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[ ]

$$\frac{df}{dt} \quad f - \frac{df}{dt} \quad [ ]$$

$$f - \frac{df}{dt} \quad [ ]$$

$$[ ] \quad \frac{df}{dt}$$

[ ]

$$[ ] \cdot \left(\frac{df}{dt}\right) \quad \frac{df}{dt}$$

$$\frac{df}{dt} \quad \frac{df}{dt}$$

[ ]

$$\frac{df}{dt}$$

$$\frac{df}{dt} \quad [ \quad ]$$

DFT

[ ]

( SPS )

$$L = \frac{\text{Load} - \text{Generation}}{\text{Load}}$$

(SPS)

Generation L ( )

[ ]

SPS

[ ]

L

$$f = ( \quad ) ( \quad ) ( \quad )$$

( )

$$LD = \frac{\frac{L}{1+L} - d(1 - \frac{f}{f_n})}{1 - d(1 - \frac{f}{f_n})} \quad ( )$$

f p.u.      L ( )  
d      f<sub>n</sub> ,

$$\frac{df}{dt}$$

[ ]

/ WSCC

[ ]

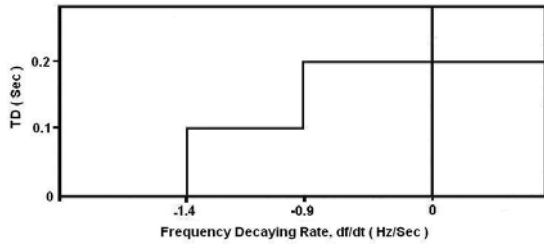
[ ]

/

$$f - \frac{df}{dt}$$

WSCC

[ ]



$$T_D - \frac{df}{dt}$$

( )

$$\frac{df}{dt}$$

$$\frac{df}{dt}$$

$$LD - \frac{df}{dt}$$

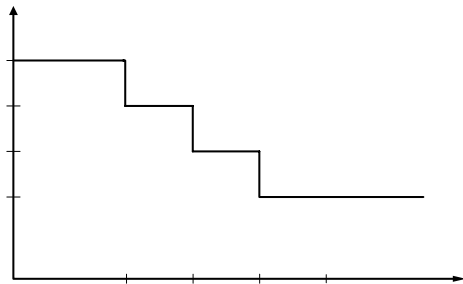
$$LD - \frac{df}{dt}$$

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( )

$$\frac{df}{dt}$$



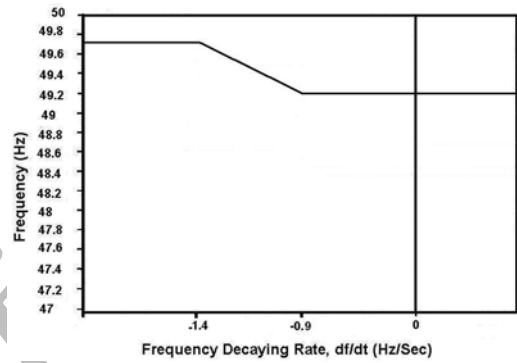
$$LD - \frac{df}{dt}$$

( )

$$f - \frac{df}{dt}$$

[ ] [ ]

$$f - \frac{df}{dt}$$



$$f - \frac{df}{dt}$$

$$\left| \frac{df}{dt} \right| \quad ( )$$

$$\left| \frac{df}{dt} \right|$$

( )

$$T_D - \frac{df}{dt}$$

$$T_D - \frac{df}{dt}$$

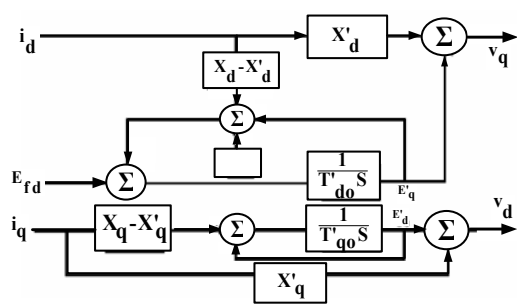
$T_D$

( )

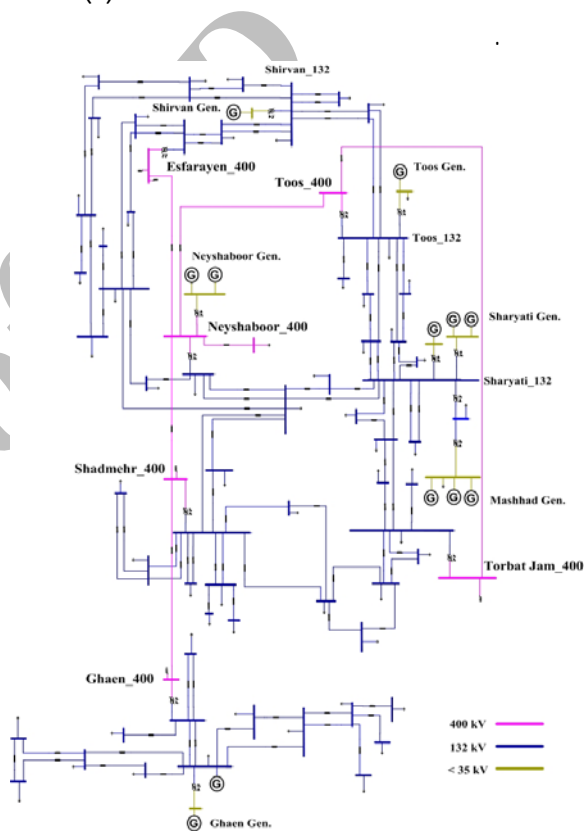
AVR

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[ ]



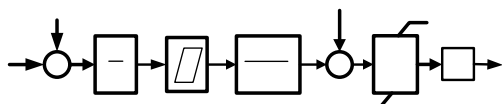
( )



AGC

[ ]

( )



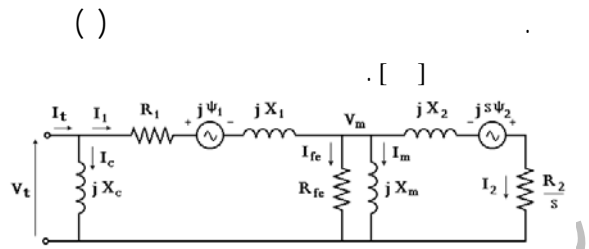
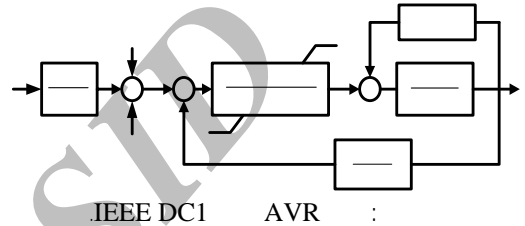
( )

:T<sub>1</sub>

:T<sub>2</sub>

( ) :f<sub>0</sub> :R  
 ΔF = f-f<sub>0</sub> :P<sub>Max</sub>  
 P<sub>0</sub> :Qa1 :P<sub>Min</sub>  
 :KPF1  
 :KQF1 AVR  
 :KQF2 AVR

IEEE TYPE DC1 AVR  
 ( ) AVR  
 :KPV1 [ ]  
 :KPV2  
 :KQV1  
 :KQV2  
 IEEE DC1 AVR :



EPRI

$$\frac{P}{P_0} = P_{a1} \left(\frac{V}{V_0}\right)^{K_{PV1}} (1 + K_{PF1} * \Delta F) + P_{a2} \left(\frac{V}{V_0}\right)^{K_{PV2}} \quad ( )$$

$$\frac{Q}{Q_0} = Q_{a1} \left(\frac{V}{V_0}\right)^{K_{QV1}} (1 + K_{QF1} * \Delta F) + Q_{a2} \left(\frac{V}{V_0}\right)^{K_{QV2}} (1 + K_{QF2} * \Delta F) \quad ( )$$

$$P_{a1} + P_{a2} = 1 \quad ( )$$

$$Q_{a1} + Q_{a2} = \frac{Q_0}{P_0} \quad ( )$$

:Q P

:Pa1

:Pa2

:Q<sub>0</sub> P<sub>0</sub>

( )

(V<sub>0</sub>)

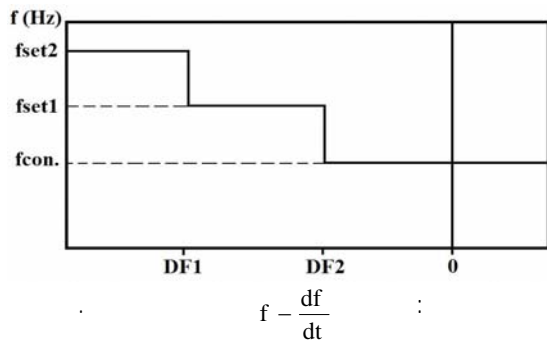
:V

( )

:V<sub>0</sub>

( )

:f



$$= \text{MW}$$

$$L = /$$

$$d = /$$

$$f( ) = \text{Hz}$$

$$( ) ( )$$

$$LD \quad \text{MW} / \text{pu}$$

$$/$$

$$( )$$

$$( )$$

$$f - \frac{df}{dt}$$

	(Hz)	LD
	/	%
		%
	/	%
	/	%

AVR

$$f - \frac{df}{dt}$$

$$f - \frac{df}{dt}$$

$$[ ]$$

$$[ ]$$

$$\left| \frac{df}{dt} \right| < |DF2|$$

$$( )$$

$$|DF2| \leq \left| \frac{df}{dt} \right| \leq |DF1|$$

$$( )$$

$$\left| \frac{df}{dt} \right| > |DF1|$$

$$( )$$



$$f_{set1} \quad f_{set2}$$

( )

$$f_{set2}$$

DF2 DF1

Hz

/

Hz

/

DF2 DF1

DF1

$$f_{set1} = f_{con.} + 0.25$$

$$f_{set2} = f_{con.} + 0.5$$

$$f_{set1} \quad ( )$$

$$( )$$

$$f_{set2}$$

$$f_{con.}$$

$$|DF1| \quad \left| \frac{df}{dt} \right|$$

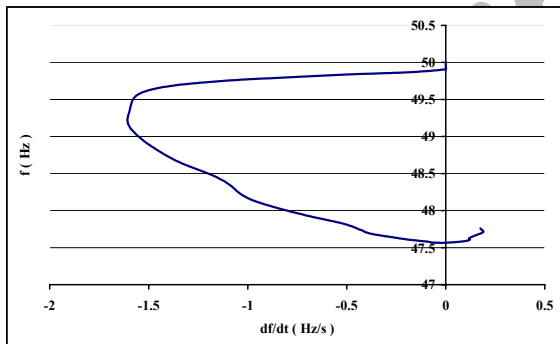
N

( )

DF1

$$|DF1| = \text{Min}_{i=1}^N \left( \text{Max} \left| \frac{df}{dt} \right| \right) - 0.2$$

( )



( )

$$\left| \frac{df}{dt} \right| > |DF1|$$

$$f - \frac{df}{dt}$$

$$\text{Max} \left| \frac{df}{dt} \right|$$

/ Hz/s

$$f - \frac{df}{dt}$$

( )

$$\text{Max} \left| \frac{df}{dt} \right|$$

$$|DF1| \quad ( )$$

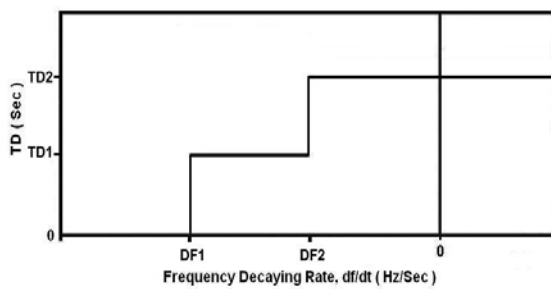
/ Hz/s

/

$$f_{set2}$$

DF1

DF2



N

( )

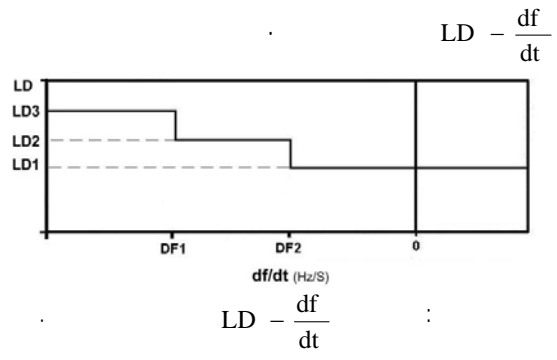
N

$$T_D - \frac{df}{dt}$$

$$\frac{df}{dt} \quad LD - \frac{df}{dt} \quad T_D - \frac{df}{dt}$$

$$LD \quad ( ) \quad T_D - \frac{df}{dt} \quad ( )$$

$$f - \frac{df}{dt} \quad DF2 \quad DF1 \quad f - \frac{df}{dt}$$



LD2 LD1

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$$\left| \frac{df}{dt} \right| < |DF2|$$

$$|DF2| \leq \left| \frac{df}{dt} \right| \leq |DF1|$$

$$\left| \frac{df}{dt} \right| > |DF1|$$

( ) ( )

LD

/ s TD2

TD1 / s TD2

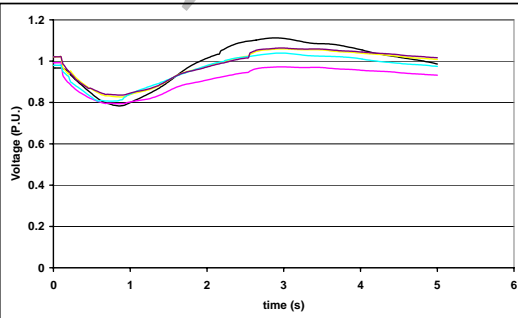
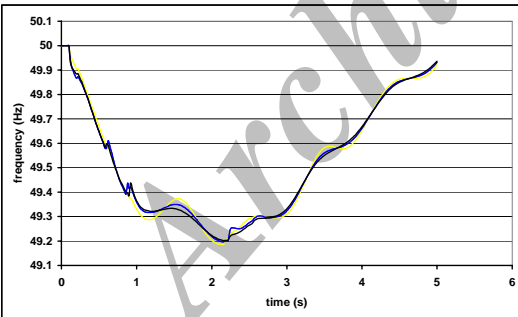
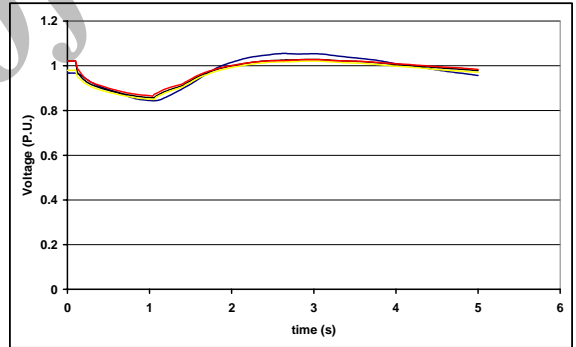
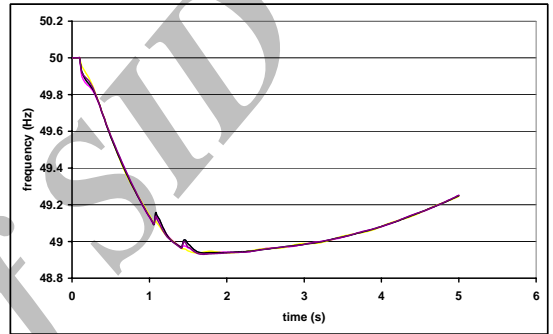
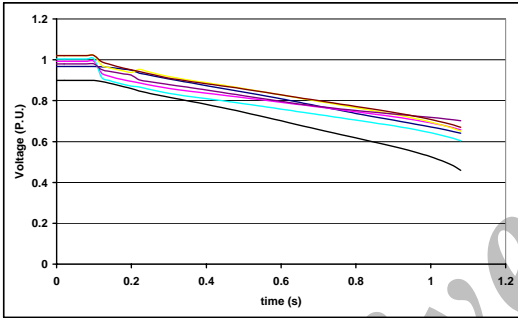
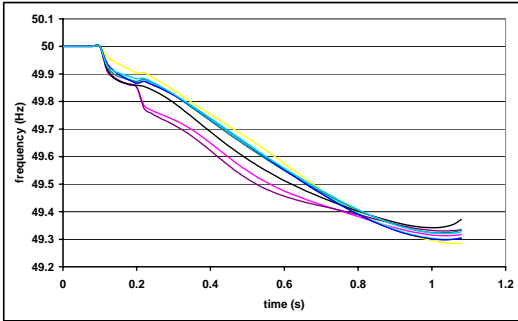
/ s

TD2 TD1

/ s

( )

( )



$$\dot{f} = \frac{df}{dt}$$

$$T_D - \frac{df}{dt} \quad LD - \frac{df}{dt}$$

$$f - \frac{df}{dt}$$

$$f - \frac{df}{dt}$$

$$f - \frac{df}{dt}$$

( )

$$/ \text{ Hz/s} \quad \frac{df}{dt}$$

$$f - \frac{df}{dt}$$

( )

( )

$$T_D - \frac{df}{dt} \quad LD - \frac{df}{dt}$$

$$f - \frac{df}{dt}$$

$$f - \frac{df}{dt}$$

$$f - \frac{df}{dt}$$

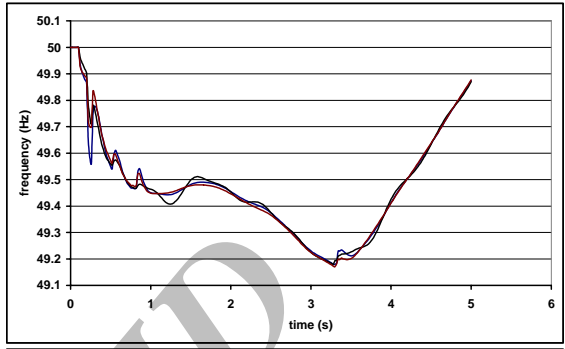
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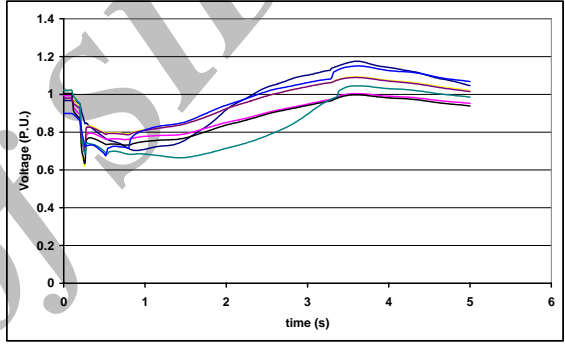
/

$$f - \frac{df}{dt}$$



$$f - \frac{df}{dt}$$

:



$$f - \frac{df}{dt}$$

:

$$f - \frac{df}{dt}$$

( )

:

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$$f - \frac{df}{dt}$$

$$f - \frac{df}{dt}$$

$$f - \frac{df}{dt}$$

:

$$T_D - \frac{df}{dt}$$

$$LD - \frac{df}{dt}$$

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- 1 - System Protection Schemes  
2 - Event Based  
3 - Response Based  
4 - Zero Crossing  
5 - Least Square Error  
6 - Orthogonal Filters  
7 - Discrete Fourier Transform  
8 - Adaptive  
9 - Lumped Model  
10 - Automatic Generation Control

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