| **Revision History** | | | |
| --- | --- | --- | --- |
| **Rev No.** | **Date of Issue** | **Comments** | **Author** |
| 0.1 | 2013/01/31 | Copy from Toggle6 Register Definitions 0V5  Modify HV Trim settings in Register7 | Pete Good |
| 0.2 | 2013/02/10 | Remove reg8<5> & reg10<5> - unused in Toggle7 | Pete Good |
| 0.3 | 2013/02/11 | Change references to sw\_four\_spi to sw\_two\_spi  Modify Toggle7 Register Map (Table 1‑2) for Dual Voltage Actuation (DVA) & remove register14  Set product ID = 50 (Table 1‑15)  Remove Reg0<5> global lock bit  Modify Register 4 (Section 1.6) for DVA Low State  Modify Register 7 (Section 1.9) for DVA High State  Add notes that Registers 0, 4 & 7 can be preset | Pete Good |
| 0.4 | 2013/02/12 | Remove Reg0<1> | Pete Good |
| 0.5 | 2013/02/14 | Change reg6\_l<0> from unused to ‘snooze mode’ enable  Change reg8\_l<5> from unused to DVA disable | Pete Good |
| 0.6 | 2013/02/15 | Remove ‘snooze mode’ enable, make reg6\_l<0> unused, the bandgap will automatically go through ‘snooze’ during power-up from sleep  Change reg8\_l<5> from unused to DVA mode during startb  Set HV trim 00000 = 10110 (40.25V) | Pete Good |
| 0.7 | 2013/02/20 | Update Register1 (Table 1‑3) BCD to beam mapping | Pete Good |
| 0.8 | 2013/02/20 | Add drawing showing beam turn-on order in Appendix (Section 2)  Fix row breaks in Table 1‑3  Update Register2 (Table 1‑4Table 1‑3) BCD to beam mapping  Update Register2 (Table 1‑5) BCD to beam mapping | Pete Good |
| 0.9 | 2013/03/01 | Define reg9<3> to control analog test mux to DATO | Pete Good |
| 1.0 | 2013/03/03 | Adjust Register1, Register2 & Register3 capacitance settings to be typically 80% of ‘max’ after normalization (i.e. maximum for each bank= 5.9pF)  Update Section 2 to reflect 5.9pF bank max capacitance | Pete Good |
| 1.1 | 2013/03/19 | Move eFUSe prg\_en away from id\_chk to lessen chance that SPI errors can blow eFUSE. Reg9<4:0> re-ordered | Pete Good |
| 1.2 | 2013/04/02 | Add definition of Bus Reset bit Register26<7>  Add section 1.13 and renumber subsequent sections  Remove erroneous don’t cares from Reg1-3 BCD input definitions. 6 LSBs are required, the 2 MSBs are XX | Pete Good |

# RFFE/wiSPI/IFX Register Details

## Toggle4 Register Map

The digital block contains nineteen, 8-bit registers.

Table ‑ Toggle7 Register Map

|  |  |
| --- | --- |
| **Data Bits** | **Description** |
| Reg0<7:0> | Global Controls |
| Reg1<7:0> | Tuning Word for Capacitor C1 |
| Reg2<7:0> | Tuning Word for Capacitor C2 |
| Reg3<7:0> | Tuning Word for Capacitor C3 |
| Reg4<7:0> | HV Trim & Oscillator Trim for DVA low setting |
| Reg5<7:0> | eFUSE Write and Read-Back |
| Reg6<7:0> | Block Enables |
| Reg7<7:0> | HV Trim & Oscillator Trim for DVA high setting |
| Reg8<7:0> | START Mode & Charge Pump Strength |
| Reg9<7:0> | TEST\_OUT & eFUSE Controls |
| Reg10<7:0> | Interface I/O Controls |
| Reg11<7:0> | Shadow Register Tuning Word for Capacitor C1 |
| Reg12<7:0> | Shadow Register Tuning Word for Capacitor C2 |
| Reg13<7:0> | Shadow Register Tuning Word for Capacitor C3 |
| Reg28<7:0> | RFFE PM\_TRIG Register |
| Reg29<7:0> | RFFE Product\_ID Register (Read Only) |
| Reg30<7:0> | RFFE Mfg\_ID Register LSBs (Read Only) |
| Reg31<7:0> | RFFE Mfg\_ID Register MSBs (Read Only) |

## Register0 – Global Controls

All bits are active high. For reg0<7:0> the default state (after Vdd applied) can be preset by the inputs reg0\_preset<7:0>. Reg0\_preset<7:0> = 01000000 and can be changed by V1 mask.

Table ‑ Register0 Bit Definitions

|  |  |  |  |
| --- | --- | --- | --- |
| **Top Level**  **Net Name** | **Cell** | **Cell Pin Name** | **Description** |
| Reg0<7> | Not used | Not used | Not used |
| Reg0<6> | sw\_two\_spi | Internal to sw\_two\_spi | Used to set the device into active regulation mode, determined by:  Active regulation is determined by:  Reg0<0> OR (Reg0<6> AND XCTRL)  Active regulation is ORed with cell enables (see Table 1‑8) to enable all required blocks. |
| Reg0<5:3> | Not used | Not used | Not used |
| Reg0<2> | tcode\_mult\_64 | mult\_by\_1 | Bypass eFUSE Multiplier  1 = multiply cap word by 1x  0 = multiply cap word be eFUSE code |
| Reg0<1> | Not used | Not used | Not used |
| Reg0<0> | Sw\_two\_spi | Internal to sw\_two\_spi | Used to set the device into active regulation mode, determined by:  Active regulation is determined by:  Reg0<0> OR (Reg0<6> AND XCTRL)  Active regulation is ORed with cell enables (see Table 1‑8) to enable all required blocks. |

## Register1 & Shadow Register11 - Capacitor C1 Setting

Default state (after Vdd applied) is low (inactive). Typical capacitance values are shown after internal normalization. Register1 value to beam mapping can be modified with a two mask change (V1 & V2)

Table ‑ Register1 & Register11 Bit Definitions

|  |  |  |  |
| --- | --- | --- | --- |
| **Reg1<7:0> Value** | **Number of Beams Activated** | **Activated Beams** | **WS1050 Cap Value (pF)** |
| XX111011 | 14 + fractional2 + fractional1 | Cell D76 beam4  Cell D76 beam1  Cell C76 beam4  Cell C76 beam1  Cell C87 beam1  Cell D87 beam4  Cell D76 beam3  Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell D87 beam1  Cell C87 beam4 | 5.9 |
| XX111010 | 14 + fractional2 | Cell D76 beam4  Cell D76 beam1  Cell C76 beam4  Cell C76 beam1  Cell C87 beam1  Cell D87 beam4  Cell D76 beam3  Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell D87 beam1 | 5.8 |
| XX111001 | 14 + fractional1 | Cell D76 beam4  Cell D76 beam1  Cell C76 beam4  Cell C76 beam1  Cell C87 beam1  Cell D87 beam4  Cell D76 beam3  Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell C87 beam4 | 5.7 |
| XX111000 | 14 | Cell D76 beam4  Cell D76 beam1  Cell C76 beam4  Cell C76 beam1  Cell C87 beam1  Cell D87 beam4  Cell D76 beam3  Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3 | 5.6 |
| XX110111 | 13 + fractional2 + fractional1 | Cell D76 beam1  Cell C76 beam4  Cell C76 beam1  Cell C87 beam1  Cell D87 beam4  Cell D76 beam3  Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell D87 beam1  Cell C87 beam4 | 5.5 |
| XX110110 | 13 + fractional2 | Cell D76 beam1  Cell C76 beam4  Cell C76 beam1  Cell C87 beam1  Cell D87 beam4  Cell D76 beam3  Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell D87 beam1 | 5.4 |
| XX110101 | 13 + fractional1 | Cell D76 beam1  Cell C76 beam4  Cell C76 beam1  Cell C87 beam1  Cell D87 beam4  Cell D76 beam3  Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell C87 beam4 | 5.3 |
| XX110100 | 13 | Cell D76 beam1  Cell C76 beam4  Cell C76 beam1  Cell C87 beam1  Cell D87 beam4  Cell D76 beam3  Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3 | 5.2 |
| XX110011 | 12 + fractional2 + fractional1 | Cell C76 beam4  Cell C76 beam1  Cell C87 beam1  Cell D87 beam4  Cell D76 beam3  Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell D87 beam1  Cell C87 beam4 | 5.1 |
| XX110010 | 12 + fractional2 | Cell C76 beam4  Cell C76 beam1  Cell C87 beam1  Cell D87 beam4  Cell D76 beam3  Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell D87 beam1 | 5.0 |
| XX110001 | 12 + fractional1 | Cell C76 beam4  Cell C76 beam1  Cell C87 beam1  Cell D87 beam4  Cell D76 beam3  Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell C87 beam4 | 4.9 |
| XX110000 | 12 | Cell C76 beam4  Cell C76 beam1  Cell C87 beam1  Cell D87 beam4  Cell D76 beam3  Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3 | 4.8 |
| XX101111 | 11 + fractional2 + fractional1 | Cell C76 beam1  Cell C87 beam1  Cell D87 beam4  Cell D76 beam3  Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell D87 beam1  Cell C87 beam4 | 4.7 |
| XX101110 | 11 + fractional2 | Cell C76 beam1  Cell C87 beam1  Cell D87 beam4  Cell D76 beam3  Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell D87 beam1 | 4.6 |
| XX101101 | 11 + fractional1 | Cell C76 beam1  Cell C87 beam1  Cell D87 beam4  Cell D76 beam3  Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell C87 beam4 | 4.5 |
| XX101100 | 11 | Cell C76 beam1  Cell C87 beam1  Cell D87 beam4  Cell D76 beam3  Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3 | 4.4 |
| XX101011 | 10 + fractional2 + fractional1 | Cell C87 beam1  Cell D87 beam4  Cell D76 beam3  Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell D87 beam1  Cell C87 beam4 | 4.3 |
| XX101010 | 10 + fractional2 | Cell C87 beam1  Cell D87 beam4  Cell D76 beam3  Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell D87 beam1 | 4.2 |
| XX101001 | 10 + fractional1 | Cell C87 beam1  Cell D87 beam4  Cell D76 beam3  Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell C87 beam4 | 4.1 |
| XX101000 | 10 | Cell C87 beam1  Cell D87 beam4  Cell D76 beam3  Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3 | 4.0 |
| XX100111 | 9 + fractional2 + fractional1 | Cell D87 beam4  Cell D76 beam3  Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell D87 beam1  Cell C87 beam4 | 3.9 |
| XX100110 | 9 + fractional2 | Cell D87 beam4  Cell D76 beam3  Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell D87 beam1 | 3.8 |
| XX100101 | 9 + fractional1 | Cell D87 beam4  Cell D76 beam3  Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell C87 beam4 | 3.7 |
| XX100100 | 9 | Cell D87 beam4  Cell D76 beam3  Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3 | 3.6 |
| XX100011 | 8 + fractional2 + fractional1 | Cell D76 beam3  Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell D87 beam1  Cell C87 beam4 | 3.5 |
| XX100010 | 8 + fractional2 | Cell D76 beam3  Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell D87 beam1 | 3.4 |
| XX100001 | 8 + fractional1 | Cell D76 beam3  Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell C87 beam4 | 3.3 |
| XX100000 | 8 | Cell D76 beam3  Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3 | 3.2 |
| XX011111 | 7 + fractional2 + fractional1 | Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell D87 beam1  Cell C87 beam4 | 3.1 |
| XX011110 | 7 + fractional2 | Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell D87 beam1 | 3.0 |
| XX011101 | 7 + fractional1 | Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell C87 beam4 | 2.9 |
| XX011100 | 7 | Cell D76 beam2  Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3 | 2.8 |
| XX011011 | 6 + fractional2 + fractional1 | Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell D87 beam1  Cell C87 beam4 | 2.7 |
| XX011010 | 6 + fractional2 | Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell D87 beam1 | 2.6 |
| XX011001 | 6 + fractional1 | Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell C87 beam4 | 2.5 |
| XX011000 | 6 | Cell C76 beam3  Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3 | 2.4 |
| XX010111 | 5 + fractional2 + fractional1 | Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell D87 beam1  Cell C87 beam4 | 2.3 |
| XX010110 | 5 + fractional2 | Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell D87 beam1 | 2.2 |
| XX010101 | 5 + fractional1 | Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell C87 beam4 | 2.1 |
| XX010100 | 5 | Cell C76 beam2  Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3 | 2.0 |
| XX010011 | 4 + fractional2 + fractional1 | Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell D87 beam1  Cell C87 beam4 | 1.9 |
| XX010010 | 4 + fractional2 | Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell D87 beam1 | 1.8 |
| XX010001 | 4 + fractional1 | Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell C87 beam4 | 1.7 |
| XX010000 | 4 | Cell C87 beam2  Cell C87 beam3  Cell D87 beam2  Cell D87 beam3 | 1.6 |
| XX001111 | 3 + fractional2 + fractional1 | Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell D87 beam1  Cell C87 beam4 | 1.5 |
| XX001110 | 3 + fractional2 | Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell D87 beam1 | 1.4 |
| XX001101 | 3 + fractional1 | Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell C87 beam4 | 1.3 |
| XX001100 | 3 | Cell C87 beam3  Cell D87 beam2  Cell D87 beam3  Cell D87 beam3 | 1.2 |
| XX001011 | 2 + fractional2 + fractional1 | Cell D87 beam2  Cell D87 beam3  Cell D87 beam1  Cell C87 beam4 | 1.1 |
| XX001010 | 2 + fractional2 | Cell D87 beam2  Cell D87 beam3  Cell D87 beam1 | 1.0 |
| XX001001 | 2 + fractional1 | Cell D87 beam2  Cell D87 beam3  Cell C87 beam4 | 0.9 |
| XX001000 | 2 | Cell D87 beam2  Cell D87 beam3 | 0.8 |
| XX000111 | 1 + fractional2 + fractional1 | Cell D87 beam3  Cell D87 beam1  Cell C87 beam4 | 0.7 |
| XX000110 | 1 + fractional2 | Cell D87 beam3  Cell D87 beam1 | 0.6 |
| XX000101 | 1 + fractional1 | Cell D87 beam3  Cell C87 beam4 | 0.5 |
| XX000100 | 1 | Cell D87 beam3 | 0.4 |
| XX000011 | 0 + fractional2 + fractional1 | Cell D87 beam1  Cell C87 beam4 | 0.3 |
| XX000010 | 0 + fractional2 | Cell D87 beam1 | 0.2 |
| XX000001 | 0 + fractional1 | Cell C87 beam4 | 0.1 |
| XX000000 | No beams | No beams | 0 |

## Register2 & Shadow Register12 - Capacitor C2 Setting

Default state (after Vdd applied) is low (inactive). Typical capacitance values are shown after internal normalization. Register1 value to beam mapping can be modified with a two mask change (V1 & V2)

Table ‑ Register2 & Register12 Bit Definitions

|  |  |  |  |
| --- | --- | --- | --- |
| **Reg1<7:0> Value** | **Number of Beams Activated** | **Activated Beams** | **WS1050 Cap Value (pF)** |
| XX111011 | 14 + fractional2 + fractional1 | Cell D43 beam4  Cell D43 beam1  Cell C43 beam4  Cell C43 beam1  Cell C32 beam1  Cell D32 beam4  Cell D43 beam3  Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell D32 beam1  Cell C32 beam4 | 5.9 |
| XX111010 | 14 + fractional2 | Cell D43 beam4  Cell D43 beam1  Cell C43 beam4  Cell C43 beam1  Cell C32 beam1  Cell D32 beam4  Cell D43 beam3  Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell D32 beam1 | 5.8 |
| XX111001 | 14 + fractional1 | Cell D43 beam4  Cell D43 beam1  Cell C43 beam4  Cell C43 beam1  Cell C32 beam1  Cell D32 beam4  Cell D43 beam3  Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell C32 beam4 | 5.7 |
| XX111000 | 14 | Cell D43 beam4  Cell D43 beam1  Cell C43 beam4  Cell C43 beam1  Cell C32 beam1  Cell D32 beam4  Cell D43 beam3  Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3 | 5.6 |
| XX110111 | 13 + fractional2 + fractional1 | Cell D43 beam1  Cell C43 beam4  Cell C43 beam1  Cell C32 beam1  Cell D32 beam4  Cell D43 beam3  Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell D32 beam1  Cell C32 beam4 | 5.5 |
| XX110110 | 13 + fractional2 | Cell D43 beam1  Cell C43 beam4  Cell C43 beam1  Cell C32 beam1  Cell D32 beam4  Cell D43 beam3  Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell D32 beam1 | 5.4 |
| XX110101 | 13 + fractional1 | Cell D43 beam1  Cell C43 beam4  Cell C43 beam1  Cell C32 beam1  Cell D32 beam4  Cell D43 beam3  Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell C32 beam4 | 5.3 |
| XX110100 | 13 | Cell D43 beam1  Cell C43 beam4  Cell C43 beam1  Cell C32 beam1  Cell D32 beam4  Cell D43 beam3  Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3 | 5.2 |
| XX110011 | 12 + fractional2 + fractional1 | Cell C43 beam4  Cell C43 beam1  Cell C32 beam1  Cell D32 beam4  Cell D43 beam3  Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell D32 beam1  Cell C32 beam4 | 5.1 |
| XX110010 | 12 + fractional2 | Cell C43 beam4  Cell C43 beam1  Cell C32 beam1  Cell D32 beam4  Cell D43 beam3  Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell D32 beam1 | 5.0 |
| XX110001 | 12 + fractional1 | Cell C43 beam4  Cell C43 beam1  Cell C32 beam1  Cell D32 beam4  Cell D43 beam3  Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell C32 beam4 | 4.9 |
| XX110000 | 12 | Cell C43 beam4  Cell C43 beam1  Cell C32 beam1  Cell D32 beam4  Cell D43 beam3  Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3 | 4.8 |
| XX101111 | 11 + fractional2 + fractional1 | Cell C43 beam1  Cell C32 beam1  Cell D32 beam4  Cell D43 beam3  Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell D32 beam1  Cell C32 beam4 | 4.7 |
| XX101110 | 11 + fractional2 | Cell C43 beam1  Cell C32 beam1  Cell D32 beam4  Cell D43 beam3  Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell D32 beam1 | 4.6 |
| XX101101 | 11 + fractional1 | Cell C43 beam1  Cell C32 beam1  Cell D32 beam4  Cell D43 beam3  Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell C32 beam4 | 4.5 |
| XX101100 | 11 | Cell C43 beam1  Cell C32 beam1  Cell D32 beam4  Cell D43 beam3  Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3 | 4.4 |
| XX101011 | 10 + fractional2 + fractional1 | Cell C32 beam1  Cell D32 beam4  Cell D43 beam3  Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell D32 beam1  Cell C32 beam4 | 4.3 |
| XX101010 | 10 + fractional2 | Cell C32 beam1  Cell D32 beam4  Cell D43 beam3  Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell D32 beam1 | 4.2 |
| XX101001 | 10 + fractional1 | Cell C32 beam1  Cell D32 beam4  Cell D43 beam3  Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell C32 beam4 | 4.1 |
| XX101000 | 10 | Cell C32 beam1  Cell D32 beam4  Cell D43 beam3  Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3 | 4.0 |
| XX100111 | 9 + fractional2 + fractional1 | Cell D32 beam4  Cell D43 beam3  Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell D32 beam1  Cell C32 beam4 | 3.9 |
| XX100110 | 9 + fractional2 | Cell D32 beam4  Cell D43 beam3  Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell D32 beam1 | 3.8 |
| XX100101 | 9 + fractional1 | Cell D32 beam4  Cell D43 beam3  Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell C32 beam4 | 3.7 |
| XX100100 | 9 | Cell D32 beam4  Cell D43 beam3  Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3 | 3.6 |
| XX100011 | 8 + fractional2 + fractional1 | Cell D43 beam3  Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell D32 beam1  Cell C32 beam4 | 3.5 |
| XX100010 | 8 + fractional2 | Cell D43 beam3  Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell D32 beam1 | 3.4 |
| XX100001 | 8 + fractional1 | Cell D43 beam3  Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell C32 beam4 | 3.3 |
| XX100000 | 8 | Cell D43 beam3  Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3 | 3.2 |
| XX011111 | 7 + fractional2 + fractional1 | Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell D32 beam1  Cell C32 beam4 | 3.1 |
| XX011110 | 7 + fractional2 | Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell D32 beam1 | 3.0 |
| XX011101 | 7 + fractional1 | Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell C32 beam4 | 2.9 |
| XX011100 | 7 | Cell D43 beam2  Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3 | 2.8 |
| XX011011 | 6 + fractional2 + fractional1 | Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell D32 beam1  Cell C32 beam4 | 2.7 |
| XX011010 | 6 + fractional2 | Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell D32 beam1 | 2.6 |
| XX011001 | 6 + fractional1 | Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell C32 beam4 | 2.5 |
| XX011000 | 6 | Cell C43 beam3  Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3 | 2.4 |
| XX010111 | 5 + fractional2 + fractional1 | Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell D32 beam1  Cell C32 beam4 | 2.3 |
| XX010110 | 5 + fractional2 | Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell D32 beam1 | 2.2 |
| XX010101 | 5 + fractional1 | Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell C32 beam4 | 2.1 |
| XX010100 | 5 | Cell C43 beam2  Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3 | 2.0 |
| XX010011 | 4 + fractional2 + fractional1 | Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell D32 beam1  Cell C32 beam4 | 1.9 |
| XX010010 | 4 + fractional2 | Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell D32 beam1 | 1.8 |
| XX010001 | 4 + fractional1 | Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell C32 beam4 | 1.7 |
| XX010000 | 4 | Cell C32 beam2  Cell C32 beam3  Cell D32 beam2  Cell D32 beam3 | 1.6 |
| XX001111 | 3 + fractional2 + fractional1 | Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell D32 beam1  Cell C32 beam4 | 1.5 |
| XX001110 | 3 + fractional2 | Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell D32 beam1 | 1.4 |
| XX001101 | 3 + fractional1 | Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell C32 beam4 | 1.3 |
| XX001100 | 3 | Cell C32 beam3  Cell D32 beam2  Cell D32 beam3  Cell D32 beam3 | 1.2 |
| XX001011 | 2 + fractional2 + fractional1 | Cell D32 beam2  Cell D32 beam3  Cell D32 beam1  Cell C32 beam4 | 1.1 |
| XX001010 | 2 + fractional2 | Cell D32 beam2  Cell D32 beam3  Cell D32 beam1 | 1.0 |
| XX001001 | 2 + fractional1 | Cell D32 beam2  Cell D32 beam3  Cell C32 beam4 | 0.9 |
| XX001000 | 2 | Cell D32 beam2  Cell D32 beam3 | 0.8 |
| XX000111 | 1 + fractional2 + fractional1 | Cell D32 beam3  Cell D32 beam1  Cell C32 beam4 | 0.7 |
| XX000110 | 1 + fractional2 | Cell D32 beam3  Cell D32 beam1 | 0.6 |
| XX000101 | 1 + fractional1 | Cell D32 beam3  Cell C32 beam4 | 0.5 |
| XX000100 | 1 | Cell D32 beam3 | 0.4 |
| XX000011 | 0 + fractional2 + fractional1 | Cell D32 beam1  Cell C32 beam4 | 0.3 |
| XX000010 | 0 + fractional2 | Cell D32 beam1 | 0.2 |
| XX000001 | 0 + fractional1 | Cell C32 beam4 | 0.1 |
| XX000000 | No beams | No beams | 0 |

## Register3 & Shadow Register13 - Capacitor C3 Setting

Default state (after Vdd applied) is low (inactive). Typical capacitance values are shown after internal normalization. Register1 value to beam mapping can be modified with a two mask change (V1 & V2)

Table ‑ Register3 & Register13 Bit Definitions

|  |  |  |  |
| --- | --- | --- | --- |
| **Reg1<7:0> Value** | **Number of Beams Activated** | **Activated Beams** | **WS1050 Cap Value (pF)** |
| XX111011 | 14 + fractional2 + fractional1 | Cell E87 beam4  Cell E32 beam4  Cell E32 beam1  Cell E43 beam1  Cell E76 beam1  Cell E87 beam1  Cell E87 beam3  Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E43 beam4  Cell E76 beam4 | 5.9 |
| XX111010 | 14 + fractional2 | Cell E87 beam4  Cell E32 beam4  Cell E32 beam1  Cell E43 beam1  Cell E76 beam1  Cell E87 beam1  Cell E87 beam1  Cell E87 beam3  Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E43 beam4 | 5.8 |
| XX111001 | 14 + fractional1 | Cell E87 beam4  Cell E32 beam4  Cell E32 beam1  Cell E43 beam1  Cell E76 beam1  Cell E87 beam1  Cell E87 beam3  Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E76 beam4 | 5.7 |
| XX111000 | 14 | Cell E87 beam4  Cell E32 beam4  Cell E32 beam1  Cell E43 beam1  Cell E76 beam1  Cell E87 beam1  Cell E87 beam3  Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2 | 5.6 |
| XX110111 | 13 + fractional2 + fractional1 | Cell E32 beam4  Cell E32 beam1  Cell E43 beam1  Cell E76 beam1  Cell E87 beam1  Cell E87 beam3  Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E43 beam4  Cell E76 beam4 | 5.5 |
| XX110110 | 13 + fractional2 | Cell E32 beam4  Cell E32 beam1  Cell E43 beam1  Cell E76 beam1  Cell E87 beam1  Cell E87 beam1  Cell E87 beam3  Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E43 beam4 | 5.4 |
| XX110101 | 13 + fractional1 | Cell E32 beam4  Cell E32 beam1  Cell E43 beam1  Cell E76 beam1  Cell E87 beam1  Cell E87 beam3  Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E76 beam4 | 5.3 |
| XX110100 | 13 | Cell E32 beam4  Cell E32 beam1  Cell E43 beam1  Cell E76 beam1  Cell E87 beam1  Cell E87 beam3  Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2 | 5.2 |
| XX110011 | 12 + fractional2 + fractional1 | Cell E32 beam1  Cell E43 beam1  Cell E76 beam1  Cell E87 beam1  Cell E87 beam3  Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E43 beam4  Cell E76 beam4 | 5.1 |
| XX110010 | 12 + fractional2 | Cell E32 beam1  Cell E43 beam1  Cell E76 beam1  Cell E87 beam1  Cell E87 beam1  Cell E87 beam3  Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E43 beam4 | 5.0 |
| XX110001 | 12 + fractional1 | Cell E32 beam1  Cell E43 beam1  Cell E76 beam1  Cell E87 beam1  Cell E87 beam3  Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E76 beam4 | 4.9 |
| XX110000 | 12 | Cell E32 beam1  Cell E43 beam1  Cell E76 beam1  Cell E87 beam1  Cell E87 beam3  Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2 | 4.8 |
| XX101111 | 11 + fractional2 + fractional1 | Cell E43 beam1  Cell E76 beam1  Cell E87 beam1  Cell E87 beam3  Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E43 beam4  Cell E76 beam4 | 4.7 |
| XX101110 | 11 + fractional2 | Cell E43 beam1  Cell E76 beam1  Cell E87 beam1  Cell E87 beam1  Cell E87 beam3  Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E43 beam4 | 4.6 |
| XX101101 | 11 + fractional1 | Cell E43 beam1  Cell E76 beam1  Cell E87 beam1  Cell E87 beam3  Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E76 beam4 | 4.5 |
| XX101100 | 11 | Cell E43 beam1  Cell E76 beam1  Cell E87 beam1  Cell E87 beam3  Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2 | 4.4 |
| XX101011 | 10 + fractional2 + fractional1 | Cell E76 beam1  Cell E87 beam1  Cell E87 beam3  Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E43 beam4  Cell E76 beam4 | 4.3 |
| XX101010 | 10 + fractional2 | Cell E76 beam1  Cell E87 beam1  Cell E87 beam1  Cell E87 beam3  Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E43 beam4 | 4.2 |
| XX101001 | 10 + fractional1 | Cell E76 beam1  Cell E87 beam1  Cell E87 beam3  Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E76 beam4 | 4.1 |
| XX101000 | 10 | Cell E76 beam1  Cell E87 beam1  Cell E87 beam3  Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2 | 4.0 |
| XX100111 | 9 + fractional2 + fractional1 | Cell E87 beam1  Cell E87 beam3  Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E43 beam4  Cell E76 beam4 | 3.9 |
| XX100110 | 9 + fractional2 | Cell E87 beam1  Cell E87 beam1  Cell E87 beam3  Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E43 beam4 | 3.8 |
| XX100101 | 9 + fractional1 | Cell E87 beam1  Cell E87 beam3  Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E76 beam4 | 3.7 |
| XX100100 | 9 | Cell E87 beam1  Cell E87 beam3  Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2 | 3.6 |
| XX100011 | 8 + fractional2 + fractional1 | Cell E87 beam3  Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E43 beam4  Cell E76 beam4 | 3.5 |
| XX100010 | 8 + fractional2 | Cell E87 beam3  Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E43 beam4 | 3.4 |
| XX100001 | 8 + fractional1 | Cell E87 beam3  Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E76 beam4 | 3.3 |
| XX100000 | 8 | Cell E87 beam3  Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2 | 3.2 |
| XX011111 | 7 + fractional2 + fractional1 | Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E43 beam4  Cell E76 beam4 | 3.1 |
| XX011110 | 7 + fractional2 | Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E43 beam4 | 3.0 |
| XX011101 | 7 + fractional1 | Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E76 beam4 | 2.9 |
| XX011100 | 7 | Cell E76 beam3  Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2 | 2.8 |
| XX011011 | 6 + fractional2 + fractional1 | Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E43 beam4  Cell E76 beam4 | 2.7 |
| XX011010 | 6 + fractional2 | Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E43 beam4 | 2.6 |
| XX011001 | 6 + fractional1 | Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E76 beam4 | 2.5 |
| XX011000 | 6 | Cell E43 beam3  Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2 | 2.4 |
| XX010111 | 5 + fractional2 + fractional1 | Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E43 beam4  Cell E76 beam4 | 2.3 |
| XX010110 | 5 + fractional2 | Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E43 beam4 | 2.2 |
| XX010101 | 5 + fractional1 | Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E76 beam4 | 2.1 |
| XX010100 | 5 | Cell E32 beam3  Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2 | 2.0 |
| XX010011 | 4 + fractional2 + fractional1 | Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E43 beam4  Cell E76 beam4 | 1.9 |
| XX010010 | 4 + fractional2 | Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E43 beam4 | 1.8 |
| XX010001 | 4 + fractional1 | Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E76 beam4 | 1.7 |
| XX010000 | 4 | Cell E32 beam2  Cell E43 beam2  Cell E76 beam2  Cell E87 beam2 | 1.6 |
| XX001111 | 3 + fractional2 + fractional1 | Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E43 beam4  Cell E76 beam4 | 1.5 |
| XX001110 | 3 + fractional2 | Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E43 beam4 | 1.4 |
| XX001101 | 3 + fractional1 | Cell E43 beam2  Cell E76 beam2  Cell E87 beam2  Cell E76 beam4 | 1.3 |
| XX001100 | 3 | Cell E43 beam2  Cell E76 beam2  Cell E87 beam2 | 1.2 |
| XX001011 | 2 + fractional2 + fractional1 | Cell E76 beam2  Cell E87 beam2  Cell E43 beam4  Cell E76 beam4 | 1.1 |
| XX001010 | 2 + fractional2 | Cell E76 beam2  Cell E87 beam2  Cell E43 beam4 | 1.0 |
| XX001001 | 2 + fractional1 | Cell E76 beam2  Cell E87 beam2  Cell E76 beam4 | 0.9 |
| XX001000 | 2 | Cell E76 beam2  Cell E87 beam2 | 0.8 |
| XX000111 | 1 + fractional2 + fractional1 | Cell E87 beam2  Cell E43 beam4  Cell E76 beam4 | 0.7 |
| XX000110 | 1 + fractional2 | Cell E87 beam2  Cell E43 beam4 | 0.6 |
| XX000101 | 1 + fractional1 | Cell E87 beam2  Cell E76 beam4 | 0.5 |
| XX000100 | 1 | Cell E87 beam2 | 0.4 |
| XX000011 | 0 + fractional2 + fractional1 | Cell E43 beam4  Cell E76 beam4 | 0.3 |
| XX000010 | 0 + fractional2 | Cell E43 beam4 | 0.2 |
| XX000001 | 0 + fractional1 | Cell E76 beam4 | 0.1 |
| XX000000 | No beams | No beams | 0 |

## Register4 – HV Trim and Oscillator Frequency for DVA Low State

All bits are active high. For reg0<7:0> the default state (after Vdd applied) can be preset by the inputs reg4\_preset<7:0>. Reg4\_preset<7:0> = XXXXXXXX and can be modified with a one mask change (V1).

Table ‑ Register7 Bit Definitions

|  |  |  |  |
| --- | --- | --- | --- |
| **Top Level**  **Net Name** | **Cell** | **Cell Pin Name** | **Description** |
| reg4\_l<7:5> | ra\_prg\_rng\_osc\_togl6 | ib\_prg<2:0> | Program ring oscillator bias currents to set center frequency. Frequency is dependent on Vdd, as well as the programmed bias setting.  000 & 011 codes are the same frequency  Code 2.7V 3.0V 5.0V  000 = 54 44 16  001 = 23 18 7  010 = 39 31 12  011 = 54 44 16  100 = 68 58 21  101 = 81 71 27  110 = 93 83 32  111 = 104 95 38 |
| reg4\_r<4:0> | ac\_feedback\_divider\_togl7 | b4,b3,b2,b1,b0 | 00000 & 10010 codes are the same voltage  Code HV  11111 = 62V (OVST) Use Vdd=5.0V  11110 = 60V (OVST) for OVST settings  11101 = 55.0  11100 = 50.0  11011 = 44.0  11010 = 43.25  11001 = 42.5  11000 = 41.75  10111 = 41.0  10110 = 40.25  10101 = 39.5  10100 = 38.75  10011 = 38  10010 = 37.25  10001 = 36.5  10000 = 35.75  01111 = 35.0  01110 = 34.25  01101 = 33.5  01100 = 32.75  01011 = 32.0  01010 = 31.25  01001 = 30.5  01000 = 29.75  00111 = 29  00110 = 28.25  00101 = 27.5  00100 = 26.75  00011 = 26.0  00010 = 25.25  00001 = 24.5  00000 = 40.25 |

## Register5 – eFUSE Write and Read Back

All bits are active high. For reg5<3:0> the default state (after Vdd applied) is low (inactive).

For reg5<7:4> the default state (after Vdd applied) is the programmed eFUSE state of that device.

Table ‑ Register5 Bit Definitions

|  |  |  |  |
| --- | --- | --- | --- |
| **Top Level**  **Net Name** | **Cell** | **Cell Pin Name** | **Description** |
| reg5\_in<7:4> | ra\_4bit\_eFUSE\_togl4 | out<3:0> | NOTE: Reg5<7:4> is Read Only.  The eFUSE values are automatically interrogated at power up and the value latched. To transfer the latched value into Reg5, write any value to Reg5. |
| reg5\_out\_l<3:0> | ra\_4bit\_eFUSE\_togl4 | prg\_sel<3:0> | Set the eFUSE bits to be blown when reg9<5> is high. To program the fuses reg9<5> is cycled low-high-low (see Table 1‑11). |

## Register6 – Block Enables

All bits are active high. Default state (after power-on reset) is low (inactive).

Table ‑ Register6 Bit Definitions

|  |  |  |  |
| --- | --- | --- | --- |
| **Top Level**  **Net Name** | **Cell** | **Cell Pin Name** | **Description** |
| reg6or\_r<7> | ac\_bgp\_togl6 | en | Enable bandgap (ORed with reg0<6>). |
| reg6or\_r<6> | ra\_n\_cmp\_tmn2i | en\_hi | Enable loop comparator (ORed with reg0<6>).  This bit is also used to trigger the START signal for HV Driver power-up. |
| reg6or\_r<5> | ac\_feedback\_divider\_togl6 | enable | Enable feedback divider op-amp  (ORed with reg0<6>). |
| reg6or\_l<4> | ra\_prg\_rng\_osc\_togl6 | en\_hi  start\_reg | Enable Oscillator bias and allow ring to oscillate (ORed with reg0<6>). |
| reg6\_l<3> | ra\_prg\_rng\_osc\_togl6 | allwy\_on | Force the oscillator to run continuously.  1 = Oscillator runs continuously  0 = Oscillator gated on by regulation. |
| reg6\_l<2> | ra\_prg\_rng\_osc\_togl6 | bias\_on | 1 = Oscillator bias on when reg6<4> high  0 = Oscillator bias gated on by comparator |
| reg6\_l<1> | ra\_clk\_gating\_togl6 | disable\_cp | Gates-off the charge pump clock.  Disable is active high. |
| reg6\_r<0> | bp\_bgp\_togl7 | en | Enables bandgap ‘snooze’ mode to keep on critical bias circuits to allow fastest start-up  r6or<7> r6<0>  ---------- --------  0 0 = Sleep Mode, Ibgp= 0  0 1 = Snooze Mode, Ibgp ~0.6uA  1 X = Bandgap Active, Ibgp ~ |

## Register7 – HV Trim and Oscillator Frequency for DVA High State

All bits are active high. For reg0<7:0> the default state (after Vdd applied) can be preset by the inputs reg7\_preset<7:0>. Reg7\_preset<7:0> = 11110011 and can be modified with a one mask change (V1).

Table ‑ Register7 Bit Definitions

|  |  |  |  |
| --- | --- | --- | --- |
| **Top Level**  **Net Name** | **Cell** | **Cell Pin Name** | **Description** |
| reg7\_l<7:5> | ra\_prg\_rng\_osc\_togl6 | ib\_prg<2:0> | Program ring oscillator bias currents to set center frequency. Frequency is dependent on Vdd, as well as the programmed bias setting.  000 & 011 codes are the same frequency  Code 2.7V 3.0V 5.0V  000 = 54 44 16  001 = 23 18 7  010 = 39 31 12  011 = 54 44 16  100 = 68 58 21  101 = 81 71 27  110 = 93 83 32  111 = 104 95 38 |
| reg7\_r<4:0> | ac\_feedback\_divider\_togl7 | b4,b3,b2,b1,b0 | 00000 & 10110 codes are the same voltage  Code HV  11111 = 62V (OVST) Use Vdd=5.0V  11110 = 60V (OVST) for OVST settings  11101 = 55.0  11100 = 50.0  11011 = 44.0  11010 = 43.25  11001 = 42.5  11000 = 41.75  10111 = 41.0  10110 = 40.25  10101 = 39.5  10100 = 38.75  10011 = 38  10010 = 37.25  10001 = 36.5  10000 = 35.75  01111 = 35.0  01110 = 34.25  01101 = 33.5  01100 = 32.75  01011 = 32.0  01010 = 31.25  01001 = 30.5  01000 = 29.75  00111 = 29  00110 = 28.25  00101 = 27.5  00100 = 26.75  00011 = 26.0  00010 = 25.25  00001 = 24.5  00000 = 40.25 |

## Register8 – START & Charge Pump Strength

All bits are active high. Default state (after power-on reset) is low (inactive)

Table ‑ Register8 Bit Definitions

|  |  |  |  |
| --- | --- | --- | --- |
| **Top Level**  **Net Name** | **Cell** | **Cell Pin Name** | **Description** |
| reg8\_l<7> | Not used | Not used | Not used |
| reg8\_l<6> | pg\_dva\_cntrl | startup\_mode | 0 = Loop ramps up using DVA low settings  1 = loop ramps up using DVA high settings |
| reg8\_l<5> | pg\_dva\_cntrl | disable | 0 = Enable dual voltage actuation (DVA)  Low-state Fosc & HV Trim set by Reg4  Low-state Pump stages forced to 26  High-state Fosc & HV Trim set by Reg7  High-state Pump stages set by Reg8<4:2>  1 = Disable dual voltage actuation (DVA)  Fosc & HV Trim set by Reg7  Pump stages set by Reg8<4:2> |
| reg8\_l<4:2> | ra\_n32\_cp\_top\_togl6\_DN\_DVA | strength<2:0> | Charge Pump Strength, reg8\_l<4:2>  000 = 32 stages (default)  100 = 30 stages  110 = 28 stages  111 = 26 stages  All other settings are invalid  See re8<5> for Pump Strength during DVA |
| reg8\_l<1:0> | pg\_start\_counter | force\_start\_on | NOTE: Toggle4 START count hard-wired to 000, i.e. release drivers on first comparator high-low  00 = Don’t Care  01 = START forced off  10 = START forced on  11 = START forced on |

## Register9 – DATO/TEST\_OUT Pin & eFUSE Controls

All bits are active high. Default state (after power-on reset) is low (inactive)

Table ‑ Register9 Bit Definitions

|  |  |  |  |
| --- | --- | --- | --- |
| **Top Level**  **Net Name** | **Cell** | **Cell Pin Name** | **Description** |
| reg9<7:6> | sw\_two\_spi | Internal to sw\_two\_spi | Master DATO/TEST\_OUT Pin Control  00 = DATO  01 = TEST\_OUT (controlled by reg9<3:0>)  10 = SPI Clock  11 = SPI Data In |
| reg9\_l<5> | ra\_4bit\_eFUSE\_togl6 | ID\_CHK | Trigger eFUSE read-back. Program sequence 0 - 1 - 0 to trigger read-back. |
| reg9\_l<4> | bp\_dato\_ctrl | ana\_test\_en | Controls ra\_rffe\_spi\_io\_togl6 do\_4w\_en pin to make the digital output driver tristate when the analog test mux is selected.  0 = DATO controlled by sw\_two\_spi  1 = DATO tristate, enable analog mux to DATO |
| reg9\_l<3> | ra\_clk\_gating\_togl6 | en\_comp\_test | Select comparator output to TEST\_OUT pin |
| reg9\_l<2> | ra\_clk\_gating\_togl6 | en\_clk\_test | Select charge pump clock to TEST\_OUT pin |
| reg9\_l<1> | ra\_clk\_gating\_togl6 | en\_start\_test | Select start signal to TEST\_OUT pin |
| reg9\_l<0> | ra\_4bit\_eFUSE\_togl6 | prg\_en | Blows all eFUSEs set by reg5<3:0>.  To program the eFUSEs reg9<4> is cycled low-high-low. The high period should be 800us.  Falling edge of reg9<4> triggers eFUSe read-back. |

## Register10 – Interface I/O Controls

All bits are active high. Default state (after power-on reset) is low (inactive)

Table ‑ Register10 Bit Definitions

|  |  |  |  |
| --- | --- | --- | --- |
| **Top Level**  **Net Name** | **Cell** | **Cell Pin Name** | **Description** |
| reg10<7:5> | Not Used | Not Used | Not Used |
| reg10\_l<4:2> | ra\_rffe\_spi\_io\_togl6 | tx\_tweak<2:0> | SPI read-back output driver strength  000 = 1.0x (39pF to 44pF load capacitance)  001 = 0.8x (29pF to 34pF “ “  010 = 0.5x (19pF to 24pF “ “  011 = 0.3x ( 9pF to 14pF “ “  100 = 1.3x (48pF to 58pF “ “  101 = 1.5x (58pF to 68pF “ “  110 = 2.0x (68pF to 78pF “ “  111 = 2.8x (96pF to 116pF “ “ |
| reg10\_l<1:0> | ra\_rffe\_spi\_io\_togl6 | rx\_tweak<1:0> | Select RFI Filter on Clock & Data Inputs  00 = Filters connected to Clock & Data inputs  01 = No Filter on Data input  10 = No Filter on Clock input  11 = No Filters on either input |

## Register26 – Bus Reset Bit

All bits are active high. Default state (after power-on reset) is low (inactive)

Table ‑ Register26 Bit Definitions

|  |  |  |  |
| --- | --- | --- | --- |
| **Top Level**  **Net Name** | **Cell** | **Cell Pin Name** | **Description** |
| Reg26<7> | sw\_two\_spi | Internal to  sw\_two\_spi | 0 = No Action  1 = Triggers PoR to reset to power-up state |
| Reg26<6:0> | Not Used | Not Used | Not Used |

## Register28 – PM\_TRIG Register from RFFE

All bits are active high. Default state (after power-on reset) is low (inactive)

Table ‑ Register28 Bit Definitions

|  |  |  |  |
| --- | --- | --- | --- |
| **Top Level**  **Net Name** | **Cell** | **Cell Pin Name** | **Description** |
| Reg28<7:6> | sw\_two\_spi | Internal to sw\_two\_spi | RFFE PWR\_MODE  00 = Normal Operation - Reg0<6>=1 Charge Pump On  01 = Default Settings - Reg6<0>=1 Charge Pump On  10 = Low Power - Reg0<6>=0 Sleep Mode  11 = Not Used |
| Reg28<5> | sw\_two\_spi | Internal to sw\_two\_spi | Not Used (Trigger Mask 2) |
| Reg28<4> | sw\_two\_spi | Internal to sw\_two\_spi | Not Used (Trigger Mask 1) |
| Reg28<3> | sw\_two\_spi | Internal to sw\_two\_spi | Not Used (Trigger Mask 0)  Trigger shadow registers are always written directly as Reg11-14 |
| Reg28<2> | sw\_two\_spi | Internal to sw\_two\_spi | Not Used (Trigger 2) |
| Reg28<1> | sw\_two\_spi | Internal to sw\_two\_spi | Not Used (Trigger 1) |
| Reg28<0> | sw\_two\_spi | Internal to sw\_two\_spi | Trigger 0  0 = Select Regs1-4 to control capacitors  1 = Select Regs11-14 to control capacitors |

## Register29 – RFFE Product ID Register (Read Only)

All bits are active high. Default state (after power-on reset) is low (inactive)

Table ‑ Register29 Bit Definitions

|  |  |  |  |
| --- | --- | --- | --- |
| **Top Level**  **Net Name** | **Cell** | **Cell Pin Name** | **Description** |
| Reg29<7:0> | sw\_two\_spi | prod\_id<7:0> | Toggle7 = 00110010 (50, for WS1050)  Will change with silicon revision |

## Register30 – RFFE Manufacturer\_ID LSBs (Read Only)

All bits are active high. Default state (after power-on reset) is low (inactive)

Table ‑ Register30 Bit Definitions

|  |  |  |  |
| --- | --- | --- | --- |
| **Top Level**  **Net Name** | **Cell** | **Cell Pin Name** | **Description** |
| Reg30<7:0> | sw\_two\_spi | mfg\_id<7:0> | RFFE Manufacturer\_ID<7:0>  = 01000011 (WiSpry ID = 0x243) |

## Register31 – RFFE Manufacturer\_ID MSBs (Read Only)

All bits are active high. Default state (after power-on reset) is low (inactive)

Table ‑ Register31 Bit Definitions

|  |  |  |  |
| --- | --- | --- | --- |
| **Top Level**  **Net Name** | **Cell** | **Cell Pin Name** | **Description** |
| Reg31<7:6> | Not used | Not used | Not used |
| Reg31<5:4> | sw\_two\_spi | mfg\_id<9:8> | RFFE Manufacturer\_ID<9:8>  = 10 (WiSpry ID = 0x243) |
| Reg31<3:0> | Not used | Not used | Not used |

# Appendix – Thermometer Beam Turn-On Order

## 