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DS21600/DS21602/DS21604
3.3V/5V Clock Rate Adapter

www.maxim-ic.com

GENERAL DESCRIPTION

The DS21600/DS21602/DS21604 are multiple-rate clock adapters that convert between E-carrier and T-carrier clocks rates. A T1 or E1 clock output, CLKOUT1, is available, along with a higher multiple rate clock output, CLKOUT2. CLKOUT1 and CLKOUT2 are frequency locked to the clock input CLKIN. The clock outputs, along with frame-sync output, can be phase-aligned to a frame-sync input. The devices are fully compatible with the LXP600A, LXP602, and LXP604, and operate from either a 5V or 3.3V supply. All operation modes include a standard 8kHz output.

The DS21600/DS21602/DS21604 are available in 16-pin SO, and are rated for industrial temperatures.

ORDERING INFORMATION

PART	TEMP RANGE	PIN-PACKAGE
DS21600SN	-40°C to +85°C	16 SO
DS21600SN+	-40°C to +85°C	16 SO
DS21600N	-40°C to +85°C	8 DIP
DS21600N+	-40°C to +85°C	8 DIP
DS21602SN	-40°C to +85°C	16 SO
DS21602SN+	-40°C to +85°C	16 SO
DS21602N	-40°C to +85°C	8 DIP
DS21602N+	-40°C to +85°C	8 DIP
DS21604SN	-40°C to +85°C	16 SO
DS21604SN+	-40°C to +85°C	16 SO
DS21604N	-40°C to +85°C	8 DIP
DS21604N+	-40°C to +85°C	8 DIP

+ Denotes a lead(Pb)-free/RoHS-compliant device.

FREQUENCY CONVERSIONS (MHz)

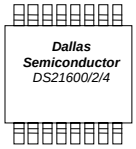
PART	CLKIN	CLKOUT1	CLKOUT2
DS21600	1.544	2.048	6.144
	2.048	1.544	6.176
DS21602	1.544	2.048	8.192
	2.048	1.544	6.176
DS21604	1.544	4.096	8.192
	4.096	1.544	6.176

FEATURES

- **Direct Drop-In Replacement for LXP600ASE, LXP602SE, and LXP604SE**
- **Converts E-Carrier Clock Rates to T-Carrier Clock Rates**
- **Converts T-Carrier Clock Rates to E-Carrier Clock Rates**
- **3.3V or 5V Supply**
- **Low Jitter Output**
- **Multiple Output Clocks Synchronized to Input Clock**
- **8kHz Frequency-Locked Output for All Operation Modes**
- **No External Components Required**
- **16-Pin SO and 8-Pin DIP**
- **Industrial Temperature Range: -40°C to +85°C**

PIN CONFIGURATION

TOP VIEW



SO

Note: *Some revisions of this device may incorporate deviations from published specifications known as errata. Multiple revisions of any device may be simultaneously available through various sales channels. For information about device errata, click here: www.maxim-ic.com/errata.*

REV: 011606

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. PIN DESCRIPTION

Table 1-A. Pin Description

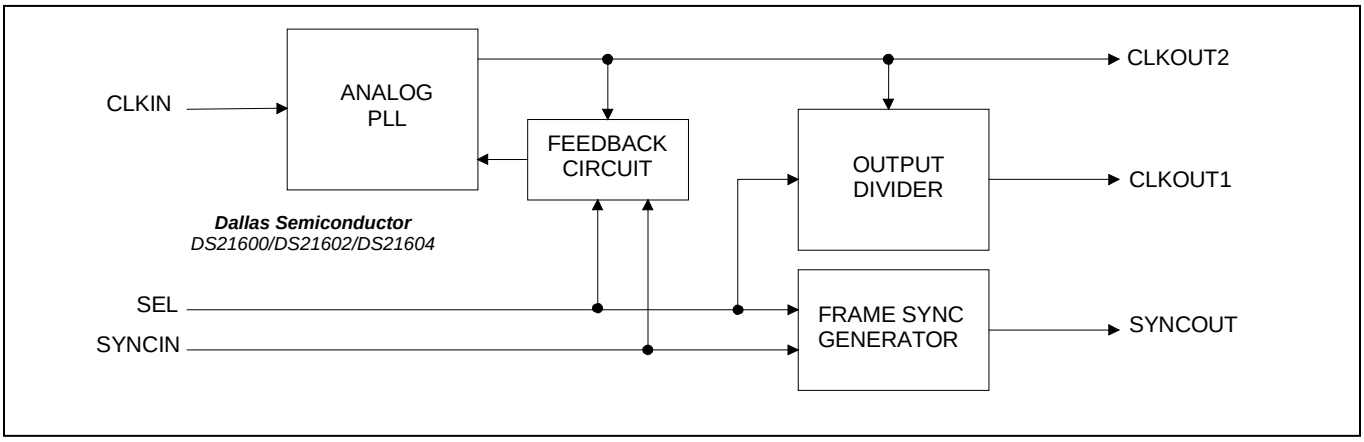
PIN		NAME	TYPE	FUNCTION
DIP	SO			
—	1, 3, 6, 8, 10, 11, 13, 15	N.C.	—	No Connect
1	2	SYNCOUT	Output	Synchronization Output. An 8kHz output that can be synchronized to the clock outputs.
2	4	CLKOUT2	Output	Clock Output 2. T1 or E1 carrier clock output referenced to CLKIN.
3	5	CLKIN	Input	Clock Input. Reference Clock Input. CLKOUT1 and CLKOUT2 will be referenced to this clock.
4	7	CLKOUT1	Output	Clock Output 1. T1 or E1 carrier clock output referenced to CLKIN.
5	9	Vss	Supply	Ground
6	12	SEL	Input	Clock Mode Select. Conversion mode select.
7	14	SYNCIN	Input	Synchronization Input. Used to synchronize the clock outputs and SYNCOUT to CLKIN and SYNCIN. SYNCIN should be tied high or low when not in use.
8	16	V_{DD}	Supply	Positive Supply, 3.3V or 5V ±5%

1.1 Pin Name Cross-Reference to LXP60X

Table 1-B. Pin Name Cross-Reference to LXP60x

DS21600/DS21602 /DS21604	LXP600ALXP602/LXP604	FUNCTION
SYNCOUT	FSO	Synchronization Pulse Output
CLKOUT2	HFO	Clock 2 Output
CLKIN	CLKI	Clock Input
CLKOUT1	CLKO	Clock 1 Output
V_{SS}	GND	Ground
SEL	SEL	Clock Mode Select
SYNCIN	FSI	Synchronization Pulse Input
N.C.	N.C.	No Connect
V_{DD}	V_{CC}	Positive Supply

Figure 1-1. Block Diagram



2. FUNCTIONAL DESCRIPTION

A clock input at CLKIN is converted to an alternate clock rate available on CLKOUT1. A higher multiple-rate clock also is available on CLKOUT2. Additionally, an 8kHz clock locked to CLKIN is always available at the SYNCOUT pin. The SEL pin controls clock-rate conversion selection.

2.1 Mode Select

The SEL pin is used to select the operating frequencies. Table 2-A shows the SEL state for the various operating modes of the DS21600, DS21602, and DS21604.

Table 2-A. Frequency Conversions (MHz)

PART	SEL	CLKIN	CLKOUT1	CLKOUT2
DS21600	0	1.544	2.048	6.144
	1	2.048	1.544	6.176
DS21602	0	1.544	2.048	8.192
	1	2.048	1.544	6.176
DS21604	0	1.544	4.096	8.192
	1	4.096	1.544	6.176

2.2 Frame-Sync Input

In all cases, CLKOUT1 and CLKOUT2 are frequency-locked to CLKIN. CLKOUT1, CLKOUT2, and SYNCOUT are phased-locked to SYNCIN when SYNCIN is asserted. The signal applied to SYNCIN can be 8kHz or some integer subrate such as 1kHz, 2kHz, or 4kHz. Phase synchronization occurs within a maximum of 50ms when SYNCIN is 8kHz.

3. OUTPUT JITTER

Table 3-A shows the output jitter specifications for 2.048MHz (or 4.096MHz) to 1.544MHz conversions (SEL = 1) and 1.544MHz to 2.048MHz (or 4.096MHz) conversions (SEL = 0).

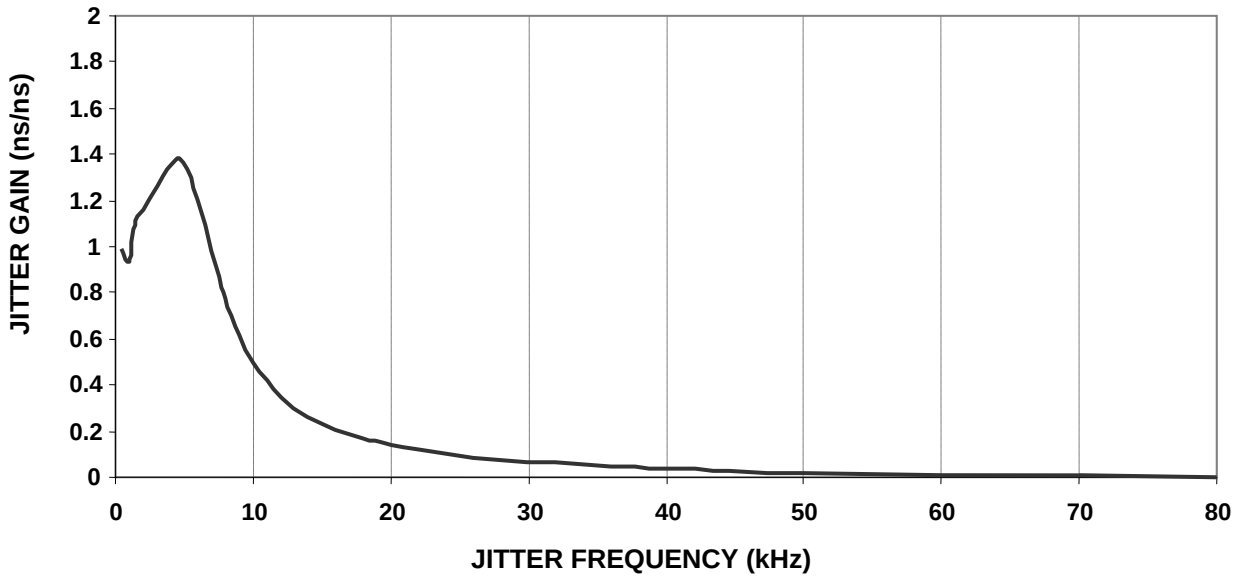
Table 3-A. Output Jitter Specifications

CLKIN (MHz)	CLKOUT1 (MHz)	FREQUENCY BAND	SPECIFICATION	VALUE	TYP	MAX	UNITS
1.544	2.048	20Hz–100kHz	G.823	1.500	0.018	0.035	UI_{P-P}
		18kHz–100kHz	G.823	0.200	0.012	0.025	UI_{P-P}
2.048 or 4.096	1.544	No bandlimiting	TR62411	0.050	0.010	0.020	UI_{P-P}
		10Hz–40kHz	TR62411	0.025	0.005	0.010	UI_{P-P}
		8kHz–40kHz	TR62411	0.025	0.006	0.012	UI_{P-P}

3.1 Jitter Transfer

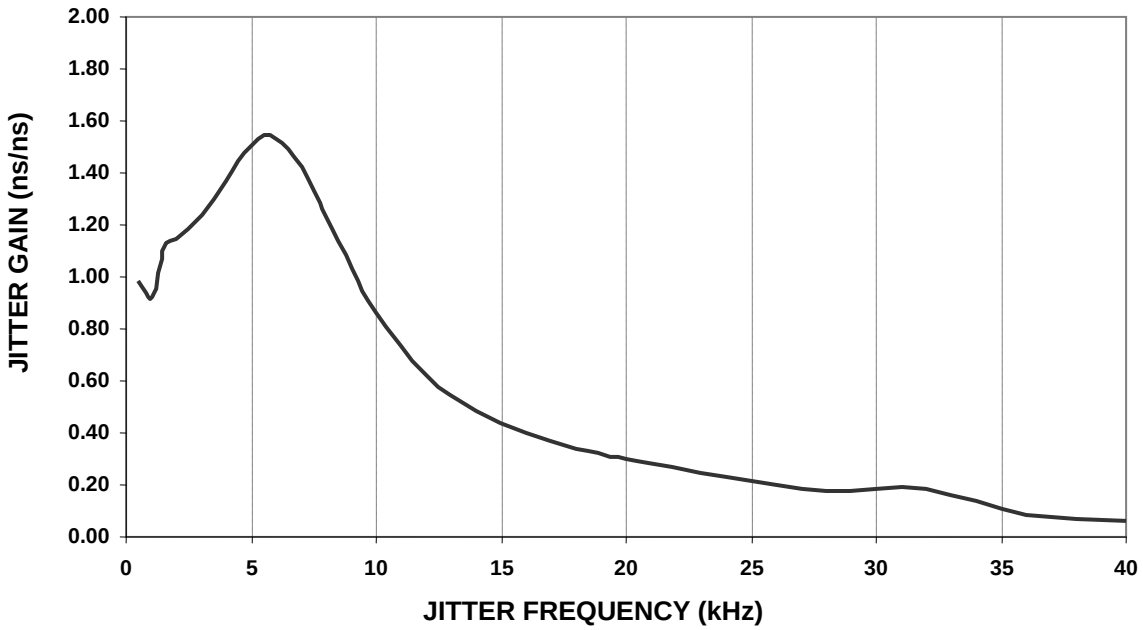
Figure 3-1 and Figure 3-2 show jitter transfer for 2.048MHz-to-1.544MHz conversions and vice versa.

Figure 3-1. Nominal Jitter Transfer for 2.048MHz-to-1.544MHz Conversion



NOTE: THE TYPICAL PEAK JITTER GAIN OF THE DS21600/DS21602/DS21604 IS ABOUT 1.6 FOR CONVERSION FROM T1 TO E1. THE TYPICAL PEAK-JITTER GAIN OF THE LEVEL ONE DEVICE IS ABOUT 1.1. HOWEVER, THE JITTER GAIN FOR THE DS21600/DS21602/DS21604 PEAKS IN THE 4kHz TO 8kHz RANGE, WHEREAS THE PEAK JITTER GAIN FOR THE LXP6XX DEVICES SPANS A GREATER FREQUENCY RANGE (20kHz TO 40kHz).

Figure 3-2. Nominal Jitter Transfer for 1.544MHz-to-2.048MHz Conversion



NOTE: THE TYPICAL PEAK JITTER GAIN OF THE DS21600/DS21602/DS21604 IS ABOUT 1.6 FOR CONVERSION FROM T1 TO E1. THE TYPICAL PEAK-JITTER GAIN OF THE LEVEL ONE DEVICE IS ABOUT 1.1. HOWEVER, THE JITTER GAIN FOR THE DS21600/DS21602/DS21604 PEAKS IN THE 4kHz TO 8kHz RANGE, WHEREAS THE PEAK JITTER GAIN FOR THE LXP6XX DEVICES SPANS A GREATER FREQUENCY RANGE (20kHz TO 40kHz).

4. OPERATING PARAMETERS

ABSOLUTE MAXIMUM RATINGS

Voltage Range on Any Pin Relative to Ground……..-1.0V to +6.0V
Operating Temperature Range for DS21600SN, DS21602SN, DS21604SN…….-40°C to +85°C
Storage Temperature Range……-55°C to +125°C
Soldering Temperature..…….See IPC/JEDEC J-STD-020 Specification

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods can affect device reliability.

RECOMMENDED DC OPERATING CONDITIONS

(T_A = -40°C to +85°C)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Logic 1	V_{IH}	(Note 1)	2.0		5.5	V
Logic 0	V_{IL}	(Note 1)	-0.3		+0.8	V
Supply Voltage	V_{DD}	3.3V	3.135	3.3	3.465	V
		5V	4.75	5	5.25	

DC CHARACTERISTICS

(V_{DD} = 3.3V/5V ± 5%, T_A = -40°C to +85°C.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Current	I_{DD}	(Note 2)			14	mA
Input Leakage	I_{IL}	(Note 3)	-1.0		+1.0	µA
Output Leakage	I_{LO}				1.0	µA
Output Current (2.4V)	I_{OH}		-1.0			mA
Output Current (0.4V)	I_{OL}		+4.0			mA

AC TIMING

(Figure 4-1, Figure 4-2, Figure 4-3, Figure 4-4, and Figure 4-5)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Capture Range on CLKIN		(Note 1)	±10,000			ppm
Lock Range on CLKIN		(Note 1)	±10,000			ppm
CLKIN Duty Cycle		(Note 1)	35		65	%
SYNCIN Setup to CLKIN Rising	t_{SU}	(Note 1)	46			ns
SYNCIN Hold After CLKIN Rising	t_{HI}	(Note 1)	30			ns
SYNCIN Pulse Width	t_{PW}	(Note 1)	76		CLKIN period	ns
CLKOUT1 Delay from CLKIN Rising	t_D	3.3V (Note 1)	-15	0	+41	ns
		5V (Note 1)	-15	0	+22	
CLKOUT1 Duty Cycle	C_D	(Note 1)		50		%
SYNCOUT Delay from CLKOUT2	t_{DF}	(Note 1)	-5		30	ns
SYNCOUT Pulse Width	t_{SPW}	(Note 1)		CLKOUT 1 period		ns
CLKOUT1 Delay from CLKOUT2 Rising	t_{DH}	3.3V (Note 1)	-15	0	+15	ns
Rise/Fall Time on CLKIN, SYNCIN	t_{RF}	3.3V (Note 1)			60	ns
		5V (Note 1)			40	
Rise/Fall Time on CLKOUT1, SYNCOUT, CLKOUT2 (Note 4)	t_{RF}	3.3V (Note 1)			75	ns
		5V (Note 1)			40	

Note 1: Guaranteed by design.
Note 2: 100pF load on all outputs.
Note 3: $0V < V_{IN} < V_{DD}$.
Note 4: 100pF load on CLKOUT1, SYNCOUT, CLKOUT2.

Figure 4-1. DS21600/DS21602 High-to-Low Frequency Conversion Frame-Sync Alignment

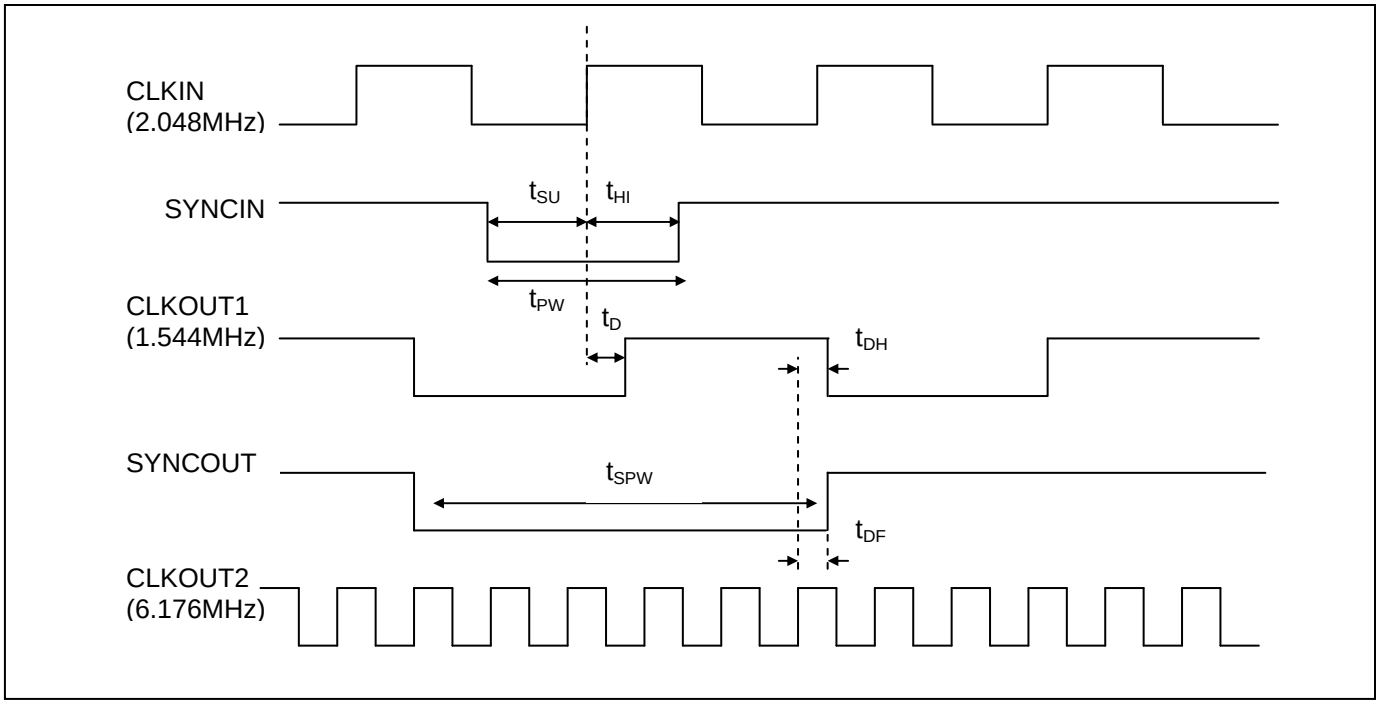


Figure 4-2. DS21604 High-To-Low Frequency Conversion Frame-Sync Alignment

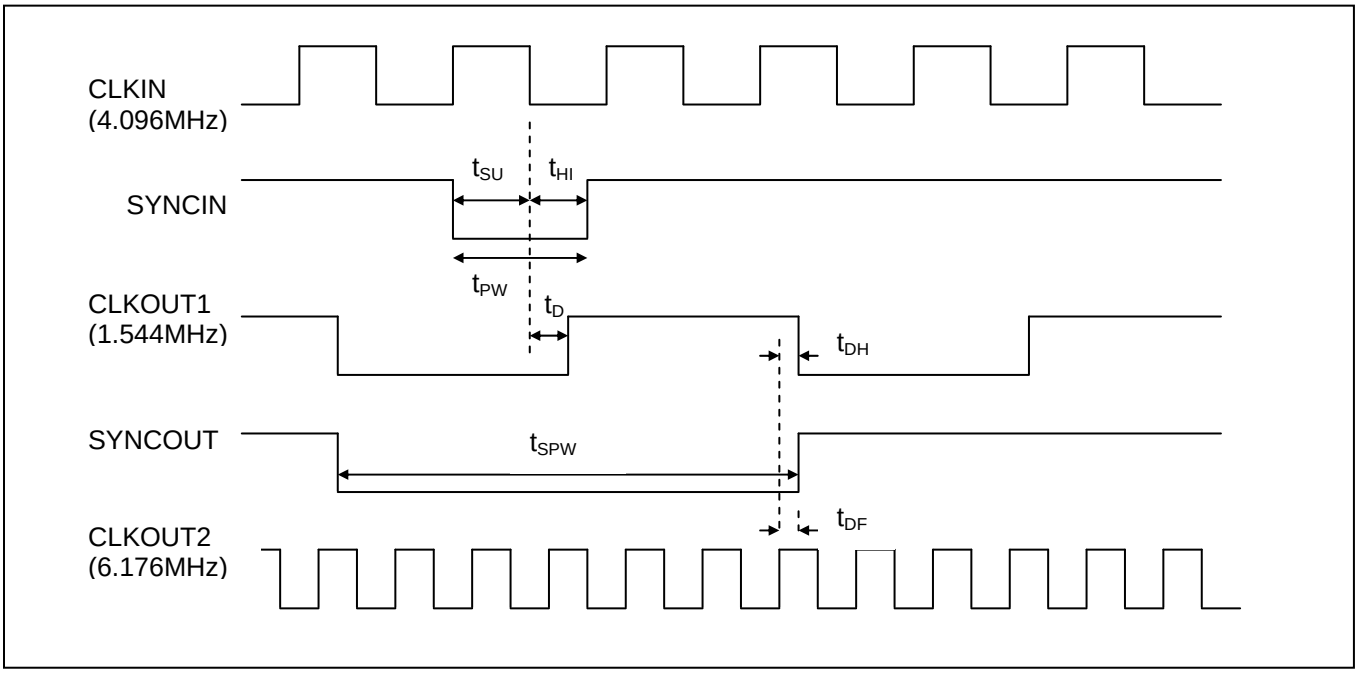


Figure 4-3. DS21600 Low-to-High Frequency Conversion Frame-Sync Alignment

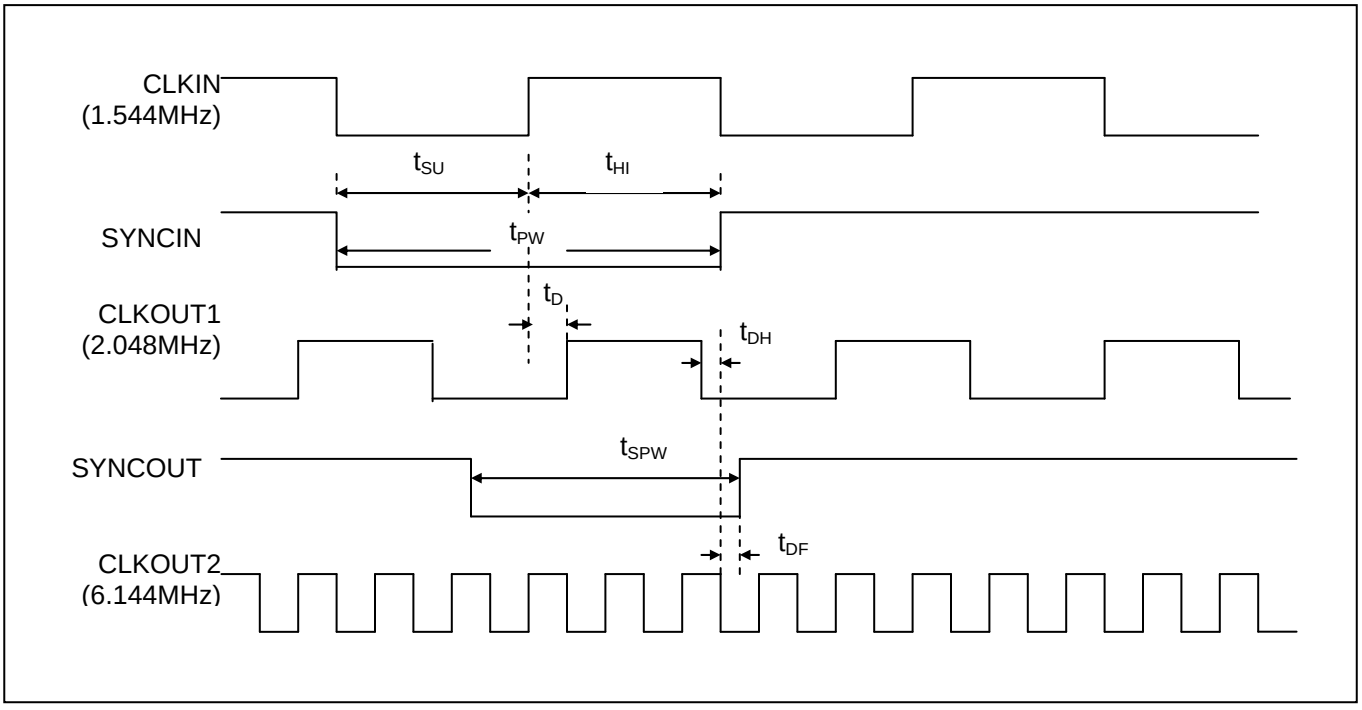


Figure 4-4. DS21602 Low-to-High Frequency Conversion Frame-Sync Alignment

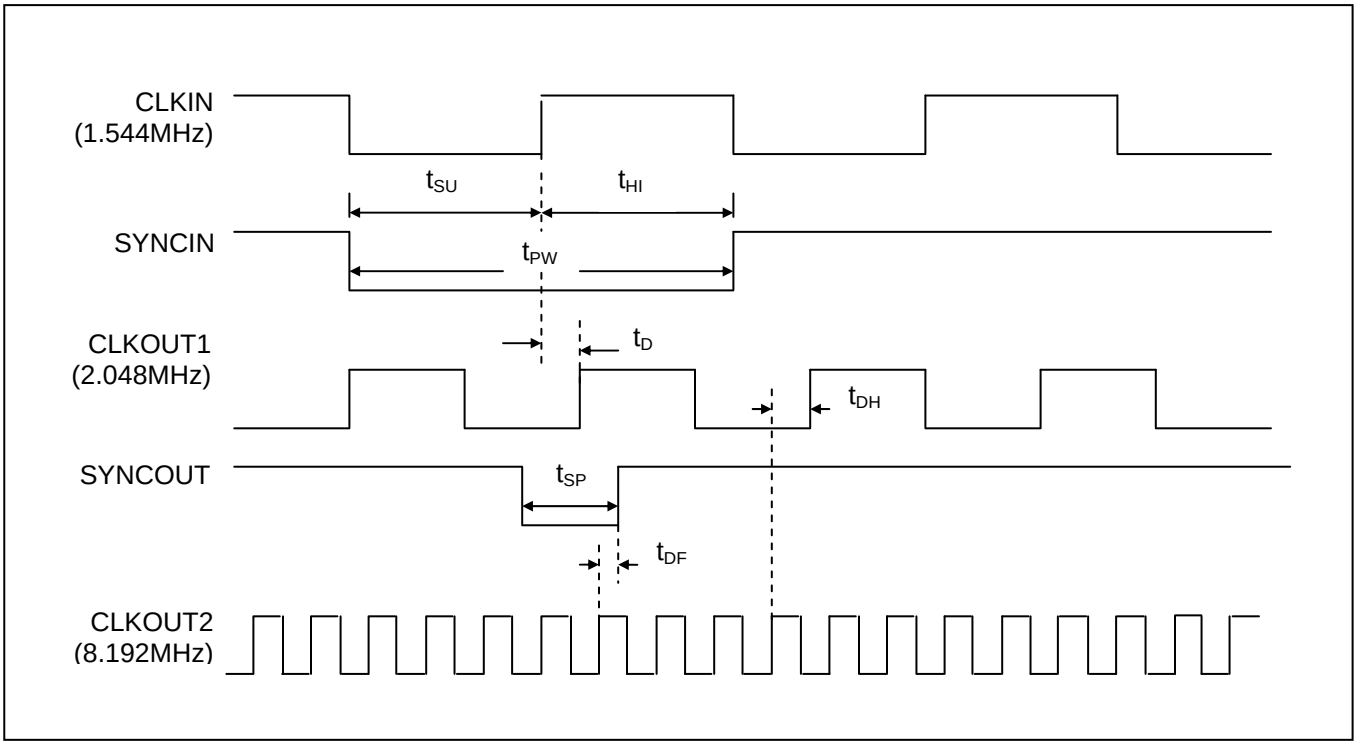
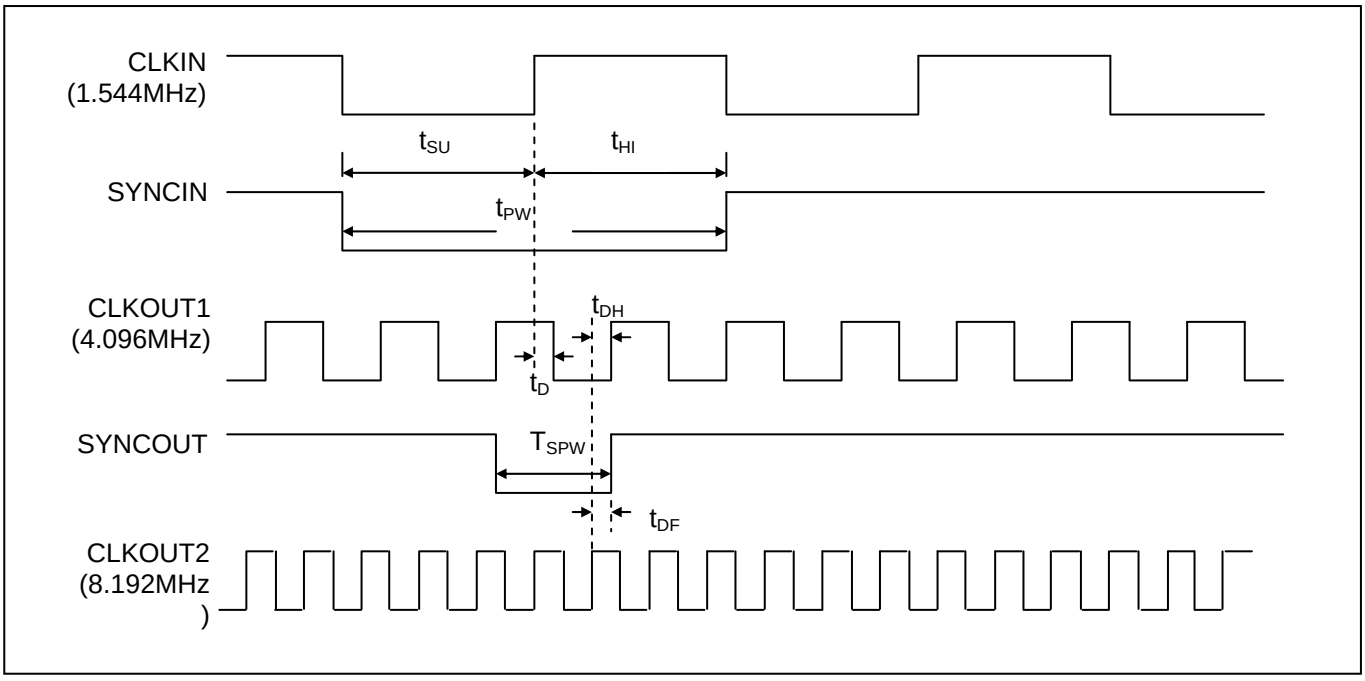


Figure 4-5. DS21604 Low-to-High Frequency Conversion Frame-Sync Alignment



5. PACKAGE INFORMATION

For the latest package outline information and land patterns, go to www.maxim-ic.com/packages.

PACKAGE TYPE	PACKAGE CODE	DOCUMENT NO.
16 SO	W16+11	**21-0042**
8 PDIP	P8+8	**21-0043**

6. REVISION HISTORY

REVISION	DESCRIPTION
082100	Preliminary release.
083100	Added package specifications.
090100	Correct operating voltage range.
011101	Added mechanical drawing for DIP package.
092801	Added jitter specifications and pin list for all packages; added timing diagrams.
032002	Updated jitter specifications.
032803	Added 3.3V operation specifications.
113004	Added the spec for soldering temperature in the *Absolute Maximum Ratings* section.
112105	Changed timing specs in DC Characteristics and AC Timing tables to guaranteed by design.
011606	Added lead-free packages to Ordering Information on page 1.

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