2005　1　27

EMC　　WG

社団法人日本電機工業会

1. ……1
1.1 ……1
1.2 ……2
1.3 ……2
1.4 ……3
2. ……3
2.1 ( ) ……3
2.2 ( ) ……6
2.3 ……7
2.4 ……8
2.5 ……12
2.6 ……13
2.7 EMC ……28
3. 29
4. WG ……31
5. ……33
1 14
CV PVC V-t

1.

1.1

IEC

JEMA WG 3

EMC

WG CV CVT

(CV CVT)

WG CV CVT

– ( ) PVC V-T

V-T

( )

WG

(1)

(2) –

A

EMC

(3) B ( ) -

(4) B V-T (

) 100

( )

(5) [( )]

V-T

(6) –

(7) – (

)

(8) EMC CV CVT

CV CVT

35 (H16.11.17 18)
(H-1)P145 P148

1.2
(1) CV CVT

(2)

EMC
WG

1.3
2 1 WG 16
WG

1.3.1 CV CVT
(1)

(2)
(3) ( )
(4)
1.3.2
(1)
(2) EMC

1.4

WG

( ) [WG ( )]
[WG ( )]
[WG ( )]
(2004 7)
[WG ( )]
[WG TGA( )]
[WG TGA( )]

( )

( )

( )
( )

2001 6 2002 2 4
WG 2002 2 4 (1) WG2005 1 27 (16)

2.

2.1 ( )

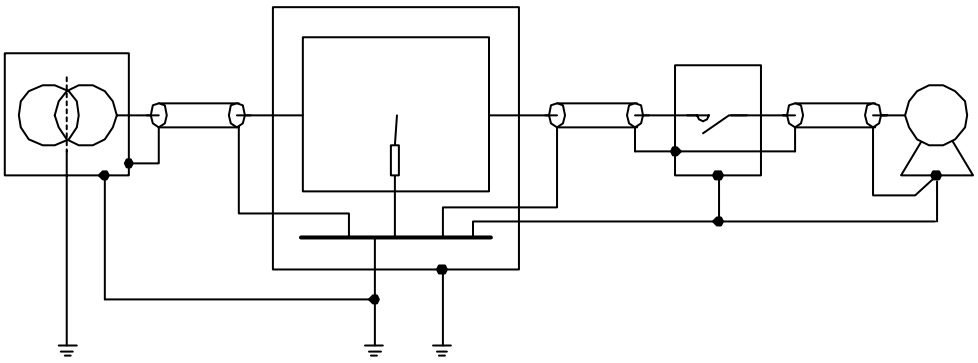
(1) ( )
(2)
(3)
(4) ( )
(5)
(6) ( )
(7) dv/dt
2.1-1 2.1-1 2.1-4

A
B ( )
C ( )
D E ( )

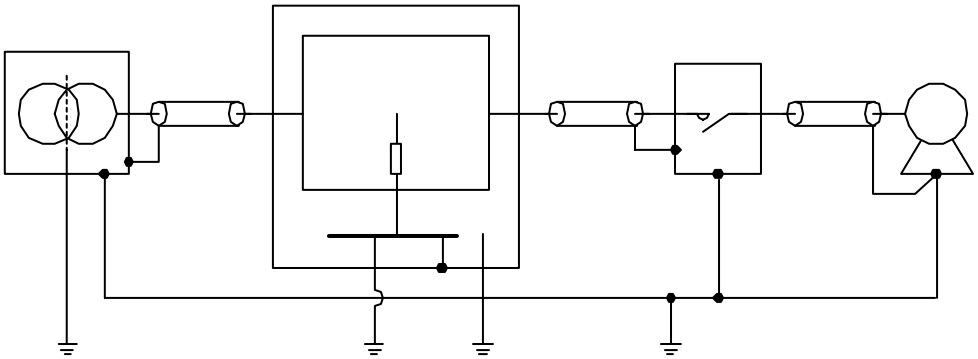
A B C 3
D E

2.1-1

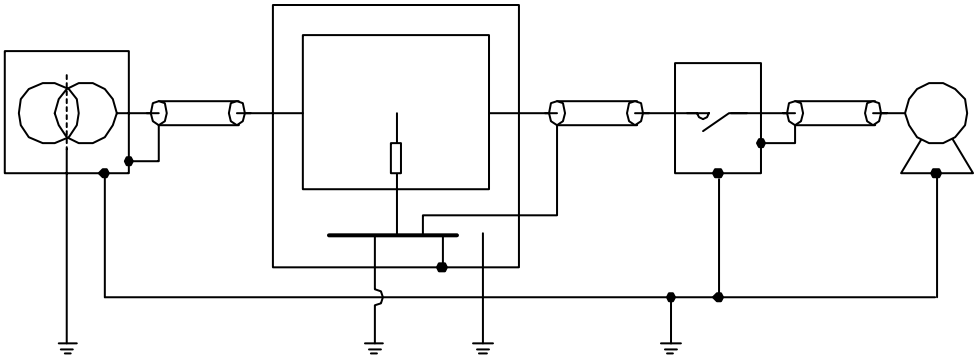
		A	B	C	D	E
	AC (kV)	3.3	3.3	3.3(GTO)/1.9(IGBT)	3.3/6.6	3.3/6.6
	DC (kV)	2.35 × 2	3 × 2	3 × 2/1.65 × 2	1.3(INV)	0.85(INV)
		3	3	3	3 INV	2 INV
		GTO/IEGT	GTO/GCT	GTO/IGBT	IGBT	IGBT
					INV	INV
					INV	
( )		3kV CV 6kV CV ( ) 0.7 0.6 3 CVT 3	3 CVT 3	3 CVT 3 6kVDC 6.6kV CVT 3.3kVDC 3.3kV CVT		
		200m	300m			(100m)
INV		2300V 9 3300V 8	2300V 11 3300V 9.5	2200V GTO 12 3300V GTO 6 2200V IGBT 4	5	7
dv/dt						(DC dv/dt)
		2.1-1	2.1-2	2.1-3	2.1-4	2.1-4



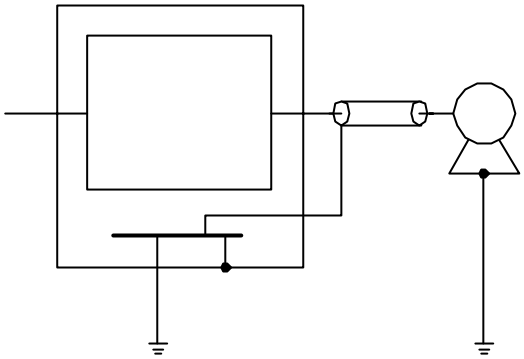
2.1-1　A



2.1-2　B



2.1-3　C



2.1-4　D　　E

2.2 ( )

2.2.1

(–)

2.1

(1) (A)

50V

2

5 6 354

(2) (B)

(3) (C D E)

(4)

2.2.2

( ) ( )

2.2.3 EMC

EMC

2.3

2.6 μs

2000 $3000V_{p-p}$

(1) 1

A

http://ECCj06.ECCj.or.jp/Cgi-Bin/qAnDA/hE_qA/ElEC/D0104.html

2.3-1 ( )

			60Hz		10kHz	
	5.2mA	3.5mA	1.1mA	0.7mA	12mA	8mA
	9	6	1.8	1.2	17	11
	62	41	9	6	55	37
	74	50	16	10.5	75	50
			23	15	94	63
0.03s	1300	1300	1000	1000	1100	1100
3.0s	500	500	100	100	500	500
	2.75					

( )

2.3-1 ( ) 60Hz 10kHz

(2) 2

http://ContEst.thinkquEst.gr.jp/tqj1998/10157/worD/txt34.htm

( )

( )

200V

200V

50 60Hz 4

(50kHz) 50mA 100mA

50 100V 300V 150

300V

( )

(3) 1

(1995.9.25)

pp.13-14

2.3-1

1

2 3 50% 99.5%

4 99.5% (Let go)

5 6 50% 0.5% (

)

(3) (50Hz/60Hz) 0.5mA 1kHz

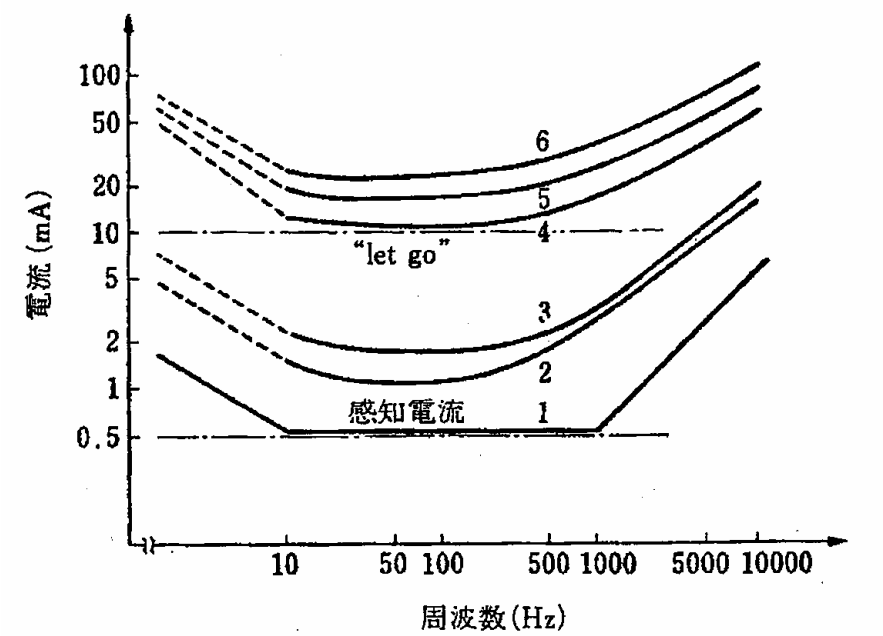
10kHz(100µs 50µs) 5mA

100kHz(10µs 5µs) 50mA

600V ( )

10kHz 6000V

2000 3000$V_{p\text{-}p}$



2.3-1

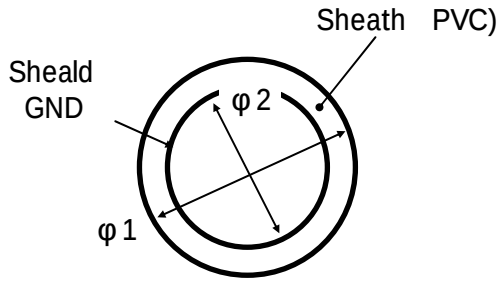
2.4

V-T

(1)

( ) V-T

2.4.1 (1)



2.4−1

	PVC
(mm)	3.1mm
ϕ1	39mm
ϕ2	32.8mm

6600V 325mm^2 CV (2000)

2.4-1

(1) 1(AC CSV CEV)

2.4-2

CSV CEV

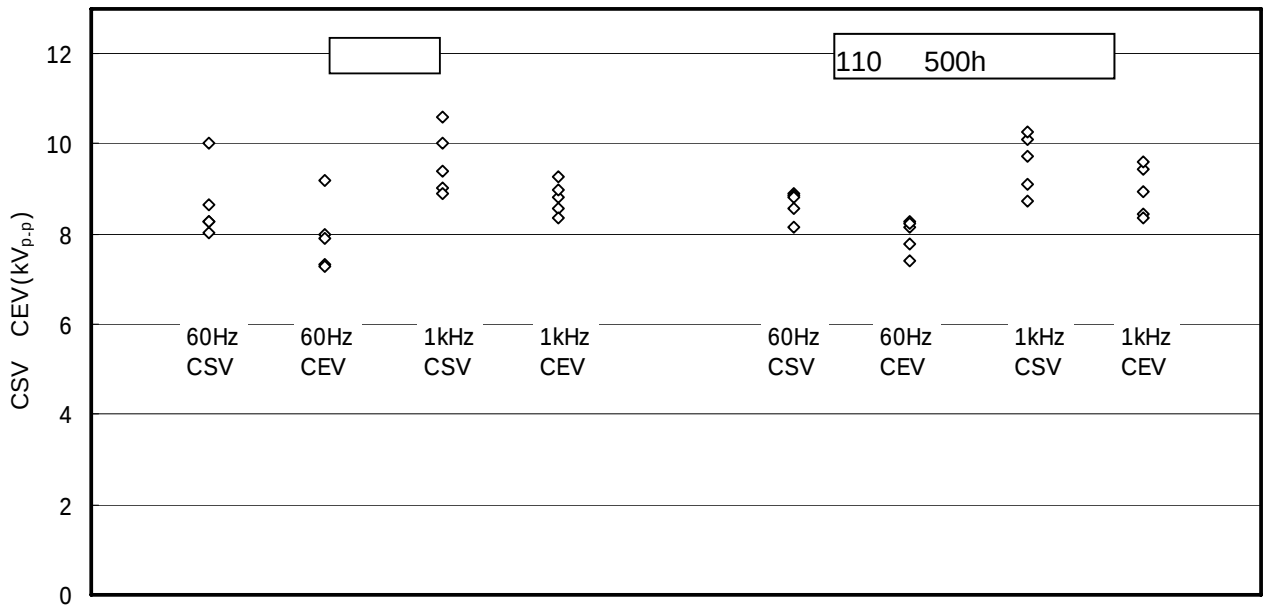
PVC 110

500h (PVC 70%)

CEV CSV 90

CEV 7 kV_{p-p}

6600V CV (60pps)



2.4-2 AC CSV CEV( )

(2) 2(CSV CEV)

(1 10 100μs)

2.4-3 2.4-4

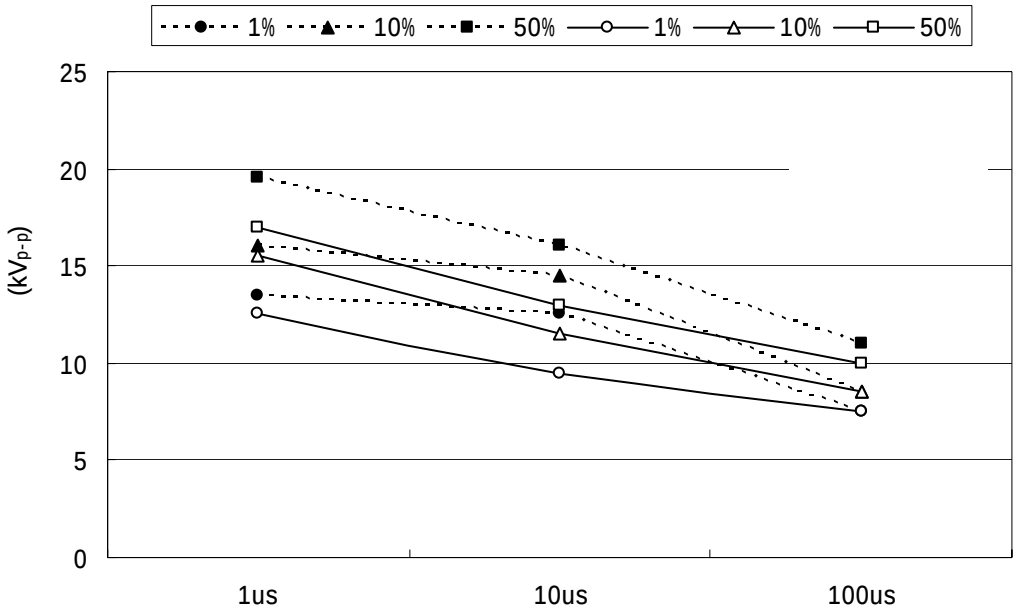
CSV AC peak to peak 100μs peak to peak

CSV 1

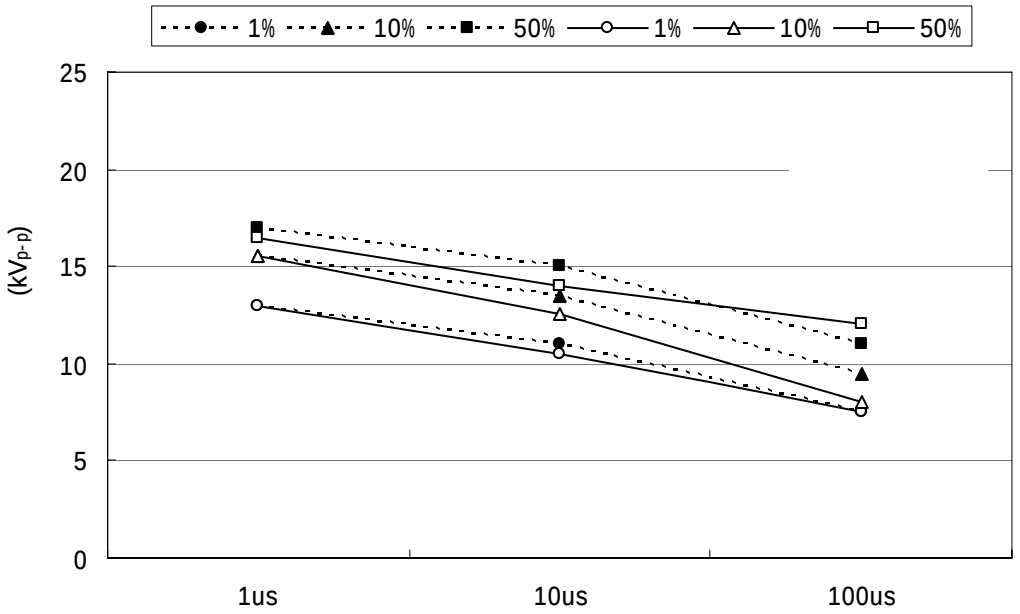
1μs 12kV_{p-p} 100μs 7.5kV_{p-p}

1.5μs CSV

CSV AC



2.4-3 CSV( )



2.4-4 CSV( )

(3) V-T

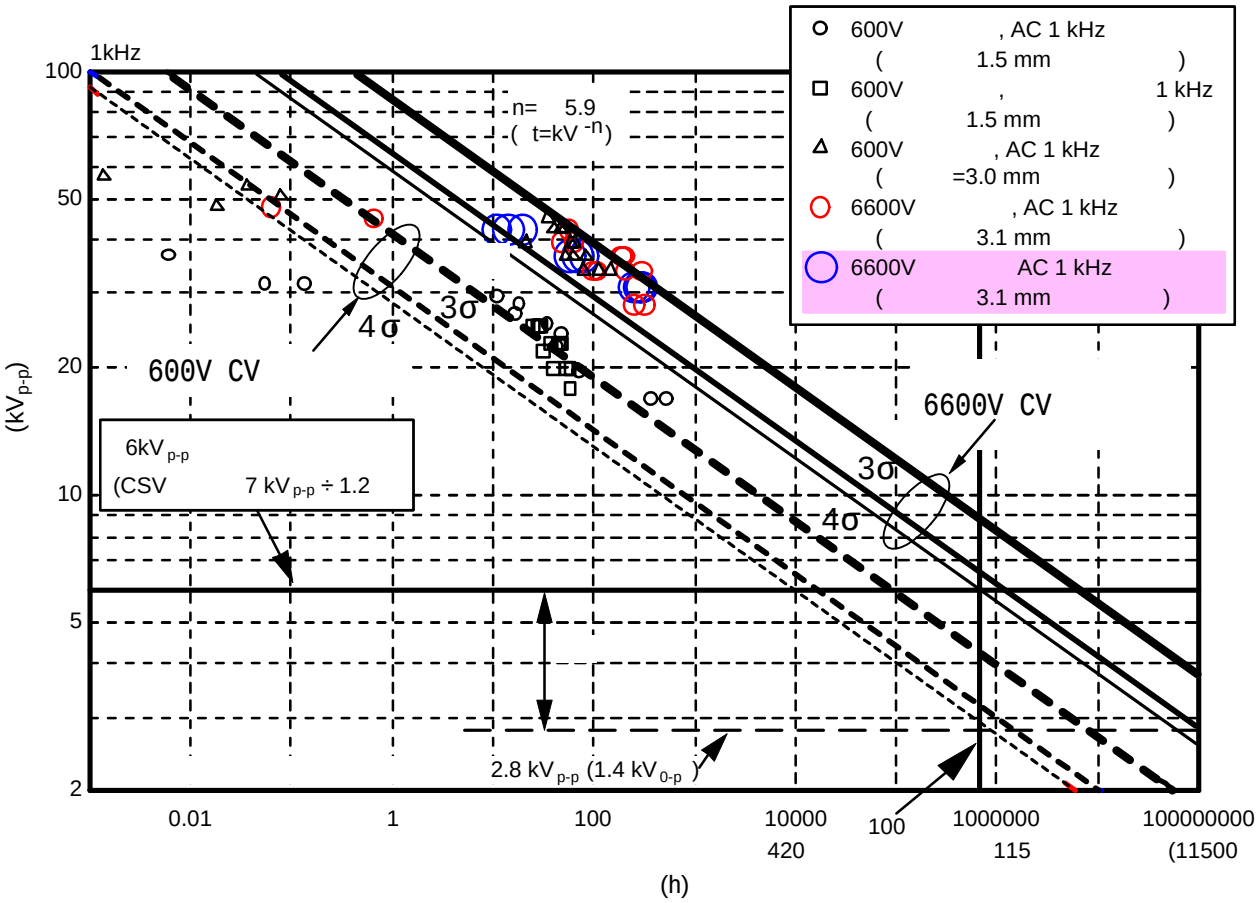
V-T

2.4-5

V-T (AC/)

(– –) peak to peak

2.8k V_{p-p} (100)



2.4-5 V-T

2.4.2 ( ) V-T

CV PVC AC1kHz 12.7kV PVC V-T

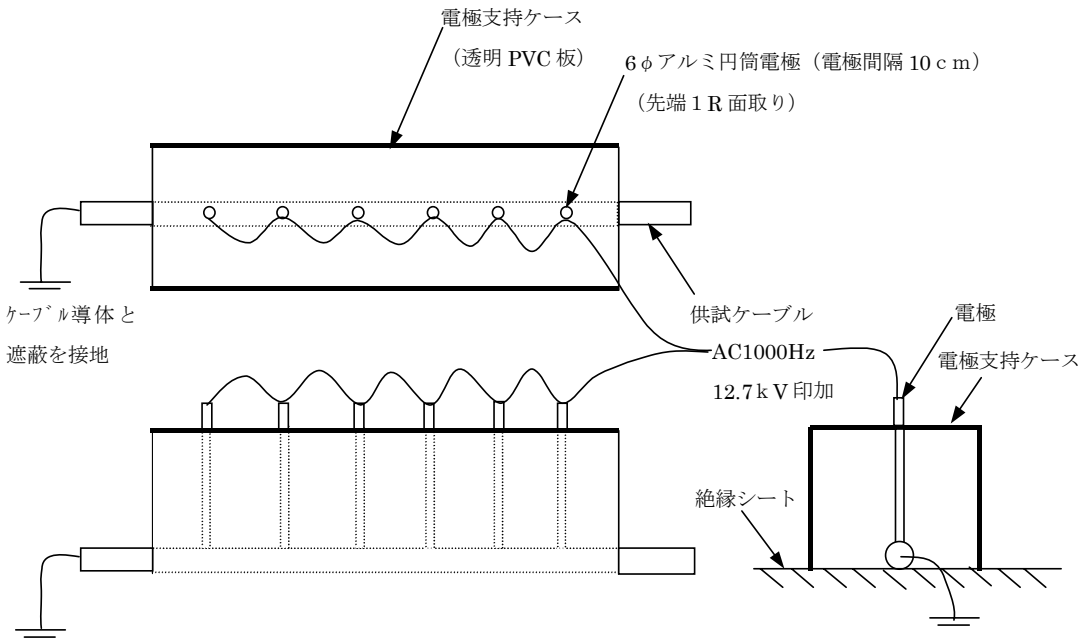
6600V 325mm^2 CV (2000)

(1)

AC1kHz (AC12.7kV) PVC (PVC

3.1 1.9 0.4mm)

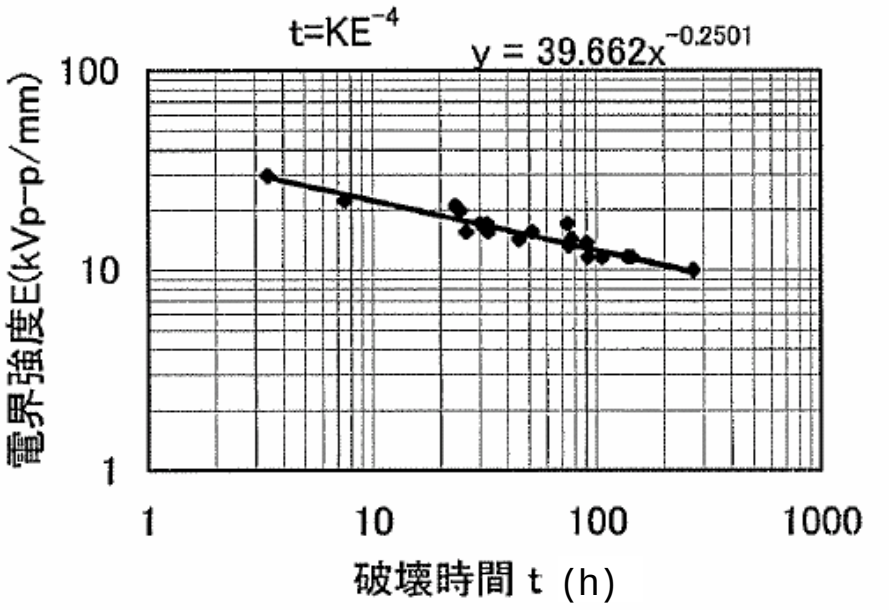
V-T



2.4-6

(2)

2.4-7 2.4.1 V-T (2.4-5)



2.4-7 CV PVC V-T

2.4-5 6600V 3.1mm 40kV 100h 1mm

40/3.1 12.9kV/mm 2.4-7 100h

2.5

2.4

(1) (70) V-T

(2) 2.8kV$_p$ $_p$max(B)

CSV CEV 7.0kV_{p-p}min

CSV (1μs

12kV_{p-p}) 1.5μs

(3) 2.8kV_{p-p} 1kHz( ) 100

(4)

(5)

(6)

CSV

2.6

3

C

2.6.1

(1) 3

2.6.1-1 3 3

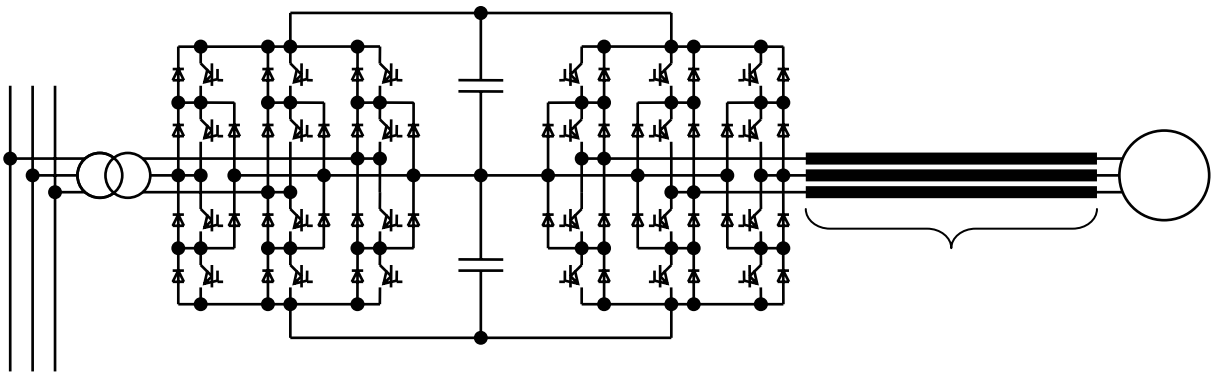
2.6.1-2 3

3

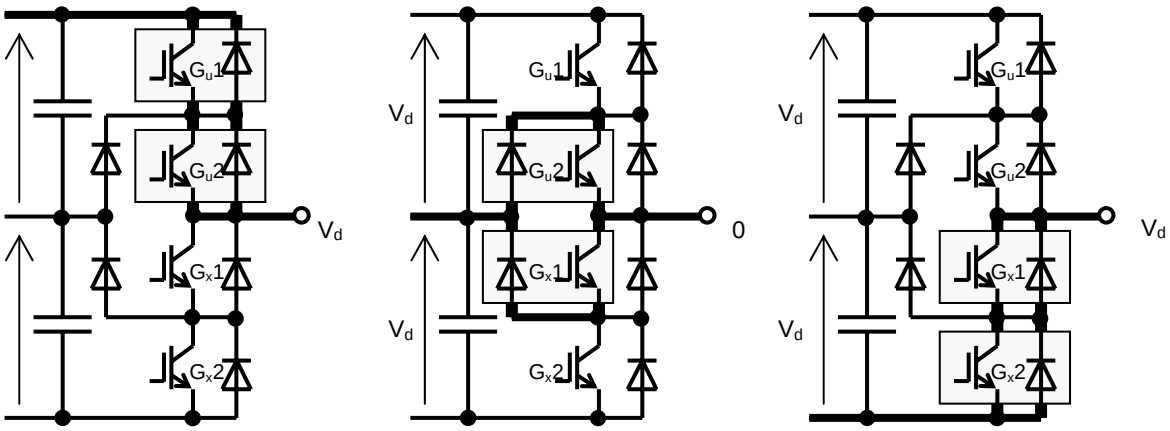
2.6.1-2 b) 3

GTO GCT(IGCT) IGBT IEGT

IEGT 3 2.6.1-1



2.6.1-1 3



a) b) c)

2.6.1-2 3 ( )

2.6.1-1 3

	8MVA(150%-1)
	1358A
	3400V
(P N)	2345V
	1μs
(P N)	12000μF
/	512Hz/1024Hz( )
/ ON	20μs/25μs
	IEGT (4.5kV-4kA)

(2)

– 2.6.1-2

250mm^2 325mm^2

2.6.1-2

V			mm^2	A	Ω/km 20	mH/km	μF/km	kg/km	mm	mm	mm	mm	mm
3300	CVT	3	200	485	0.0933	0.308	0.510	7406	67.0	17.0	3.5	0.1	2.7
3300	CVT	3	250	560	0.0754	0.302	0.550	8980	71.0	19.0	3.5	0.1	2.8
3300	CVT	3	325	660	0.0579	0.289	0.610	11400	78.0	21.7	3.5	0.1	3.0
3300	CVT	3	400	750	0.0471	0.289	0.590	14400	86.0	24.1	4.0	0.1	3.2
3300	CVT	3	500	855	0.0376	0.281	0.660	17000	93.0	27.1	4.0	0.1	3.4
3300	CVT	3	600	950	0.0314	0.279	0.710	20200	100.0	29.5	4.0	0.1	3.6

(3)

2.1

(4)

–

(5)

2.6.1-3 IEGT

U V W (Q2 Q3)

U Q1 U P

U P

SE

U V V V

W

(6)

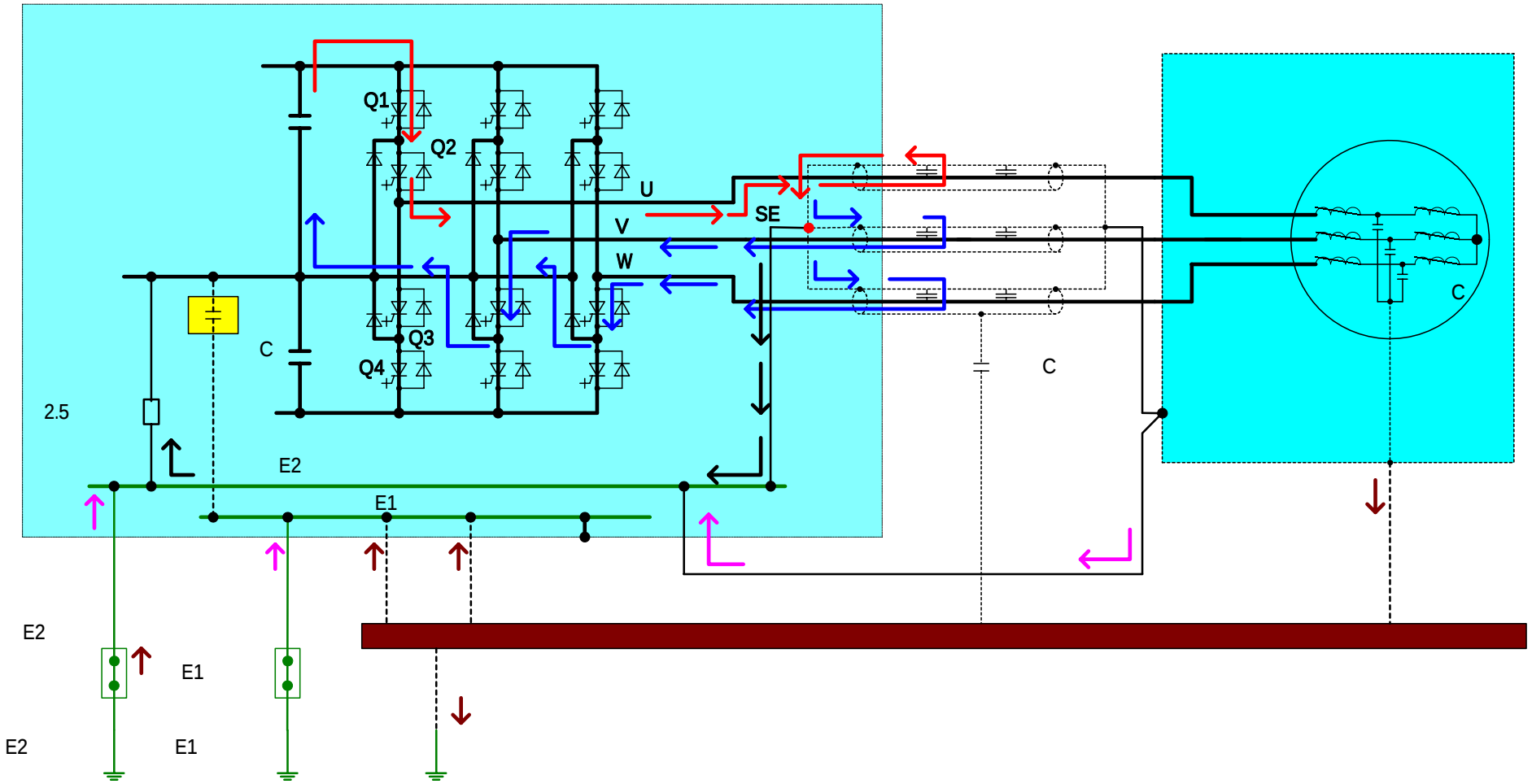
2.6.1-4

2 2 3

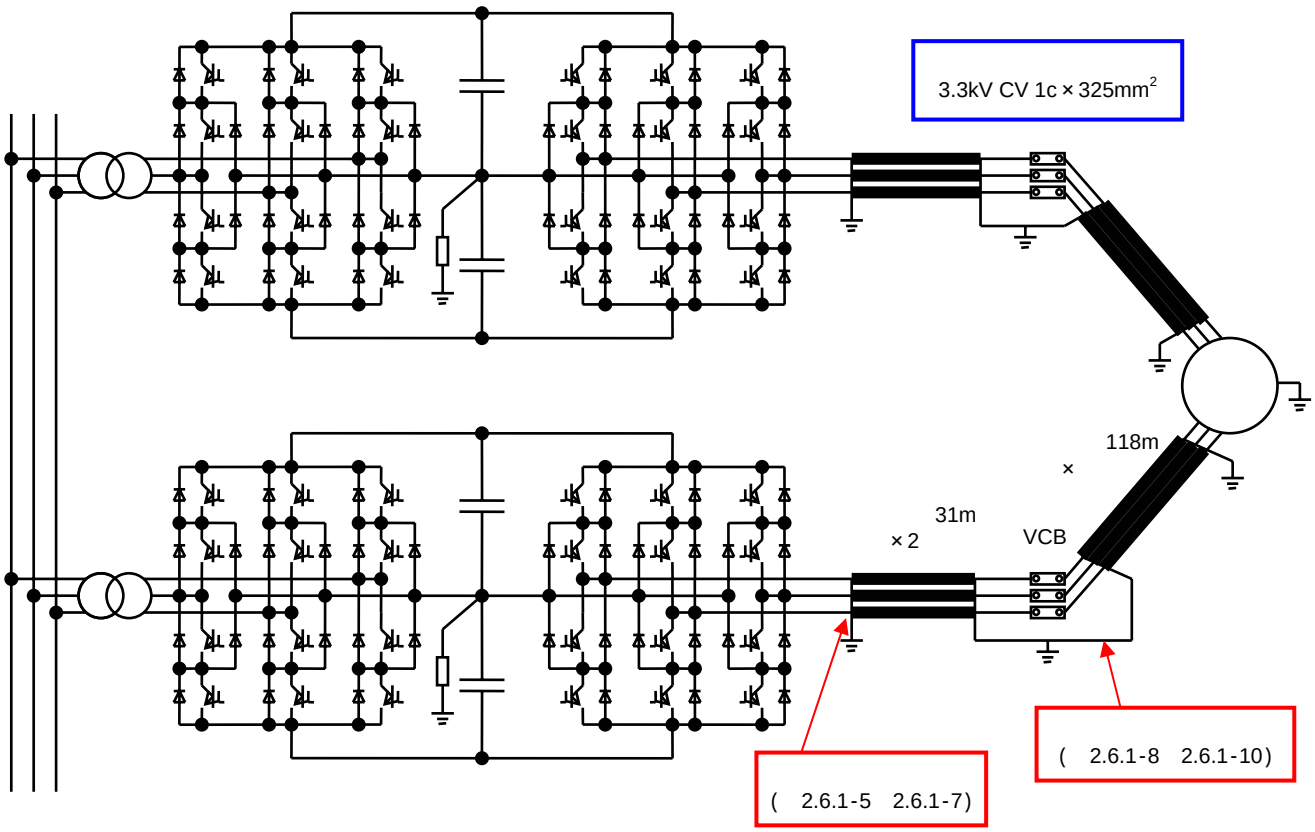
VCB 31m×2 VCB 118m×1

VCB 2.6.1-4

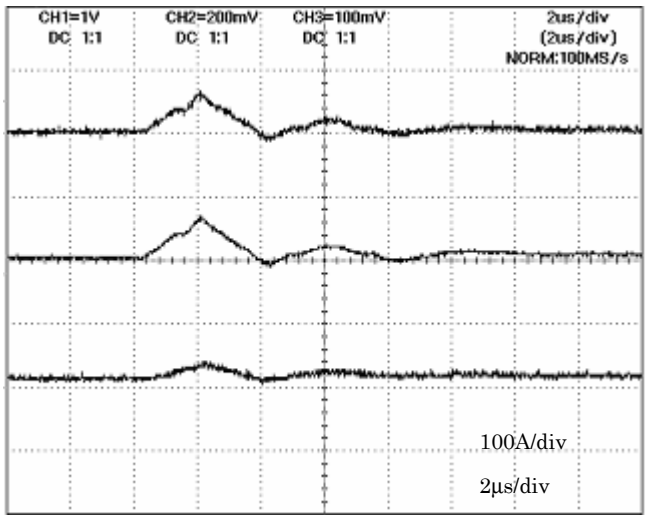
2.6.1-5 2.6.1-10



2.6.1-3 (IEGT)



2.6.1-4



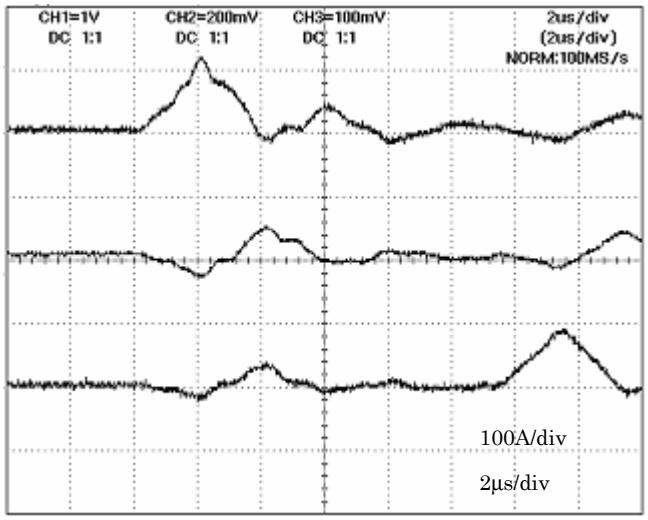
2

U (1)

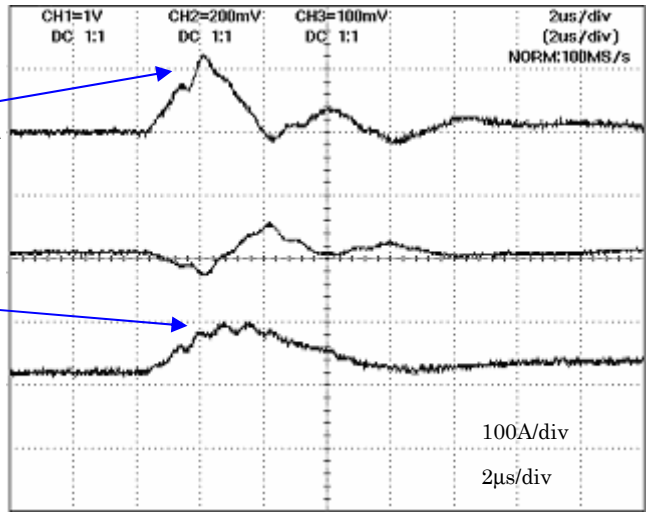
U (2)

U

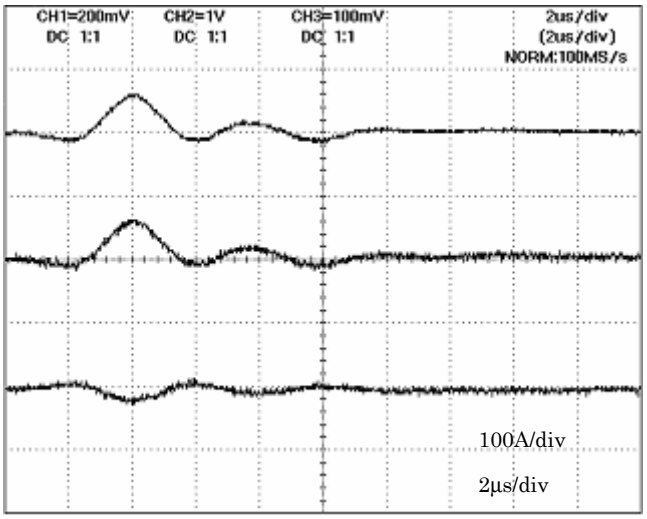
2.6.1-5 (U 1 2)



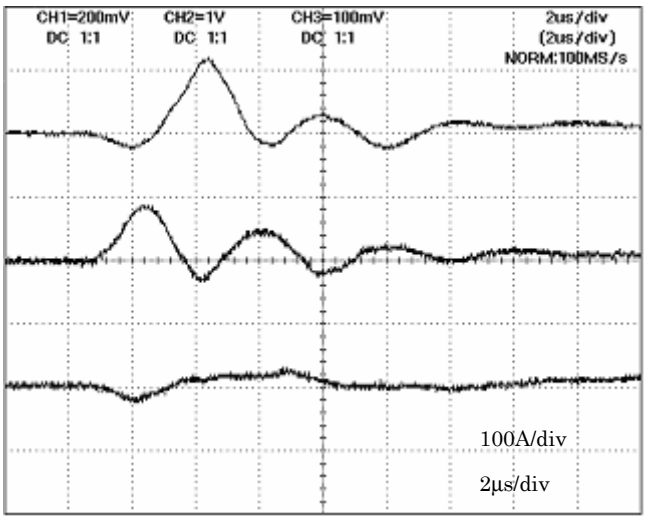
2.6.1-6 (U V W)



2.6.1-7 (U V)

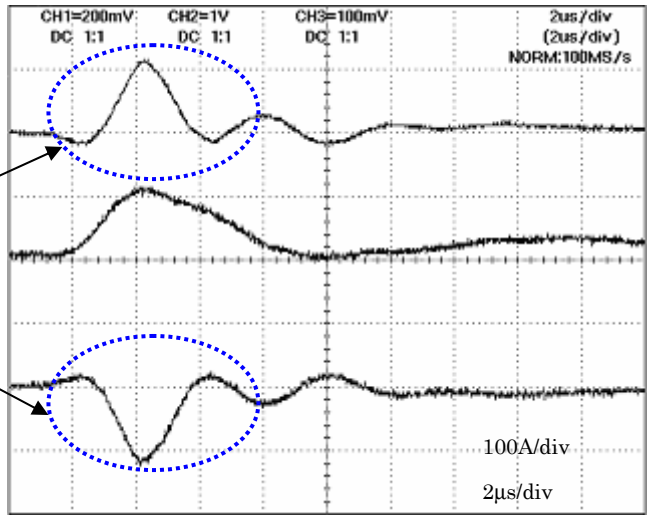


2.6.1-8 VCB (U 1 2)



VCB U
VCB V
VCB W

2.6.1-9 VCB (U V W)



VCB

VCB U
VCB
VCB U

2.6.1-10 VCB (U U)

(7)

120A(2) 4μs

2.6.1-7 100A

2.6.1-5 2.6.1-8 2

2.6.1-8 〃 〃 VCB (118m)

– (20A)

2.6.1-10 VCB U VCB

U

2.6.2

(1)

PS CAD/EMTDC(Ver.3.0.8)

2.6.3-1

3

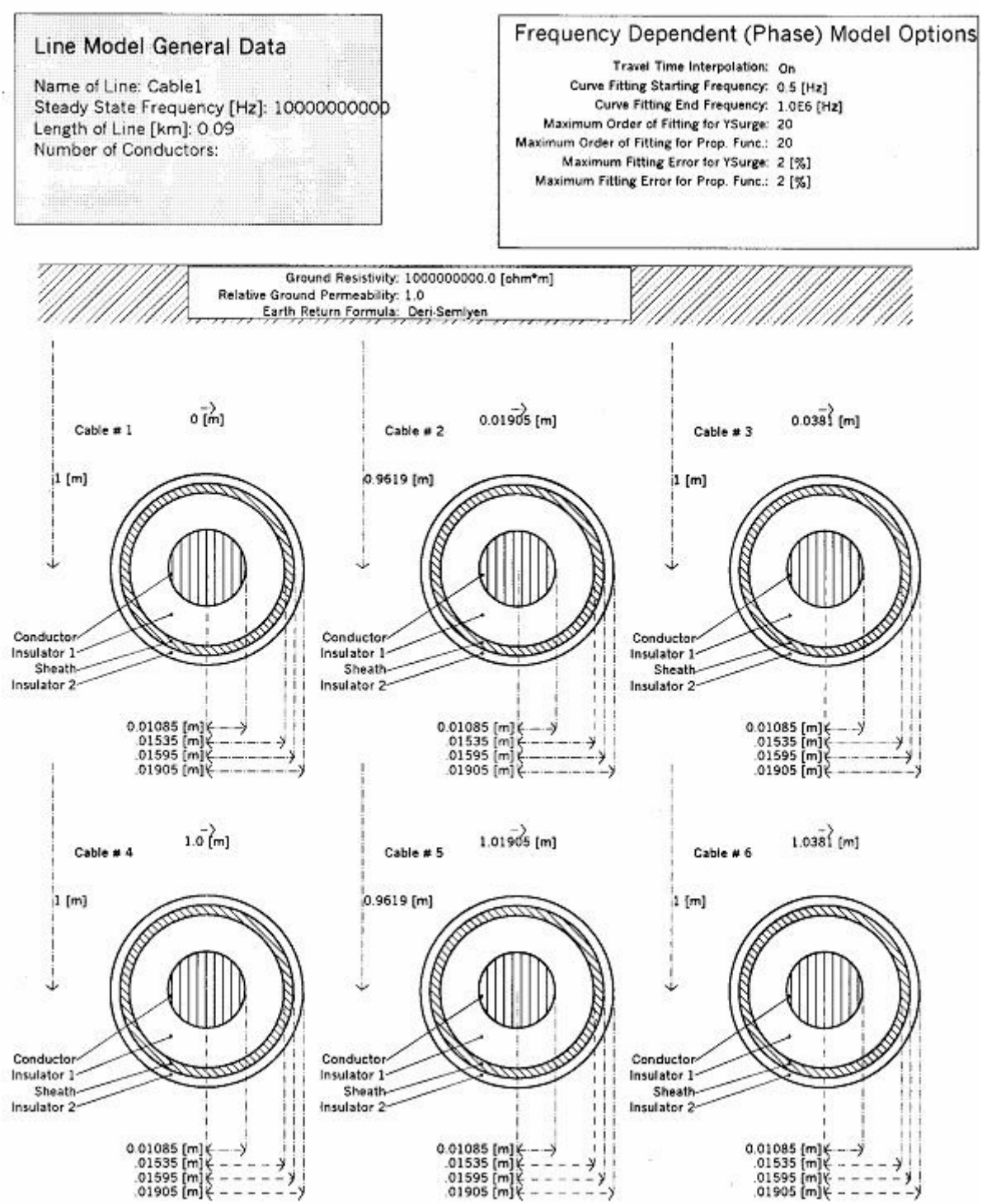
LR

V W U 0V→2345V

EMTDC

2.6.2-2

2



2.6.2-2 EMTDC

(2)

EMTDC

L

240A (120A) 2

(3)

1

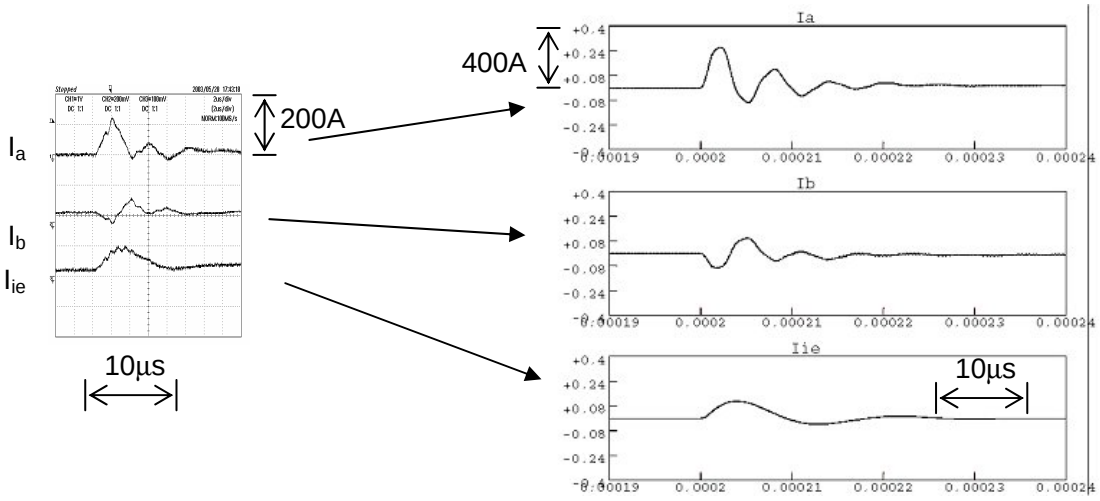
kV

kA

(10μs/DiV)

2.6.2-3

( ) 2



2.6.2-3

(4)

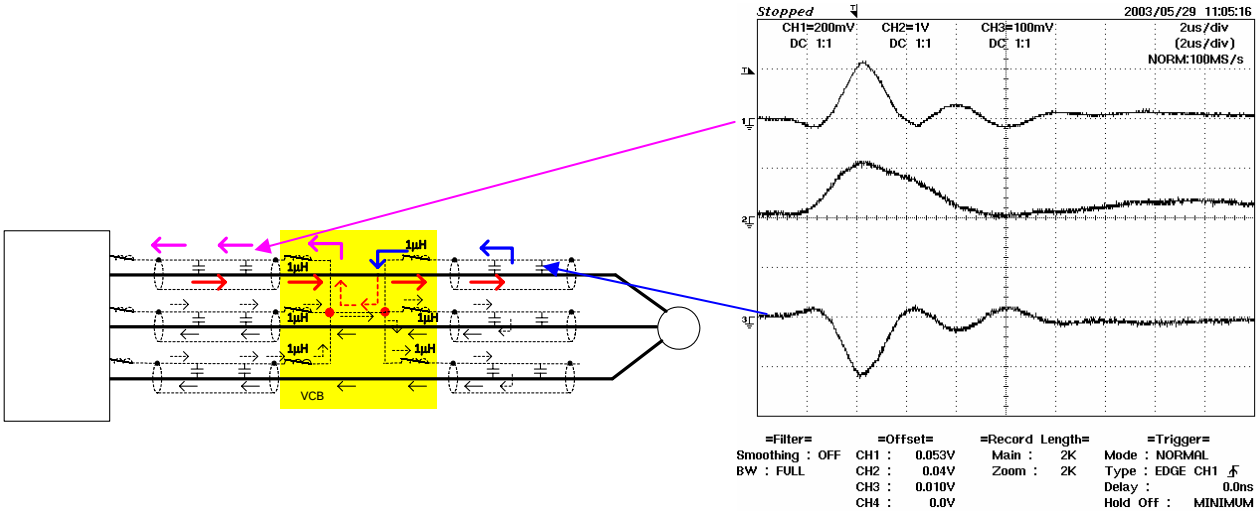
2.6.1 (5)

120A 240A

100kHz

U U

VCB VCB



2.6.2-4

2.5Ω (E2)

SE

(E1)

(SE)

(Z_{SE}) 2.6.1-3 U

SE 2/3 SE 1/3 2345V SE

800V SE E2 2.5Ω

SE

2.6.3

PSCAD/EMTDC(Ver.3.0.8) 2.6.3-1

(1)

100m 1

2 8 2.6.3-1

(2)

2.5Ω 8 10
2.6.3-2

(3)

10(1)
12(2)

(4)

0(IGBT
) 1μs(IEGT) 3μs(GCT/IGCT)

2.6.3-3
2.6.4
3

( )

( )

2.7 EMC

IEC

EMC

(1)

JEC-2451-2002

JEC-2452 -2002

JEC-2453 -

IEC 61800 -1:1997 Adjustable speed electrical power drive systems - Part 1: General requirements - Rating specifications for low voltage adjustable speed d.c.power drive systems

IEC 61800 -2:1998 Adjustable speed electrical power drive systems - Part 2: General requirements - Rating specifications for low voltage adjustable frequency a.c. power drive systems

IEC 61800 -3:2004 Adjustable speed electrical power drive systems – Part 3: EMC requirements and specific test methods

IEC 61800 -4: 2002 Adjustable speed electrical power drive systems - Part 4: General requirements – Rating specifications for a.c. power drive systems above 1000 V a.c and not exceeding 35 kV

(2)

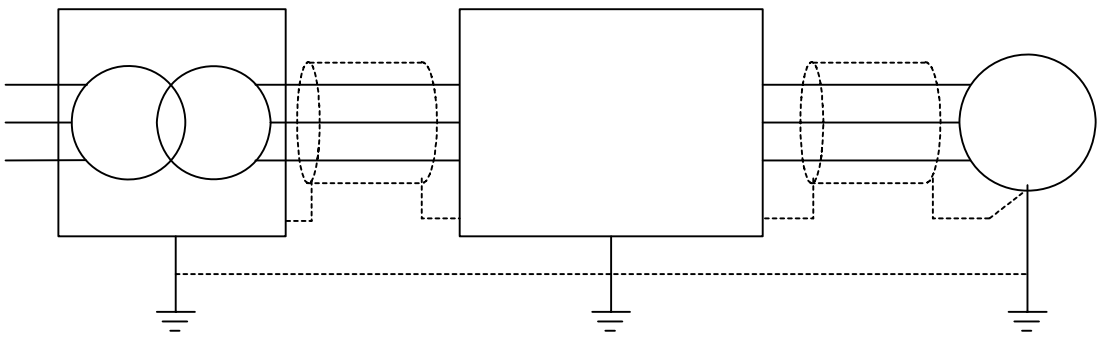
IEC 61800-4 " Equipotential bonding of main components( ) "

EMC

2.7-1

A B C

2.7-1



2.7-1

(3)

(

)

PWM 2.1

3.

EMC

2.6

3.

(1)

3 3

EMC

3

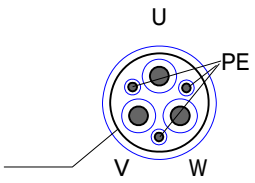
PWM "Evaluation of Motor Power Cables for PWM AC Drives (John Bentley IEEE Transactions on Industry Applications 1997)"

3 3 ( )

3 (PE) 3

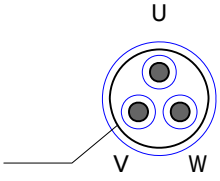
1

3



3-1 3 3

3 ( )

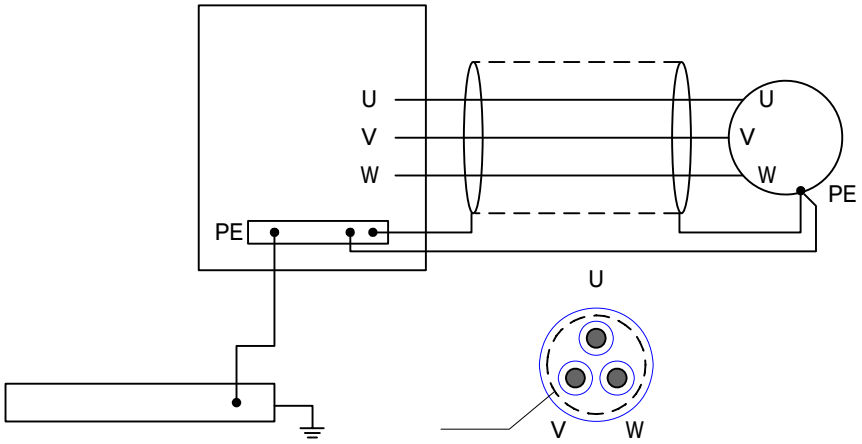


3-2 3

50

( )

3 (50%)



3-3

(2)

(CV)

PWM PWM

EMC

EMC 3 3

1 1/2 3 3

3 3kV

3

3-4

3-4

3

3 (CVT)

3

3　6kV　CV　CVT

600V　PWM

3　6kV　CV　CVT　PWM

PWM

4. WG

WG　16

1	2002 2　4	WG 5　1)　3) 1) 2) 3) EMC 4) FMEA 5)	
2	2002 4　12	EMC　( ) ( ) (　)	
3	2002 6　17	EMC　(IEC) ( ) (　)	
4	2002 8　26	EMC　( ) ( ) (　)	

5	2002 10 21	( )	
6	2002 12 3	(IEC)	
7	2003 2 7	EMC (IEC) ( ) (WG)	
8	2003 5 16	( )	
9	2003 7 7	( ) EMC (IEC)	
10	2003 9 12	( ) ( ) EMC ( )	
11	2003 11 7	(IEEE)	
12	2004 1 23	(	

13	2004 3 25	( ) (WG)	
14	2004 7 7	( )	
15	2004 10 19	( )	
16	2005 1 27		

5.

WG 3 (CV CVT)

CV CVT ( )

WG

EMC /

WG

EMC

EMC

WG

WG

WG