

## Application Note AN3201-06: Increasing Coefficient Precision

### Introduction

The DRE uses a coefficient with 7 magnitude bits below the binary point, giving a range of 0.0078125-0.9921875. However, with an internal datapath bitwidth of 20 bits, not all the precision available is fully utilized during multiplications. A method of increasing the precision is proposed, and a software tool is introduced which will generate the necessary values.

### Algorithm

By doing more than one multiplication for a coefficient, it is possible to increase the combined coefficients' conjugate bitwidth. One extra multiplication is equivalent to increasing the coefficient to 14 bits; two extra multiplications are equal to increasing the coefficient to 19 bits (due to the internal truncation to 19 fractional bits post-multiplication). This effect may be observed in the most basic case, a simple bit shift. If a value is to be right-shifted 14 bits (equivalent to a multiplication by  $1/2^{14} = 1/16384 = 6.1035 \times 10^{-5}$ ), the code can accomplish this in the DRE with two 7-bit shifts:

```
WZP tmp K=0000001B ; Shift accumulator right by 7 bits
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```

The correct coefficient values to use are clear in the simple bit shifting case. For more complicated coefficients, the difficulty is the decomposition into two or three values whose product is closest to the original. Fortunately, this is easy to calculate with software. The DRECoef coefficient calculator will decompose a given coefficient into two 7-bit magnitude values, or three magnitude values consisting of two 7-bit and one 5-bit.

### Invoking the Coefficient Calculator

To invoke the coefficient calculator from the command line, type:

```
DRECoef num_coeffs coefficient
```

where **num\_coeffs** is the number of coefficients to calculate, either 2 or 3, and **coefficient** is the value to decompose, either in a decimal number less than 1, or a hex value prefixed with '\$'. The hex value must be less than 14 bits if 2 coefficients are being calculated, and less than 19 bits if 3 coefficients are being calculated.

For example, if you wish to calculate 3 coefficients from the value \$33AE, type:

```
DRECoef 3 $33AE
```

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