IEEE Standard Decimal Floating Point

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$$(-1)^{sign} \times coefficient \times 10^{exponent}$$

Density packed decimal

Binary integer decimal

Density Packed Decimal

$$(-1)^{sign} \times coefficient \times 10^{exponent}$$

Format	decimal32	decimal64	decimal128
Format length	32	64	128
Exponent continuation length	6	8	12
Coefficient continuation length	20	50	110
Total Exponent length	8	10	14
Total Coefficient length in digits	7	16	34
E_{max}	96	384	6144
E_{min}	–95	–383	–6143
bias	101	398	6176

64 bit Density Packed Decimal

sign	Combination	Exponent continuation	Coefficient continuation
1 bit	5 bits	8 bits	50 bits

Sign	Combination
1 if negative 0 if positive	5(Two MSB of Exponent & MSD of coefficient) – 6 Bit are packed into 5 bit encoding

Exponent continuation

8 (Remaining 10 LSB of the exponent) Bits on the left place first.

Coefficient continuation

50 (Each ten bits is for three digit using DPD encoding) so maximum digit is (50/10)*3=15

64 bit Density Packed Decimal continued….

Combination
5(Two MSB of Exponent & MSD of coefficient) – 6 Bit are packed into 5 bit encoding

Combination Example			
Combination field (5 bits)	Type	Exponent MSBs (2 bits)	Coefficient MSD (4 bits)
a b c d e	Finite	a b	0 c d e
1 1 c d e	Finite	c d	1 0 0 e
1 1 1 1 0	Infinity	- -	- - - -
1 1 1 1 1	NaN	- -	- - - -

DPD Encoding with Example

Digit 1	Digit 2	Digit 3
a b c d	**e** f g h	**i** j k l

Coefficient continuation

50 (Each ten bits is for three digit using DPD encoding) so maximum digit is (50/10)*3=15

P	Q	R	S	T	U	V	W	X	Y	a	e	l
b	c	d	f	g	h	0	j	k	l	0	0	0
b	c	d	f	g	h	1	0	0	l	0	0	1
b	c	d	j	k	h	1	0	1	l	0	1	0
b	c	d	1	0	h	1	1	1	l	0	1	1
j	k	d	f	g	h	1	1	0	l	1	0	0
f	g	d	0	1	h	1	1	1	l	1	0	1
j	k	d	0	0	h	1	1	1	l	1	1	0
0	0	d	1	1	h	1	1	1	l	1	1	1

Example

Digit 1	Digit 2	Digit 3
0	**8**	**9**
a b c d	**e** f g h	**i** j k l
0 0 0 0	1 0 0 0	1 0 0 1
b c d 1 0 h 1 1 1 l		
0 0 0 1 0 0 1 1 1 1		

64 bit Density Packed Decimal

-7.50 here {1,750,-2} son in 64bit format bellow is the calculation

Sign bit is 1 for negative

Coefficient is 750 ; we have 16 digit for coefficient MSD will combination with combination field and rest 15 digit will remain in coefficient continuity 50 bit in 3digit for each 10 bit group so the 16 digit of coefficient will 0000000000000750. so fist digit is combination and rest 15 digit are DPD encoding of here DPD of 750 is 1111010000

Exponent is -2 and bias is 398 so exponent is 396 binary is 0110001100 so exponent is 10001100

1	01000	10001100	00000000000000000000000000000000000000000001111010000
s	combi nation	Exponent continuation	Coefficient continuation

Hex code A2 30 00 00 00 00 03 D0