National Semiconductor

DS8614/DS8615/DS8616/DS8617 130/225 MHz Low Power Dual Modulus Prescalers

General Description

The DS8614 series products are low power dual modulus prescalers which divide by 20/21, 32/33, 40/41, and 64/65, respectively. The modulus control (MC) input selects division by N when at a high TTL level and division by N + 1 when at a low TTL level. The clock inputs are buffered, providing 40/100 mVrms input sensitivity. The two outputs provide the user the option to wire either a totem-pole or open-collector output structure. Additionally, the user can wire a resistor between the two output pins to minimize edge transition emissions. The outputs are designed to drive positive edge triggered PLLs. These products can be operated from either an unregulated 5.5V to 13.5V source or regulated 5V ±10% source. Unregulated operation is obtained by connecting V_S to the source with V_{REG} open. Regulated operation is obtained by connecting both V_S and V_{REG} to the supply source.

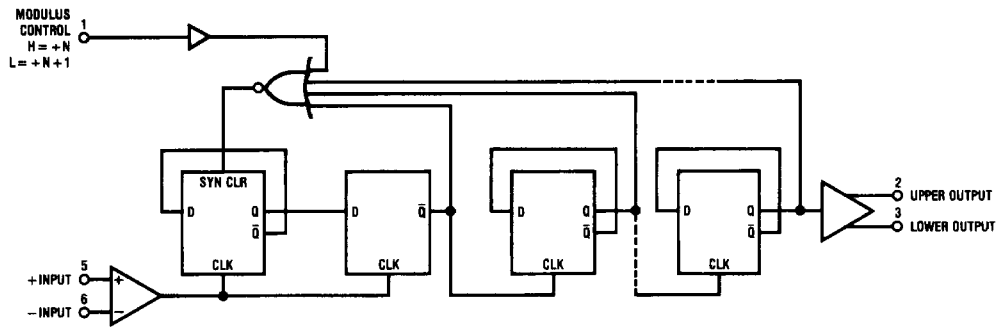
The device can be used in phase-locked loop applications such as FM radio or other communications bands to prescale the input frequency down to a more usable level. A digital frequency display system can also be derived separately or in conjunction with a phase-locked loop, and it can extend the useful range of many inexpensive frequency counters to 225 MHz.

Features

- Input frequency: 130 MHz (-4); 225 MHz (-2)
- Low power: 10 mA (-4, -2)
- Input sensitivity: 100 mVrms (-4); 40 mVrms (-2)
- Pin compatible with Motorola MC12015-17 prescalers
- Unregulated/regulated power supply option

Logic and Connection Diagrams

Generalized ÷ N/N + 1



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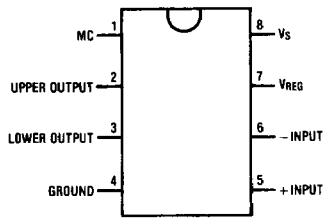
Dual-In-Line Package



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Top View

Order Number DS8614N-4, DS8615N-4, DS8616N-4, DS8617N-4, DS8614N-2, DS8616N-2, DS8614M-4, DS8615M-4, DS8616M-4 or DS8617M-4
See NS Package Number N08E, M08A

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

V_S, Unregulated Supply Voltage	15V
V_{REG}, Regulated Supply Voltage	7V
Modulus Control Input Voltage	7V
Open-Collector Output Voltage	7V
Operating Free Air Temperature Range	−30°C to +70°C
Storage Temperature Range	−65°C to +150°C

Recommended Operating Conditions

Symbol	Parameter	Conditions	DS8614-4 DS8615-4 DS8616-4 DS8617-4		DS8614-2 DS8615-2 DS8616-2 DS8617-2		Units
			Min	Max	Min	Max	
V_S	Unregulated Supply Voltage	V_{REG} = Open	6.8	13.5	5.5	13.5	V
V_{REG}	Regulated Supply Voltage	V_S and V_{REG} Shorted	4.5	5.5	4.5	5.5	V
f_{MAX}	Toggle Frequency	V_{IN} = 100 mVrms	20	130		225	MHz
V_{IN}	Input Signal Amplitude		100	300	40	300	mVrms
V_{SLW}	Slew Rate		20		20		V/μs
I_{OH}	High Level Output Current			−400		−400	μA
I_{OL}	Low Level Output Current			2.0		2.0	mA

DC Electrical Characteristics (Notes 2 and 3)

Symbol	Parameter	Conditions	DS8614-4 DS8615-4 DS8616-4 DS8617-4		DS8614-2 DS8615-2 DS8616-2 DS8617-2		Units
			Min	Max	Min	Max	
V_{IH}	High Level MC Input Voltage	V_S = 13.5V, V_{REG} = Open	2.0		2.0		V
V_{IL}	Low Level MC Input Voltage	V_{REG} = V_S = 4.5V		0.8		0.8	V
V_{OH}	High Level Output Voltage	I_{OH} = −0.4 mA, Pins 2 and 3 Shorted	V_{REG} −2		V_{REG} −2		V
I_{CEX}	Open-Collector High Level Output	Lower Output = 5.5V		100		100	μA
V_{OL}	Low Level Output Voltage	V_{REG} = 4.5V, I_{OL} = 2 mA		0.5		0.5	V
I_I	Max MC Input Current	V_S = 13.5V, V_{REG} = Open, V_{IH} = 7V		100		100	μA
I_{IH}	High Level MC Input Current	V_{REG} = 4.5V, V_{IH} = 2.7V		20		20	μA
I_{IL}	Low Level MC Input Current	V_S = 13.5V, V_{REG} = Open, V_{IL} = 0.4V		−200		−200	μA
I_S	Supply Current, Unregulated Mode	V_S = 13.5V, V_{REG} = Open		10		10	mA
I_{REG}	Supply Current, Regulated Mode	V_S = V_{REG} = 5.5V		10		10	mA

Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the device should be operated at these limits. The table of "Electrical Characteristics" provides conditions for actual device operation.

Note 2: Unless otherwise specified Min/Max limits apply across the −30°C to +70°C range.

Note 3: All current into device pins shown as positive, out of device pins as negative, all voltages referenced to ground unless otherwise noted. All values shown as Max or Min on absolute value basis.

AC Electrical Characteristics V_{CC} = 5V ±10%, T_A = −30°C to +70°C

Symbol	Parameter		Conditions	Min	Max	Units
$t_{MODULUS}$	Modulus Set-Up Time (Notes 4 and 5)	DS8614			55	
		DS8615, DS8616			65	ns
		DS8617			75	
R_{IN}	AC Input Resistance		V_{IN} = 100 MHz and 50 mVrms	1.0		kΩ
C_{IN}	Input Capacitance		V_{IN} = 100 MHz and 50 mVrms	3	10	pF

Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. Except for "Operating Temperature Range" they are not meant to imply that the devices should be operated at these limits. The table of "Electrical Characteristics" provides conditions for actual device operation.

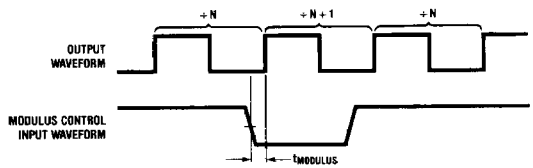
Note 2: Unless otherwise specified min/max limits apply across the −30°C to +70°C temperature range.

Note 3: All currents into device pins are shown as positive, out of device pins as negative, all voltages referenced to ground unless otherwise noted. All values shown as max or min on absolute value basis.

Note 4: $t_{MODULUS}$ = the period of time the modulus control level must be defined prior to the positive transition of the prescaler output to ensure proper modulus selection.

Note 5: See Timing Diagrams.

Timing Diagram



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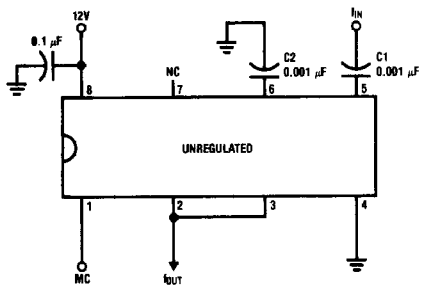
The logical state of the modulus control input just prior to the output's rising edge will determine the modulus ratio of the device immediately following that rising edge. The pulse width difference of N and N + 1 operation occurs during the output = HI conditions.

Typical Applications



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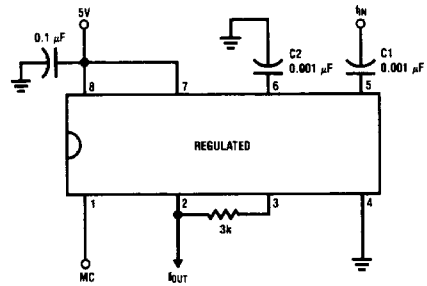

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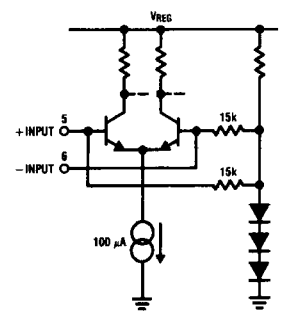
Schematic Diagrams



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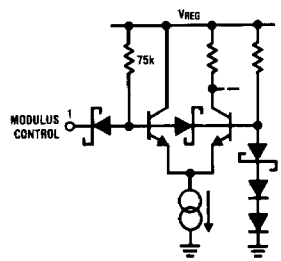

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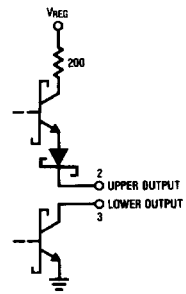

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Application Hints

OPERATING NOTES

The signal source is usually capacitively coupled to the input. At higher frequencies a 0.001 μF input capacitor (C1) is usually sufficient, with larger values used at the lower frequencies. If the input signal is likely to be interrupted, it may be desirable to connect a 100 kΩ resistor between one input and ground to stabilize the device. In the single-ended mode, it is preferable to connect the resistor to the unused input. In the differential mode, the resistor can be connected to either input. The addition of the 100 kΩ pulldown resistor causes a loss of input sensitivity, but prevents circuit oscillations under no signal (open circuit) conditions. In addition, in the single ended mode, a capacitor of 0.001 μF (C2) should be connected between the unused input and the ground plane to provide a good high frequency bypass. The capacitor should be made larger for lower frequencies.

The input waveform may be sinusoidal, but below about 20 MHz the operation of the circuit becomes dependent on the slew rate of the input rather than amplitude. A square wave input with a slew rate of greater than 20 V/μs will permit correct operation down to lower frequencies, provided the proper input coupling capacitor is provided.

For regulated mode operation connect V_S to V_{REG} to ensure proper operation (see Typical Application diagram).