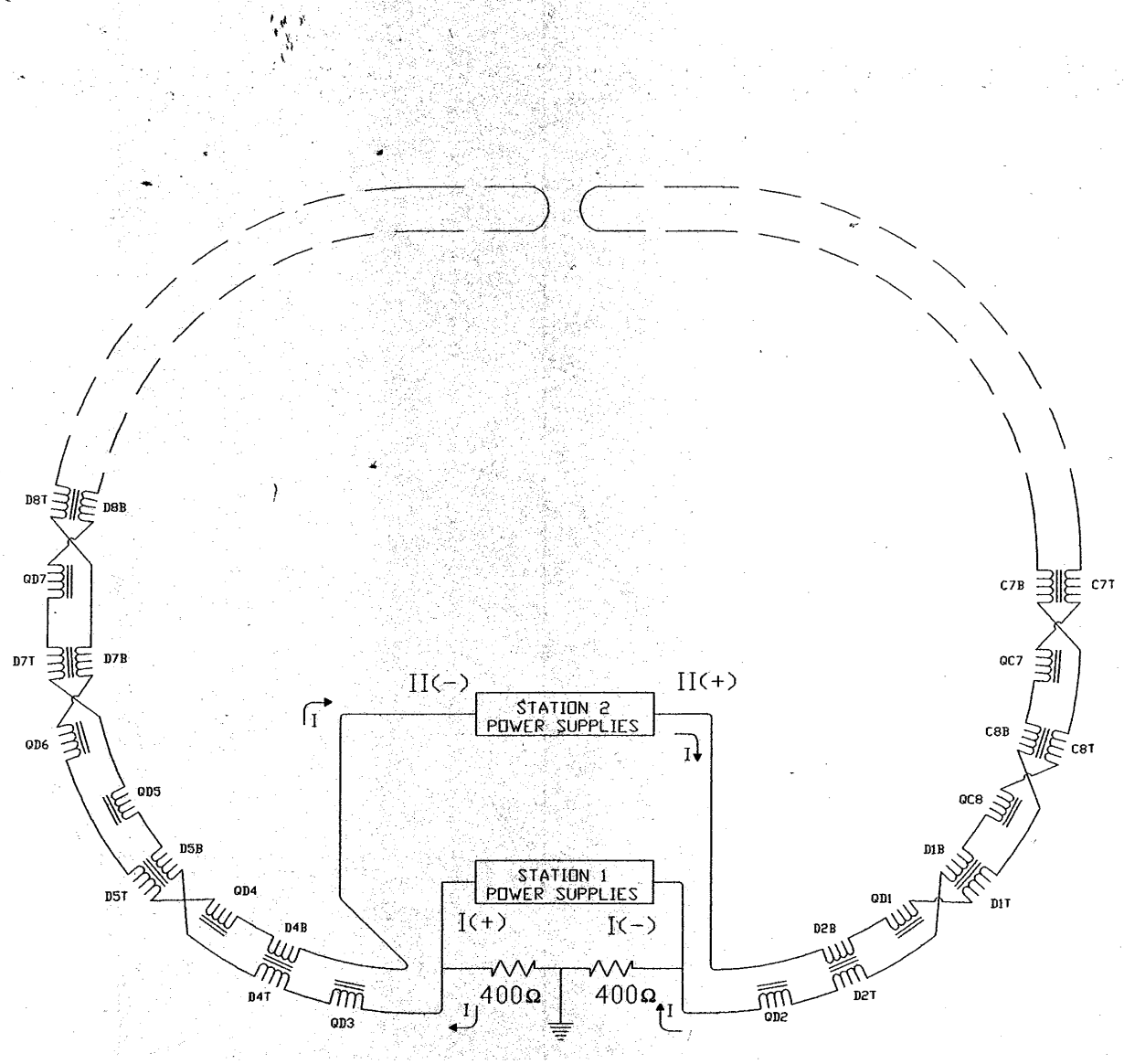
BOOSTER MAIN MAGNET POWER SUPPLY/PARAMETERS FOR BAF APPLICATION

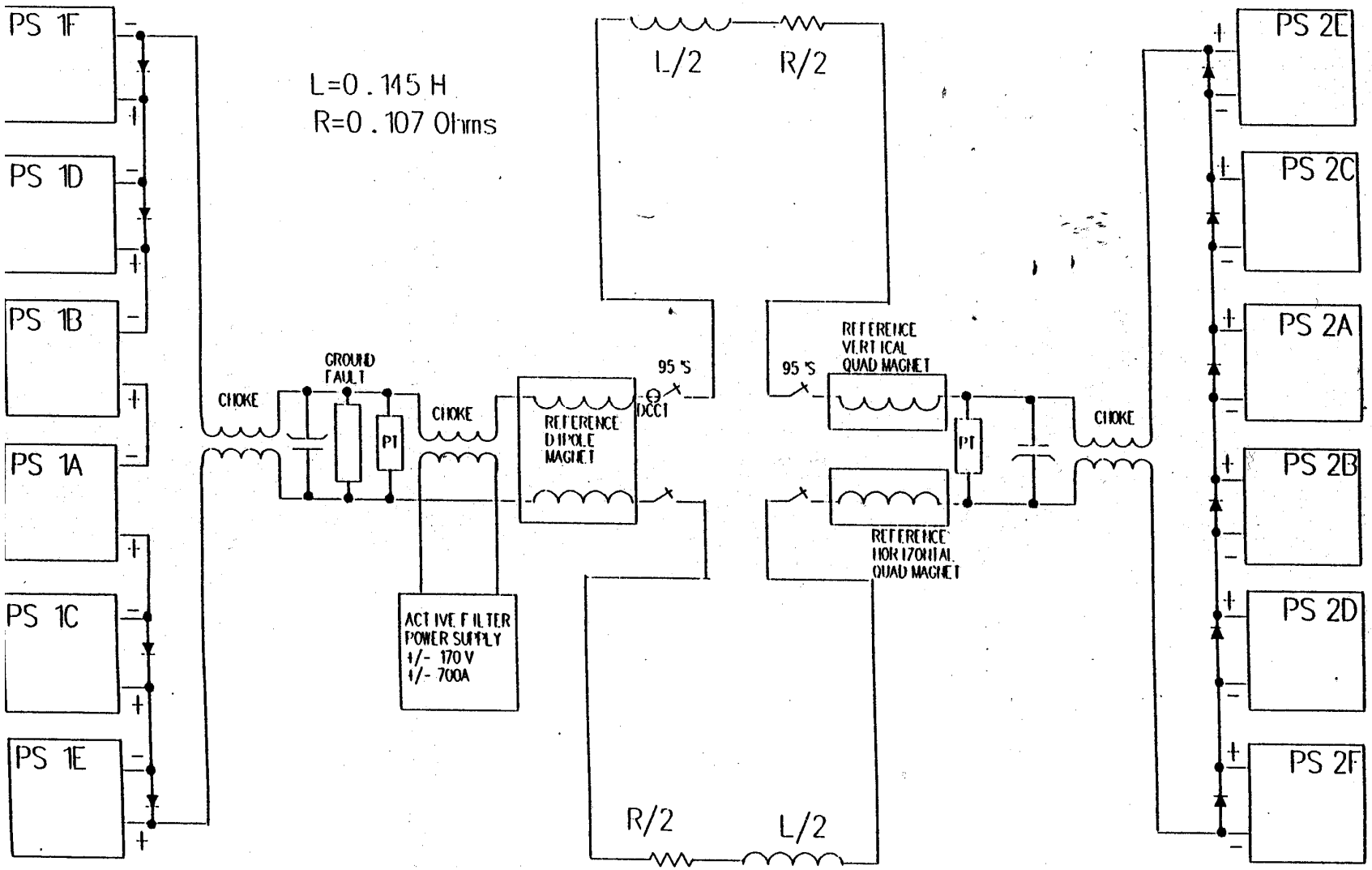
IOANNIS MARNERIS

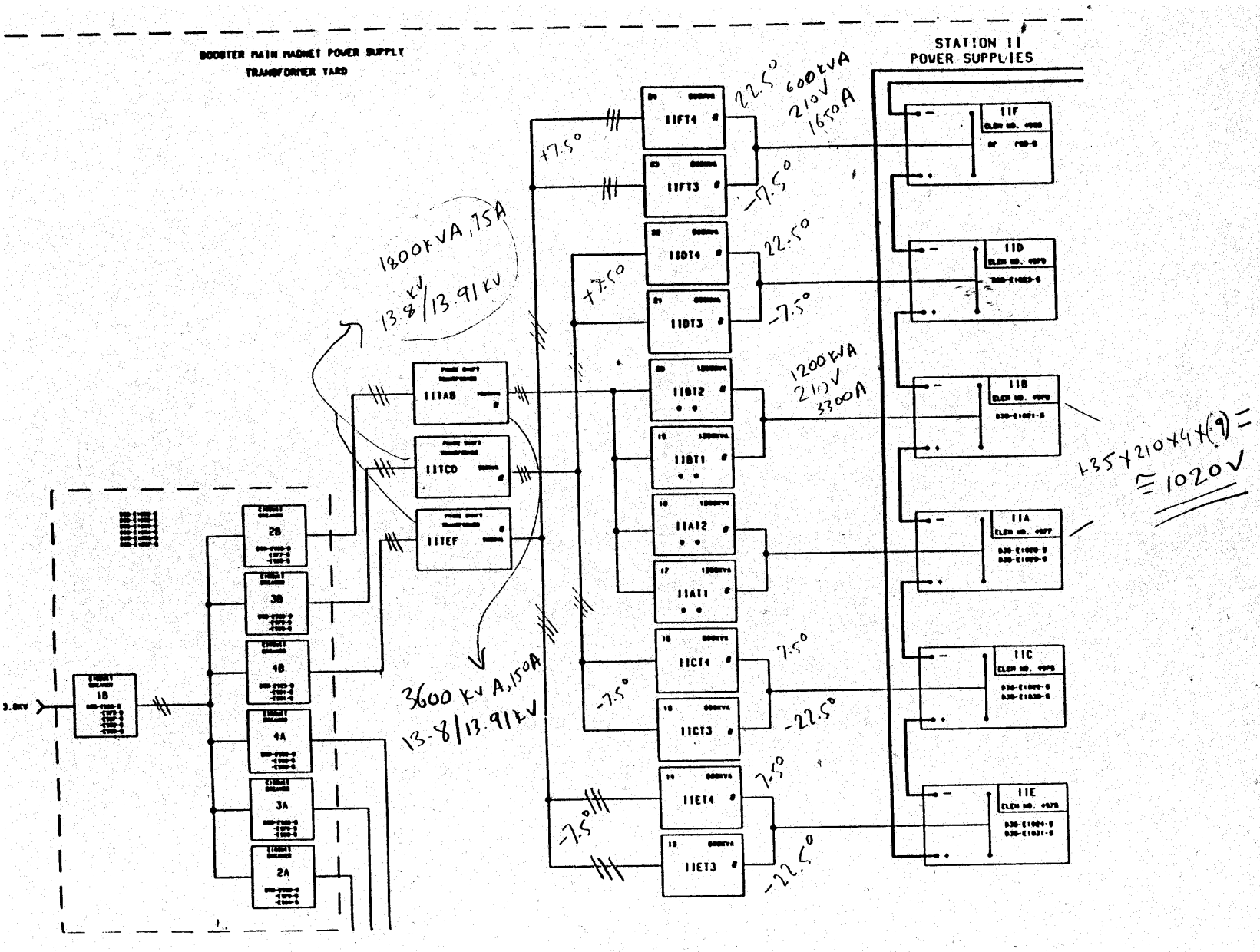
DATE: 5/1/02

BOOSTER MMPS
+/- 6000V, 2700A PULSED
OR +/- 2000V, 5000A PULSED



BOOSTER MAIN MAGNET POWER SUPPLY BLOCK DIAGRAM




BOOSTER MAIN MAGNET POWER SUPPLY
TRANSFORMER YARD
STATION 11
POWER SUPPLIES
11FT4
11FT3
11DT4
11DT3
11BT2
11BT1
11A12
11AT1
11CT4
11CT3
11ET4
11ET3
11AB
11CD
11EF
1B
2B
3B
4B
4A
3A
2A
11F
11D
11B
11A
11C
11E
22.5°
+7.5°
-7.5°
600KVA
210V
1650A
1200KVA
210V
3300A
1800KVA, 15A
13.8 KV
13.8/13.91KV
3600 KV A, 150A
13.8/13.91KV
1.35×210×4×(9)=
≅1020V

PPMR

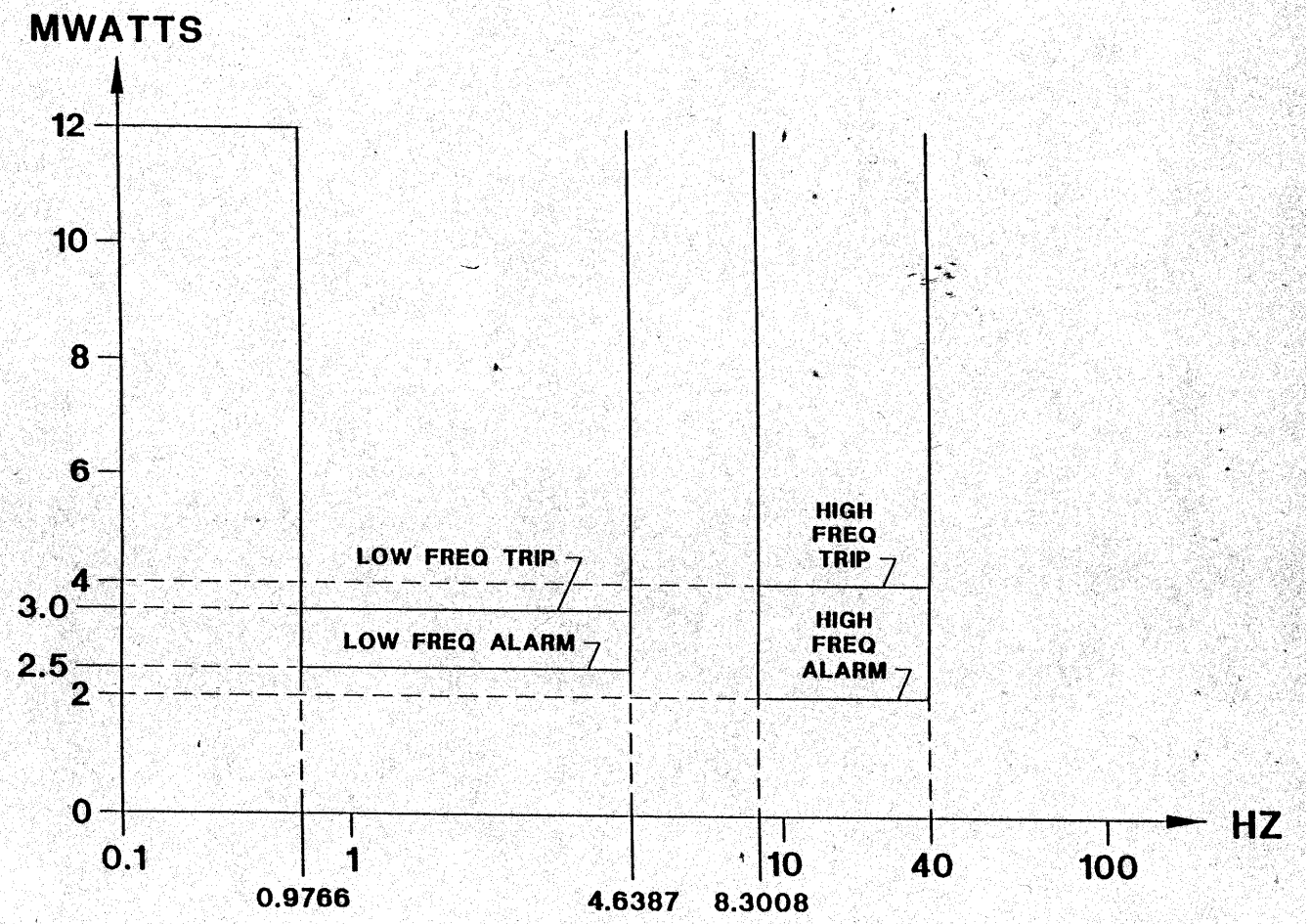


Figure 1 TRIP AND ALARM SETTINGS

BOOSTER MMPS ANALYSIS FOR BAF USING IAB POWER SUPPLY ONLY DUTY CYCLE 17%

DATE: 4/17/02

IOANNIS MARNERIS

$T := 6$ $tr := 1.5$ $tft := 1$

$t := 0, 0.01 .. T$

$Ifp := 250$ $Ift := 5000$

$a := \frac{Ift - Ifp}{tr}$ $Ift := Ifp + a \cdot tr$ $R := 0.1075$ $L := 0.145$

$I1(t) := if(t < tr, Ifp + a \cdot t, Ifp + a \cdot (tr))$

$I2(t) := if(t > tft + tr, -a \cdot t + Ifp + a \cdot (tr + tr + tft), Ifp)$

$I3(t) := if(t \le tr + tft, I1(t), I2(t))$

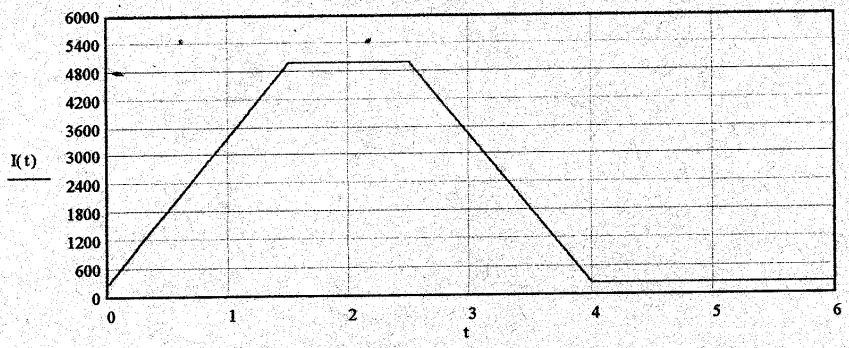
$I(t) := if(t \le 2 \cdot tr + tft, I3(t), Ifp)$ $V(t) := L \cdot \frac{d}{dt} I(t) + I(t) \cdot R$

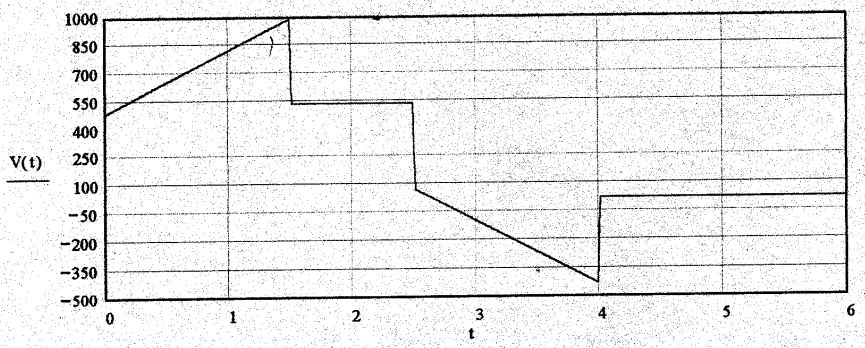
$Pam := \frac{R}{T} \cdot \int_0^T I(t)^2 dt$

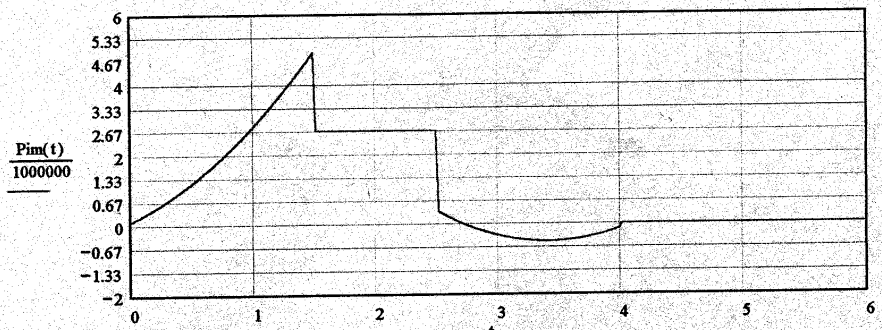
$Pim(t) := I(t) \cdot V(t)$

$Irms := \sqrt{\frac{1}{T} \cdot \left(\int_0^T I(t)^2 dt \right)}$ $Irms = 2.928 \cdot 10^3$

$\frac{Pam}{1000} = 921.633$







CALCULATIONS ON THE 1200 KVA TRANSFORMER

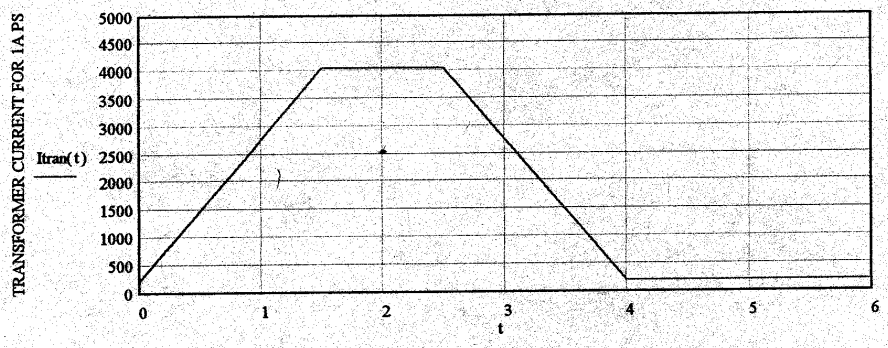
$Vtrans := 210$ $Ptran\_rms = 1200000$ $Itran\_rms = 3300$

$Edo1A := Vtrans \cdot 1.35$ $Edo1A = 283.5$

$$Ptran(t) = Itran(t) \cdot Vtrans \cdot \sqrt{3} \cdot \frac{\frac{V(t)}{4}}{Edo1A} = \frac{\frac{V(t)}{4} \cdot I(t)}{0.96}$$ **WITH IIAB NOT ON**

$$Itran(t) := \frac{\frac{I(t)}{0.96}}{\left(\frac{Vtrans \cdot \sqrt{3}}{Edo1A}\right)} \qquad Itran(t) := \frac{1.35 \cdot I(t)}{0.96 \cdot \sqrt{3}}$$

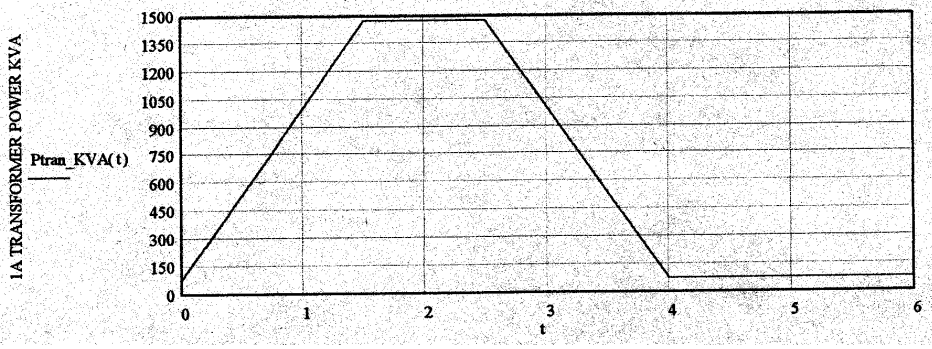
$$Ptran(t) := Itran(t) \cdot Vtrans \cdot \sqrt{3} \cdot \frac{\frac{V(t)}{4}}{Edo1A} \qquad Ptran\_KVA(t) := \frac{Itran(t) \cdot Vtrans \cdot \sqrt{3}}{1000} \qquad Irms\_tran := \sqrt{\frac{1}{T} \cdot \left(\int_0^T Itran(t)^2 dt \right)}$$



$Irms\_tran = 2.377 \cdot 10^3$

LIMIT IS 3300 A

$$\frac{1}{T} \cdot \int_0^T Ptran\_KVA(t)\, dt = 658.301$$

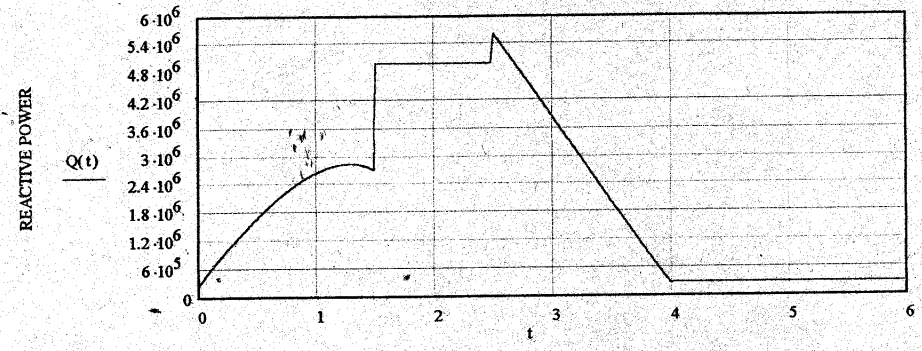


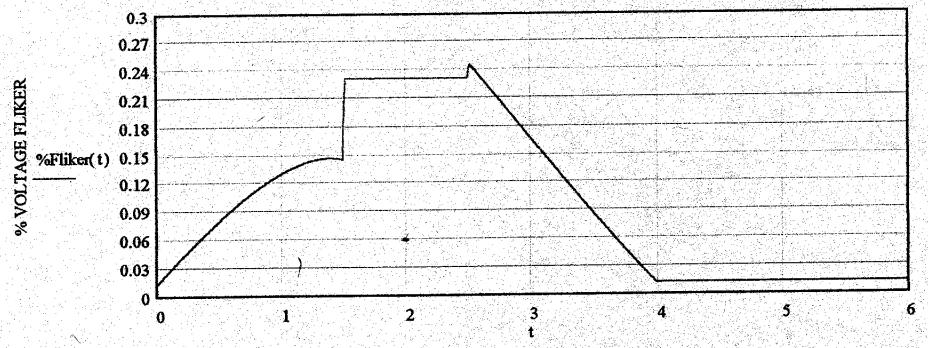
FROM MARVIN'S PAPER

$R := 0.265$ $X := 2.063$ $SCC := 2308 \cdot 10^6$

$$Q(t) := \tan\left(\operatorname{acos}\left(\left|\frac{\frac{V(t)}{4}}{Edo1A}\right|\right)\right) \cdot Pim(t)$$

$$\%Fliker(t) := \frac{Q(t) + Pim(t) \cdot \left(\frac{R}{X}\right)}{SCC} \cdot 100$$

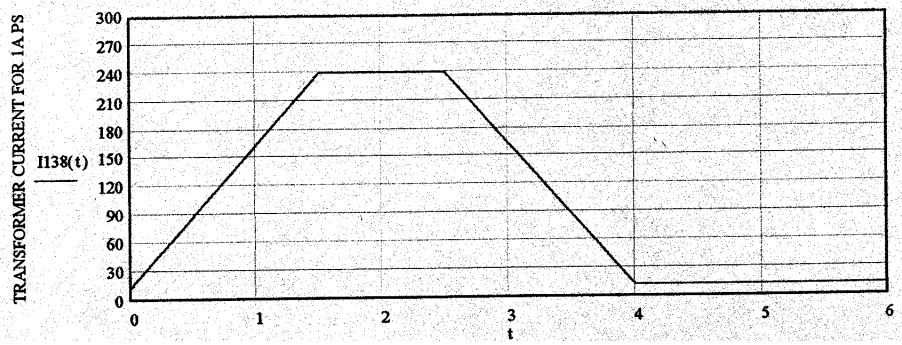




CALCULATE THE CURRENT OF THE 14.2 KV TRANSFORMERS AT THE PRIMARY

$$I138(t) := \frac{Itran(t)}{67.62} \cdot 4$$

$$Irms\_138 := \sqrt{\frac{1}{T} \cdot \left(\int_0^T I138(t)^2 dt\right)}$$



Irms_138 = 140.625

LIMIT IS 150 A

$T := 4$ $tr := 0.5$ $tft := 1$

BOOSTER MMPS ANALYSIS FOR BAF USING IAB AND IIAB POWER SUPPLIES ONLY DUTY CYCLE 25%

DATE: 9/25/00

IOANNIS MARNERIS

$t := 0, 0.001 .. T$

$Ifp := 350$ $Ift := 5000$

$a := \frac{Ift - Ifp}{tr}$ $Ift := Ifp + a \cdot tr$

$R := 0.1075$ $L := 0.145$

$I1(t) := if(t < tr, Ifp + a \cdot t, Ifp + a \cdot (tr))$

$I2(t) := if(t > tft + tr, -a \cdot t + Ifp + a \cdot (tr + tr + tft), Ifp)$

$I3(t) := if(t \le tr + tft, I1(t), I2(t))$

$I(t) := if(t \le 2 \cdot tr + tft, I3(t), Ifp)$ $V(t) := L \cdot \frac{d}{dt} I(t) + I(t) \cdot R$

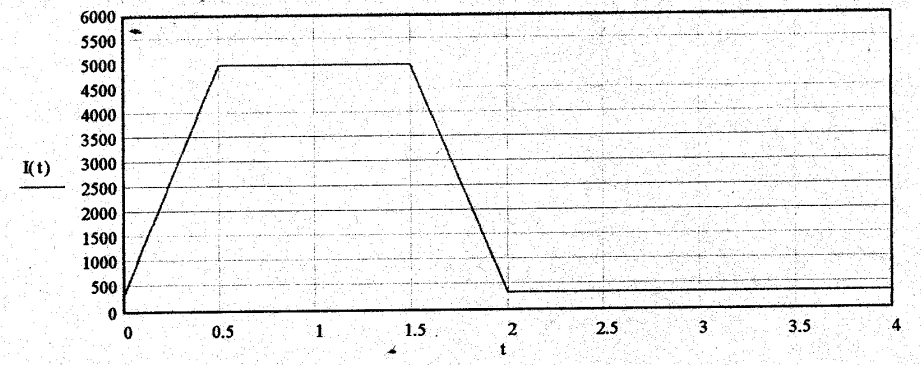
what we could do

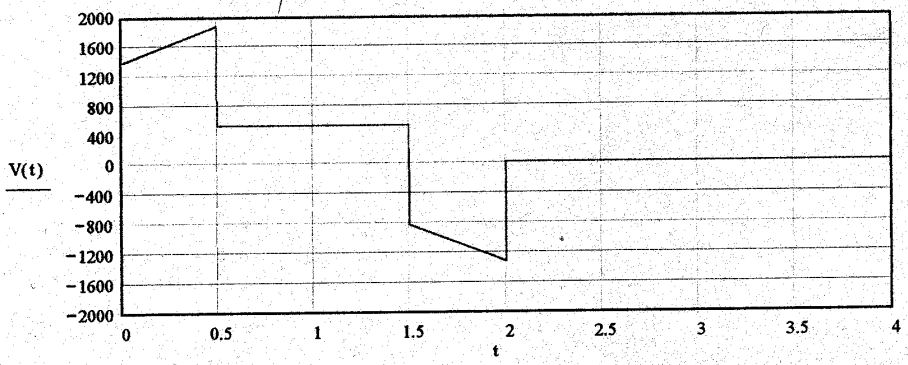
$$Pam := \frac{R}{T} \cdot \int_0^T I(t)^2 dt$$

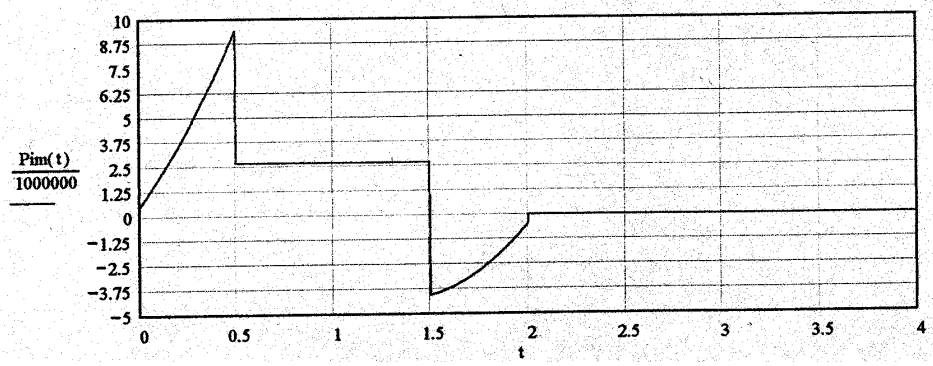
$$Irms := \sqrt{\frac{1}{T} \cdot \left(\int_0^T I(t)^2 dt \right)} \quad Irms = 2.924 \cdot 10^3$$

$Pim(t) := I(t) \cdot V(t)$

$\frac{Pam}{1000} = 919.192$







CALCULATIONS ON THE 1200KVA TRANSFORMER

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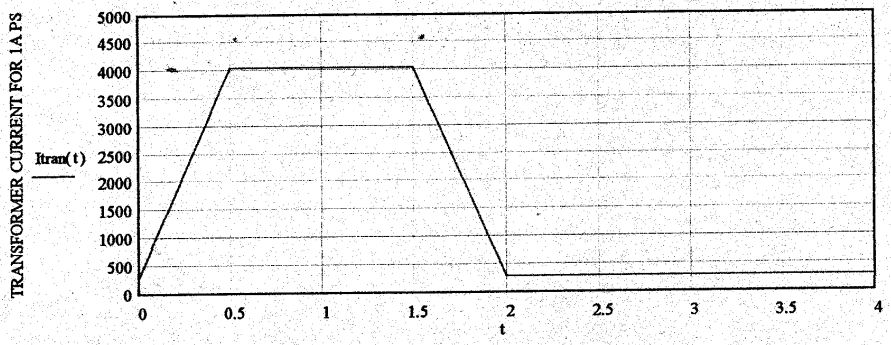
$Edo1A := Vtrans \cdot 1.35$ $Edo1A = 283.5$

$Ptran(t) = Itran(t) \cdot Vtrans \cdot \sqrt{3} \cdot \frac{\frac{V(t)}{8}}{Edo1A} = \frac{\frac{V(t)}{8} \cdot I(t)}{0.96}$ **WITH IIAB NOT BYPASSED**

$Itran(t) := \frac{\frac{I(t)}{0.96}}{\left(Vtrans \cdot \sqrt{3}\right)}$ $Itran(t) := \frac{1.35 \cdot I(t)}{0.96 \cdot \sqrt{3}}$

$Ptran(t) := Itran(t) \cdot Vtrans \cdot \sqrt{3} \cdot \frac{\frac{V(t)}{8}}{Edo1A}$ $Ptran\_KVA(t) := \frac{Itran(t) \cdot Vtrans \cdot \sqrt{3}}{1000}$ $Irms\_tran := \sqrt{\frac{1}{T} \cdot \left(\int_0^T Itran(t)^2 dt \right)}$

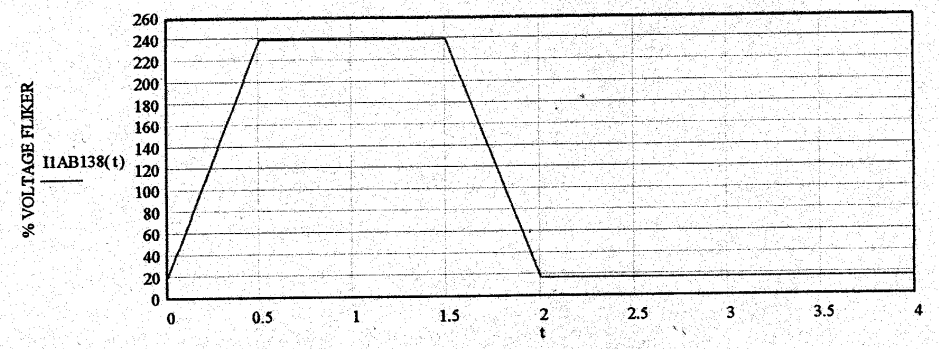


$Irms\_tran = 2.374 \cdot 10^3$

LIMIT IS 3300 A

CALCULATE THE CURRENT OF THE 14.2 KV TRANSFORMERS AT THE PRIMARY

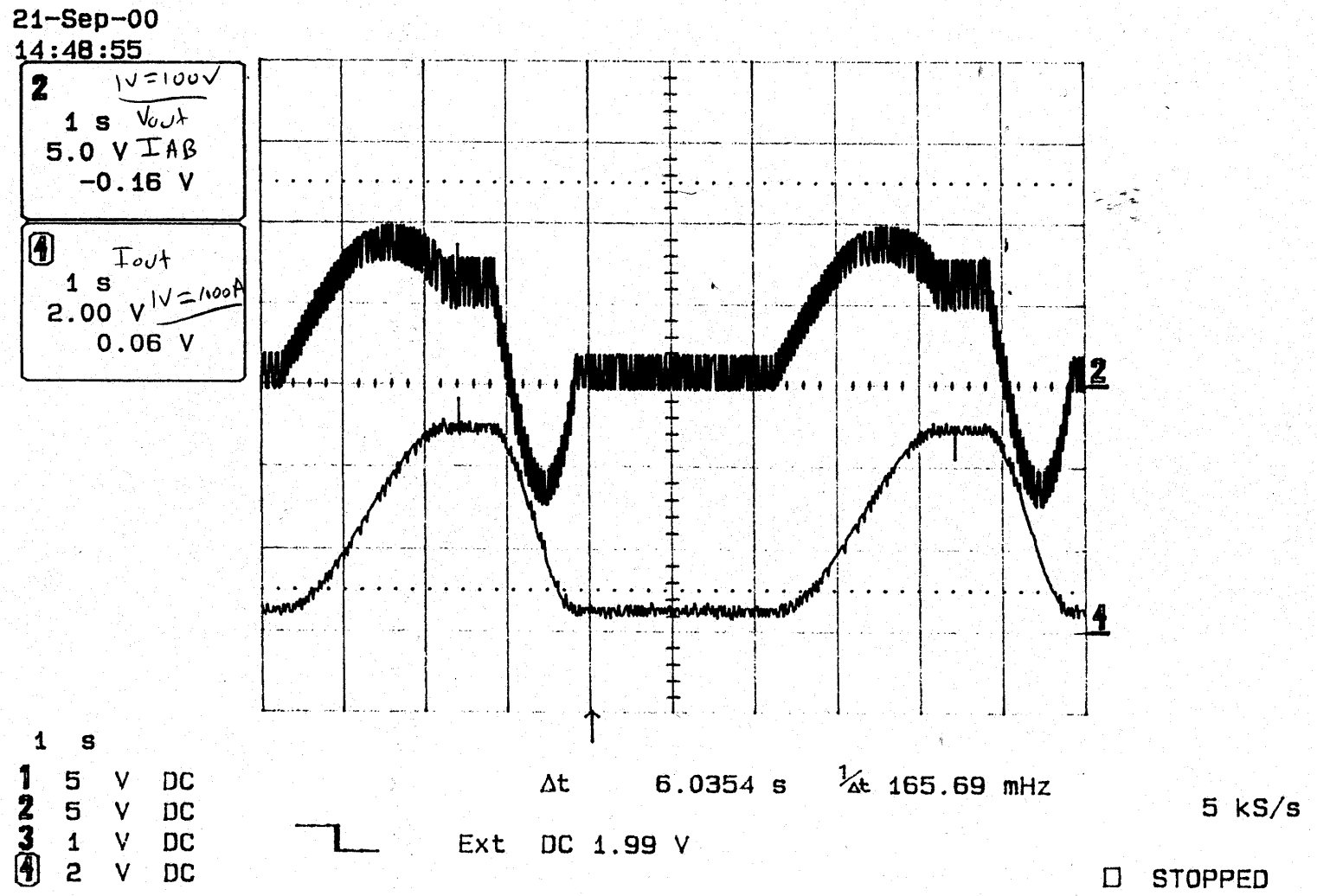
$I1AB138(t) := \frac{Vtrans}{14200} \cdot Itran(t) \cdot 4$



$Irms\_138 := \sqrt{\frac{1}{T} \cdot \left(\int_0^T I1AB138(t)^2 dt \right)}$ $Irms\_138 = 140.44$ **LIMIT IS 150 A**

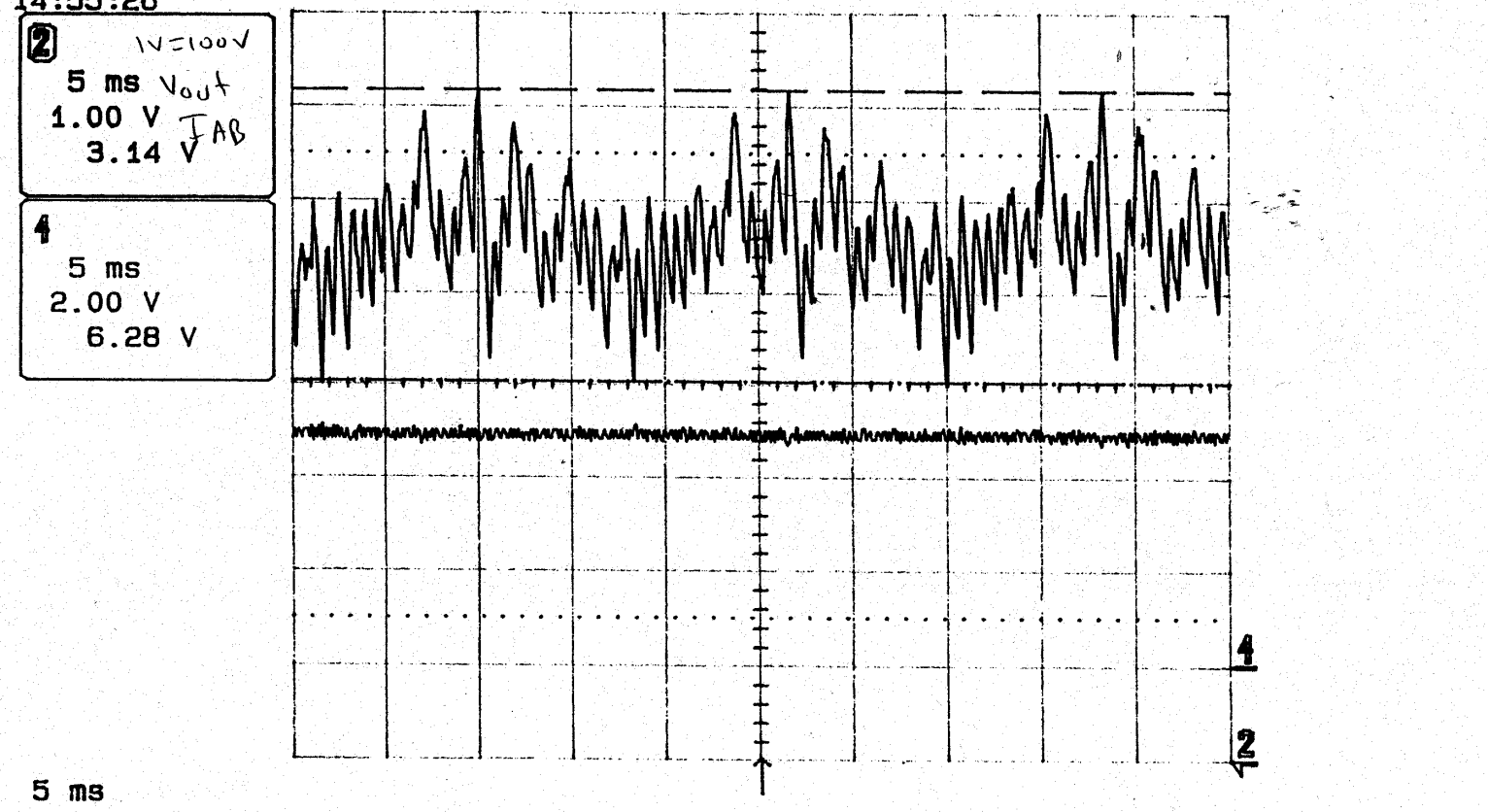
I = 5000 A

IAB outs



I = 5000A voltage ripple during the flat top unfiltered

$V_{ripple\,p\text{-}p} = 3.14\ V_{pp}$

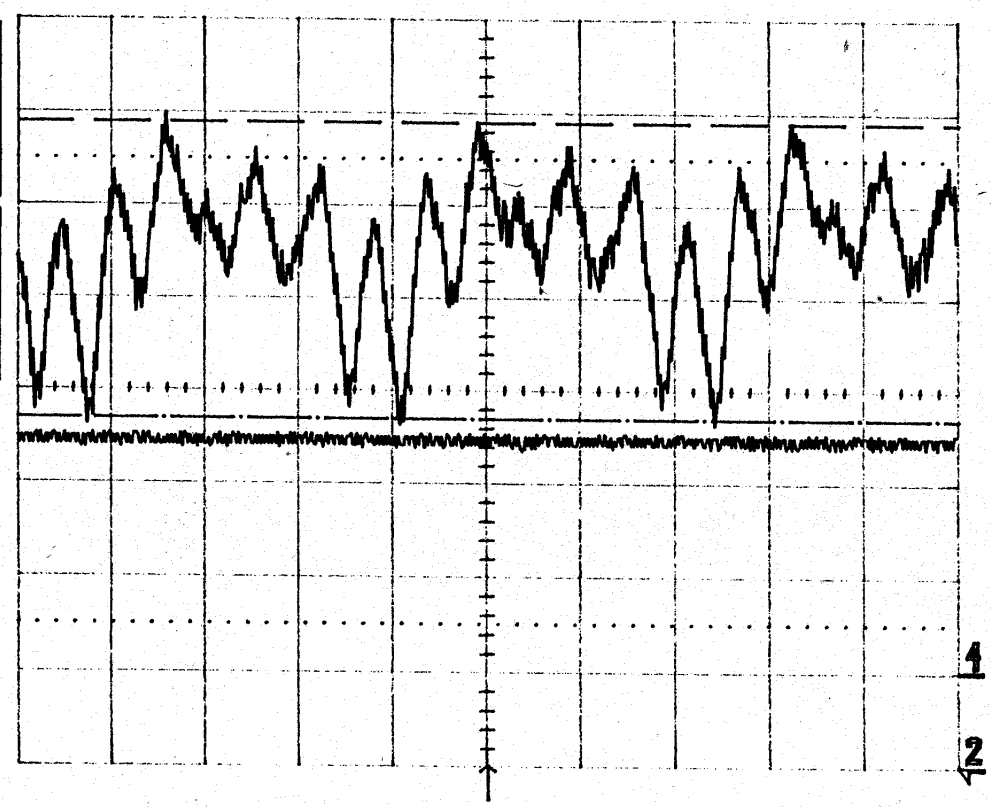


I = 5000 A Voltage ripple filtered st1
st2 = 0
$\boxed{V_{R\text{-}pele\,PP} = 160\ V_{PP}}$ Largest Freq = 360 Hz

21-Sep-00
15:03:29

2 1V = 1000V
5 ms
50mV
160.2mV

4
5 ms
2.00 V
6.41 V



5 ms
1 5 V DC
2 50 mV DC
3 1 V DC
4 2 V DC

Ext DC 1.99 V

1 MS/s

NORMAL

TRIAB CURRENT RMS

I = 5000A

T = 6 sec

$I_{TRIAB\ RMS} = \sqrt{\frac{1}{T}\int_0^T I_{TR}^2\,dt} + 24$

$= \sqrt{\frac{1}{6}(181)^2 2.0} + 24 =$

$= 104 + 24 = 128A$

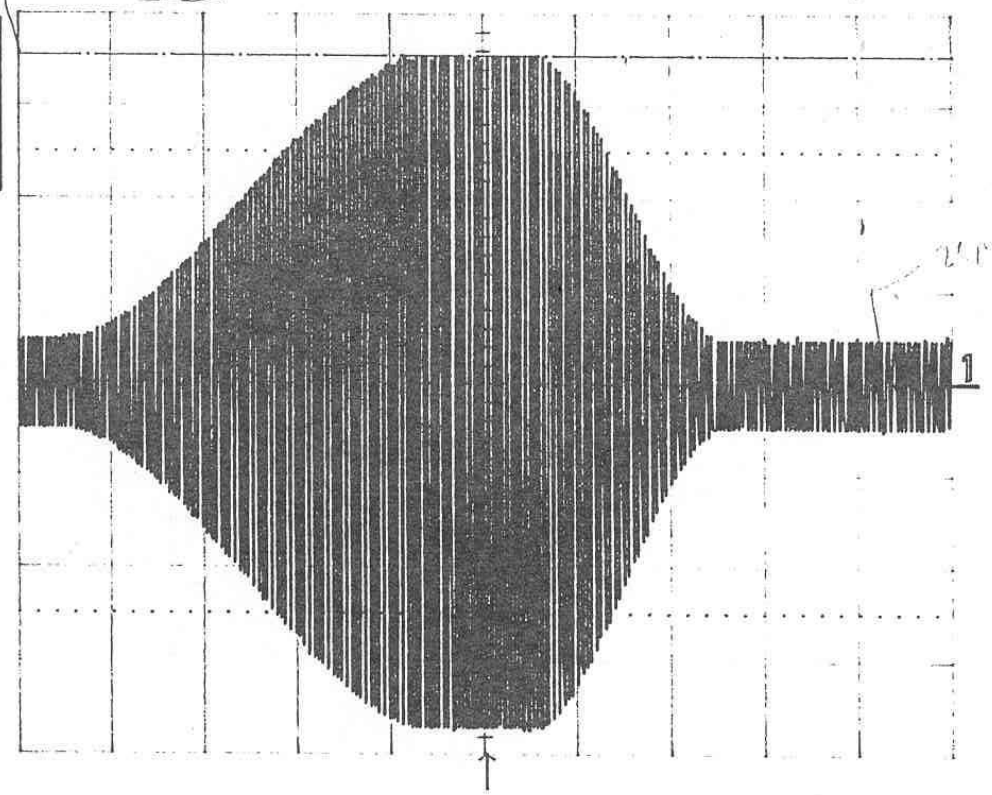
→ 205 A RMS

22-Sep-00
9:46:37

1
.5 s
200mV
704mV

100mV = 29.12 A RMS

$T_{TR} = 60°C$



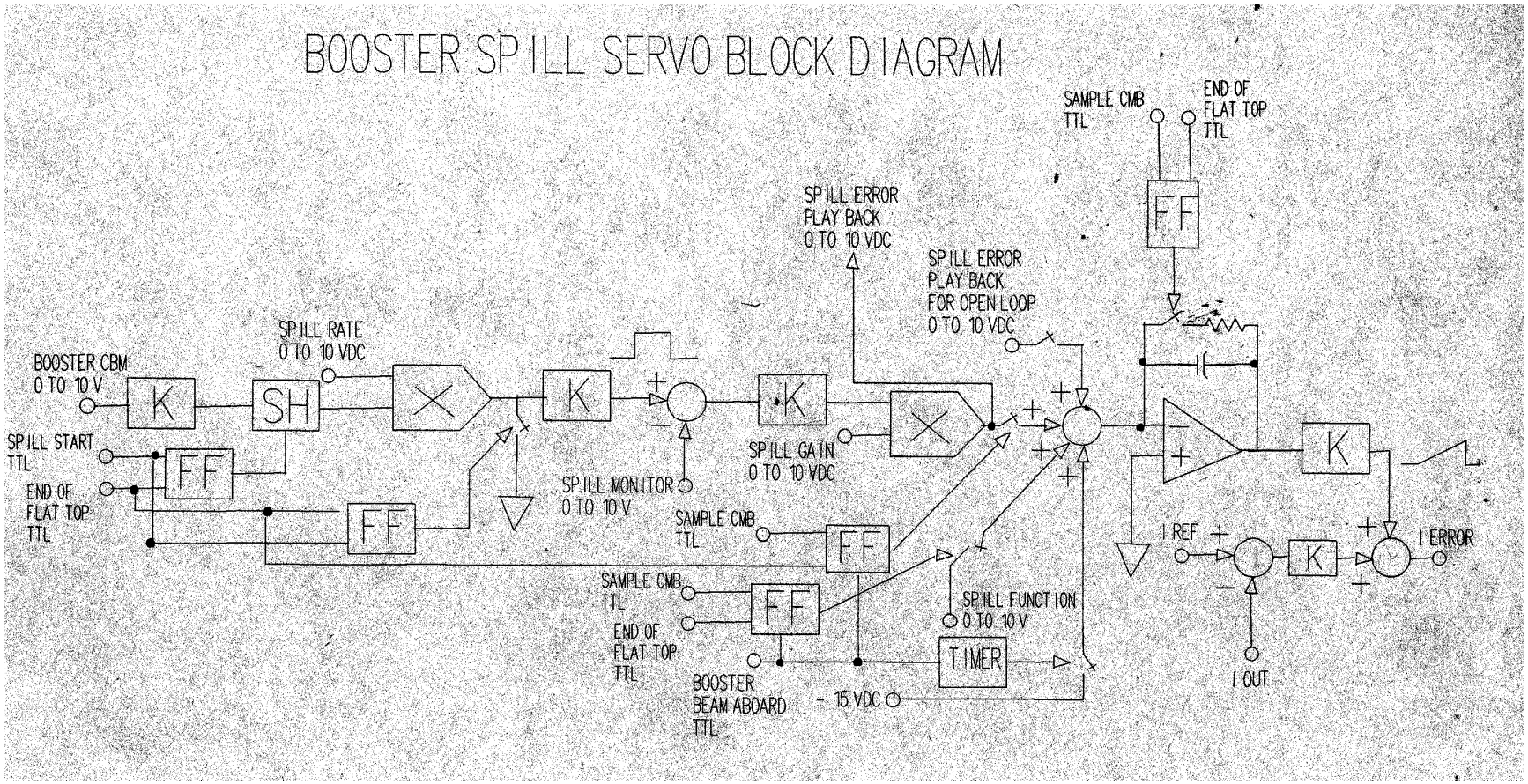
.5 s
1 .2 V DC
2 5 V DC
3 1 V DC
4 2 V DC

Ext DC 1.99 V

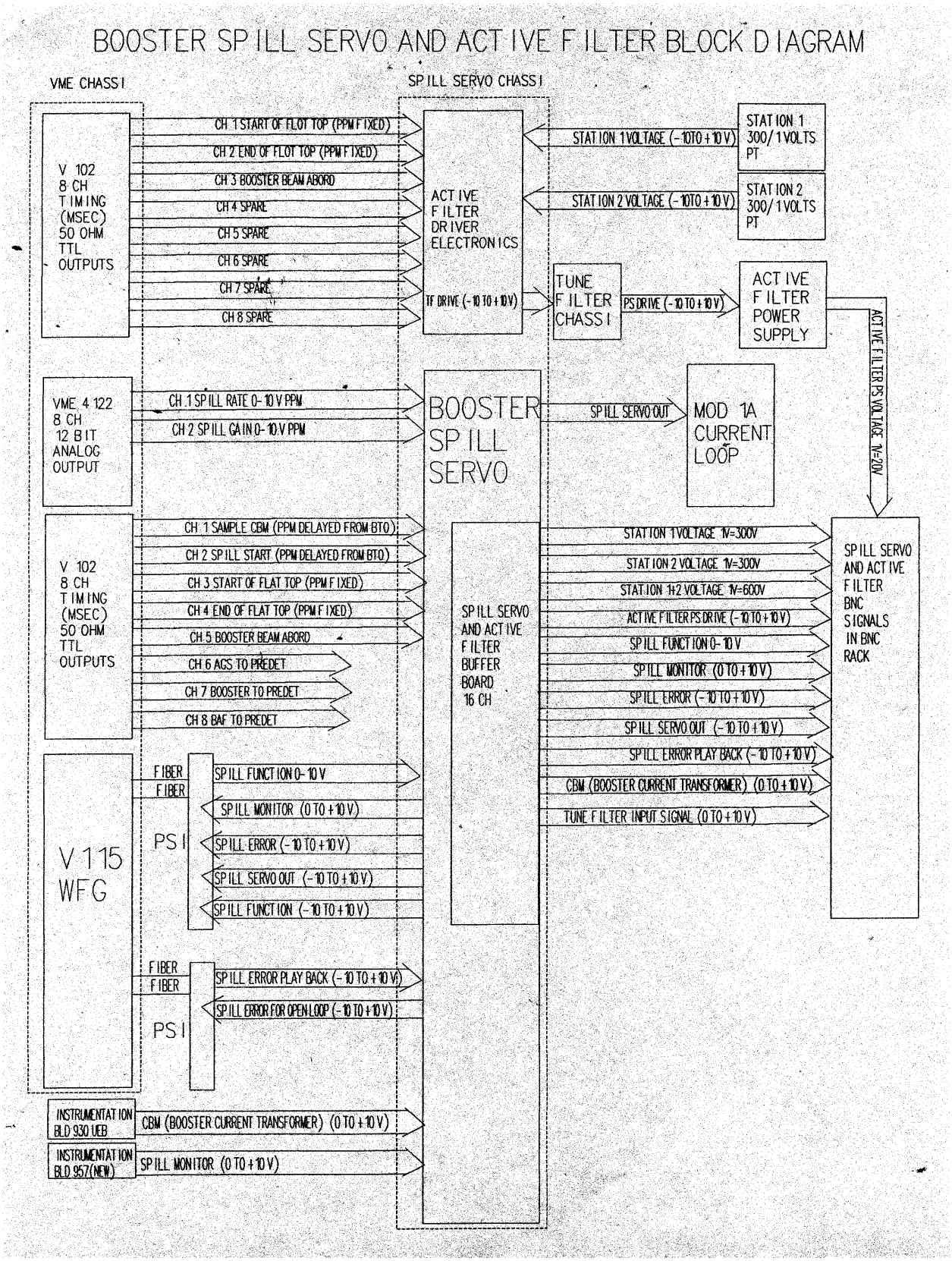
10 kS/s

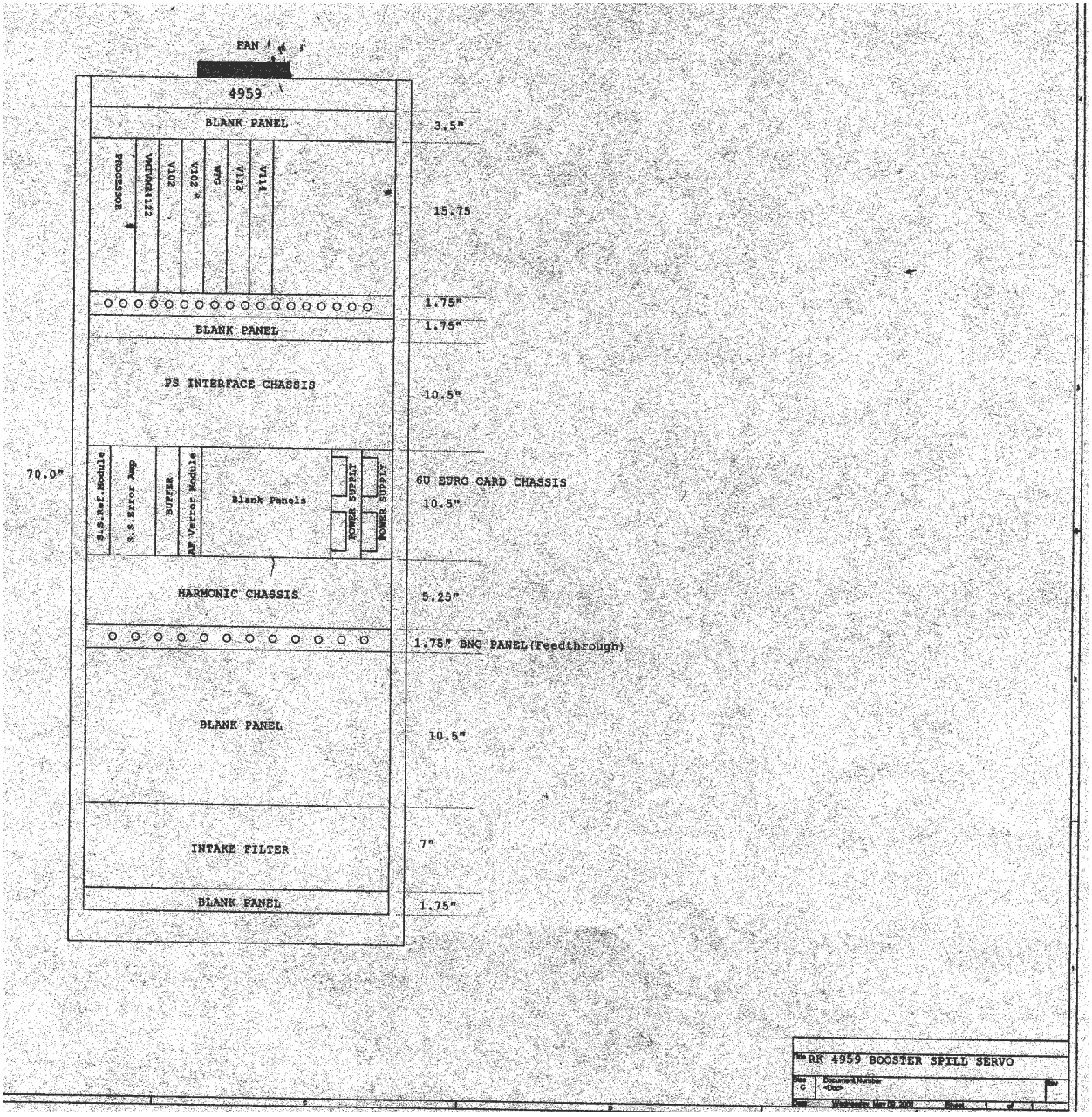
STOPPED

BOOSTER SPILL SERVO BLOCK DIAGRAM



BOOSTER SPILL SERVO AND ACTIVE FILTER BLOCK DIAGRAM




FAN
4959
BLANK PANEL
3.5"
PROCESSOR
VMTVME4122
V102
V102 *
WFG
V113
V114
15.75
1.75"
BLANK PANEL
1.75"
PS INTERFACE CHASSIS
10.5"
70.0"
S.S.Ref.Module
S.S.Error Amp
BUFFER
AF Verror Module
Blank Panels
POWER SUPPLY
POWER SUPPLY
6U EURO CARD CHASSIS
10.5"
HARMONIC CHASSIS
5.25"
1.75" BNC PANEL(Feedthrough)
BLANK PANEL
10.5"
INTAKE FILTER
7"
BLANK PANEL
1.75"
Title RK 4959 BOOSTER SPILL SERVO
Size C
Document Number <Doc>
Rev
Date Wednesday, May 09, 2001
Sheet 1 of 1