range 0°C to 70°C
Series resistance 50Ω
Series resonant
Overall tolerance ± .01%

Bulova Frequency Control Products
61-20 Woodside Avenue
Woodside, New York 11377
(212) 335-6000
CAL Crystal
1142 N. Gilbert Street
Anaheim, California 92801
(Available in HC-18 small can)
(714) 991-1580
CTS Knights Inc.
101 East Church Street
Sandwich, Illinois 60548
(815) 786-8411

CRYSTAL MANUFACTURERS (Partial List)

Northern Engineering Laboratories
357 Beloit Street
Burlington, Wisconsin 53105
(414) 763-3591

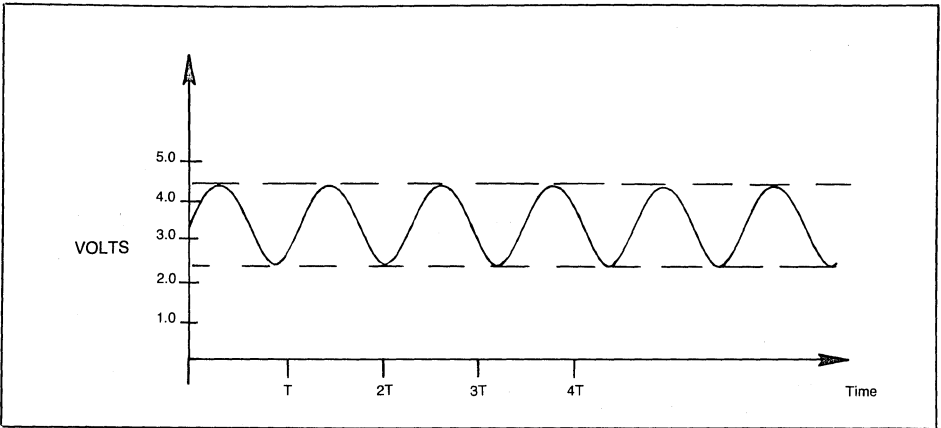


Figure 1 TYPICAL CRYSTAL WAVEFORM

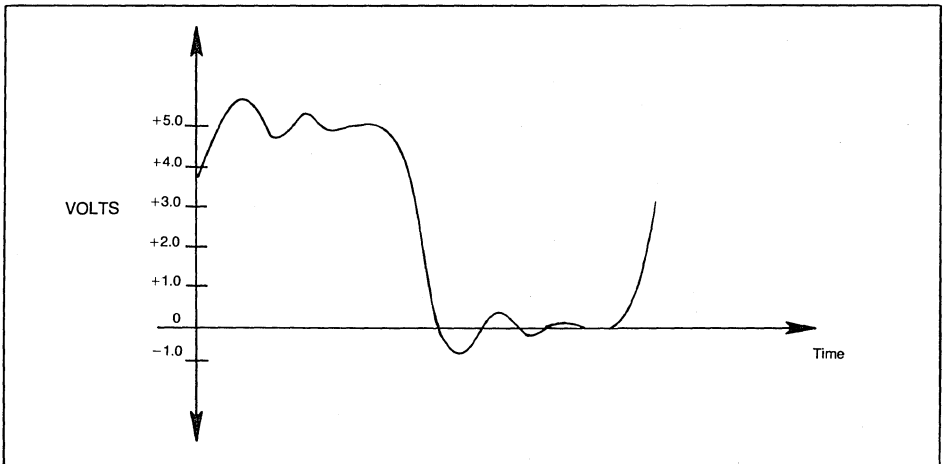


Figure 2 TYPICAL "RINGING" WAVEFORM

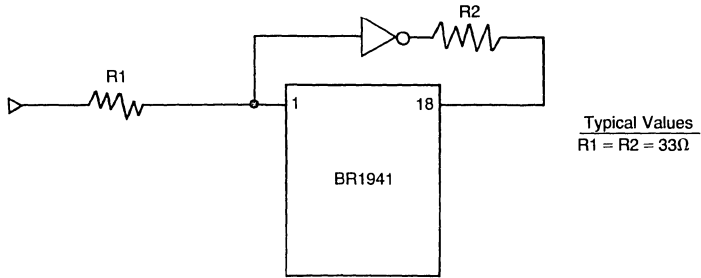


Figure 3 SERIES RESISTOR TO MATCH IMPEDANCE

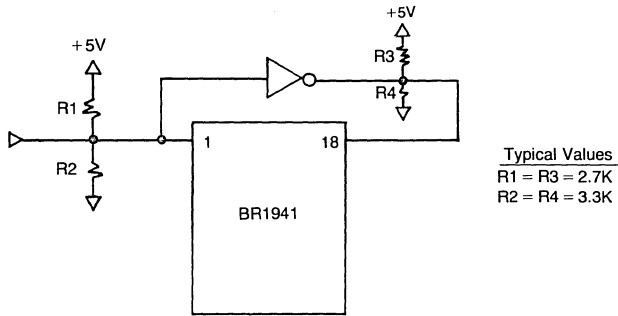


Figure 4 PULL-UP/PULL-DOWN RESISTORS TO MATCH IMPEDANCE

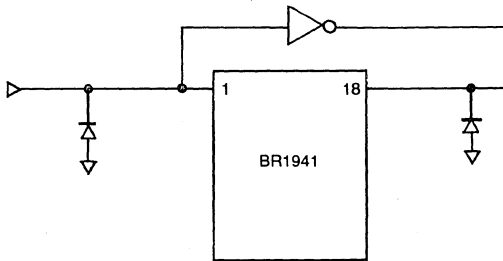
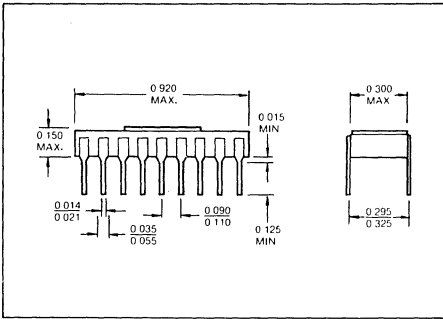
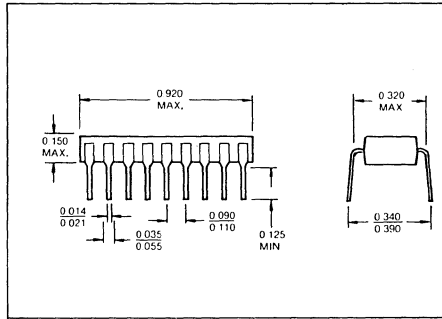


Figure 5 HIGH-SPEED DIODE TO CLAMP UNDERSHOOT



BR1941L CERAMIC PACKAGE



BR1941M PLASTIC PACKAGE

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