

INTRODUCTION

The DS1085/DS1085L produces a wide range of frequencies (8.1kHz to 133MHz and 4.1kHz to 66MHz, respectively) on the main oscillator output (OUT1) and 8.2MHz to 133MHz and 4.13MHz to 66MHz, respectively, on the reference oscillator output (OUT0). The DS1085/DS1085L allows the user to divide down the frequency (as in the DS1077/DS1077L) but also change the master frequency using DAC and OFFSET. The frequency can be changed by using the internal registers. The DS1085 and DS1085L have the same internal registers, which will be discussed below. The default frequency, DAC step size, DAC default, and OFFSET step size are different between devices and device versions (see Table 1). To assist in determining which registers to change, an interactive frequency calculator for the DS1085/DS1085L has been developed. The general equations the frequency calculator uses are given in the *DS1085/DS1085L Registers* section, for more details and the specific equations see the *Appendix*.

DEVICE DEFAULTS Table 1

DS1085 Device Version	Frequency	DAC Step Size	DAC Default	OFFSET Step Size
-10	97.1MHz	10kHz	500	5.12MHz
-25	104.6MHz	25kHz	600	6.4MHz
-50	101.8MHz	50kHz	500	6.4MHz
DS1085L Device Version	Frequency	DAC Step Size	DAC Default	OFFSET Step Size
-5	48.58MHz	5kHz	500	2.56MHz
-12	52.3MHz	12.5kHz	600	3.2MHz
-25	50.9MHz	25kHz	500	3.2MHz

DS1085/DS1085L REGISTERS

The DS1085/DS1085L's frequencies can be programmed by changing the four frequency variables. The four frequency variables are the prescaler M, divisor N, OFFSET, and DAC. Descriptions of each register and how the frequency is affected by each variable are described below. Refer to the block diagram in the datasheet for more information.

Prescalers (MUX Register) (Address 02h)

The prescalers divide down the output frequency. P0 is the OUT0 prescaler, and P1 is the OUT1 prescaler. The MUX register sets the prescalers (bits 1 to 4). See Tables 2 and 3 for more information.

PRESCALERS Table 2

0M1 (Bit 4)	0M0 (Bit 3)	Prescaler P0 Divisor "M"	1M1 (Bit 2)	1M0 (Bit 1)	Prescaler P1 Divisor "M"
0	0	1*	0	0	1*
0	1	2	0	1	2
1	0	4	1	0	4
1	1	8	1	1	8

*Factory default setting

The prescalers (M) are not calculated in the frequency calculator. The outputs are divided into four boxes, one for each prescaler value. The prescaler would be calculated similar to the divisor by

$$M = \frac{F_{default}}{F_{required} * N} \quad \text{Equation 1}$$

where $F_{default}$ is the default frequency for the device, $F_{required}$ is the user specified frequency, and N is the divisor.

MUX REGISTER Table 3

	Byte 1								Byte 0							
	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0						
Name		PDN1	PDN0	SEL0	EN0	0M1	0M0	1M1	1M0	DIV1	-	-	-	-	-	-
Default Setting	0	0	0	1	1	0	0	0	0	0	X	X	X	X	X	X

DIV Register (Address 01h)

The divisor affects only the OUT1 output. When DIV1=0 in the MUX register (Address 02h, bit 0), the N divider is enabled (see Table 3). The N divider defaults enabled. The frequency will be divided by N, so the larger the N, the smaller the frequency. The divisor values range from 2 to 1025. The DIV register consists of 10 bits. The lower 6 bits of byte 0 are not used.

To calculate the DIV register value, subtract '2' from the divisor (N) given in the frequency calculator. Convert the decimal number to binary. The last 2 bits in the binary number are the first 2 bits of DIV register byte 0 (see Example 1).

Example 1:

If Divisor (N) = 100d, convert 98d to binary (98d => 1100010b).

Byte 1 = 00011000b = 18h

Byte 0 = 10xxxxxxb = 80h

The divisor, N, is calculated by

$$N = \frac{F_{default}}{F_{required} * M} \quad \text{Equation 2}$$

where $F_{default}$ is the default frequency for the device, $F_{required}$ is the user specified frequency, and M is the prescaler.

DIV REGISTER Table 4

Bit Value in DIV Register (Binary)	Bit Value in DIV Register (HEX)	Divisor (N) (Value Calculated in Frequency Calculator)
00000000 00XXXXXX	00 00	2
00000000 01XXXXXX	00 40	3
00000000 10XXXXXX	00 80	4
00000000 11XXXXXX	00 C0	5
00000001 00XXXXXX	01 00	6
-	-	-
-	-	-
11111111 11XXXXXX	FF C0	1025

OFFSET Register (Address 0Eh)

The OFFSET step sizes are listed below for each type of device:

DS1085Z-10 => 5.12MHz	DS1085LZ-5 => 2.56MHz
DS1085Z-25 => 6.4MHz	DS1085LZ-12 => 3.2MHz
DS1085Z-50 => 6.4MHz	DS1085LZ-25 => 3.2MHz

The frequency changes by the OFFSET step size (depending on the value of M and N) for each increment/decrement in the OFFSET register. When M and N are equal to '1', the OFFSET step size is listed above. If M or N is greater than '1', the OFFSET step size is divided by the value of M and/or N (see Example 2).

Note: The output frequency range and the OFFSET value must stay within the limits of the Frequency vs. Offset table in the datasheet.

Example 2:

A DS1085Z-25 was used with the following parameters:

OFFSET step size = 6.4MHz, M = 2, N = 4

$$\text{Actual OFFSET step size} = \frac{6.4\text{MHz}}{2 * 4} = 0.8\text{MHz}$$

In the frequency calculator OFFSET is calculated by

$$\text{OFFSET} = \frac{F_{\text{required}} - F_{MN}}{\text{OFFSET step size}/(M * N)} + \text{OFFSET Default} \quad \text{Equation 3}$$

where F_{required} is the user specified frequency, F_{MN} is the calculated frequency with a chosen M and N value (see *Appendix*), M is the prescaler, N is the divisor, and OFFSET step size is the step size of the OFFSET register which varies by device and version, and OFFSET Default is the default OFFSET value.

Read the RANGE (Address 37h) register for the default OFFSET value (use upper 5 bits).

Note1: This formula assumes DAC = default value.

Note2: The OFFSET value must be an integer; therefore, the OFFSET value may need to be rounded.

DAC Register (Address 08h)

The DAC register has 10-bits that control the master oscillator. The DAC step sizes are listed below for each type of device:

DS1085Z-10 => 10kHz	DS1085LZ-5 => 5kHz
DS1085Z-25 => 25kHz	DS1085LZ-12 => 12.5kHz
DS1085Z-50 => 50kHz	DS1085LZ-25 => 50kHz

The frequency changes by the DAC step size (depending on the value of M and N) for each increment/decrement in the DAC register. When M and N are equal to '1', the DAC step size is listed above. If M or N is greater than '1', the DAC step size is divided by the value of M and/or N (this is the same concept as OFFSET step size, see Example 2).

The DAC default also changes depending on the device and device version.

DS1085Z-10 => 500	DS1085LZ-5 => 500
DS1085Z-25 => 600	DS1085LZ-12 => 600
DS1085Z-50 => 500	DS1085LZ-25 => 500

The DAC value is calculated by

$$DAC = \frac{F_{required} - F_{default}}{DAC \text{ step size} / (M * N)} + DAC \text{ Default} \quad \text{Equation 4}$$

where $F_{required}$ is the user specified frequency, $F_{default}$ is the default frequency for the device, M is the prescaler, N is the divisor, DAC step size is the step size of the DAC register which varies by device and version, and DAC Default is the default DAC register value.

Note1: The output frequency range must stay within the limits of the Frequency vs. Offset table in the datasheet.

Note2: The DAC value must be between an integer 0 and 1023, therefore, the DAC value may need to be rounded.

Note3: This formula assumes OFFSET = default value. The equation to change both the OFFSET and DAC register is included in the *Appendix*.

DEVICE CURRENT

The current draw of the device differs depending on the registers that are used. When DAC or OFFSET is used without M or N, the current drawn (power used) is less than if M or N are used to obtain the same frequency (see Table 5).

TYPICAL CURRENT DRAW DEPENDING ON REGISTER Table 5

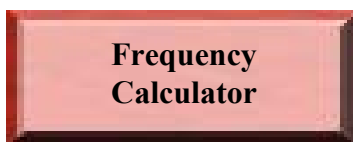
Register	Current (mA)	Frequency (MHz)
Default Frequency	31.23	103.9
M=2	25.5	52.33
N=2	28.51	52.47
OFFSET = 04h	17.43	53.47
OFFSET = 0Ah	30.8	91.03
DAC = 0E 00h	30.6	90.23

Note: The settings in the Register column are the only settings that differ from the default.

DS1085/DS1085L FREQUENCY CALCULATOR

Using formulas to calculate the frequency with the variables listed above, a frequency calculator was created. All the calculations are based off the default frequency of the device. To output the default frequency, set DAC = DAC default, OFFSET = OFFSET Default, and MUX = 97d (18h 40h). Use the up/down arrows to enter frequencies between 1MHz and 133MHz or type in the required frequency from 4.1kHz to 133MHz (depending on device). Frequencies must be entered in MHz. The user can change the Device Type, OFFSET Default, and Default Frequency to match the device and version that is used.

To open the frequency calculator, click on the button below.



Refer to the DS1085/DS1085L datasheet for more information regarding the operation of the device.

Note: The Analysis ToolPak must be enabled in Excel (go to Tools->Add-ins).

APPENDIX

The Appendix describes how to calculate the frequency in more detail using the frequency calculator equations.

1. Select DS1085 or DS1085L from the pull-down menu.
2. Select a default frequency depending on the version of the device (see Table 1).
3. Enter the OFFSET Default (read RANGE register (Address 37h) for default).
4. Choose a frequency (F_{required}).
5. Pick a value for M (1,2,4, or 8).
6. Calculate N (2 through 1025) with $N = \frac{F_{\text{default}}}{F_{\text{required}} * M}$, or choose N so the frequency is within the oscillator range for the reference and main oscillators (see range limits in *Introduction*).
7. Calculate the frequency with the values of M and N with $F_{MN} = \frac{F_{\text{default}}}{M * N}$
- 8a. If F_{MN} is close to the F_{required} , a small DAC adjustment may be necessary.
- 8b. Calculate DAC (0 through 1023) with $DAC = \frac{F_{\text{required}} - F_{MN}}{DAC \text{ step size } / (M * N)} + DAC \text{ Default}$.
- 8c. Calculate the frequency with the values of DAC, M, and N with $F_{MND} = F_{MN} - \frac{(DAC \text{ Default} - DAC) * DAC \text{ step}}{M * N}$
- 9a. If more adjustment is needed, a larger OFFSET adjustment may be necessary instead.
- 9b. Calculate OFFSET with $OFFSET = \frac{F_{\text{required}} - F_{MN}}{OFFSET \text{ step size } / (M * N)} + OFFSET \text{ Default}$.
- 9c. Calculate the frequency with the values of OFFSET, M, and N with $F_{MNOS} = F_{MN} + \frac{(OFFSET \text{ step size} * OFFSET_{\Delta})}{M * N}$ and $OFFSET_{\Delta} = (OFFSET - OFFSET \text{ Default})$.
- 10a. If F_{OS} is close to the F_{required} , a small DAC adjustment may be necessary.
- 10b. Calculate DAC with $DAC = \frac{F_{\text{required}} - F_{MNOS}}{DAC \text{ step size } / (M * N)} + DAC \text{ Default}$.
- 10c. Calculate the frequency with the values of DAC, OFFSET, M, and N with $F_{MNOSD} = F_{MNOS} - \frac{(DAC \text{ Default} - DAC) * DAC \text{ step}}{M * N}$
11. Verify the output frequency, F_{MNOS} , is within the Frequency vs. Offset table in the data sheet.
12. Also verify the output frequency range is within the main and reference oscillator range.

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