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APPLICATION NOTE

How 2-Speed Measurement Data for Synchro/Resolver is Calculated and Presented

When a ‘ratio’ is programmed (the ratio is set as the same ratio as the physical Synchro or resolver under test), then the ‘combined’ angle reading for both the coarse and fine channel will be calculated and presented in the fine channel output register. If the coarse channel register is read, it will provide the coarse angle measurement. If the fine channel register is read, it will have the ‘combined’ coarse/fine angle measurement (which is a more accurate representation of the coarse channel).

For Single Speed (Ratio=1) applications, read Data High register of that channel. For Multi-Speed (2-speed), better than 16-bit resolution is available by utilizing Data High and Data Low registers combined to determine measured angle with up to 24-bit resolution.

First read Data Low word, then Data High word of the two speed paired registers. The Data Low word must be read first, which ‘latches’ the Data High word – this ensures both the Data High word and Data Low word are ‘synchronized’ regardless of time span between word register reads. The paired “COMBINED” measurement registers, when ratios are programmed, are Ch2 Data Hi/Ch2 Data Lo, Ch4 Data Hi/Ch4 Data Lo and CH6 Data Hi/CH6 Data Lo (etc. is applicable).

For 16 bit, single speed operation, the LSB weight is (1/((2^16)-1))*360 = 0.00550 degrees
For 17 bit, ratio of 2 multi-speed, the LSB weight is (1/((2^17)-1))*360 = 0.00274 degrees
For 18 bit, ratio of 4 multi-speed, the LSB weight is (1/((2^18)-1))*360 = 0.00137 degrees
For 19 bit, ratio of 8 multi-speed, the LSB weight is (1/((2^19)-1))*360 = 0.00068 degrees
For 20 bit, ratio of 16 multi-speed, the LSB weight is (1/((2^20)-1))*360 = 0.00034 degrees
For 21 bit, ratio of 32 multi-speed, the LSB weight is (1/((2^21)-1))*360 = 0.00017 degrees
For 22 bit, ratio of 64 multi-speed, the LSB weight is (1/((2^22)-1))*360 = 0.00008 degrees
For 23 bit, ratio of 128 multi-speed, the LSB weight is (1/((2^23)-1))*360 = 0.00004 degrees
For 24 bit, ratio of 256 multi-speed, the LSB weight is (1/((2^24)-1))*360 = 0.00002 degrees

Note – calculations were rounded to nearest ten-thousandth of a degree

Example:

- Two speed ratio = 16:1 (channel pair defined as CH3, CH4)
- Two speed channel pair CH4 Hi/CH4 Lo
- CH3 HI = 0x0800 (not required for two speed)
- CH4 HI = 0x0800
- CH4 Lo = 0xE3E0 (only the upper byte (E3) is used, ignore the lower byte (E0) in the calculation.

The procedure to read two speed angle:

1. Read CH4 Lo register which is 0xE3E0 in the example case.
2. Read CH4 Hi register which is 0x0800 in the example case.
3. Calculate the two-speed combined angle by concatenating the data from CH4 HI and CH4 Lo registers. So, we have 0x800E3 and its decimal number is 524515. Two speed angle = (524515/((2^24)-1))*360 = 11.25487 degrees. This is the combined two speed angle and is providing up to 20 bit of resolution (ratio 16:1).

In NAI (typical) DLL, PC73SD4_GetTwoSpeedAngle, (example) the two speed angle is calculated as

```
// Read Angle High Resolution Lower 16 Bit Word
  binAngle = PC73SD4_READREG_ISA( Card, AngHresReg[(Channel/2)-1][PAGE],
AngHresReg[(Channel/2)-1][OFFSET] );
  tempAngle = (double)(0xffff & binAngle) * BIT16/65536.0;

  binAngle = PC73SD4_READREG_ISA( Card, AngleReg[Channel-1][PAGE], AngleReg[Channel-1]
[OFFSET] );
  // Convert Angle to double
  *Angle = tempAngle + (double)(0xffff & binAngle) * BIT16;
```

Where BIT16 is defined as 0.0054931640625.

The math in the DLL yielded the following:

1. Read the two speed pair low data = 0xE3E0 = 58336 * 0.005493164 / 65536 = 0.004889.
2. Read the two speed pair high data = 0x800 = 2048 * 0.005493164 = 11.249999872
3. Add the combined angle = coarse + fine = 11.249999872+0.004889 = 11.254888872

Note: The .dll uses 16 bit calculation for the fine angle and since the lower byte in the fine register is ignore (don’t care), the math works out correctly.