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

[]

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

[]

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

[]

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

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

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

[]

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



SPS

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

DFT

[]

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(SPS)

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

()

(SPS)

L ()

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_n

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

[]

/ WSCC

[]

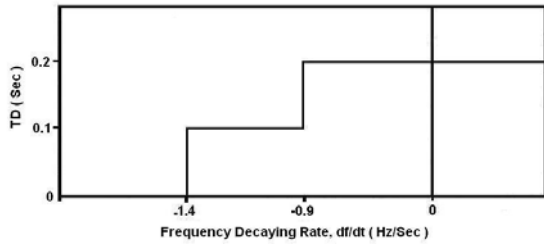
[]

/

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

WSCC

[]



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

()

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

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

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

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

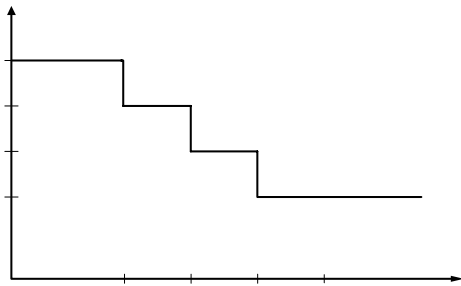
LD

()

()

()

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



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

()

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

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

T_D

()

.....

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

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

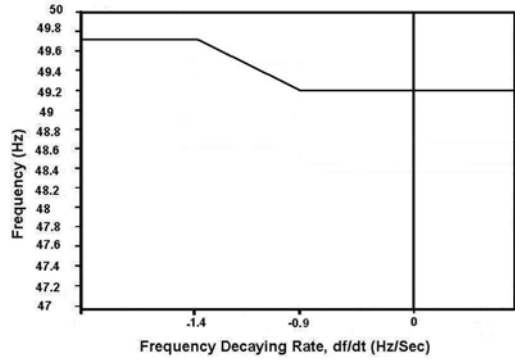
$$\frac{df}{dt}$$

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

()

[] []

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



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

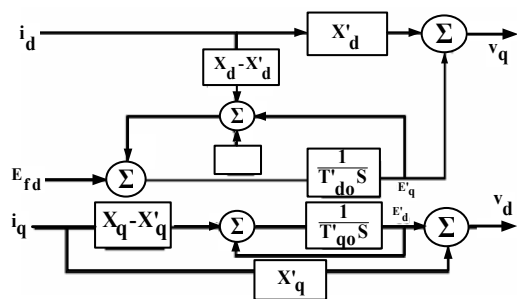
$$\left| \frac{df}{dt} \right| \quad ()$$

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

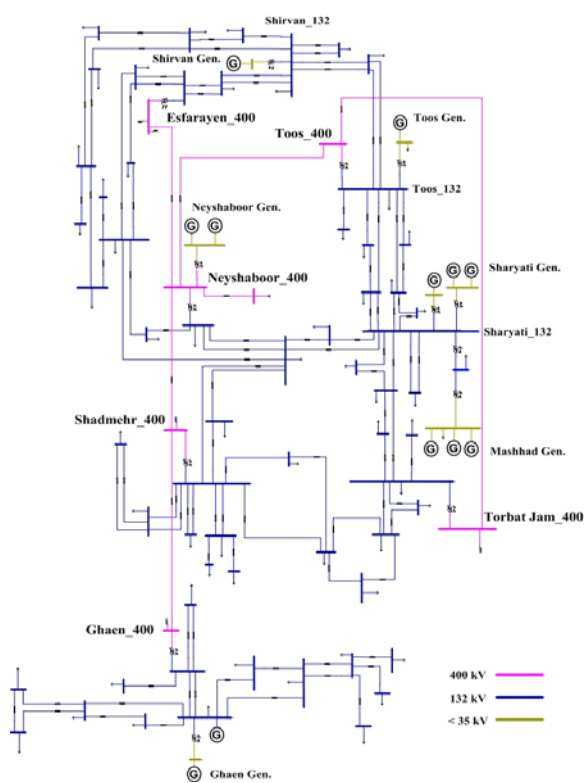
AVR

()

[]



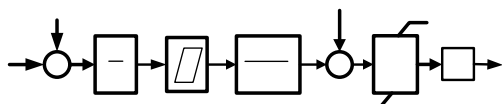
()



AGC

[]

()

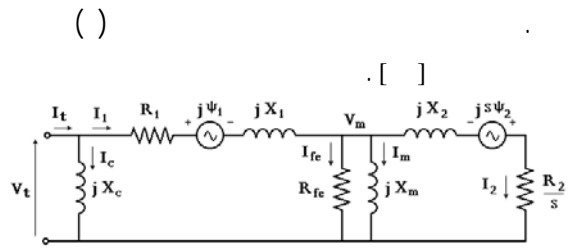
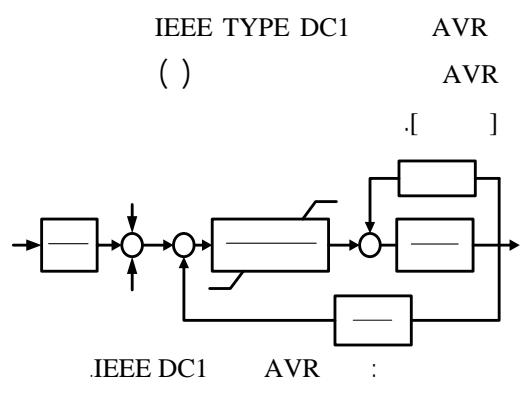


()

:T₁

:T₂

() :f₀ :R
 ΔF = f-f₀ :P_{Max}
 P₀ :Qa1 :P_{Min}
 :KPF1
 :KQF1 AVR
 :KQF2 AVR
 :KPV1
 :KPV2
 :KQV1
 :KQV2



EPRI

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

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

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

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

EPRI

:Q P

:Pa1

:Pa2

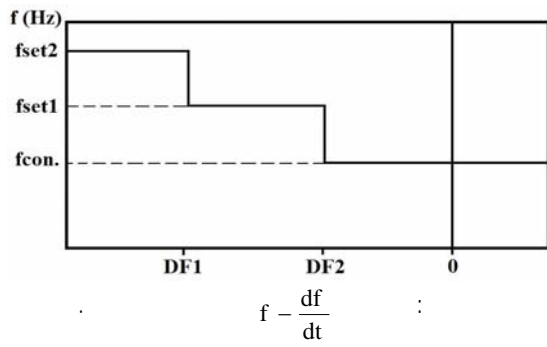
:Q₀ P₀

()

.(V₀) :V

.() :V₀

.() :f



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

()

AVR

$=$ MW
 $L = /$
 $d = /$
 $f () =$ Hz
 $() ()$
 LD MW / pu
 /
 ()

	(Hz)	LD
	/	%
		%
	/	%
	/	%

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

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

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

()

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

()

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

()

f_{set1} f_{set2}

()

f_{set2}

DF2 DF1

Hz

/

Hz

/

DF2 DF1

DF1

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

()

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

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

f_{set1} ()

()

N

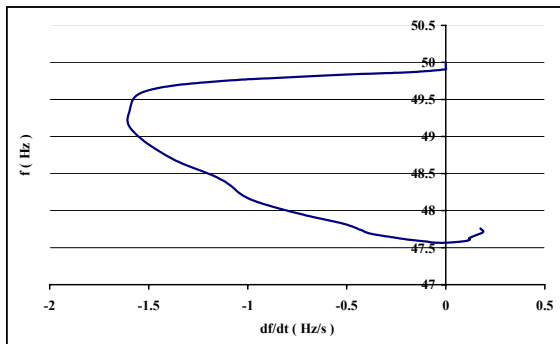
f_{set2}

()

DF1

$f_{con.}$

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



()

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

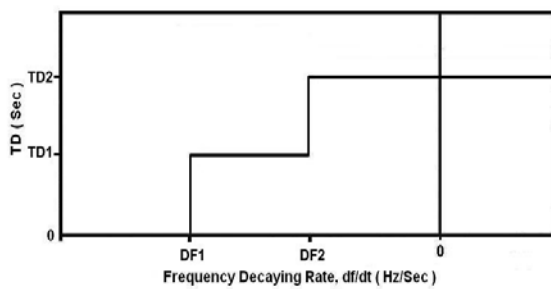
$$f - \frac{df}{dt}$$

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

/ Hz/s

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

()



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

$$|DF1| \quad ()$$

/ Hz/s

/

f_{set2}

DF1

DF2

N

()

N

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

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

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

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

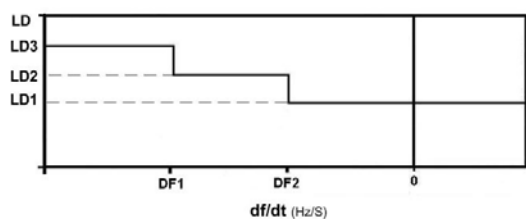
$$T_D - \frac{df}{dt} \quad ()$$

DF2 DF1

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

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

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



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

$$f - \frac{df}{dt} \quad ()$$

DF2 DF1

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

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

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

LD2 LD1

LD3

$$/ \quad () \quad () \quad L$$

$$()$$

/ s

TD2

TD1

/ s TD2

$$() \quad ()$$

LD

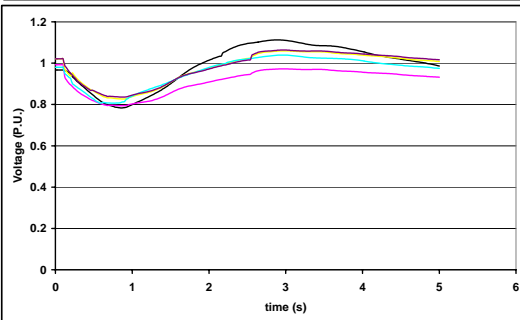
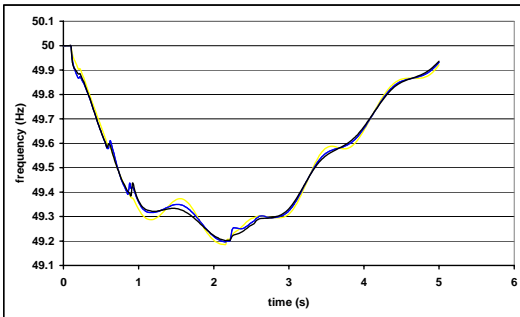
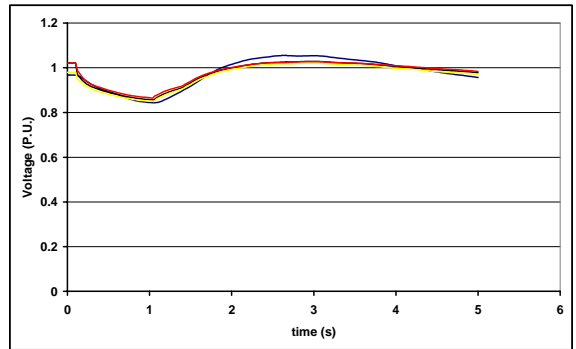
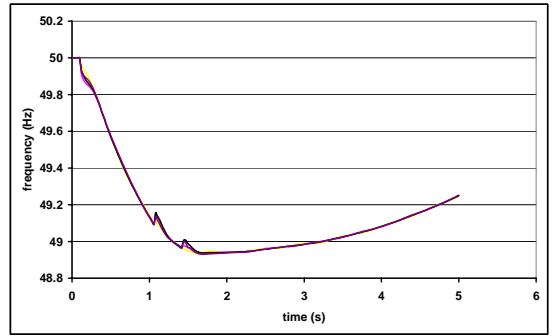
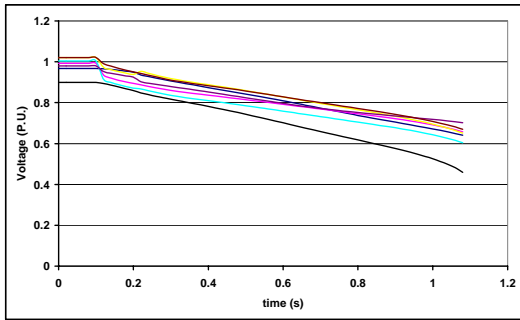
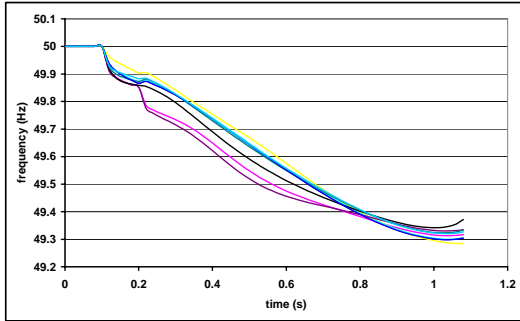
/ s

TD2 TD1

/ s

()

()



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

$$T_D = \frac{df}{dt}$$
$$LD = \frac{df}{dt}$$

$$T_D = \frac{df}{dt}$$
$$LD = \frac{df}{dt}$$

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

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

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

()

/ Hz/s

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

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

()

()

$$T_D = \frac{df}{dt}$$
$$LD = \frac{df}{dt}$$

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

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

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

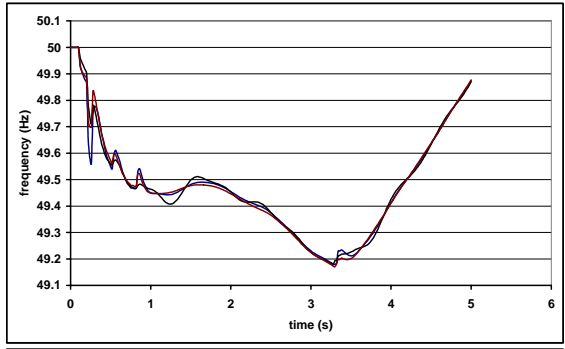
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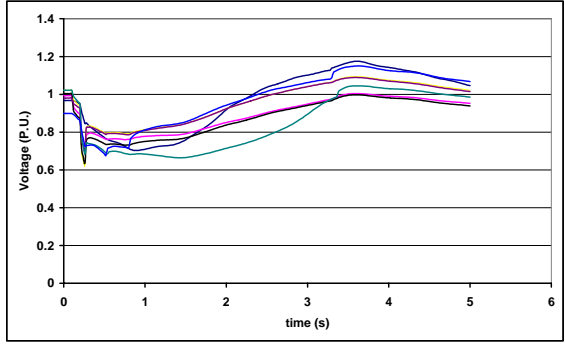
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$$f - \frac{df}{dt}$$



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

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

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

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

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

:

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

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

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

()

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

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

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

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

()

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

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

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

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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
-