Frequency Control Word Setting Procedure for 8V19N850D

1. Overview

The 8V19N850D DPLL0 and DPLL1 DCO frequency can be controlled by Frequency Control Word (FCW). This document provides an 8V19N850D general procedure of setting FCW. Examples are provided to show the register setting and expected results of the output frequencies for initial setting and subsequence FCW update. In these examples, DPLL1 is used. The same principles can be applied to DPLL0 with equivalent registers.

2. Convert ppm to FCW for Register

In write Frequency Mode, the APLL VCO is tuned by the FCW as follows:

$$F_{VCO} = F_{XO} \times N \times (1 + FCW)$$

Where:

- F_{VCO} is the APLL VCO frequency.
- F_{XO} is the OSCI/XO_DPLL frequency which is fixed.
- N is the nominal APLL feedback divider ratio.
- FCW is the tuning word which is 42 bit 2's complement and LSB is 2^{-53}
- FCW is calculated as follows:
  - $FCW = FFO \times 10^{-6} \times 2^{53}$ (Convert this FCW from decimal to HEX for registers).
  - FFO is the target fraction frequency in ppm.

3. General FCW Setting Procedure

1. Write Frequency Enable = 1.
   For DPLL1, R1A4, D5 = 1
   (For DPLL0, R124, D5 = 1)
2. Integrator Enable = 1.
   For DPLL1, R1A4, D3 = 1
   (For DPLL0, R124, D3=1)
3. Combo Enable = 1.
   For DPLL1, R1A5, D4 = 1
   (For DPLL0, R125, D4 = 1)
4. Direct Write Mode = 1.
   For DPLL1, R1A6, D0 = 1
   (For DPLL0, R126, D0 = 1)
5. Write Frequency.
   Using the equation shown above to convert ppm to hex, load the hex data to the following registers:
   For DPLL1, R1B5[1:0] = [41:40], R1B4[7:0] to 1B0[7:0] = [39:0]
   (For DPLL0, R135[1:0] = [41:40], R134[7:0] to 130[7:0] = [39:0])

4. Examples

4.1 Setting Register for Write Frequency

DPLL1 can be either free-running and lock to the local OCXO, or can be a slave of DPLL0. RFPLL locked DPLL1. For simplicity, assume the local OCXO is perfect frequency with 0 error. The Output R0 = 491.52MHz

Write register 0x1a4 = 28h (i.e., 00101000b)

D5 = 1, Write Frequency Enable,

D3 = 1 Integrator Enable,

Write register 0x1a5 = 10h (i.e., 00000001b)

D4 = 1, Combo_EN_DPLL1 Mode

Write register 0x1a6 = 03h (i.e., 00000011b)

D0 = 1, Direct Write Mode

D1 = 1 (Default = 1, FCW works either 0 or 1)

Write registers 0x1B0, 1B1, 1B2, 1B3, 1B4, 1B5 = 00 00 00 00 00 00 (0.0 ppm). At this point, the FCW is not yet applied.

Assume the OCXO has no frequency error

FCW = 0 or FWC is not yet activated, expect Output R0 = 491.520000MHz (nominal, assume the OCXO frequency does not have an error).

4.2 Update FCW

Update Frequency Control Word = 0.320ppm

Control Word in decimal = (0.320 * 10^{-6}) * 2^53 = 2882303761.517

Convert 2882303762 to hex for Register Data Write frequency field = AB CC 77 12 Hex

Write registers 0x1B0, 1B1, 1B2, 1B3, 1B4, 1B5 = 12 77 CC AB 00 00 (0.320 ppm calculated and converted from the above equation)

Expect frequency R0 = 491.520000MHz + 0.320ppm

4.3 Subsequent Update FCW

Update Frequency Control Word = 5.76ppm

Control Word in decimal = (5.76 * 10-6) * 2^53 = 51881467707.308

Convert 51881467707 to hex for Register Data Write frequency field = C 14 60 5F 3B Hex

Write registers 0x1B0, 1B1, 1B2, 1B3, 1B4, 1B5 = 3B 5F 60 14 0C 00 (5.76 ppm calculated and converted from the above equation)

Expect frequency R0 = 491.520000MHz + 5.76ppm

5. Revision History

Revision	Date	Description
1.0	Mar 17, 2021	Initial release.

IMPORTANT NOTICE AND DISCLAIMER

RENESAS ELECTRONICS CORPORATION AND ITS SUBSIDIARIES (“RENESAS”) PROVIDES TECHNICAL SPECIFICATIONS AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT OF THIRD-PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for developers who are designing with Renesas products. You are solely responsible for (1) selecting the appropriate products for your application, (2) designing, validating, and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. Renesas grants you permission to use these resources only to develop an application that uses Renesas products. Other reproduction or use of these resources is strictly prohibited. No license is granted to any other Renesas intellectual property or to any third-party intellectual property. Renesas disclaims responsibility for, and you will fully indemnify Renesas and its representatives against, any claims, damages, costs, losses, or liabilities arising from your use of these resources. Renesas' products are provided only subject to Renesas' Terms and Conditions of Sale or other applicable terms agreed to in writing. No use of any Renesas resources expands or otherwise alters any applicable warranties or warranty disclaimers for these products.

(Disclaimer Rev.1.01)

Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

Contact Information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit www.renesas.com/contact-us/.

Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.