THYRISTOR BRAKING UNIT

(Preliminary Issue)

Thyristor Braking Unit (TBU)

(Preliminary Issue)

INDEX

RENEWAL PARTS

Thyristor Braking Units (TBUs)

Name	Code	Part No.	Qty.
Control Board SAFT 185 TBC	58119687	505757	1
Power Supply SAMC 11 POW	57171847	104750	1
Interface Board SAFT 19 INF	57401389	110972	1
Interface Board SAFT 181 INF	58116076	505758	1
Pulse Amp Board SAMT 11 PAC	57211369	107392	1
Measuring Card SAFT 183 VMC	58115479	505760	1
Fan	09857931	503211	1
Circuit Breaker	35044931	504489	1
Capacitor	09833153	505761	3

TBU Parts Specific to Units

Name	Code	Part No.	kVA					
			290	460	730	340	540	870
Choke	57433124	504497		1				
Choke	57436603	504532	1					
Choke	57423439	505840					1	1
Choke	57421355	504500			1	1		
SCR Thyristor	35077065	505841	3					
SCR Thyristor	09802011	505842		3	3		3	3
SCR Thyristor	10000556	505843				3		
Thermostat	35046852	503459	1			1		
Thermostat	35044582	104743		1	1		1	1
Resistor	09827323	505846		1	1		1	1
Resistor	09827315	505845	1			1		

Name	Part No.
48 volt Power Supply 3.9A	131091
TBU Rack with Boards	505411

CONTENTS

1. General information

Thyristor braking unit (TBU) is a new module used instead of line converting unit (LCU) or line generating unit (LGU), in applications where regeneration of power is required.

Standard units available are:

SAFUX 250F380(415)	SAFUX 290F460
400F380(415)	460F460
630F380(415)	730F460
1000F380(415)	1150F460
1600F380(415)	1800F460
SAFUX 315F500	SAFUX 340F575
500F500	540F575
800F500	870F575
1250F500	1400F575
2000F500	2100F575
SAFUX 400F660	
630F660	
1000F660	
1600F660	
2500F660	

2. Design

2.1 Main circuit diagrams

Main circuit diagrams in appendix 11 and 12 and control circuit diagram in appendix 10.

2.2 Main circuit

TBU includes:

- regenerative thyristor bridge:
  - 12 "hockey pock" thyristors (400-2500kVA) or 6 thyristor modules (250-400 kVA)
  - 6 RC-snubbers
  - thermostatic switch
  - cooling elements; 2 bottom elements and 12 topping elements or only 2 bottom elements (with thyristor modules)
- filtering choke (in the small units included to the module, but in bigger units a separate module); in some applications filtering choke is not required (check DIMENSIONING INSTRUCTIONS FOR SAFUX THYRISTOR BRAKING UNITS).
- circuit cards:
  - SAMT 11 ; part of the mechanical construction
  - SAFT 183 VMC ; part of the mechanical construction
  - SAFT 185 TBC ; assembled to a card rack
  - SAFT 19 INF ; assembled to a card rack
  - SAFT 181 INF ; assembled to a card rack
  - SAMC 11 POW ; assembled to a card rack
  - SAFT 182 MOB ; mother card in the rack

2.3 Pulse amplifier card SAMT 11

Main purpose of pulse amplifier card is to construct galvanicly isolated gate pulses to the thyristors from the control card logical level signals.

Gate current is continuous as long as logical ON-signal is active; in the beginning of the gate pulse a short spike to turn on the thyristor as fast as possible.

25V 35kHz power from the power supply card SAMC 11 POW.

Scaling of the ac-line voltage and current measurements is done on the pulse amplifier card from where they go to SAMC 19 INF card.

2.4 Power supply card

Operation of the power supply card is based on push-pull principle. Input voltage 30...55VAC. Output voltages +12V, -12V, +5V, 0V to the control electronics and 25V 35kHz to the pulse amplifier.

Rated power of the power supply is 80W (48V 1.7A).

2.5 Control card SAFT 185 TBC

Main purpose of this card is to calculate firing orders to the thyristors based on:

- current discontinuity signal HOLE,
- synchronizing information from line voltage USYN
- DC-voltage

Important signals:

- FLT : summary of fault signals
- NETF: netfail signal

Self diagnostics:

- checks all components on the card and turns on the LED on the board if a fault is detected.

Block diagram of the card in figure 1.

2.6 Interface card SAMC 19 INF

Card is connected to the card rack and to the mother card SAFT 182 MOB. Also a connection with ribbon cable to control- and pulse amplifier cards.

Main functions:

- forms synchronizing signals (6*F-signal)
- netfail indication
- forms the current discontinuity signal
- frequency reference selection
- STOP-START signal
- phase locked loop for the synchronizing signal

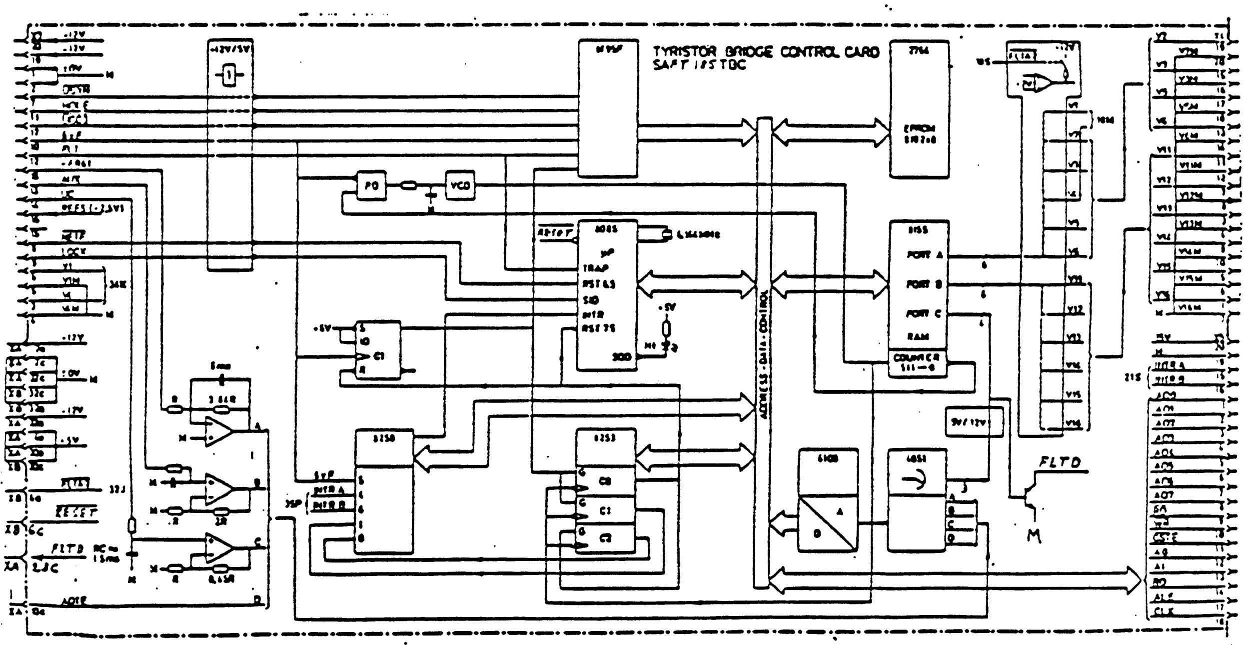

Figure 1. Block diagram

2.7 Interface card SAFT 181 INF

This is the interface card through which control card has connections to different modules. Signals to the card:

- DC-voltage information from SAFT 183 VMC
- inverter RUN signal
- overtemperature or fan motor stopped indication
- +24V from the contactor unit

Possibility to add:

- RESET switch/button for internal faults
- indication light for fault

2.8 Measuring card SAFT 183 VMC

Card measures DC-voltage and scales it (5Vdc output = rated DC-voltage). Output signal is also isolated from the DC-bus potential.

3. Operation

3.1 Main circuit operation

Regenerative bridge is build from 2-way 6-pulse thyristor bridges. Bridge that takes care of power flow from AC-line to the DC-bus is called motoring bridge. Bridge that takes care of power flow from DC-bus to the AC-line is called regenerating bridge.

Control angle of the motoring bridge is approximately 0 when power to the DC-bus is above 50% of rated (operates like a diode bridge).

When load is below 50% and current starts to change from continuous to discontinuous control angle will be changed to 0...65 degrees, which will cause the DC-voltage to decrease to 90% of rated.

If discontinuous current period exceeds the limit ($14^{\circ}...32^{\circ}$) pulses from the motoring bridge will be removed and two of the regenerating bridge thyristors will be turned on with control angle of 177.6 degrees and after this two thyristors will be turned on with 161 degrees control angle. After this, if current starts to flow, only one thyristor is turned on at a time with control angle of 155 degrees. If current still doesn't flow after this two thyristors will be turned on with control angle 0f 155...180 degrees depending from the length of "holes" in the current. If lenght of "hole" in the current still exceeds 10 degrees, pulses from the regenerating bridge will be removed and two motoring bridge thyristors will be turned on with 48 degrees control angle.

Both bridges are line commutated:

- each thyristor has a limited 180° ON-period
- ac-line voltage is used for commuation
- ON-cycle of one thyristor is 120 degrees
- commutation every 60 degrees

Firing table of the motoring bridge thyristors in figure 2.
Firing table of the regenerating bridge thyristors in figure 3.

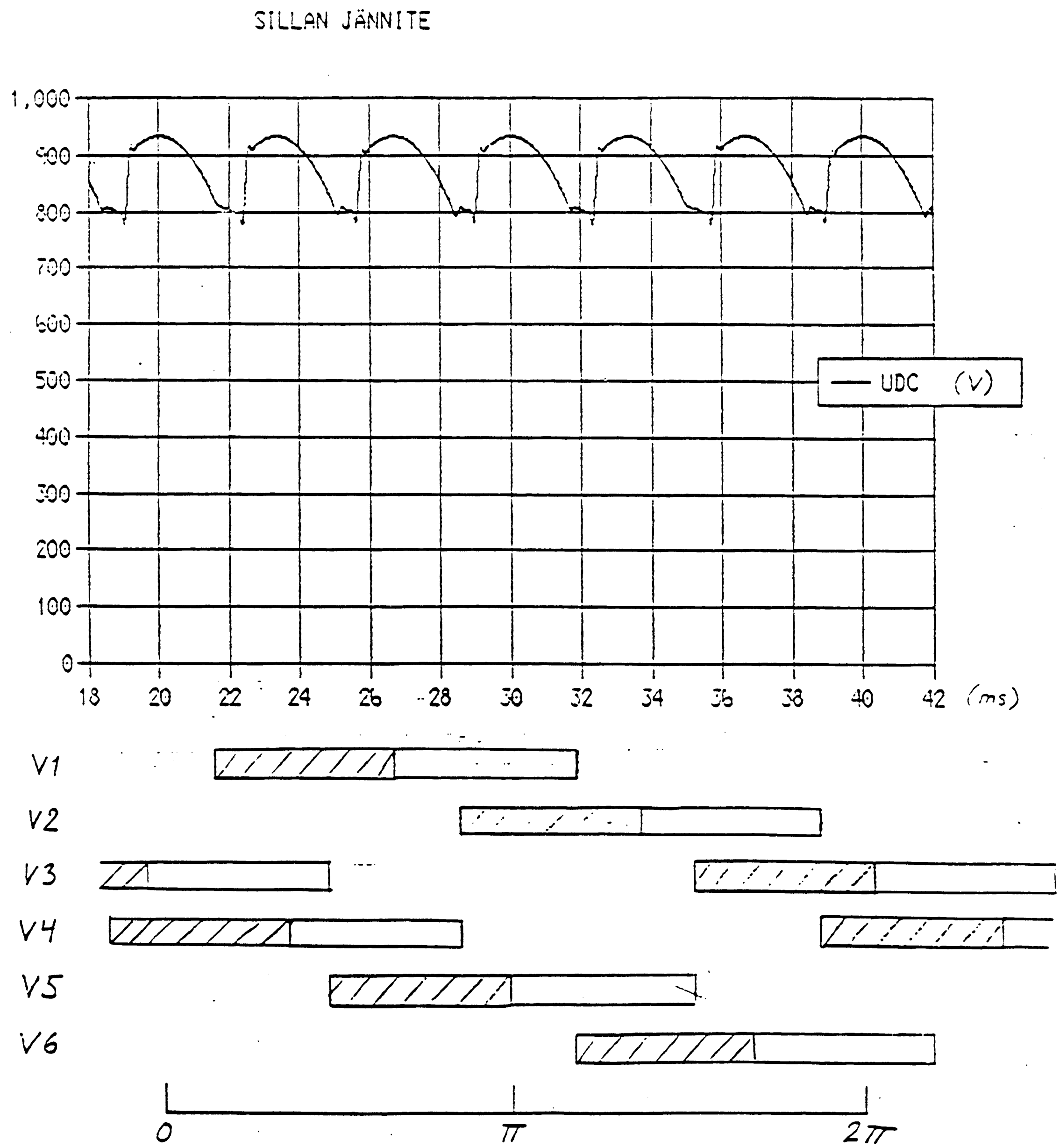

Figure 2. Firing table of the motoring bridge thyristor

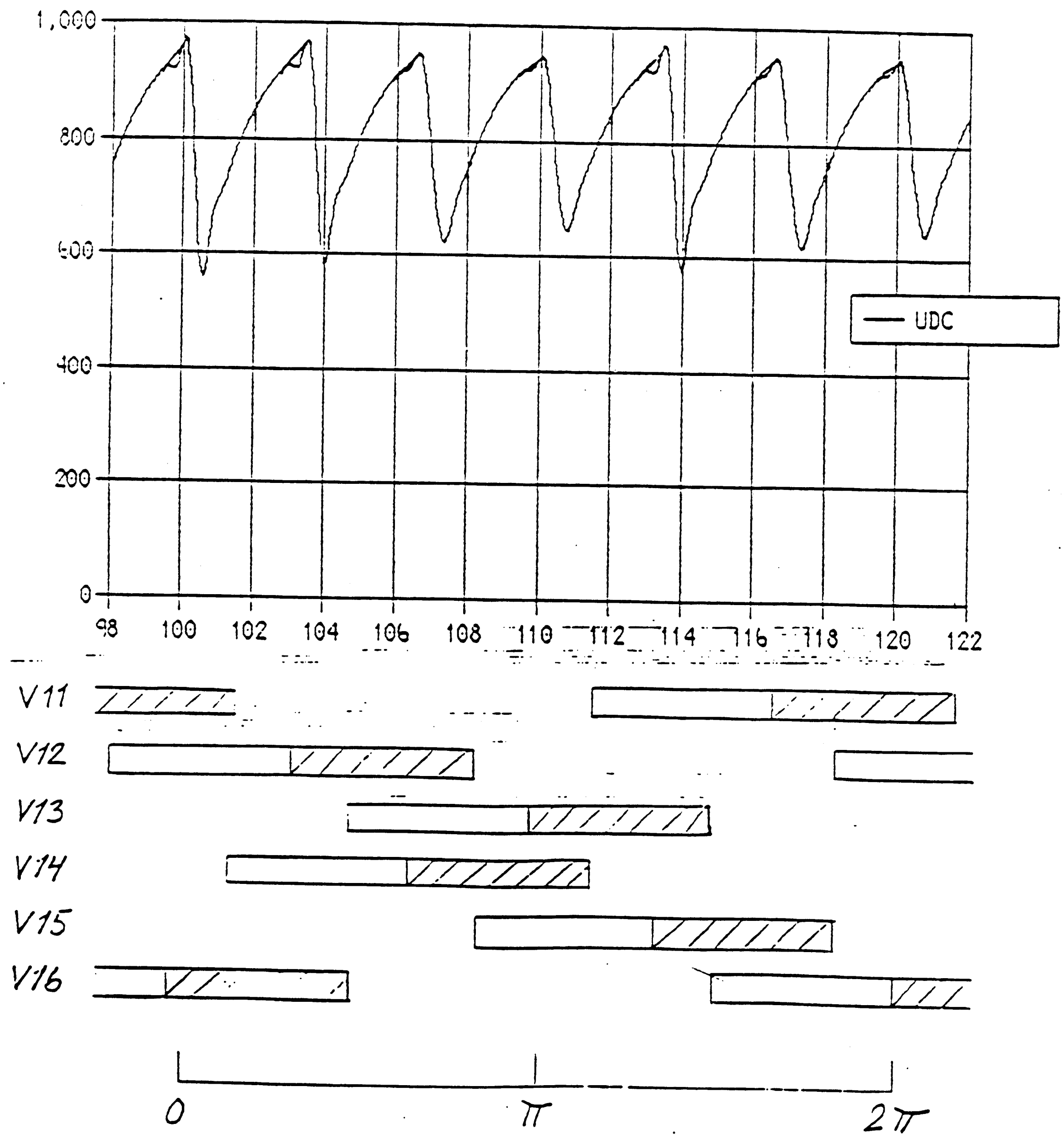

Figure 3. Firing table of the regenerating bridge thyristors

Both bridges have six common RC-snubbers. For example U-phase upper leg thyristors of both bridges have the same snubber. Snubber circuit is used to protect the bridge from voltage spikes in the AC-line and from voltage spikes caused by the reverse current of the thyristors.

3.2 Precharging of the DC-bus

When 48 voltage is connected to power supply card TBU will start operating:

- internal test
- precharge mode:
  - a/ constant angle (26^{o}) precharge with additional precharge circuit
  - b/ control angle is changed from 111 to 26 degrees; no additional pre-charge circuit reguired

a. additional precharge circuit used (jumper S3 a-c on SAFT 181 INF card):

   - precharge is done through precharge resistors and controlled by the contactor unit logic
   - when 85% of the rated DC-voltage is exceeded control is swithched to normal operation mode (motoring bridge thyristors are turned on first)

b. no additional precharge circuits used (jumper S3 a-b on SAFT 181 INF card):

   - motoring bridge control angle first 111^{o} and will be decreased when DC-voltage level increases; angle is not changed if voltage level doesn't increase. When 85% of the rated value is reached bridge operation will be changed to normal mode.

After short line voltage dips or interrupts, which don't cause lower than 90% of the rated levels in the DC-voltage, TBU will start without using precharge mode.

If signal UCC3 (inverter RUN signal) goes to zero, bridge control will be changed to precharge mode (50 degrees control angle) and it will stay there as long as UCC3 is zero.

TO PREVENT DC-BUS FUSE DESTRUCTION:

UCC3 START SIGNAL (UCC3 = HIGH) MUST BE FIRST SENT TO THE THYRISTOR BRAKING UNIT AND AFTER MINIMUM OF TWO SECOND DELAY TO THE INVERTER UNIT.

UCC3 STOP SIGNAL (UCC3 = LOW) MUST BE FIRST SENT TO THE INVERTER UNIT AND AFTER MINIMUM OF TWO SECOND DELAY TO THYRISTOR BRAKING UNIT.

3.3 Fault situations

a. thermostat switch or protection relay of the fan motor opens the current loop connected to the interface card SAFT 181 INF from where information goes to control card SAFT 185 TBC:

- if fault happens when motoring, gate pulses are turned off and bridge will be closed
- if fault happens when generating, gate pulses can't be turned off before current becomes discontinuous

In a case of a fault LED on the SAFT 181 INF card will be ON and also the light on the door will be on (optional). This fault doesn't need RESET; when fault is removed TBU will start automatically through the precharge routine.

b. internal faults in TBU:

Table 1. Internal faults in TBU

fault number	explanation of the fault
1	timing error in the bridge change
2	EPROM fault (D2, SAFT 185 TBC)
5	RAM fault (D5, SAFT 185 TBC)
7	Error in counter operation (D3, SAFT 185 TBC)
11	A/D-converter fault (D16, SAFT 185 TBC)
12	synchronizing error
13	too big a change in the control angle during two successive 60 degree cycles
14	program isn't synchronized with 6*F-signal
15	firing interrupt missing (D3, SAFT 185 TBC)

Control of the bridge follows the same procedure as during an external fault.

LED on the control card will be blinking during an internal fault; first 2 second interval when LED is OFF and after that LED will turn ON as many times as the fault number in the table 1 indicates (interval = 0.3sec). Also the light on the cabinet door will be blinking (optional).

These faults need an external RESET or control power has to be cycled.

c. Power supply fault

If error in the operation of the power supply card the LED on the card will turn OFF and operation of both bridges will be inhibited. If error disappeares control card program will start with initialization routine.

d. error in phase locked loop

If phase locked loop can't synchronize to the AC-line (phase error above 8 degrees) operation on motoring side will be stopped immediately and on regenerating side after current becomes discontinuous. Program starts with initialization routine.

e. fault in the main AC-voltage

Netfaults indication is done on SAFT 19 INF interface card:

- motoring bridge ON: change to generating bridge is inhibited and if fault doesn't disappeare motoring bridge will be turned OFF.
- generating bridge ON: control continues in a normal way if current is continuous. If line voltage doesn't recover DC-fuses will be destroyed. If line voltage recovers before fuses are destroyed control will turn the bridge OFF.
- generating bridge ON: if current doesn't flow pulses to the generating bridge will be removed. If line voltage doesn't recover within 100-200 usec bridge will be turned OFF.

After bridge is turned OFF control will monitor the line voltage and after the voltage recovers the motoring bridge will be turned ON either through the precharge routine or directly depending from the DC-voltage level.

3.4 Operation of control system

TBU control measures U- and V- phase currents and forms a HOLE signal from these two; if phase current is below 1.8% of rated current transformer value signal HOLE will be "1" and if above signal will be "0".

Synchronizing signal F is formed on the pulse amplifier card from the secondary voltages of three phase synchronizing transformer. From this signal F interface card SAMC 19 INF forms the 6*F signal, which is used to synchronize thyristor firing pulses to the AC-line frequency.

TBU control measures also DC-voltage; this measurement is used during precharge and to control that voltage doesn't decrease below critical values.

Main control program is cycled once during every 60° conduction cycle; during this conduction cycle HOLE signal is checked 26 times. Based on the number of HOLE signal zero states TBU control will calculate the actual DC-voltage value and also the new reference value. By using old reference and measured values a new control angle is calculated based on digital PI-control alcorithm.

On the motoring side DC-voltage reference is approximately 90% of the rated when load current is below 50% of TBU rated current; to achieve this with light load control angle must be between 0 and 60 degrees. When load current exceeds 50% on the motoring side output voltage reference will be changed to 100%.

On the regenerating side voltage reference will be 90% regardless of the load current. Control angle will be between 155 and 180 degrees depending of the load. On the generator mode discontinuous current will cause oscillations to the DC-bus. AC-line inductance value must be checked in each application to be sure that 25 degrees commutation margin is not exceeded.

TBU PI-control values can't be changed. P-gain is set to approximately one; 10% voltage difference will cause a 10% change to the control system. I-gain is set to 0.5 seconds. Fast changes (load steps faster than 300msec) cause vibration to the DC-voltage; if rated motor torque is reversed within less than 200msec it will cause a spike to the motor torque and a compensating pulse to the ac-line. Operation of TBU is ideal when changes in the load don't happen faster than 0.5...1.0 seconds.

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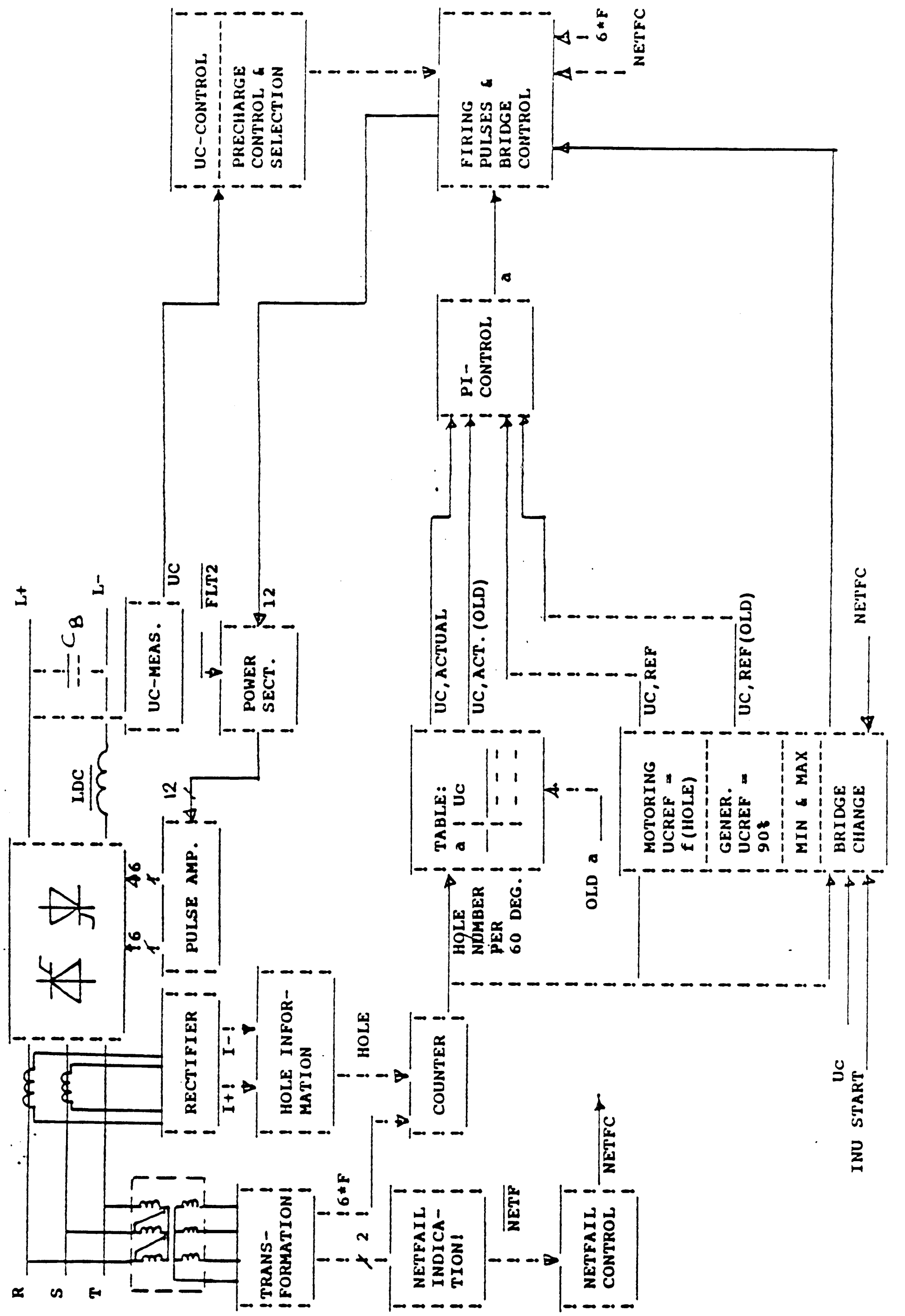
Block diagram of TBU control

APPENDIX 1



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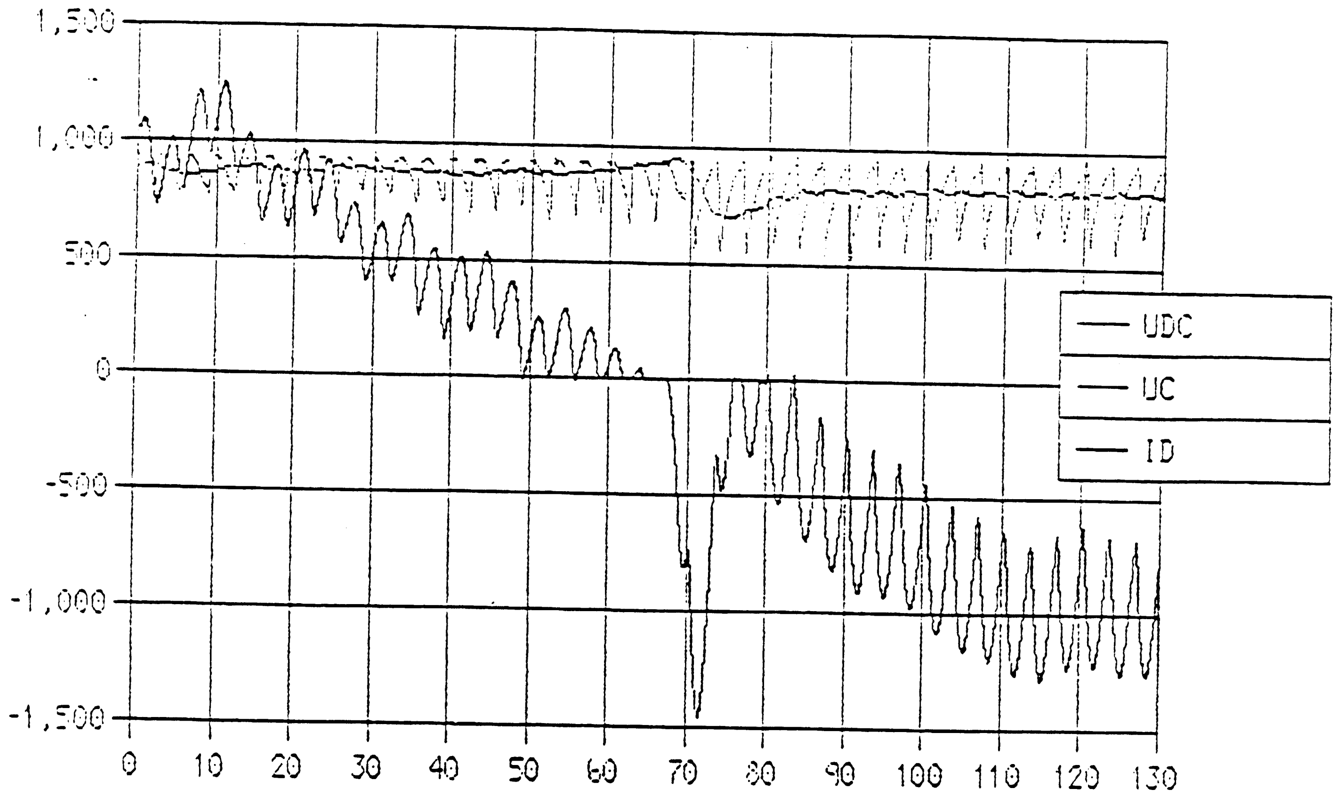
Simulation of the bridge change

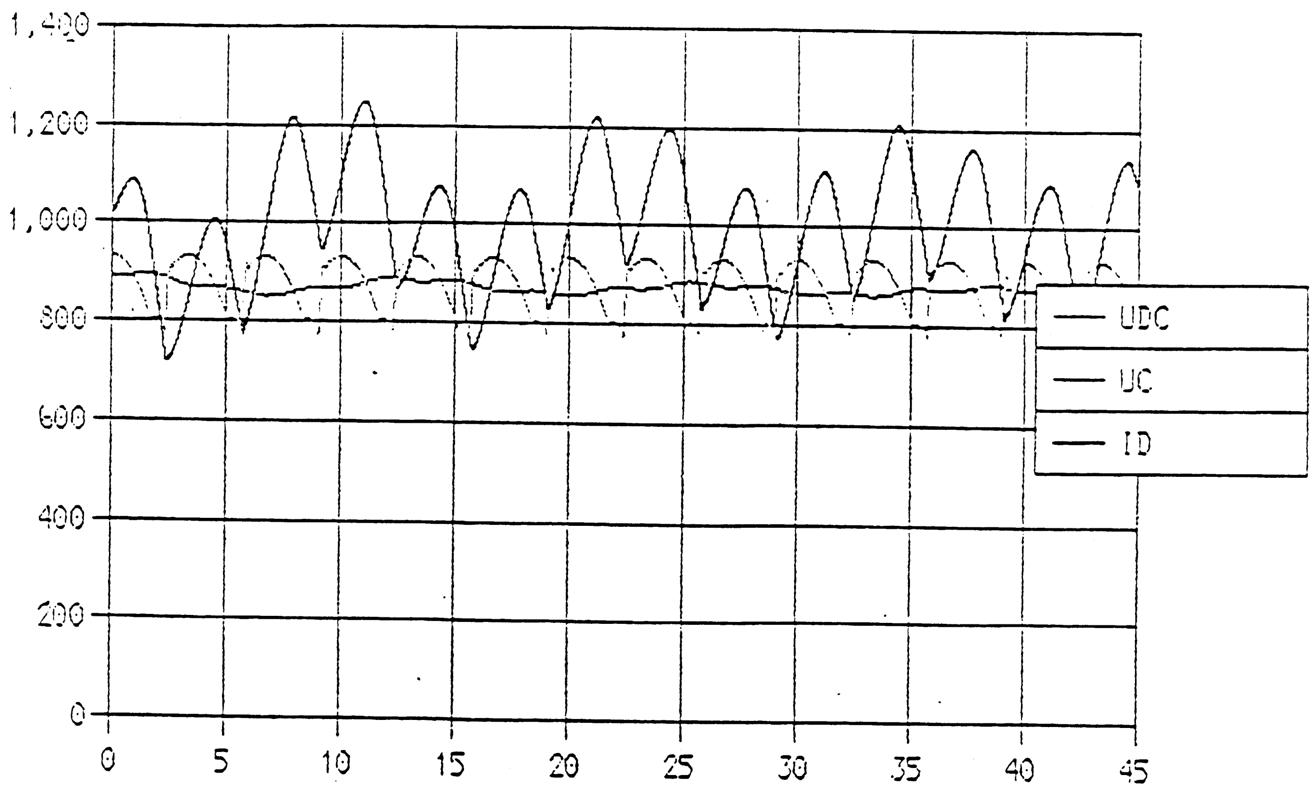
APPENDIX 2



BRIDGE CHANGE FROM MOTORING TO REGENERATING:

- load torque from +100% to -100% within 100msec
- UDC = bridge output voltage [V]
- UC = capacitor bank voltage [V]
- ID = TBU dc-current [A]

SAFUX 1000F660:



OPERATION ON MOTORING MODE (POWER FLOW FROM AC TO DC; P = 883kW)

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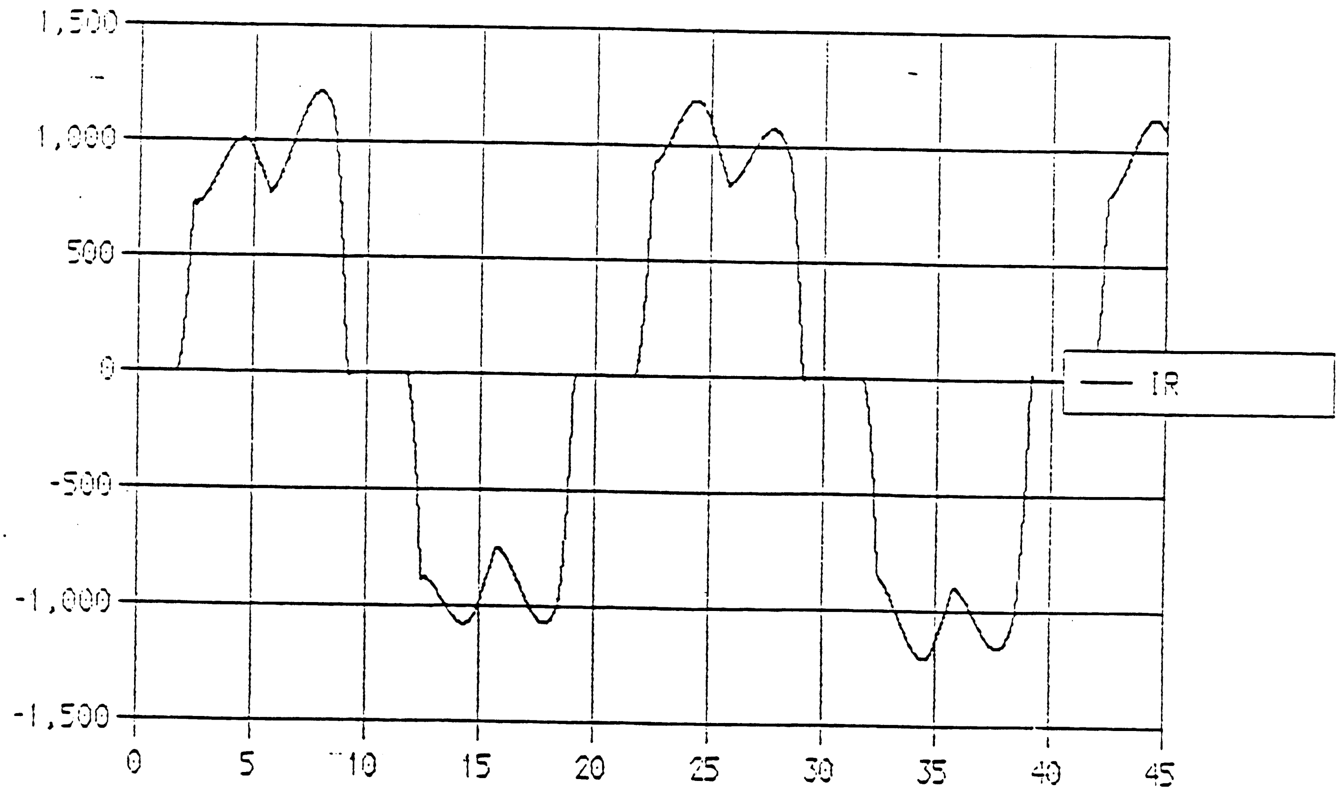
Simulation of the motoring bridge

APPENDIX 4

SAFUX 1000F660:

AC-LINE CURRENT: IR [A]



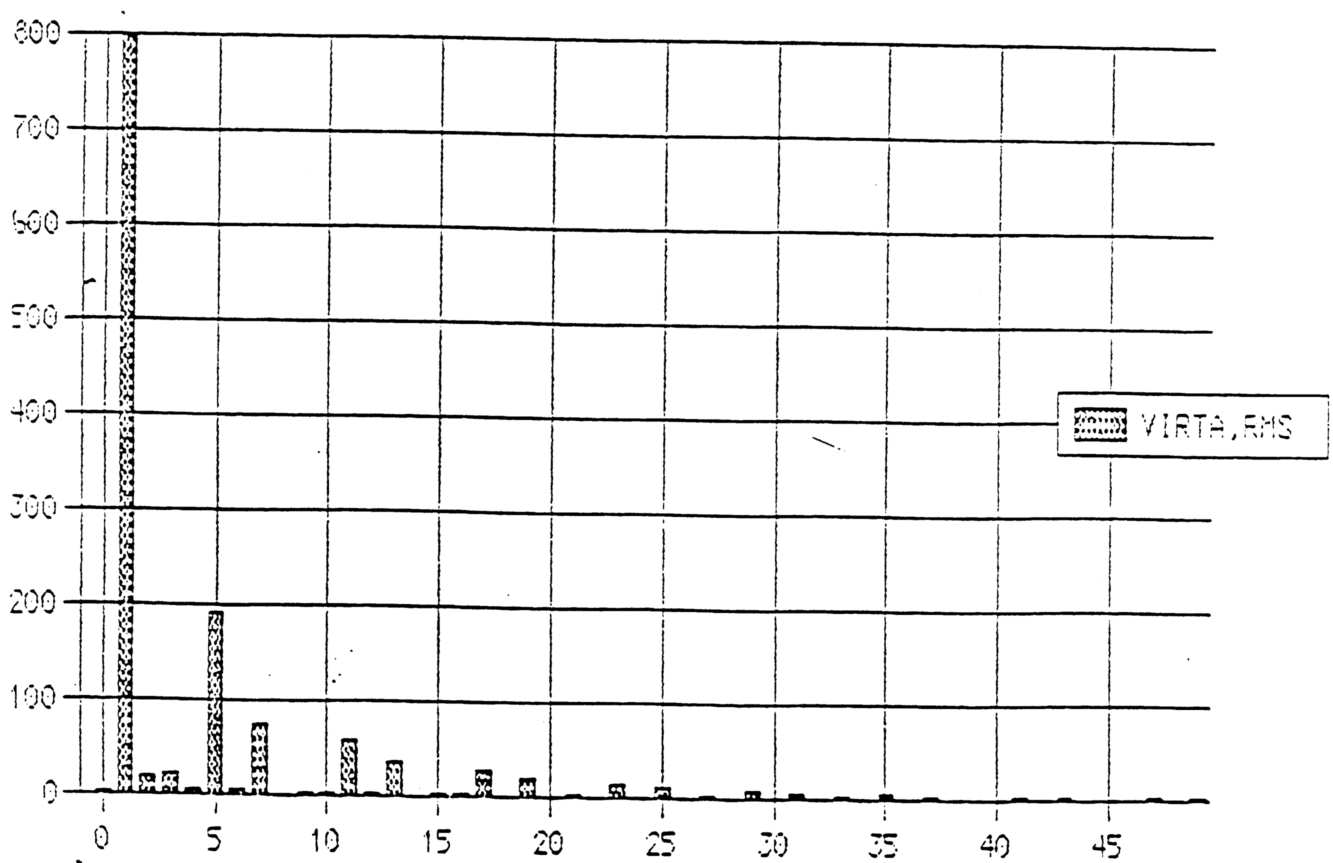
OPERATION ON MOTORING MODE (ACTIVE POWER 883 kW)

SAFUX 1000F660:

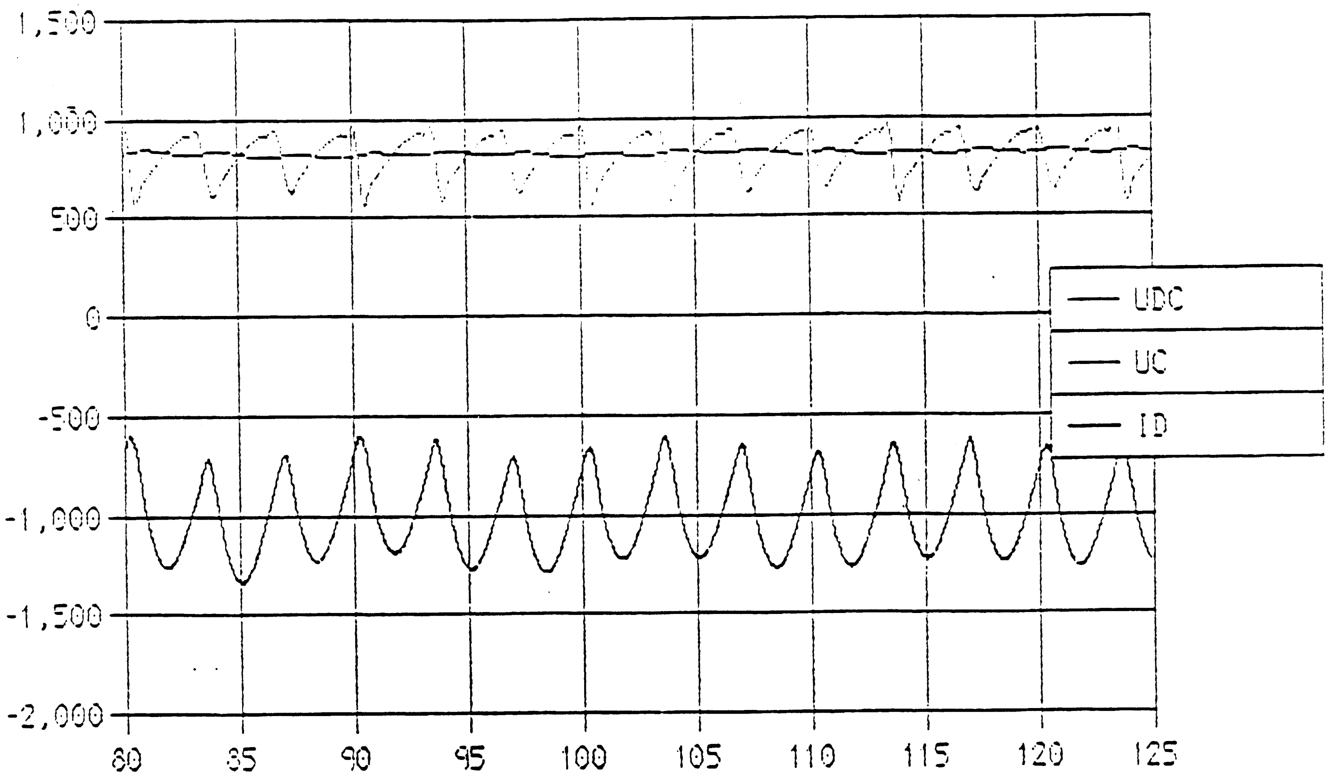
OPERATION ON MOTORING MODE (POWER FLOW FROM AC TO DC):

- CONTROL ANGLE 0^{o}
- ACTIVE POWER P = 883kW
- DISTORTION FACTOR OF CURRENT = 30.4%
- POWER FACTOR = 0.9875
- LAMDA = P/S = 0.9461
- $S = 1.732*Un * \sqrt{\sum_{n=1}^{\infty} In^{2}}$

SPECTRUM OF AC-PHASE CURRENT

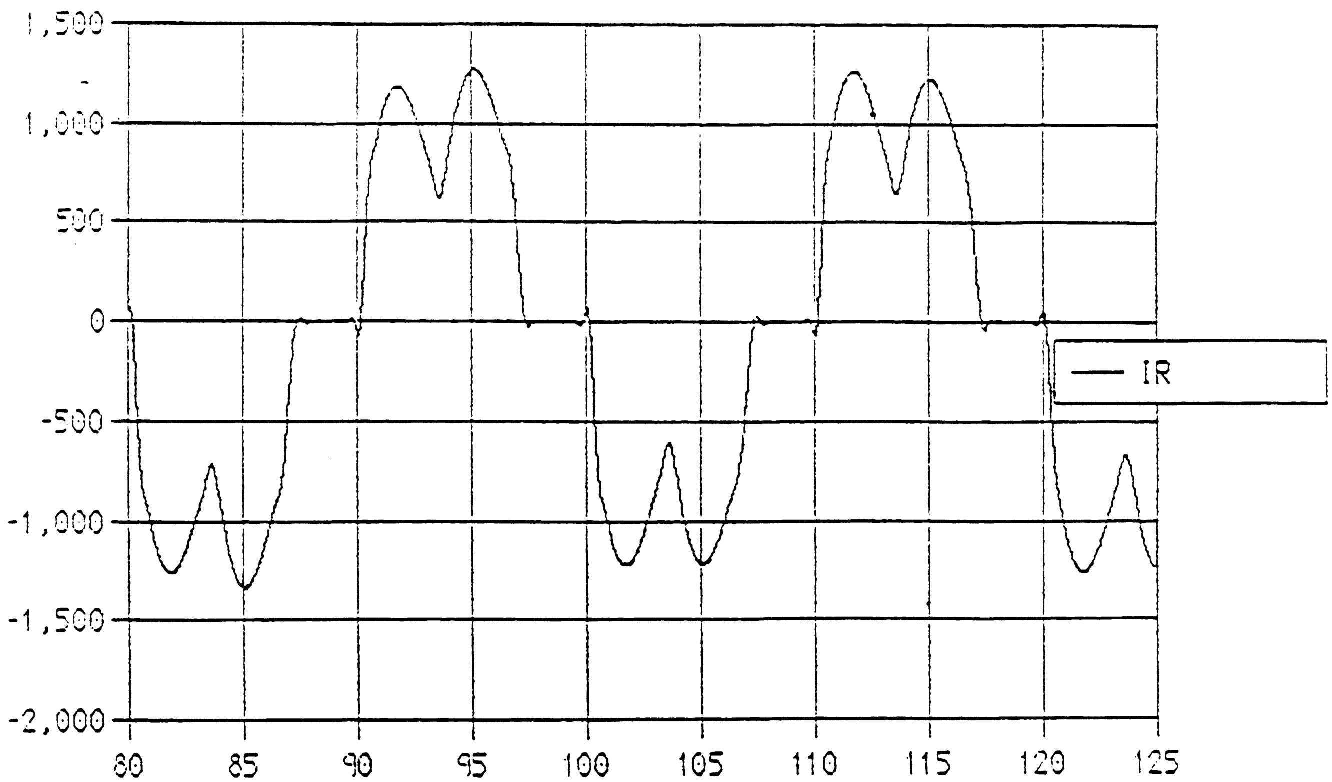


SAFUX 1000F660:



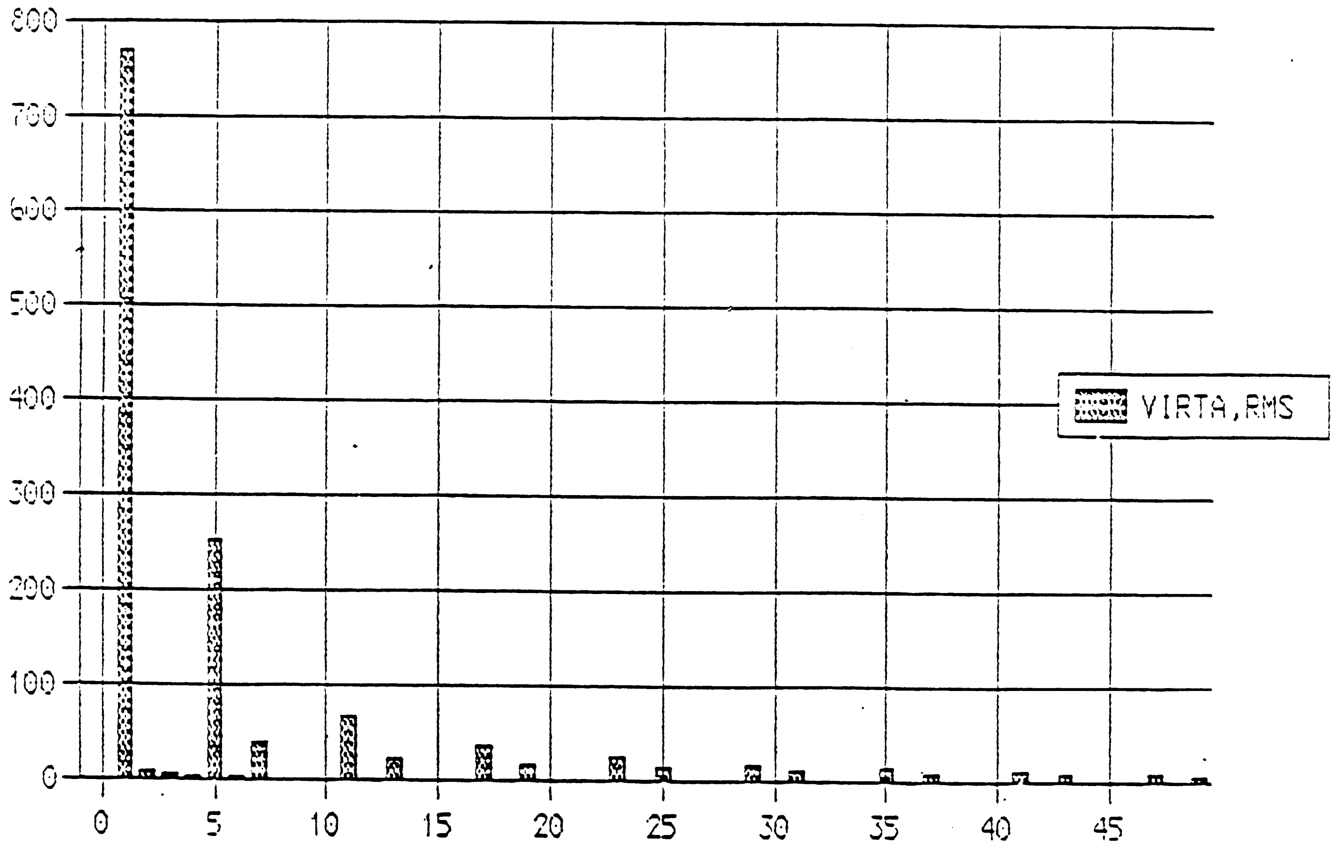
OPERATION ON REGENERATION MODE (POWER FLOW FROM DC TO AC P=816kW)

SAFUX 1000F660:
AC-LINE CURRENT: IR [A]



OPERATION IN REGENERATION MODE (POWER FLOW FROM DC TO AC P=816kW)

SAFUX 1000F660: SPECTRUM OF AC-PHASE CURRENT



OPERATION IN REGENERATION MODE (POWER FLOW FROM DC TO AC P=816kW)

- CURRENT DISTORTION FACTOR = 35.8%
- POWER FACTOR = -0.9279
- LAMDA = P/S = -0.8665
- CONTROL ANGLE = 155 DEGREES

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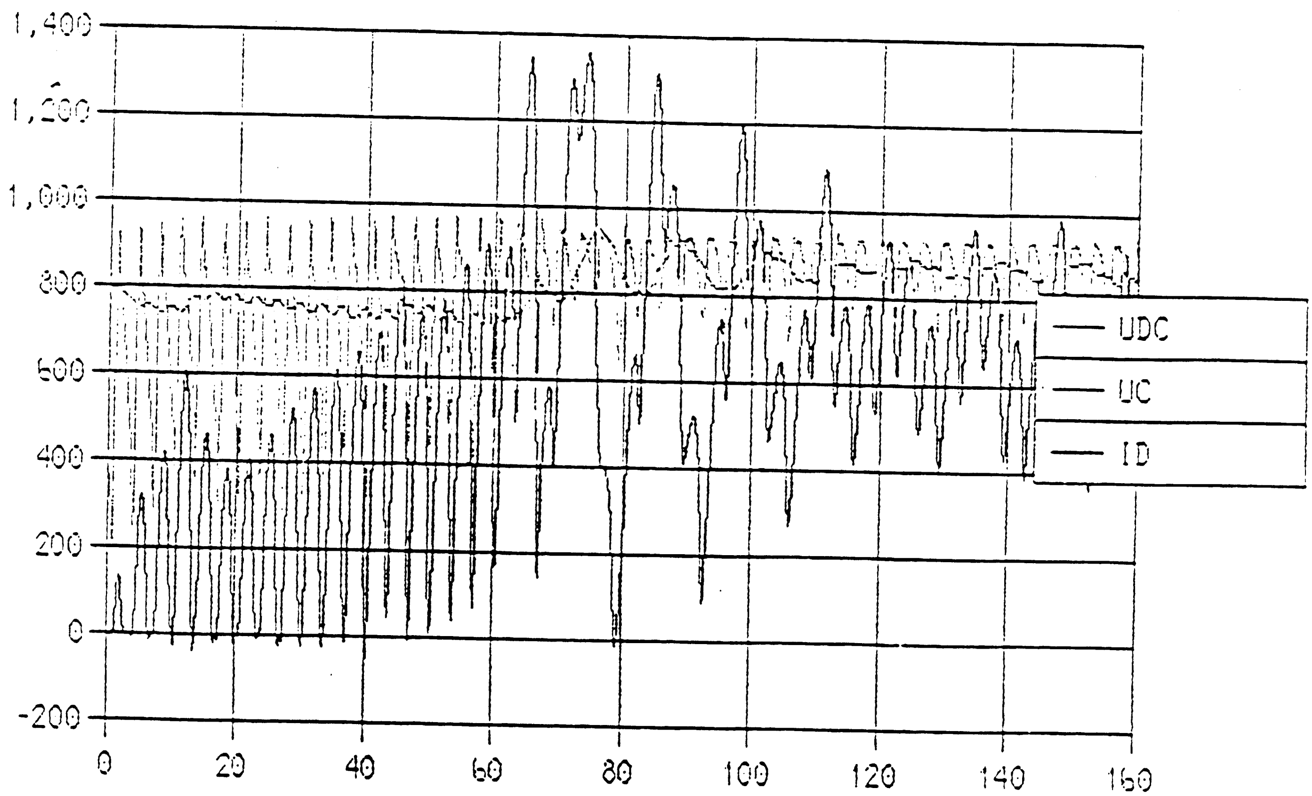
Simulation of a torque step on the motoring mode

APPENDIX 9

CURRENTS AND VOLTAGE AS A FUNCTION OF TIME



OPERATION ON MOTORING MODE:

- **torque step: +50%**
- **step rise time: 50msec**
- **integration time: 500msec**

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Main circuit
diagram

APPENDIX 10

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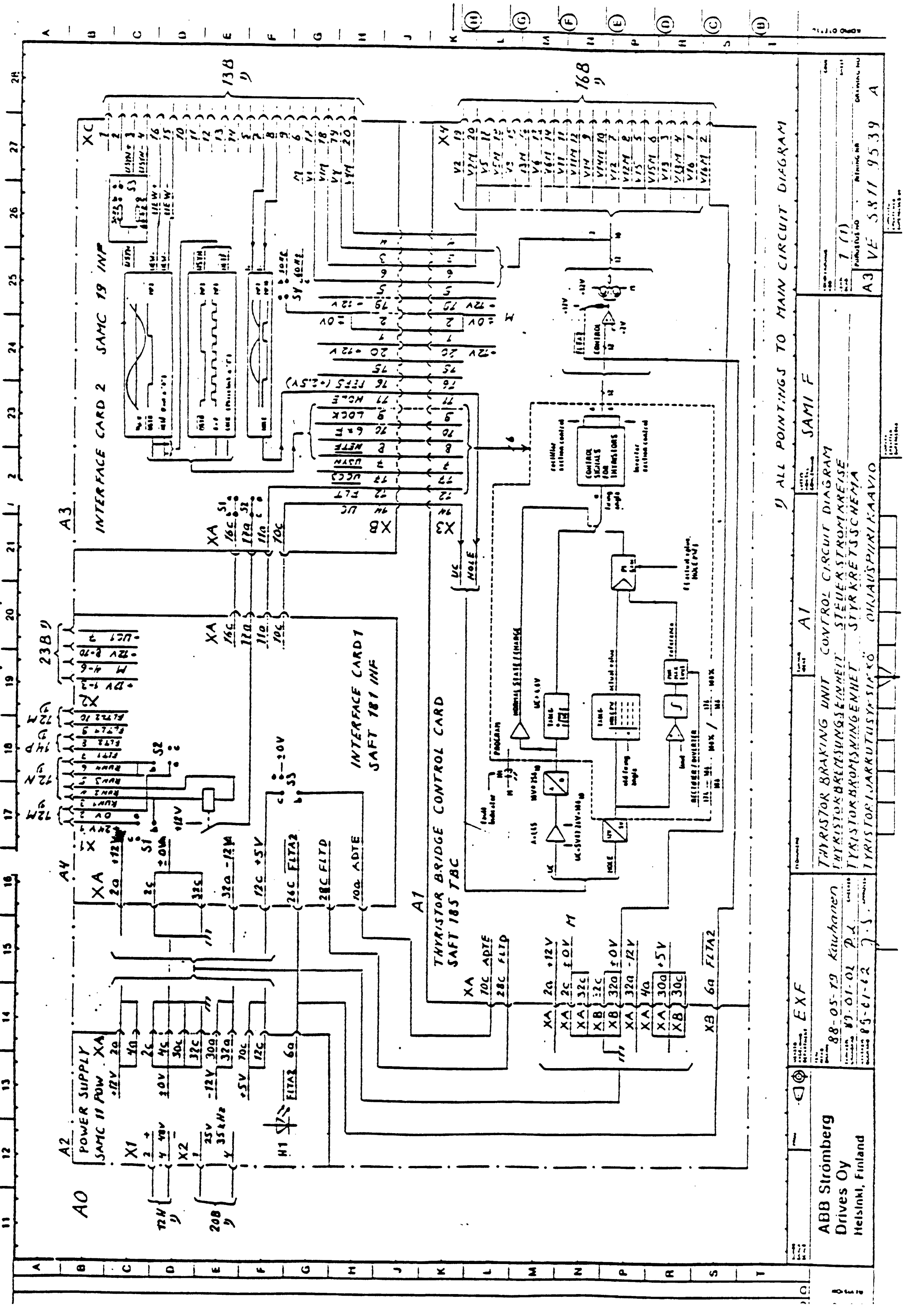
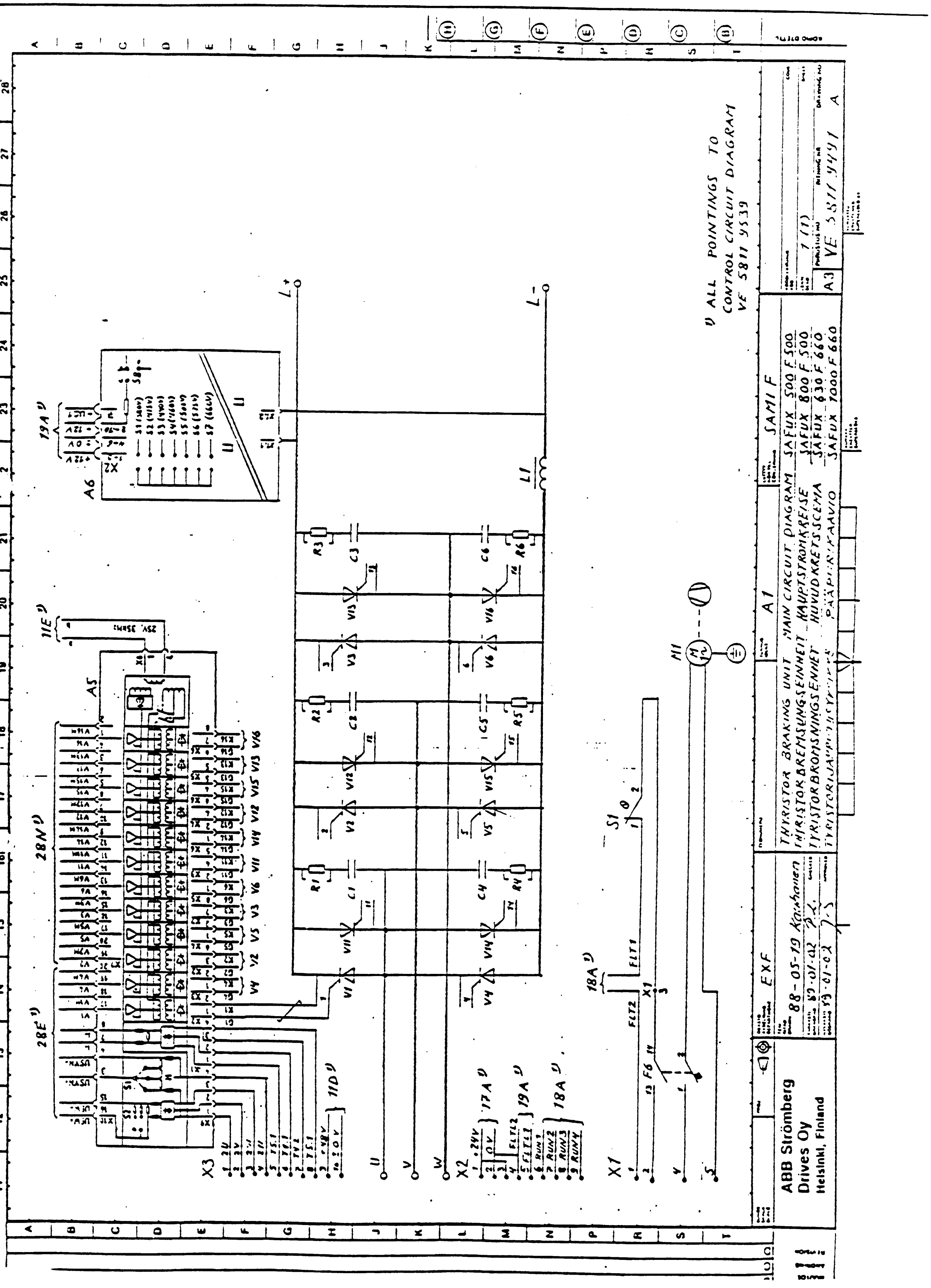


Main circuit
diagram

APPENDIX 11



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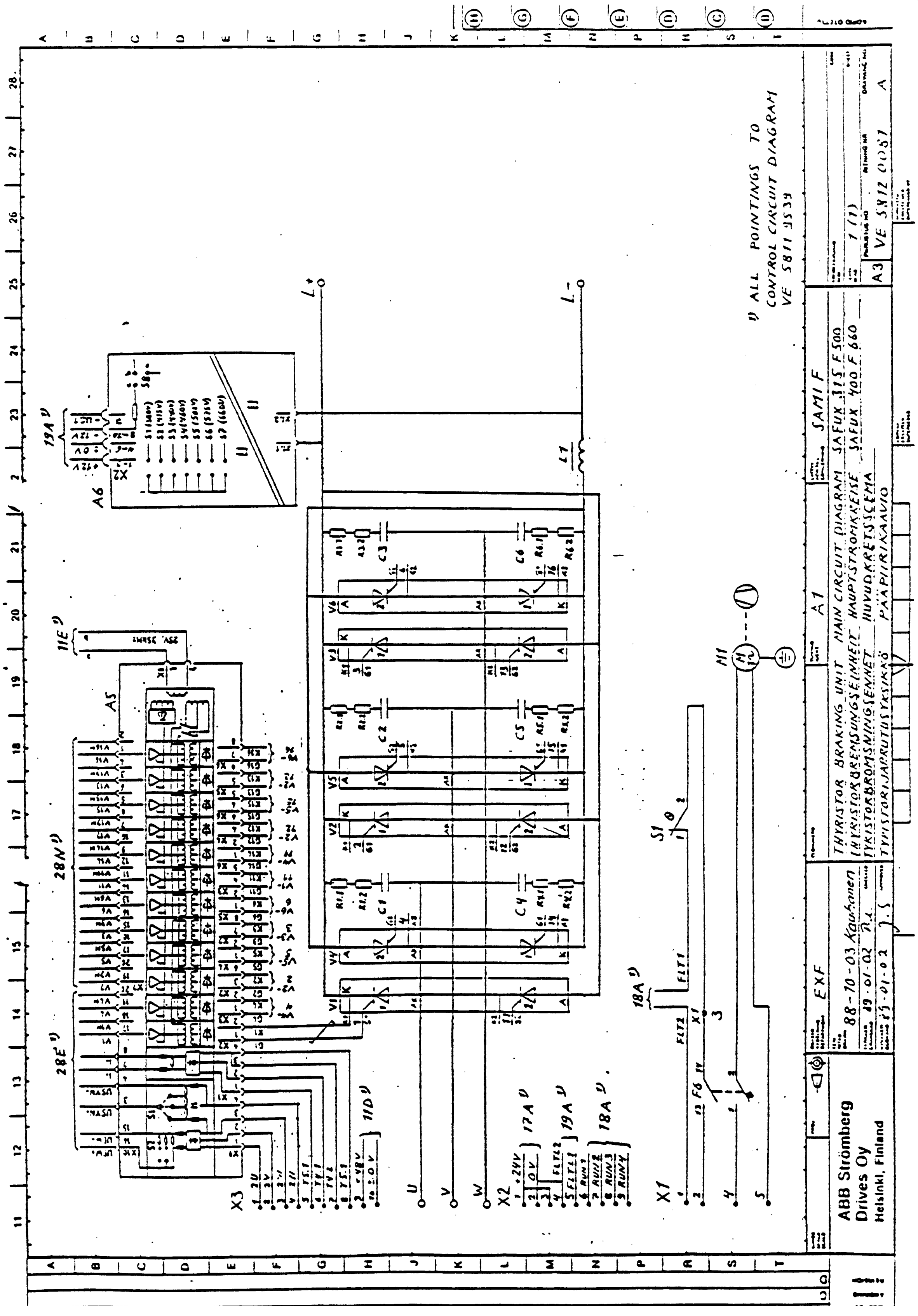
Control circuit
diagram

APPENDIX 12



6 PULSE DIODE BRIDGE OPERATION:

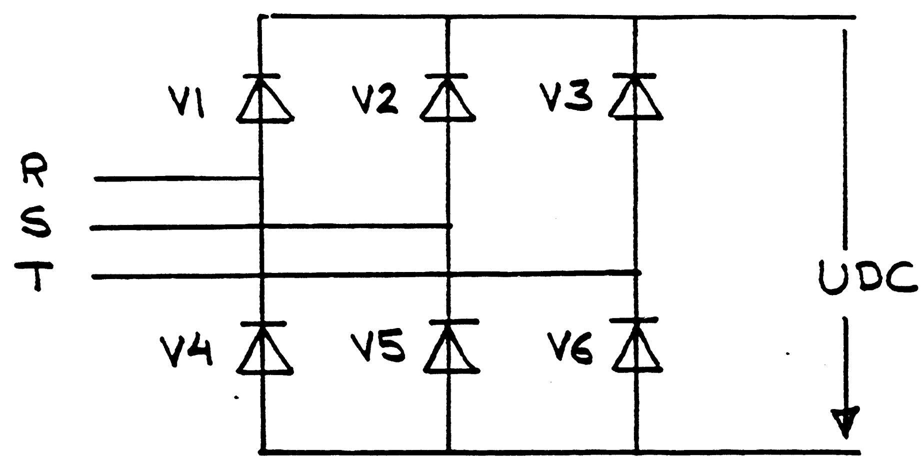


Figure 1. 6-pulse diode bridge

In figure 2 is an example of the 6-pulse diode bridge operation.

UDC(average) = 1.35 * UAC(main voltage RMS);
for example for 460VAC dc-voltage is 621VDC.

Always the diodes with positive cathode to anode voltage are ON.
In figure 2 are also the conduction sequence of diodes.

1.35 x 575 = 776 VDC

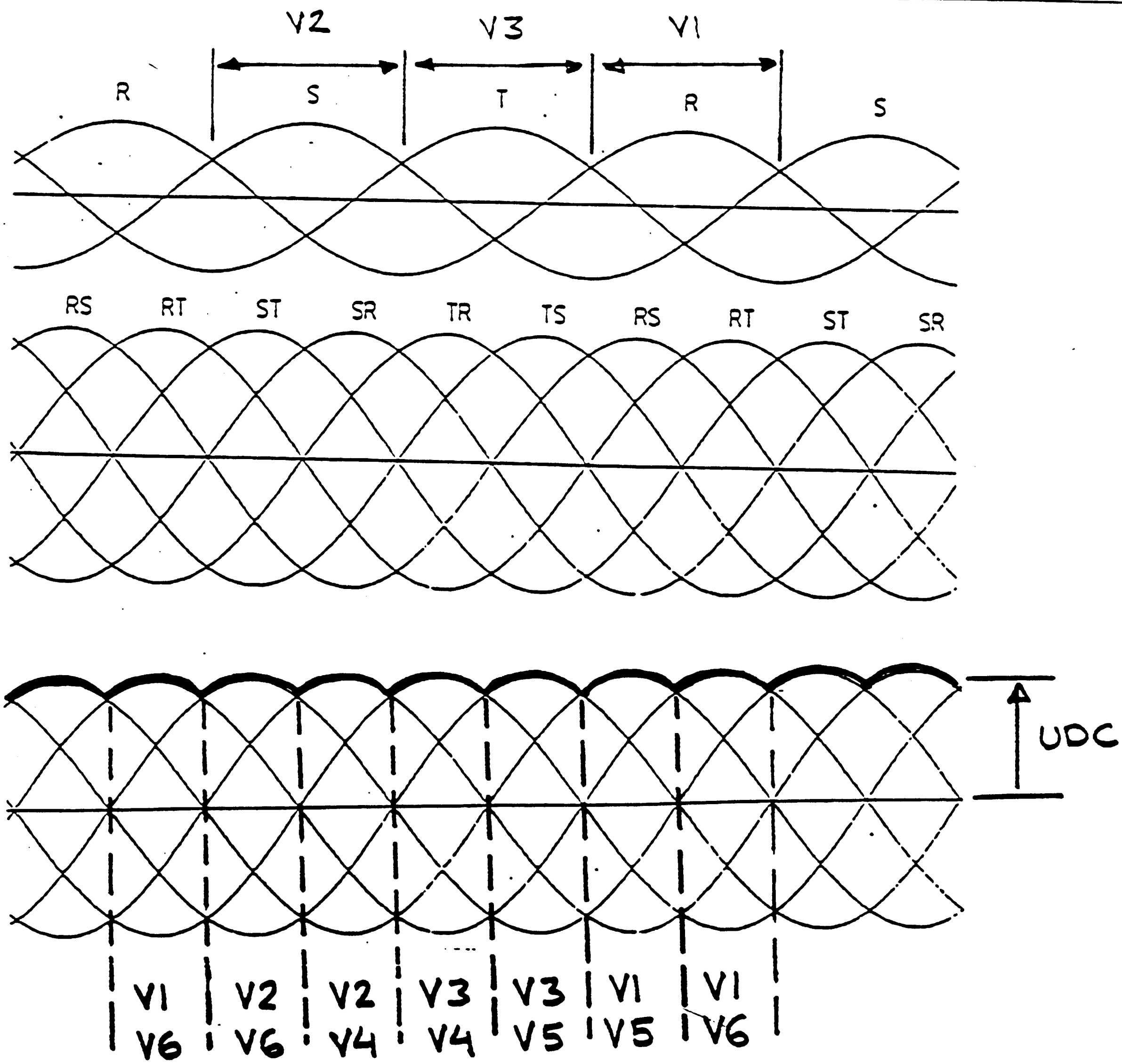


Figure 2. 6-pulse Diode bridge operation

2-WAY 6-PULSE THYRISTOR BRIDGE OPERATION:

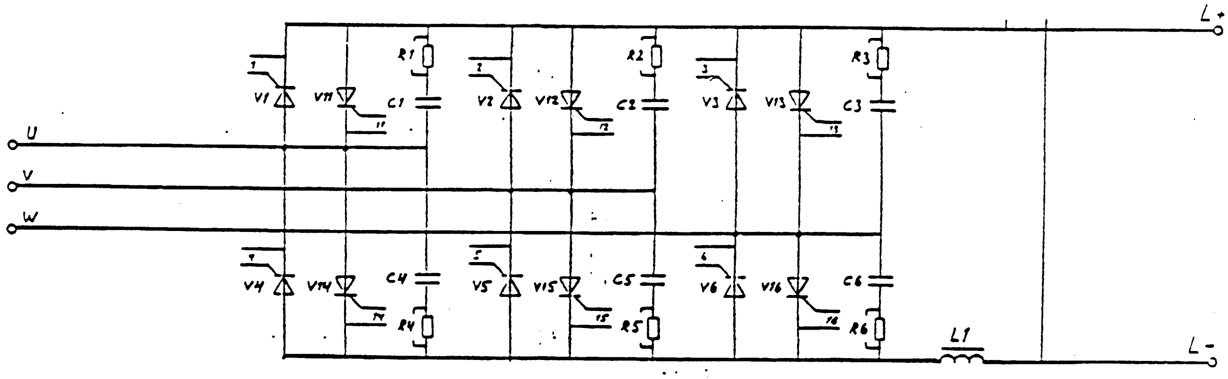


Figure 3. 2-way 6-pulse thyristor bridge

In figure 4 is an example of 2-way 6-pulse thyristor bridge when power flow is from AC-line to the DC-bus. In figure 4 the commutation angles have been ignored to make the operation of the bridge simple. By controlling the control angle of the thyristors it's possible to control the DC-bus level.

In figure 5 is an example of 2-way 6-pulse thyristor bridge when power flow is from DC-bus to the AC-line. Also in this figure commutation angles have been ignored.

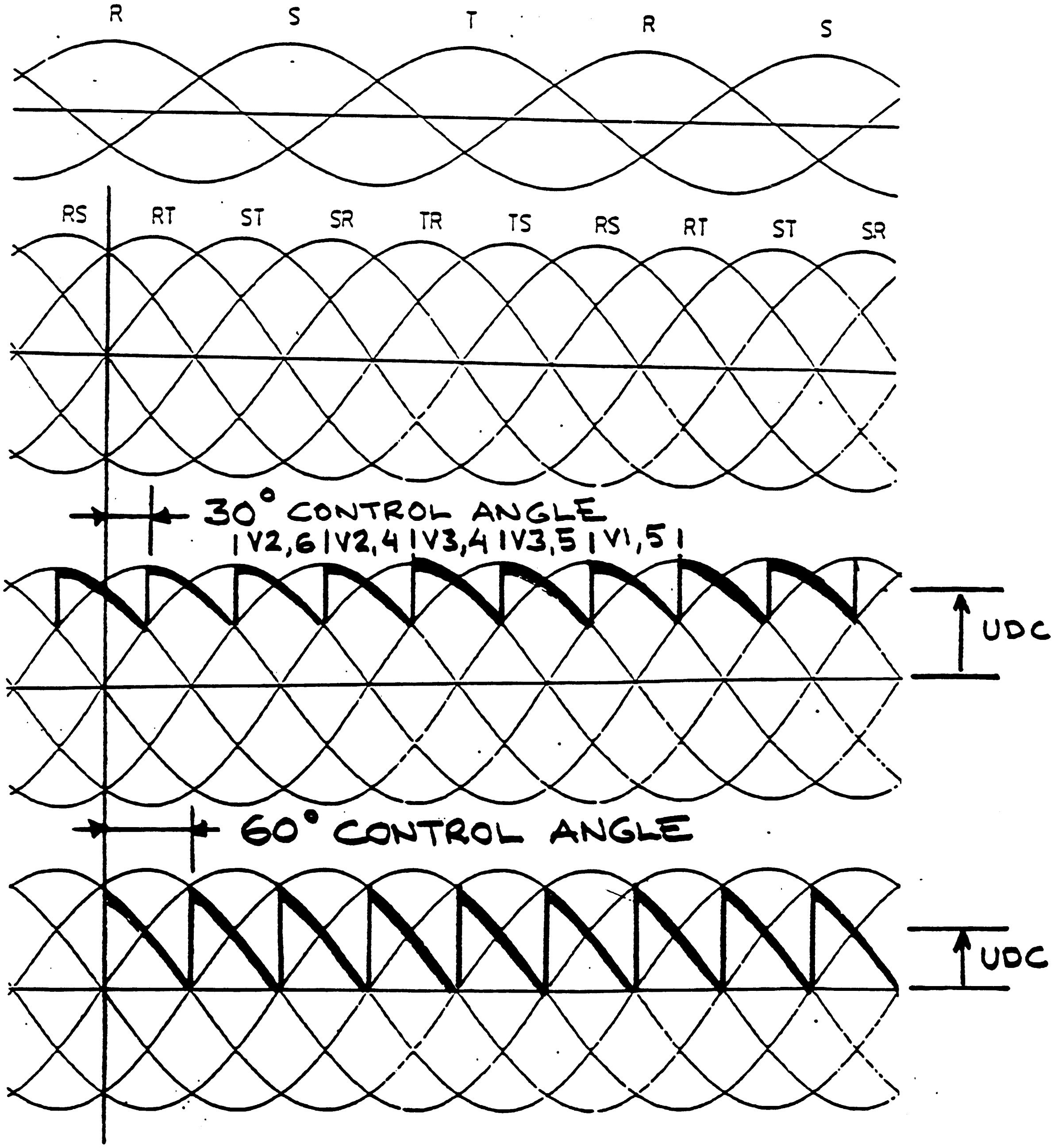


Figure 4. 2-way 6-pulse thyristor bridge operation
(power from AC to DC)

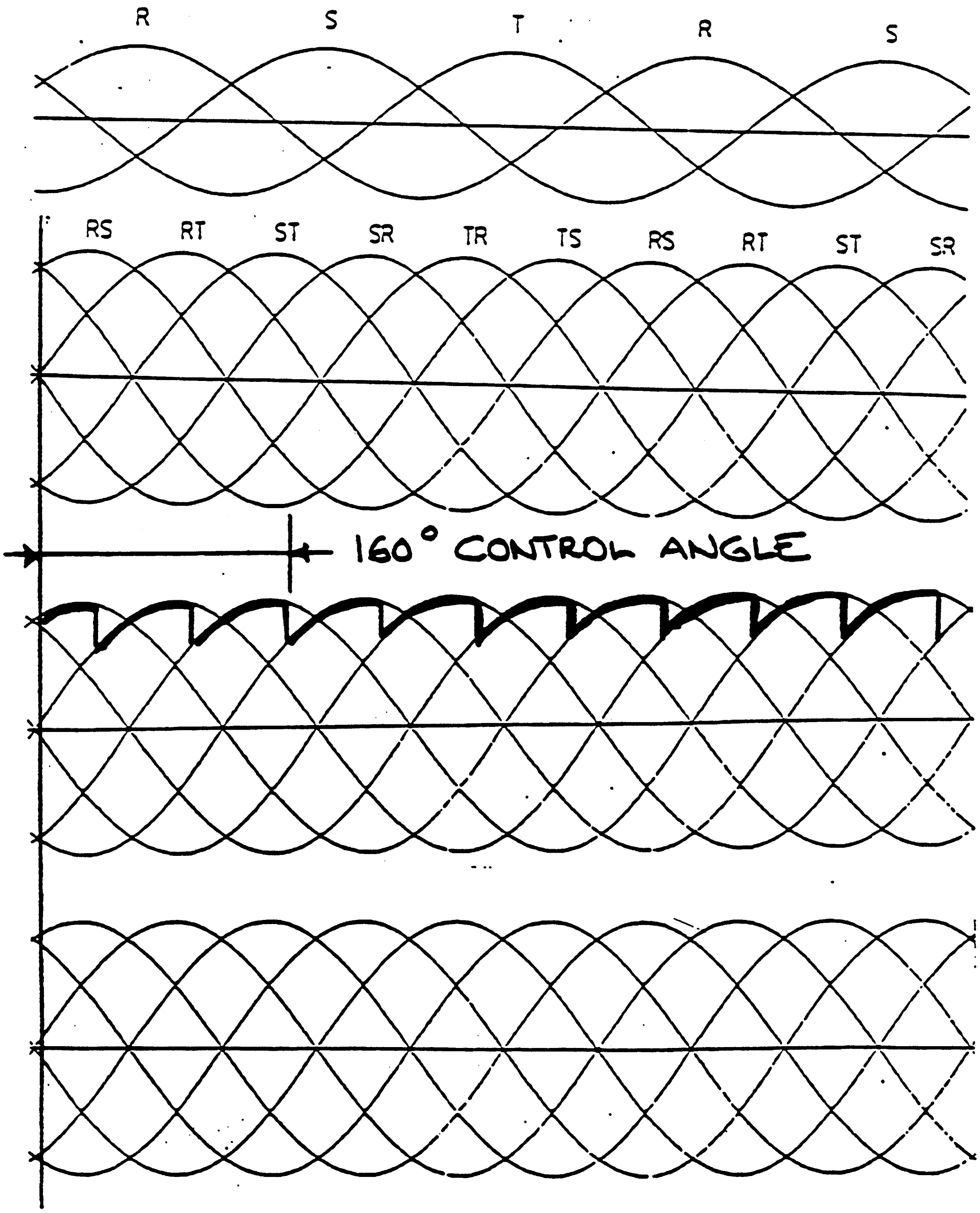
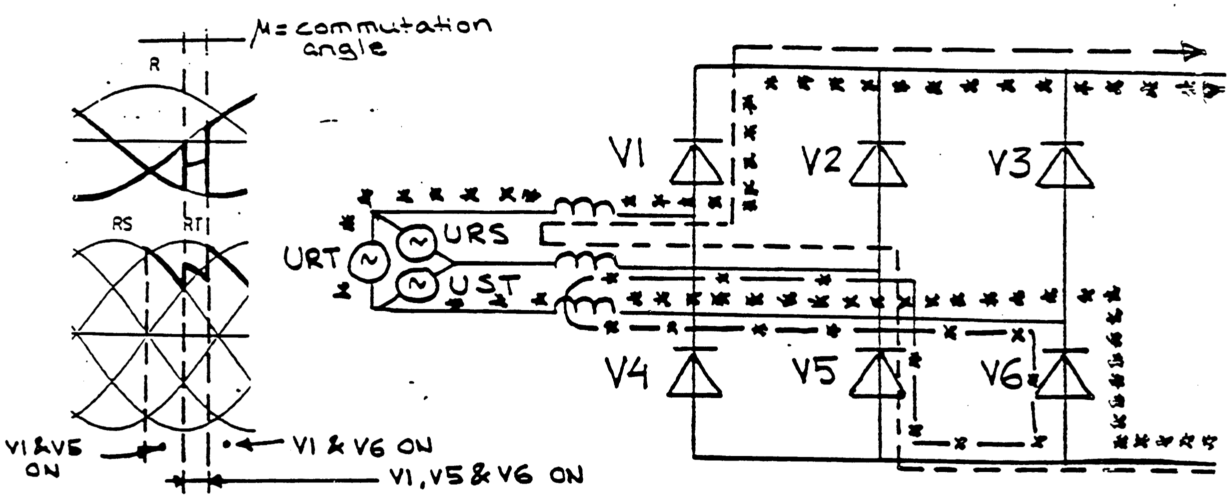


Figure 4. 2-way 6-pulse thyristor bridge operation
(power from DC to AC)

THYRISTOR BRIDGE COMMUTATION:



- during commutation of thyristors V5 and V6 notches in AC-line voltage:

$$UR = UT = \frac{US + UT}{2}$$

- during commutation DC-voltage is:

$$UDC = UR - \frac{US + UT}{2}$$

u = commutation angle
----- = current before commutation
***** = current after commutation
-*-*- - commutation current/

Figure 6. 2-way 6-pulse thyristor bridge commutation
(power from AC to DC)

Commutation time depends from the line inductance and line voltage:

$$U = L*(di/dt)$$

Voltage for example in figure 6 was UST and inductance is two times one phase inductance of the AC-line (cables and transformers included). Commutation is over when commutation current equals the DC load current ("old" thyristor" will turn OFF).

If AC-line inductance exceeds allowed limits, current doesn't reach load current level before commutation voltage (UST in figure 6) turns negative and the "old" thyristor doesn't turn OFF and as a result DC-fuses will be lost.

1. General

The task of the control board of the TBU (thyristor braking bridge) is to control the thyristors so that the DC-voltage remains at the reference value.

In the figure 1 is the block diagram of the TBU.

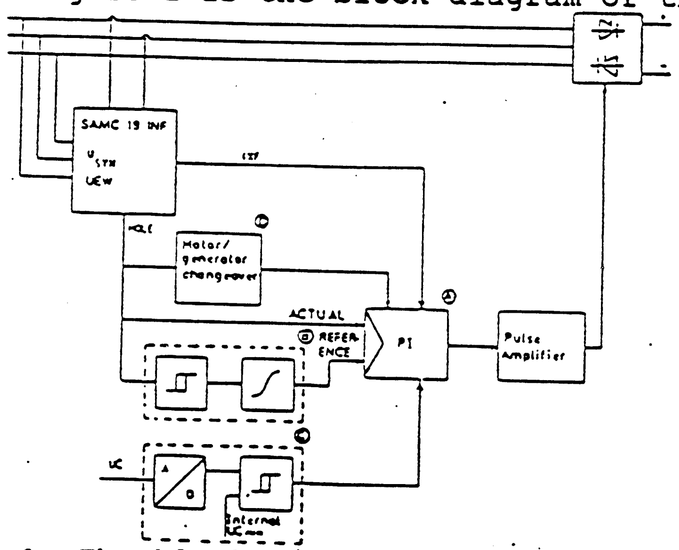


Figure 1. The block diagram of the TBU control system

The control is built from digital blocks:

- PI-controller
- integrator with a level limitation controller
- motor/generator switch logic
- internal DC-voltage supervision

The control of the thyristor bridge is synchronized to the AC-line via a three phase voltage transformer. This synchronizing transformer is connected to the pulse amplifier board SAMT 11, where the the sychronizing voltage USYN is formed. This USYN signal is used on the interface board SAMC 19 INF to from a signal 6*F (six times the frequency of the AC-line. SAMC 185 circuit diagram page 2(1-4) X3.10) used to determine the right firing instant of the thyristors.

The AC-current to/from the bridge is measured by two current transformers which are connected to the pulse amplifier board SAMT 11. On the SAMT 11 the current is rectified and transfered to the interface board SAMC 19 INF, where the conducting state information HOLE (SAMC 185 TBC page 2(1-4) X3.11) of the current is formed. The angle of the thyristors is formed according to this HOLE-signal.

In the figure 1 the PI-controller (block A) changes the firing angle according to the transit time of the current. The reference to the PI-block is the relative DC-voltage calculated based on the HOLE-signal. The reference value is formed from the HOLE-signal by the integrator and the level limitation controller (block B).

The internal DC-voltage supervision block takes part to the control during the precharge of the capacitors and when the voltage goes below the normal value.

The motor/generator switch logic operation is based to the transit time of the current:

- full load (continuous nominal current) at the motoring side will cause the firing angle to slide to 155 degrees
- when the current goes below 50% form the nominal the DC-voltage reference of the bridge will be reduced to approximately 90% from the nominal value to make the possible change to the generator side as smooth as possible
- when the bridge is used at the generator side it's controlled so that the DC-voltage is 5...10% below the nominal value so as to be sure that there's enough time for the commutations ; according to this limitation it's obvious that it can't compensate the changes in the AC-line voltage during the generator period

During the precharge of the capacitors the bridge can be controlled with a 50 degrees fixed control angle ; this is used only when the precharge resistors are present. By the switch S3 on the SAFT 181 INF board it's possible to select also a mode where the firing angle is slowly changed from 111 degrees to 50 degrees; in this case the whole precharge circuit is unnecessary.

2. Input- and output signals

2.1 Input signals

Only the signals in the following lists are used.
/ = inverse of the signal

Signal	185TBC	Page	Explanation
/USYN	X3.7	2	Signal syncronized to the AC-line frequency
6*F	X3.10	2	Six times the syncronizing signal frequency
/NETF	X3.8	1	Discontinuity in the AC-voltage
/RESET	XB.6c	1	Reset to the microprocessor from the power supply
LOCK	X3.9	1	Phase difference between the AC-line frequency and the syncronizing signal. The zero pulse width of the LOCK signal is equal to the phase difference. The actual synchronizing signal is formed on the SAMC 19 INF interface board by a phase locked circuit from the /USYN signal ; the purpose of the phase locked circuit is to inhibit the short term notches to have any effect to the final synchronizing signal
HOLE	X3.11	2	current informartion, 0 = current flows, 1 = no current
FLT	X3.12	1	outside fault indication. Can be used also as a reset to the internal faults
/UCC3	X3.17	2	RUN-information from outside (from the 1352); 0 = STOP, 1 = RUN. The STOP-command locks the firing angle to 50 degrees and inhibits the change to the generator mode. During the STOP-mode it's prohibited to load the capacitor bank not to lower the DC-voltage level. The START-information to the control board must precede the actual start of the drives (2...3 sec delay from the START-information to the actual start is a must). If the delay is too short the collapse of the DC-level can cause the fuses to blow up..

Signal	185TBC	Page	Explanation
ADTE	XA.10c	3	The selection between the two precharge types; + 5V = constant 50 degrees angle. Precharge circuit needed. 0V = the control angle is reduced starting from 111 degrees according to the level of the DC-bus. Precharge circuit not needed
UC	X3.14	3	DC-voltage measurement; +5V = nominal voltage
/FLTA2	XB.6a	4	Control power fault from the power supply (same as /RESET)

2.2 Output signals

Signal	185TBC	Page	Explanation
REF5	X3.16	3	+2.5 V reference voltage to the SAMC 19 INF board
V1... V6		4	Contorl signals to the motoring bridge
V1M... V6M		4	Contorl signals to the motoring bridge
V11... V16		4	Contorl signals to the generating bridge
V11M... V16M		4	Contorl signals to the generating bridge
FLTD	XA.28c	4	Internal fault signal to the board SAFT 181 INF. This signal will blink the light at the door as well as the led V1 on the control board (SAFT 185 TBC page 1(1-4)

3. SAFT 185 TBC operational block diagram/components

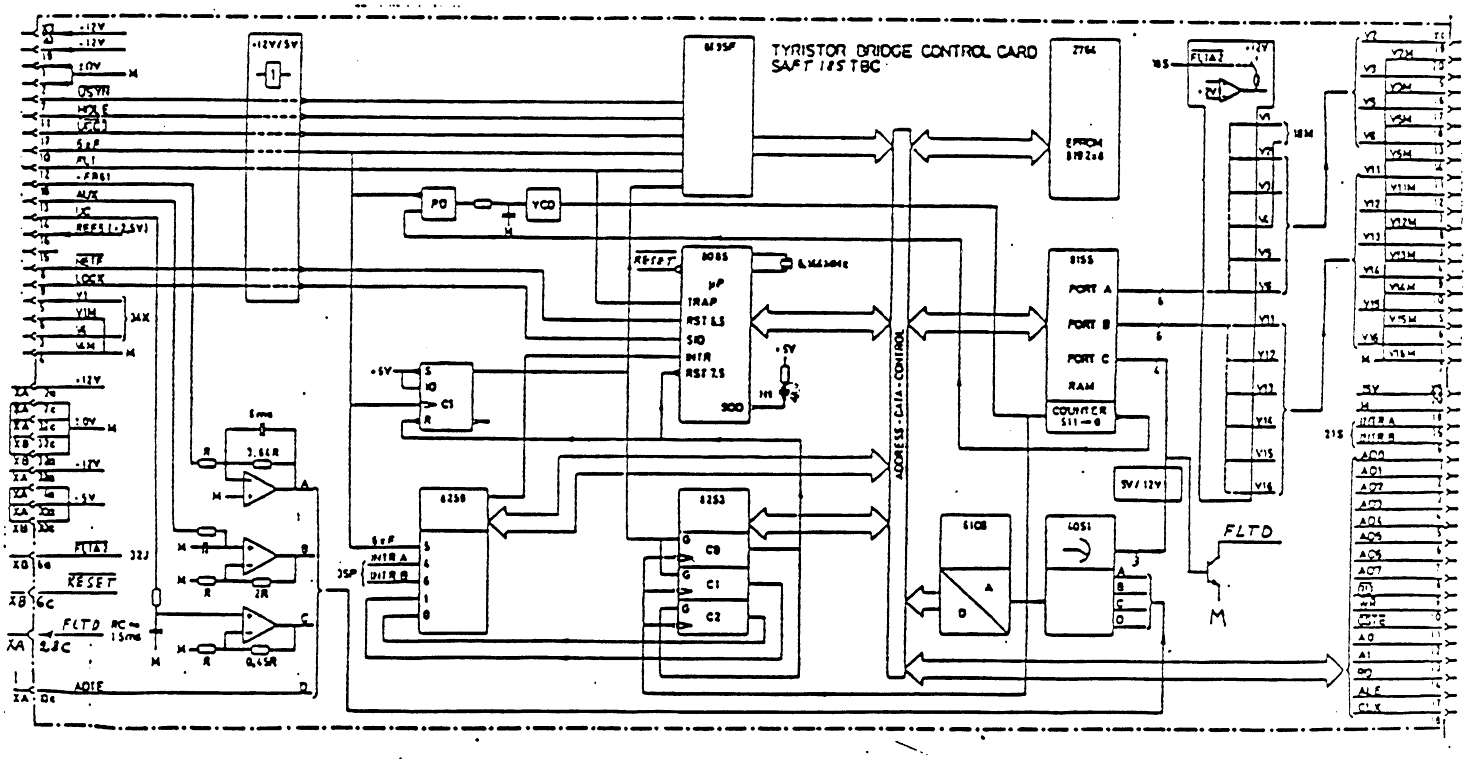


Figure 2. The block diagram of the control board

Component	Explanation
D1	8-bit INTEL-uP 8085 with a 3,072MHz internal clock frequency (6,144MHz crystal)
D2	8 kByte EPROM-memory
D3	Programmable counter; three 16-bit counters with individual clock-input, enable-input and output. Each down-counter can be programmed to six different modes. A pulse can be detected at the output when the counter reaches zero
D4	Programmable interruption-circuit; 8 possible interrupt signals to the microprosessor. Interrupt signal wired to the INTR-input of the uP the priority of which is lower than the others
D5	Programmable interface circuit with two 8 bit and one 6 bit input/output port. 256 byte RAM and a 14 bit programmable counter
D16	8 bit A/D-converter; input range 0...+10 VDC. Conversion time 3 us
D21	Analog multiplekser for the A/D-coverter input
D17	Phase locked loop; forms a clock frequency OSC that is 512 times the 6*F frequency. This signal is synchronized to the AC-line frequency; 50Hz AC-line frequency equals 153.6kHz. This clock frequency is used by the D3 to the timing of the thyristor firing

4. The clock signal in the firing counter

The firing angle is loaded to the firing counter D3 (L0). Timing is selected so that 512 equals 60 degrees. Clock signal is formed by a phase locked loop D17 and the counter D5 according to the figure 3.

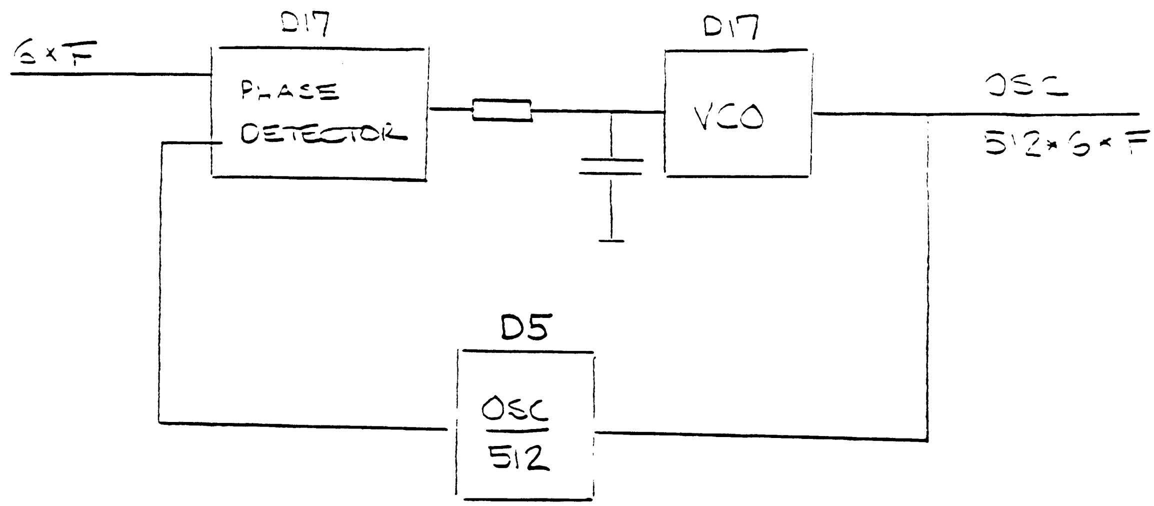


Figure 3. The clock signal OSC

The inputs to the phase detector D17 are 6*F (6*AC-line frequency) and the output of the voltage controlled oscillator VCO divided by 512.

The output of the phase detector depends from the phase difference of the input signals. If there is a change in the AC-line frequency also the phase difference and the output of the phase detector will change. Because of the change also the output of the VCO will change and as a result the phase difference will move towards zero.

The output from the VCO is 3072 times the AC-line frequency and because of the phase detection the firing time is always accurate even with a changing AC-line frequency.

5. Firing logic

D3 (L0) is used as the firing counter (at the generator side also L1). D3 counts the OSC clock pulses. The enable input of D3 is controlled by the D-flip-flop D11 output CNTEN. CNTEN changes to high state on the rising edge of 6*F-signal. When CNTEN goes up the counter L0 starts to count towards zero. When L0 reaches zero its output /FIRP goes to zero for a period of one clock cycle and at the same time CNTEN is reseted. /FIRP is connected to the uP input RST7.5, the priority of which is the highest from the maskable interrupt inputs. This RST7.5 normally causes the firing of the thyristors and the calculation of new firing pulses.

In the interrupt service program the uP writes the new firing orders to the D5 output ports A and B (A is for motor- and B for generator side). Comparators A4...A6 accomplish the level transformation from +5V to +12V. Finallu the hybride circuits A8 and A9 transfer the firing orders to the pulse amplifier board.

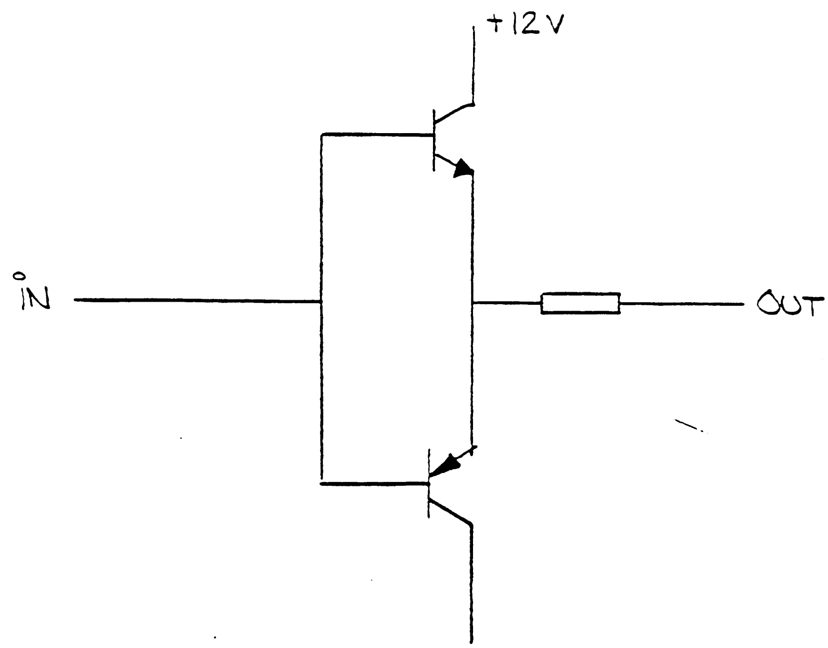


Figure 4. Hybride circuit A8-9 one phase diagram

Signal /FLTA2 inhibits the firing of the thyristors if the control power voltage levels aren't within the normal limits.

The motoring side firings are normally timed by the D3 counter L0, but after the change of the control side the next firing will be done on the rising edge of the signal 6*F.

The number corresponding the firing angle will be between 10...502 (1,2...58.8 degrees). By changing the starting number the angle can be changed by approximately 60 degrees. Additional to this also different control areas are used:

- area 0:	-30...+30	degrees motor
	+150...+210	degrees generator
- area 1:	+30...+90	degrees motor
- area 2:	+90...+150	degrees motor

Dividing the areas is a result of timing of the 6*F signal with the AC-line frequency. Changing the area means that in the table of conducting thyristors a jump up or down has to be done.

In the motor side two thyristors are always fired; in the generator side things aren't so simple. In the generator side the first firing interruption of each conduction cycle is given by the D3 counter L1, which is connected to the interrupt controller D4. In the first generator side firing after the change of the bridge two thristors are fired with the angle of 180 degrees. In the second firing only one thyristor is fired with the angle of 161 degrees. In the third firing and the firings after that one thyristor is fired with the angle of 155 degrees.

If the current stops flowing during the conduction cycle all the thyristors are turned off. In this case turning on one thyristor doesn't turn the bridge to the conductive state. Angle 155...180 degrees is loaded to the counter L0 depending on the load. Two thyristors are turned on with this angle (one of the thyristors was the one turned on before). If the current is continuous commutation will happen when one thyristor is turned on with 155 degrees angle; commutation margin will be 25 degrees. If the current is uncontinuous the current will start flowing only after two thyristors are turned on.

When the load current decreases it's important to increase the firing angle towards 180 degrees to inhibit the voltage to go lower. By turning on one thyristor before insures the commutation margin to be 25 degrees independent from the load.

The counter L2 of the circuit D3 is programmed to give a interruption 20 times during 60 degrees. After each interruption the signal HOLE is checked and according to the value in this counter either the current- or hole counter is increased by one. By this way it's easy to define the transit time of the uncontinuous current. According to this transit time the relative voltage of the bridge can be calculated and the control angle can be adjusted to the right value.

6. The principles of analog signal connections

A/D-converter D16 is a 8 bit converter, the conversion time of which is 3 usec. Input range is 0...+10 V corresponding to values 0...255 in the program. The converter is triggered by a write pulse /WR. /CSAD is the selection signal for the converter and must be zero when writing to or reading from the converter. When reading the converter the address lines A0 and A1 are used the following way:

- A0: 0 = the status of the converter
  1 = the conversion result
- A1: 0 = the conversion result as a two's complement (not used)
  1 = the conversion result as a binary number (used)

The signal to be measured is selected by the analog multiplekser D21. The channel is selected by the addresses AMUX0...AMUX2 from the circuit D5. Only the signals ADTE and UC are measured in the program. The signal ADTE is measured only once after the control powers are turned on. If ADTE is +5V, the constant angle precharge is selected (50 degrees). If ADTE is 0V, the control angle is reduced according to the UC value starting from 111 degrees.

In the DC-voltage measurement +5V equals the nominal voltage. The gain of the operational amplifier A2 is adjusted so that +5V gives 186 as the coversion result from the A/D-converter. The DC-voltage information is used only during the precharge and during line interruptions. During a normal situation the voltage measurement is not used and the bridge won't compensate the shift of the DC-voltage caused by the changes in the AC-line.

7. Operation in fault situations

Two kind of faults are possible, internal- and external faults.

External faults:

- FLT;   external fault input
-/NETF; interruption in the AC-supply voltage
- too large phase difference in the LOCK signal

Internal faults:

- damage of components
- internal loss of synchronism

7.1 Internal faults

Internal faults cause the led V1 to blink; also the signal FLTD will change the state with the same frequency as led V1. FLTD will turn the light on the TBU door on and off.

Fault codes are 1...15. In the case of a fault V1 will blink with 0.3 second intervals as many times as the fault code requires and after that it will have a 2 second pause and repeat the same cycle again.

Fault code	Explanation
1	Timing error in the change of the bridge. In the motor mode this occures if during the starting period of the bridge the first firing interruption doesn't take place within a certain time after the program has synchronized to the AC-line. This same thing can happen during the change of bridges from generator- to the motor bridge. After changing to the generator bridge the program checks if the synchronism is still correct compared to the 6*F signal; if the synchronism is lost the indication will be a timing error.
5	The RAM-memory of the circuit D5 has failed. The operation will be checked only once during the connection of the control powers.
7	Counter D3 doesn't work correctly. The operation will be checked only once during the connection of the control powers (all the three counters will be checked)
11	A/D-converter doesn't work correctly
12	Fault in the synchronizing procedure. When the signals /USYN and 6*F are high at the same time the program will calculate the right thyristors according to the control angle. If the thyristors calculated don't match with the ones picked up from the conduction order table a fault will turn on.
13	Too large change of the contorl angle between two successive 60 degrees cycles
14	Fault in in synchronizing procedure. After changing the control area the thyristors will be turned on on the rising edge of 6*F. The "area change inquiry" flag will be reseted immediately. If the flag is for some reason on after a normal firing interruption /FIRP and 6*F is at the same time one a fault will happen.

15 Watch dog in the back ground program indicates that the delay between two firing interruptions /FIRP is too long.

Internal faults can be reseted by cycling the control power or by causing an outside fault. In the case of a internal fault all the interruptions are inhibited. FLT is connected to an unmaskable interrupt signal TRAP, so the program will start running when the fault is turned off. If this FLT signal is used as a reset the possible operation of this FLT must be inhibited during a normal operation by hardware.

7.2 External faults

When ever the phase difference of the phase locked loop on the interphase board SAMC 19 INF compared to the AC-line exceeds 8 degrees it will cause an immediate stop in the motoring mode and in the generating mode a stop will be done as soon as the current changes to uncontinuous state. After the stop the program starts from the initialization routine.

External fault FLT will cause an immediate stop when motoring and a stop when generating only after the current is uncontinuous. After the stop the program returns to the initialization program.

Control power fault /FLTA2 will inhibit the firing of the thyristors. Prosessor will be reseted by the signal /RESET.

Network failure indication is performed on the board SAMC 19 INF. As an input to this board will be a six pulse rectified AC-line voltage. This unfiltered information and the same input filtered and damped by 15% will be compared by a comparator, so the signal works as a reference to itself. If the AC-linevoltage changes suddendly below 85% from the nominal average value the comparator will supply a /NETF signal, which is connected to the reset input RST6.5 of the uP. There can be several /NETF indications before actual fault is detected; the detection depens from the following circumstances:

a. Network failure when motoring:

An internal flag NETFLG is set to one. When NETFLG is one the change to the generating side is inhibited. The program will go through the following routine:

- if NETFLG = 0, normal control mode
- if NETFLG > 0, one will be added to NETFLG
- if /NETF indication dissapeares NEFLG will be reseted to zero
- if NETFLG > 3, it will cause a internal stop

b. Network failure when generating and no current flowing during the indication:

Thyristors are turned off. Delay of 100...200 us after which current is checked once again and if it's still zero the control will be turned off. If the current is flowing after the thyristors are turned off a procedure explained in part c will follow.

c. Network failure when generating and the current is flowing:

The network failure flag is set to one and the control of the thyristors continues the normal way. If the AC-line doesn't come up any more the fuses will blow up. After the firing interruption following routine will be followed:

- if /NETF signal has dissapeared, NETFLG will be set to zero and normal control will be continued
- if /NETF is on and the current is flowing normal control will be continued
- if /NETF is on and the current is zero the drive will be stopped

After the stop the program will wait for the /NETF signal to dissapeare. After the AC-line comes back up and the LOCK signal has indicated that the system is locked to the line the program will measure the value of the UDC during a period of approximately 500ms:

- If the UDC indicates that the voltage is/was below 60% from the nominal value the drive will be started through the precharge routine. The same precharge routine will be followed also if the UDC didn't exceed 90% value from the nominal DC voltage during the measurement period.

- If the UDC exceeds the value 90% form the nominal all the thyristors in the motoring bridge will be turned on several times during this 500ms period. If UDC doesn't go below 90% value the motoring brige will start to get normal firing pulses starting with the control angle 0 degrees. If this doesn't happen the precharge will precede the start.

8. Operation of the angle controller

The angle controller will follow the following formula:

```
+-d(alfa) = GPROP*(USREFP-USREF+USVAL-USVALP) +
            GINTEG*(USVAL-USREF)

+-d(alfa) = the change of the control angle ( + used on the
            motoring side and - on the generating side )
GPROP     = the gain of the P term
GINTEG    = the gain of the I term
USREF     = new reference output voltage of the bridge
USREFP    = old reference output voltage of the bridge
USVAL     = new actual value of the output voltage
USVALP    = old actual value of the output voltage
```

On the motoring side with a light load the output voltage will be 90%*Udcn and with a heavy load 100%*Udcn. The reference will be changed smoothly according to the transit time of the current.

On the generating side the refernce remains at the constant 90%*Udcn value. The actual voltage value of the bridge is calculated according to the control angle and the load determined by the transit time of the current. Checking/control of the angle is done once during every 60 degrees period.

All the reference- and actual values are relative to the AC-line voltage, which means that the controller doesn't compensate any changes in the AC-line voltage.

9. Precharge

Two possible precharge modes are available depending on the state of the signal ADTE:

- ADTE = +5V:
  Constant control angle 50 degrees used (precharge circuitry must be added).
- ADTE = 0V:
  The control angle is reduced from the starting value of 111 degrees to 50 degrees.
  The control angle will not be reduced if the UC doesn't start to increase.

In both cases the precharge will last as long as the DC voltage exceeds 85% from the nominal. With the constant angle precharge (50 degrees) it means that the precharge can be done with 90% AC-line voltage but not with a lower value.

If the signal /UCC3 goes to zero, the program returns to the precharge routine and will stay there with the angle of 50 degrees as long as the signal /UCC3 goes back to one.

10.Change of the bridge

The change of the bridge will happen always, when the current during the present 60 degrees period stops flowing and the transit period of the current is below the reference value. After the current stops flowing all the thyristors will be turned off.

The change from motoring to generating:

- if the last control angle on the motoring side is below 28 degrees the first control angle used on generating side will be approximately 180 degrees:

  If the motoring control angle was 15 degrees the first generator side firing will happen after 45 degrees from the last motor side firing pulse.

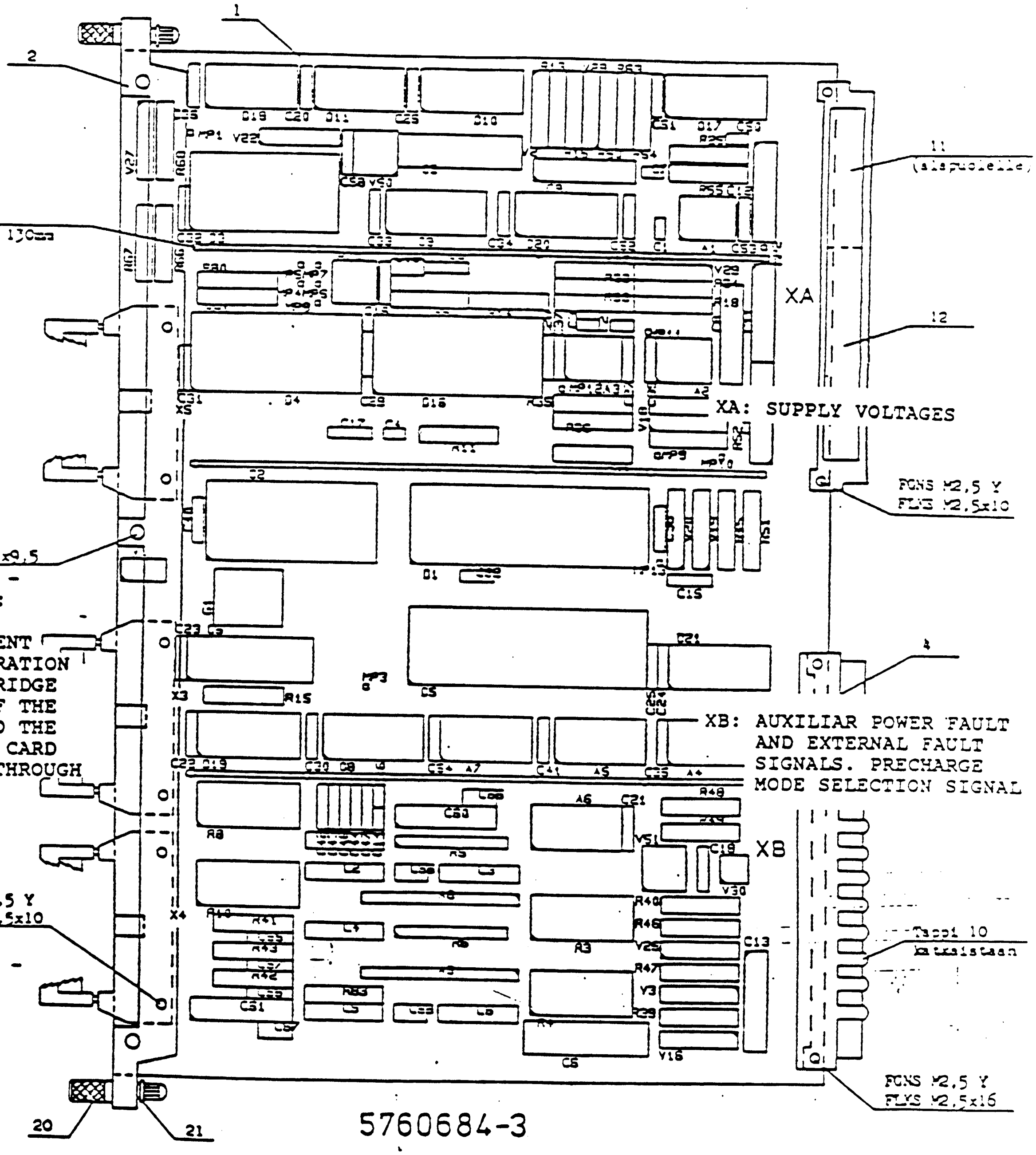
  If the motoring control angle is above 28 degrees the first generator side firing will happen in the second possible point with the angle of approximately 180 degrees. So for example if the motoring control angle is 30 degrees the first generator side firing will happen 90 degrees after the last motor side firing pulse and with a 60 degrees angle the first generator side firing will happen 60 degrees after the last motor side firing pulse.

The change from generating to motoring:

After the decision of the bridge change following will happen:

The motor bridge thyristor that is parallel with the generator bridge thyristor that was the last one turned on will be turned on. This will insure that the generator bridge really turns off. The first real motor bridge firing will happen in the first possible point with an angle of 50 degrees; if the angle of the generator bridge was 170 degrees the first motor bridge firing will happen 60 degrees after the last generator firing

APPENDIX 1/1



X3 SAFT 185 TBC - XB SAMC 19 INF :

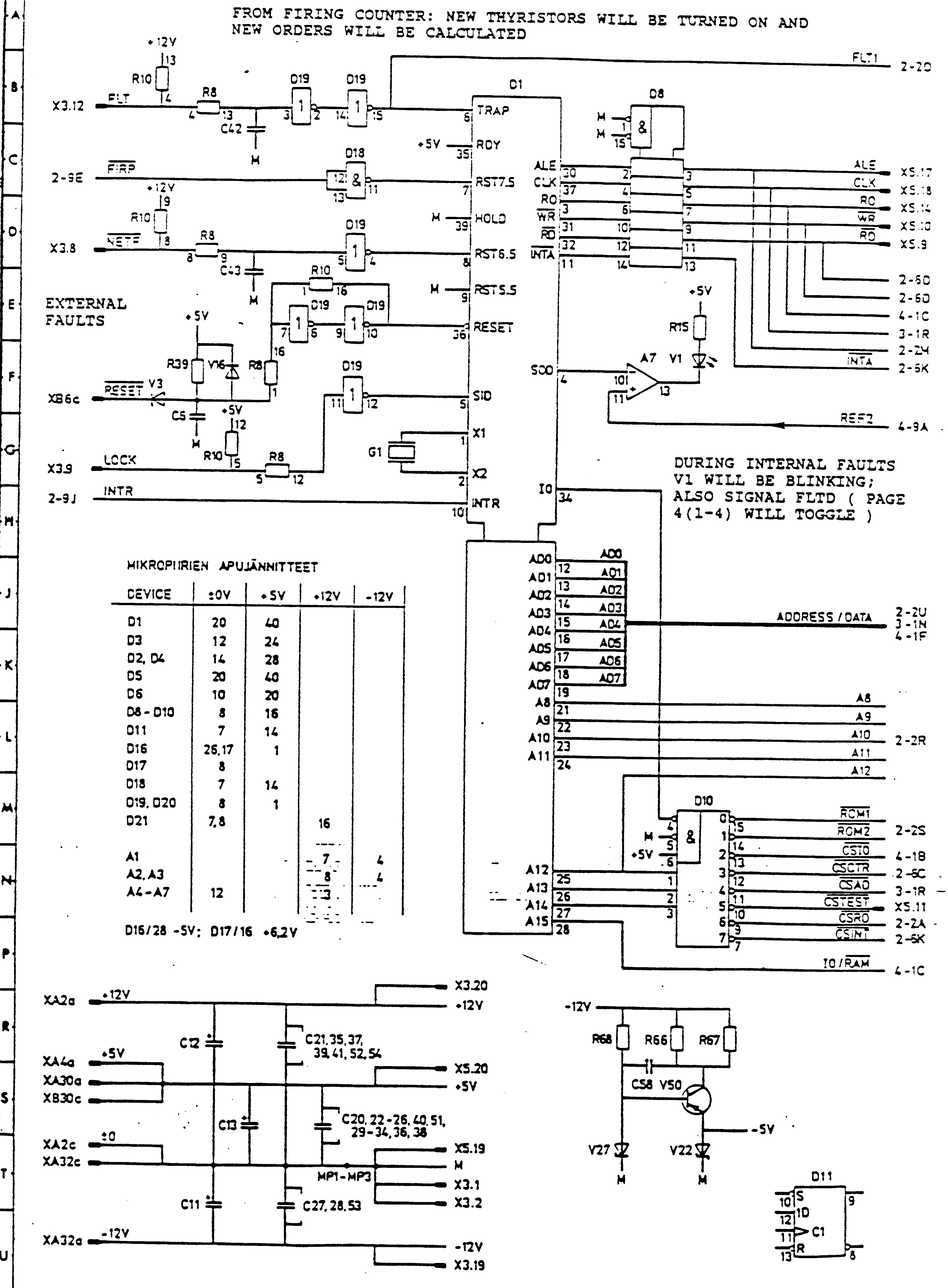
MAINLY MEASUREMENT SIGNALS AND OPERATION ORDERS TO THE BRIDGE CONTROL. PART OF THE FIRING ORDERS TO THE PULSE AMPLIFIER CARD ARE ALSO WIRED THROUGH SAMC 19 INF

X4 SAFT 185 TBC - X7 SAMT 11

FIRING ORDERS

Huom. Etutuen alle ei saa asentaa 9mm korkeampia komponentteja.

SCALE 1:1	EXH		SAMI B
Oy Strömberg Ab FINLAND	82-08-23 Psmnila	VRS-ohjauskortti ~~SAMS 15 TBC~~ SAFT 185 TBC	5735539-3



MIKROPIIRIEN APUJÄNNITTEET

DEVICE	±0V	+5V	+12V	-12V
D1	20	40		
D3	12	24		
D2, D4	14	28		
D5	20	40		
D6	10	20		
D8 - D10	8	16		
D11	7	14		
D16	26,17	1		
D17	8			
D18	7	14		
D19, D20	8	1		
D21	7,8		16	
A1			7	4
A2, A3			8	4
A4-A7	12		3	

D16/28 -5V; D17/16 +6,2V

Oy Strömberg Ab
FINLAND

EXP

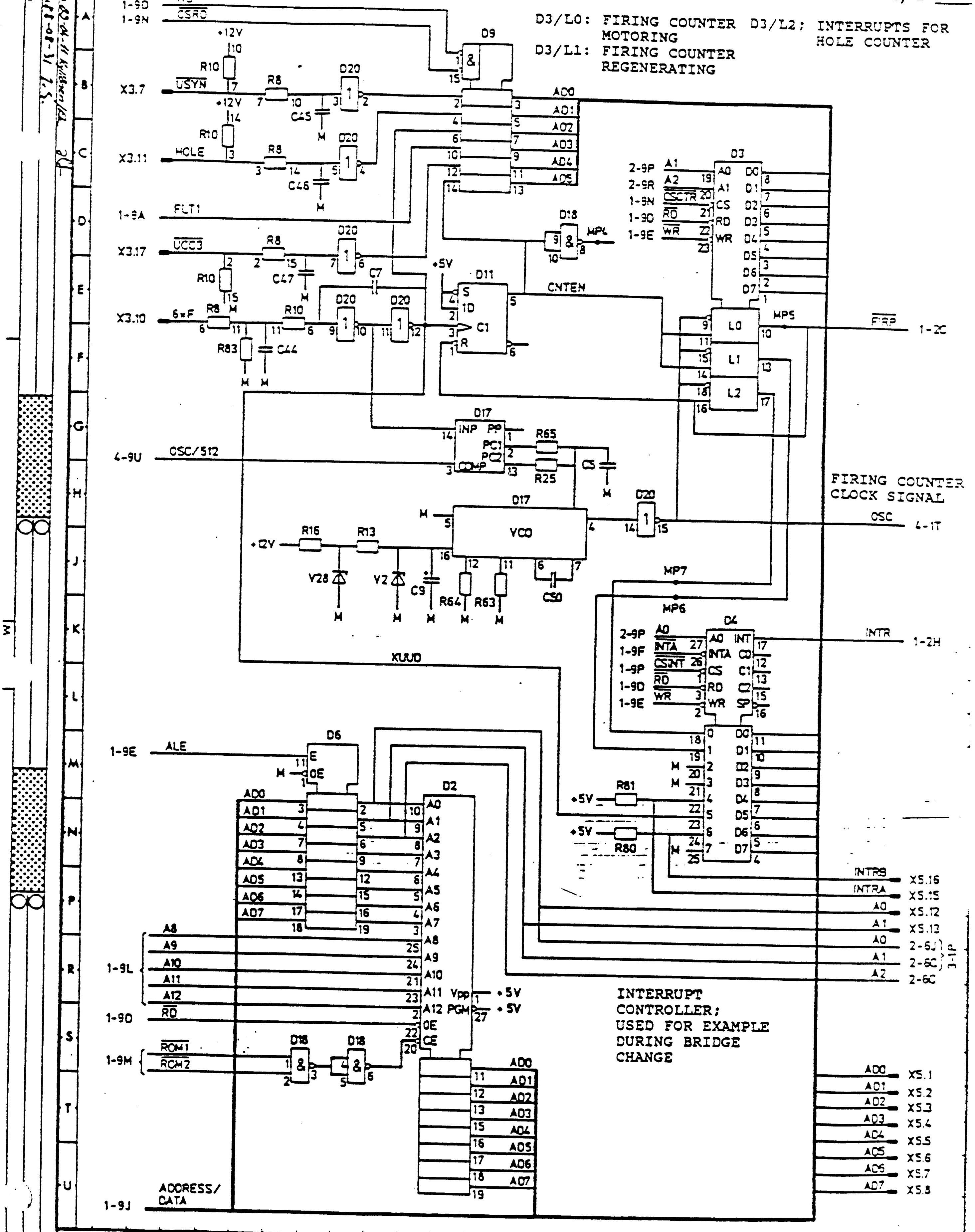
82-03-09 Torkkeli/ek

TBC-OHJAUSKORTTI

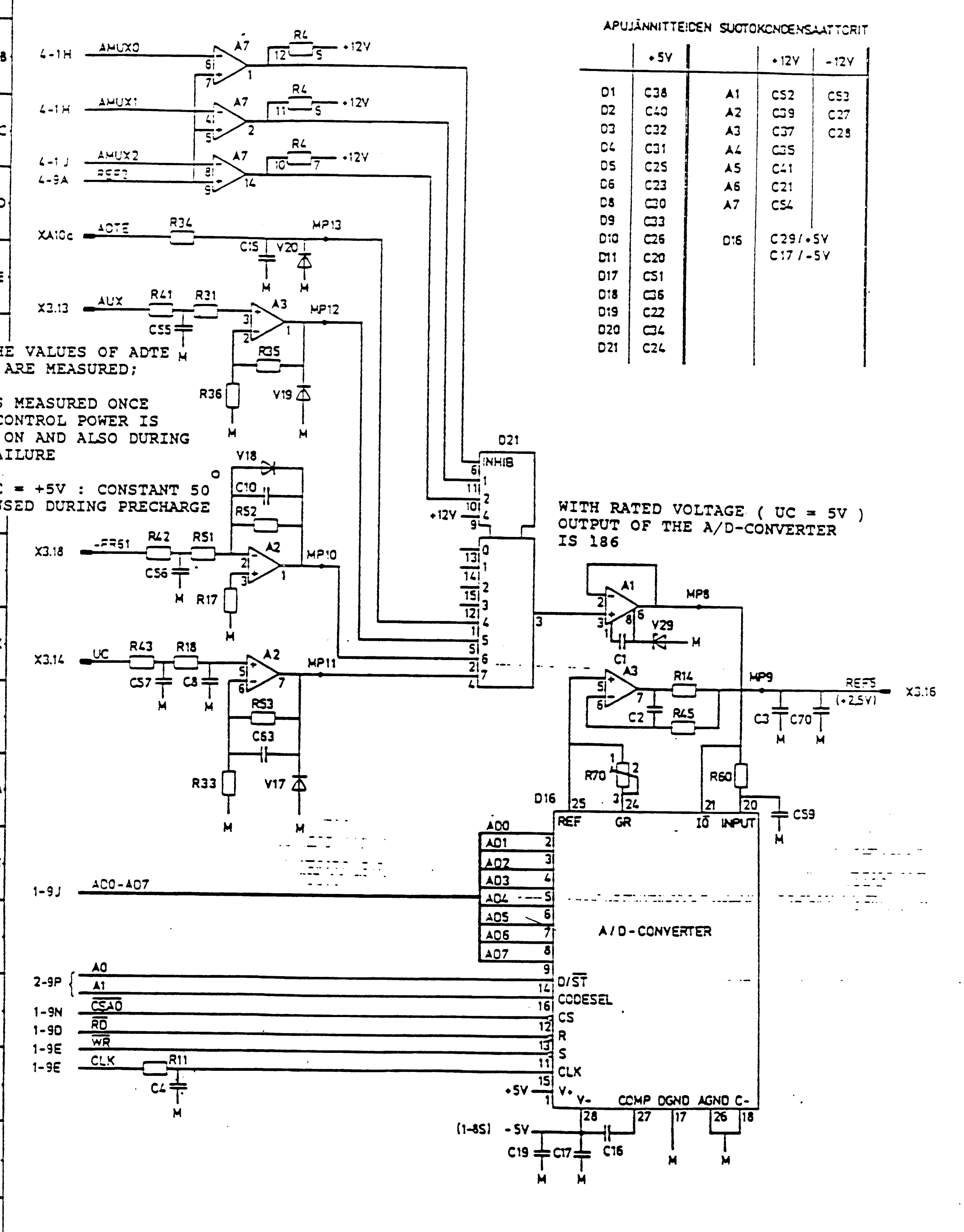
LEHTI 1 (1-4)

A3 5719537-1

APPENDIX 2/2



Oy Strömberg Ab FINLAND	82-03-09 Torkkeli/ek	TBC-OHJAUSKORTTI	2 (1-4)
	EXP		A3 5719537-1



ONLY THE VALUES OF ADTE AND UC ARE MEASURED;

ADTE IS MEASURED ONCE AFTER CONTROL POWER IS TURNED ON AND ALSO DURING A NETFAILURE

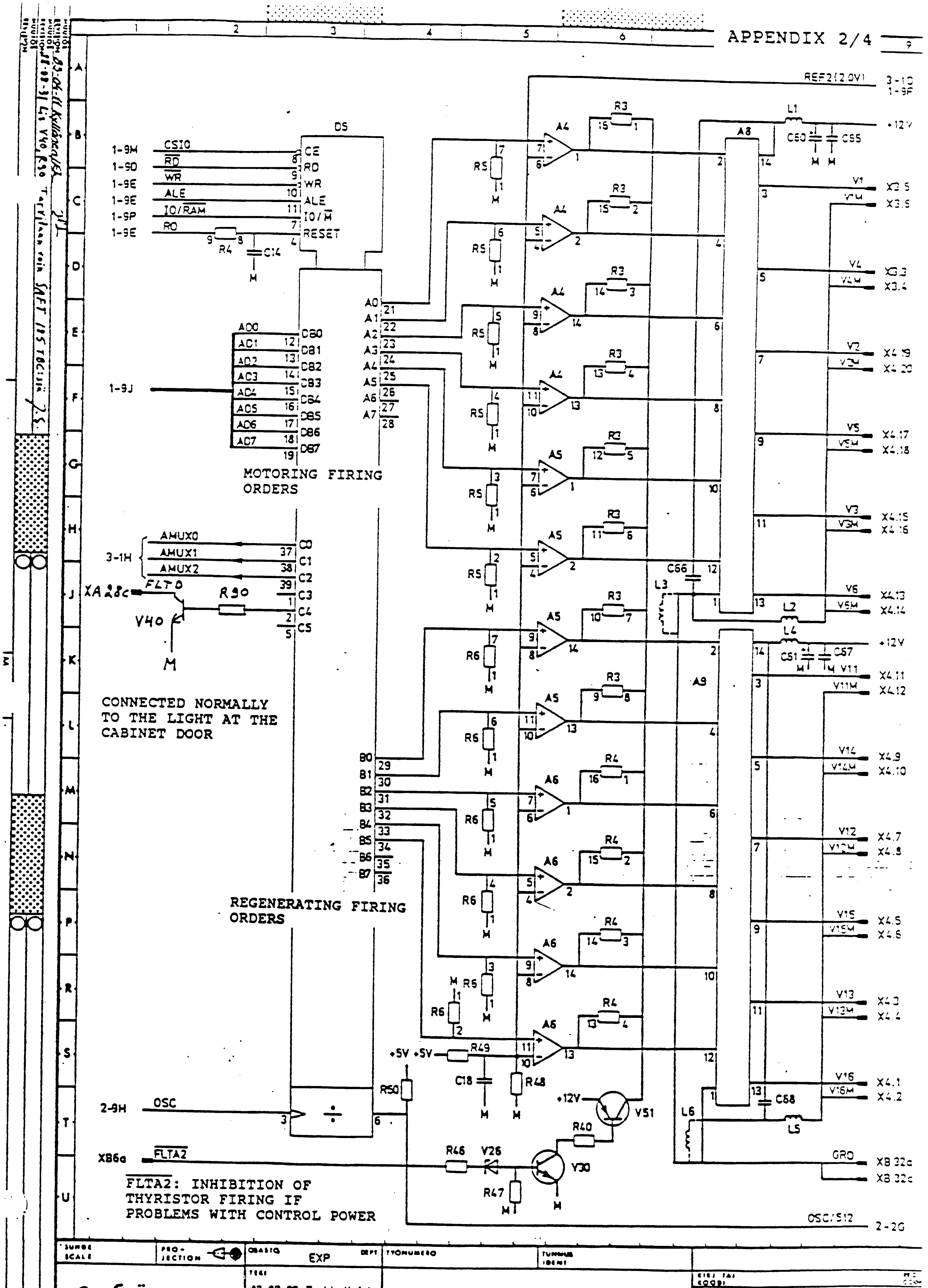
IF ADTE = +5V : CONSTANT 50° ANGLE USED DURING PRECHARGE

WITH RATED VOLTAGE (UC = 5V) OUTPUT OF THE A/D-CONVERTER IS 186

APUJÄNNITTEIDEN SUOTOKONDENSAATTORIT

	+5V		+12V	-12V
D1	C38	A1	C52	C53
D2	C40	A2	C39	C27
D3	C32	A3	C37	C28
D4	C31	A4	C35	
D5	C25	A5	C41	
D6	C23	A6	C21	
D8	C30	A7	C54	
D9	C33			
D10	C26	D16	C29 / +5V	
D11	C20		C17 / -5V	
D17	C51			
D18	C36			
D19	C22			
D20	C34			
D21	C24			

SCALE	PROJECTION	OSASTO / DEPT EXP	TYONUMERO
Oy Strömberg Ab FINLAND	TEKI 82-03-09 Torkkeli/ek	TBC-OHJAUSKORTTI	LEHTI / SHEET 3 (1-4)
			KOKO A3 PIIRUSTUSNUMERO / DRAWING NO. 5719537-1



Oy Strömberg Ab
FINLAND

EXP

82-03-09 Torkkeli/ek

TBC-OHJAUSKORTTI

M	RIVI	TUNNUS	MÄÄRÄ	YKS	DI	KOODI	OSAN NIMITYS	TYYPPI	TEKNISET ARVOT	VALMI.	MAA	HUOM
	10					5719 5398	KOKOONPANO					
	20					5719 5371	PIIRIKAAVIO					
	30											
	40	8!1	1,000	KPL	VE	5760 6043	PIIRILEVY	5760684-3	REV. D		FI	
	50	12	1,000	KPL	VE	5716 2465	TARRA PIIRILEVYT	PDL111 GMY LOGOLLA	50,8X9,5MM (ID-5233)	FANDUI	US	
	60	11	1,000	KPL	VE	3505 5398	SARJANUMEROKILPI	SARJANUMERO	10X30MM	MAINOS	FI	
	65			KPL	VE	5811 9679	TYOHJE	SAFT 185 TBC	PIIRILEVY REV D			
	66			KPL	VE	5811 9709	TYOHJE	SAFT 185 TBC	PIIRILEVY REV D			
	67											
	70	XA,XB	2,000	KPL	VE	0988 2111	EUR.LIITIN	D032MS-C1A-1,25/5	32-NAP. KOIRAS JUOT.	FERLOS	FI	
	80						32 NAP.					
	90											
	100	X3,X4,X5	3,000	KPL	VE	0980 2206	NAUHAKAAPELILIITIN	FAP-2001-1202-0AS	20-NAP. KOIRAS 90AST	YAMAIC	JP	
	110											
	120	MP1-MP13	13,00	KPL	VE	0987 8050	JUOTOSTAPPI	RIM1,3/3,5/9,7.002	CuZn, Sn	STOCKO	DE	
	130											
	140	2	1,000	KPL	VE	5716 3445	ETUTUKI	CXB		FLASTO	FI	
	150	20	2,000	KPL	VE	5716 8901	LUKITUSRUUVI	M4		NOMET	FI	
	160	21	2,000	KPL	VE	3506 4982	PIDÄTINLAATTA	FSTJ/B 4	6,5/3,2X0,5	KNORRI	FI	
	170											
	180	D1	1,000	KPL	VE	0981 8022	MIKROPROSESSORI	8085A	NMOS 8-BIT	INTEL	US	
	190	D2	1,000	KPL		5602 0110	OHJELMOITU MUISTIP.	SAFRGU 1.01B	2764A 8K EPROM	STR	FI	
	200	D3	1,000	KPL	VE	0981 8120	MIKROPIIRI	TMP8253P-5	INTERVAL TIMER	TOSHIB	JP	
	210	D4	1,000	KPL	VE	0981 8154	MIKROPIIRI	D8259A	INTERRUPT CONTROLLER	INTEL	US	
	220	D5	1,000	KPL	VE	0981 8031	256X8RAM,I/O,TIMER	D8155	256X8,2X8+1X6,14BIT	INTEL	US	
	230											
	240	D6	1,000	KPL	VE	0981 5601	MIKROPIIRI	SN 74LS373 N	TTL 8-BIT TRANSPAR.LATCH	TEXAS	US	
	250											
	260	D8,9	2,000	KPL	VE	0981 8227	MIKROPIIRI	N8T95N	HEX TRI-STATE BUFFERS	SIGNET	US	
	270	D10	1,000	KPL	VE	0981 5481	MIKROPIIRI	74LS138N	TTL 3-TO-8 LINE DECODER	TEXAS	US	
	280	D11	1,000	KPL	VE	0981 5643	MIKROPIIRI	SN74LS74AN	TTL DUAL D-TYPE FLIP FLOP	TEXAS	US	
	290	D16	1,000	KPL	VE	0981 7310	A/D-MUUNNIN	AM6108DC	8-BIT UP-SYSTEM COMPATIBL	ADM	US	
	300											
	310	D17	1,000	KPL	VE	0981 6488	MIKROPIIRI	CD4046BE	CMOS PHASE LOCKED LOOP	RCA	US	
	320	D18	1,000	KPL	VE	0981 5457	MIKROPIIRI	74LS132N	TTL QUAD NAND SCHMITT TRI	TEXAS	US	
	330	D19,20	2,000	KPL	VE	0981 6496	MIKROPIIRI	CD4049UBE	CMOS HEX INVERTER/BUFFER	RCA	US	
	340	D21	1,000	KPL	VE	0981 6518	MIKROPIIRI	CD4051BE	CMOS 8-CHANNEL MULTIPL.	RCA	US	
	350											
	360	A1	1,000	KPL	VE	0981 3489	OPER. VAHVISTIN	LM101AJ	IOS 10 NA EOS 2 MV	NS	US	
	370	A2,A3	2,000	KPL	VE	0981 3497	2X OP AMP	CA1558E	EOS 5 MV IOS 200 NA	RCA	US	
	380	A4-7	4,000	KPL	VE	0981 3365	4XCOMPARATOR	LM139J	IOS 30 NA EOS 6 MV	NS	US	
	390	A8,9	2,000	KPL	VE	5722 8938	HYBRIDIPIIRI	SH004A		SALORA	FI	
	400											
	410	V1	1,000	KPL	VE	0980 9503	LOISTEDIODI	TLUR 4400	PUN. HALK=3MM P=2,5MM	TELEFU	DE	
	420	V2	1,000	KPL	VE	0980 8906	ZENERDIODI	1N 821	6,2V 5 %	PHILIP	NL	
	430	V3,16-20	6,000	KPL	VE	0980 3190	DIODI	1N4148	75V AV0.15A 4NS	PHILIP	NL	
	440	V22	1,000	KPL	VE	0980 3734	DIODI	BYV10-20	1A 20V SCHOTTKY	PHILIP	NL	
	450	V26,27	2,000	KPL	VE	0980 8221	ZENERDIODI	BZX79C5V6	5,6V 0,4W	PHILIP	NL	
	460											
	470	V28	1,000	KPL	VE	0980 8248	ZENERDIODI	BZX79C8V2	8,2V 0,4W	PHILIP	NL	

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ALKUP. A TSTO EXF
PVM 880901 SUUNN. JUHA SUOMINEN
VIIM. A TSTO EXF
PVM 880901 SUUNN. SUOMINEN
PVM TARK.
PVM 880901 HYV. SUOMINEN

TUNNUS
KÄYTTÖKOHDE SAMI F
LISÄTIEDOT
SAMI F VASTARINNANSILLAN OHJAUSKORTTI

NIMITYS OHJAUSKORTTI
TYYPPI SAFT 185 TBC
TEKN.ARVOT

PLKA 85610
LEHTI 1 ( ) KOKO A3
KIELI FI VERSIO A
KOODI VE 5811 9687

* * * * * * * * J A T K U U * * * * * * * *

M	RIVI	TUNNUS	MÄÄRÄ	YKS	DI	KOODI	OSAN NIMITYS	TYYPPI	TEKNISET ARVOT	VALMI.	MAA	HUOM
	480	V29	1,000	KPL	VE	0980 8256	ZENERDIODI	BZX79C10	10 V 0,4W	PHILIP	NL	
	490	V30,V40	2,000	KPL	VE	0980 6458	TRANSISTORI	2N2369	NPN 0,1 A 15 V	ST	FR	
	500	V50,51	2,000	KPL	VE	0980 7683	TRANSISTORI	2N2905A	PNP 0,5A 60V	ST	FR	
	510											
	520	R3,4	2,000	KPL	VE	0991 0107	VASTUSVERKKO DIL	898-3-R5,6K	8X5,6K PR=0,2W PT=1,6W	BECKMA	US	
	530	R8	1,000	KPL	VE	0991 0115	VASTUSVERKKO DIL	898-3-R10K	8X10K PR=0,2W PT=1,6W	BECKM	US	
	540	R10	1,000	KPL	VE	0991 0123	VASTUSVERKKO DIL	898-3-R100K	8X100K PR=0,2W PT=1,6W	BECKMA	US	
	550	R5,6	2,000	KPL	VE	0990 9877	VASTUSVERKKO SIL	L-10-1-C104M2	9X100K PR=0,1 W PT=0,83W	BECKMA	US	
	560											
	570	R60	1,000	KPL		0991 0948	VASTUS	SMA0207S	47,5OHM 0,5 W 1% 50PPM	DRALOR	DE	
	580	R11,14	2,000	KPL		0991 2495	VASTUS	SMA0207S	100 OHM 0,5 W 1% 50PPM	DRALOR	DE	
	590	R66,67	2,000	KPL		0991 1138	VASTUS	SMA0207S	100 OHM 0,5 W 1% 50PPM	DRALOR	DE	
	600	R13	1,000	KPL		0991 2517	VASTUS	SMA0207S	150 OHM 0,5 W 1% 50PPM	DRALOR	DE	
	610	R16	1,000	KPL		0991 2525	VASTUS	SMA0207S	182 OHM 0,5 W 1% 50PPM	DRALOR	DE	
	620											
	630	R15	1,000	KPL		0991 2541	VASTUS	SMA0207S	267 OHM 0,5 W 1% 50PPM	DRALOR	DE	
	640	R68	1,000	KPL		0991 1227	VASTUS	SMA0207S	562 OHM 0,5 W 1% 50PPM	DRALOR	DE	
	650	R42	1,000	KPL	VE	0991 3602	VASTUS	SMA0207S	1 K 0,5 W 1% 50PPM	DRALOR	DE	
	660	R47,48	2,000	KPL		0991 2657	VASTUS	SMA0207S	2,21K 0,33W 1% 50PPM	DRALOR	DE	
	670	R49	1,000	KPL		0991 2673	VASTUS	SMA0207S	3,32K 0,33W 1% 50PPM	DRALOR	DE	
	680	R46,63	2,000	KPL		0991 2711	VASTUS	SMA0207S	6,81K 0,33W 1% 50PPM	DRALOR	DE	
	690	R17,43,45	3,000	KPL		0991 2738	VASTUS	SMA0207S	10,0K 0,33W 1% 50PPM	DRALOR	DE	
	700	R31,34-36	4,000	KPL		0991 2738	VASTUS	SMA0207S	10,0K 0,33W 1% 50PPM	DRALOR	DE	
	710	R40,41,83	3,000	KPL		0991 2738	VASTUS	SMA0207S	10,0K 0,33W 1% 50PPM	DRALOR	DE	
	720											
	730	R50,80,81	3,000	KPL		0991 2738	VASTUS	SMA0207S	10,0K 0,33W 1% 50PPM	DRALOR	DE	
	735	R90	1,000	KPL		0991 2738	VASTUS	SMA0207S	10,0K 0,33W 1% 50PPM	DRALOR	DE	
	740	R51	1,000	KPL	VE	0991 3734	VASTUS	SMA0207S	12,1K 0,5W 1% 50PPM	DRALOR	DE	
	750	R64	1,000	KPL		0991 2762	VASTUS	SMA0207S	18,2K 0,33W 1% 50PPM	DRALOR	DE	
	760	R39	1,000	KPL		0991 2827	VASTUS	SMA0207S	56,2K 0,33W 1% 50PPM	DRALOR	DE	
	770	R52	1,000	KPL	VE	0991 3807	VASTUS	SMA0207S	47,5K 0,5W 1% 50PPM	DRALOR	DE	
	780	R53	1,000	KPL	VE	0991 3840	VASTUS	SMA0207S	100 K 0,5W 1% 50PPM	DRALOR	DE	
	790											
	800	R25,65	2,000	KPL		0991 2851	VASTUS	SMA0207S	100 K 0,33W 1% 50PPM	DRALOR	DE	
	810	R18	1,000	KPL		0991 2878	VASTUS	SMA0207S	150 K 0,33W 1% 50PPM	DRALOR	DE	
	820											
	830	R33	1,000	KPL	VE	0991 3882	VASTUS	SMA0207S	221 K 0,5W 1% 50PPM	DRALOR	DE	
	840											
	850	R70	1,000	KPL	VE	0982 7579	TRIMMERIPOT.METRI	3306P-1-101	100 OHM 0,5W 10% 100 PPM	BOURNS	US	
	860											
	870	L1,2,4,5	4,000	KPL	VE	0985 0104	KURISTIN	B78 108-S1104-J	100 UH +-10% 160MA	SIEMEN	DE	
X	880	L3,6	2,000	KPL			OIKOSULKULANKA					
	890											
B	900	C1,2,4	3,000	KPL	VE	3505 0084	KONDENSAATTORI	2222 678 10339	33PF 100V 10% P=2.5	PHILIP	NL	
B	910	C7,63	2,000	KPL	VE	0983 1011	KONDENSAATTORI	CRC15A COG	100PF 100V 10%	DRALOR	DE	
B	920	C3,50	2,000	KPL	VE	3505 0922	KONDENSAATTORI	C320 C471K 2G5CA	470PF 100V 10% P=2.5	UNION	US	
B	930	C14,46	2,000	KPL	VE	3505 0906	KONDENSAATTORI	3429 100A 102K	1NF 100V 10% P=2.5	AVX	US	
	940	C15,16,47	3,000	KPL	VE	0983 0359	KONDENSAATTORI	MD01 1C103MAA	10NF 100V 20% DIP	AVX	GB	
	950											
	960	C20-45	26,00	KPL	VE	0983 0359	KONDENSAATTORI	MD01 1C103MAA	10NF 100V 20% DIP	AVX	GB	

ABB STRÖMBERG DRIVES OY FINLAND

ALKUP. A	TSTO	EXF	
PVM 880901	SUUNN.	JUHA SUOMINEN	
VIIM. A	TSTO	EXF	
PVM 880901	SUUNN.	SUOMINEN	
PVM	TARK.		
PVM 880901	HYV.	SUOMINEN	

TUNNUS
KÄYTTÖKOHDE SAMI F
LISÄTIEDOT
SAMI F VASTARINNANSILLAN OHJAUSKORTTI

NIMITYS	OHJAUSKORTTI
TYYPPI	SAFT 185 IBC
TEKN.ARVOT	

PLKA	85610
LEHTI	2 ( ) KOKO A3
KIELI	FI VERSIO A
KOODI	VE 5011 9687

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M	RIVI		TUNNUS	MÄÄRÄ	YKS	DI	KOODI	OSAN NIMITYS	TYYPPI	TEKNISET ARVOT	VALMI.	MAA	HUOM
	970		C51-59,70	10,00	KPL	VE	0983 0359	KONDENSAATTORI	MD01 1C103MAA	10NF 100V 20% DIP	AVX	GB	
	980	B	C17-19	3,000	KPL	VE	0983 0219	KONDENSAATTORI	MKT 1.05	47NF 63V, 10%	ARCOTR	IT	
	990	B	C65-68	4,000	KPL	VE	0983 0219	KONDENSAATTORI	MKT 1.05	47NF 63V 10%	ARCOTR	IT	
	1000	B	C8	1,000	KPL	VE	0983 1550	KONDENSAATTORI	MKC 1860 0,1UF 100V	0,1UF 63V 10% +150PPM	ERO	DE	
	1010												
	1020	B	C10	1,000	KPL	VE	0983 1584	KONDENSAATTORI	MKC 63	0,47UF 63V 10% +150PPM	CF	CH	
	1030	B	C5	1,000	KPL	VE	0983 1614	KONDENSAATTORI	MKC 1860-510/065	1,0UF 63V 10% +150PPM	ERO	DE	
	1035	B	C6	1,000	KPL	VE	0983 1631	KONDENSAATTORI	MKC 1860 2,2UF 63V	2,2UF 63V 10% +150 PPM/K	ERO	DE	
	1040		C9,11-13	4,000	KPL	VE	3502 3798	TANTAALIKONDENSAATT.	TAS156M020F1C	15UF 20V +-20%	MALLOR	US	
	1050		C60,61	2,000	KPL	VE	3502 3798	TANTAALIKONDENSAATT.	TAS156M020F1C	15UF 20V +-20%	MALLOR	US	
	1060												
	1070												
	1080		G1	1,000	KPL	VE	3503 2916	KIDE	6,144MHZ HC-18/U	6,144 MHZ, 75 OHM MAX	TQ	DE	
	1090												
	1100		(D1,5)	2,000	KPL	VE	0981 3748	MIKROPIIRIKANTA	D 2840Z01	40-NAP.	HARWIN	GB	
	1110		(D2,4,16)	3,000	KPL	VE	0981 3721	MIKROPIIRIKANTA	D 2828Z01	28-NAP.	HARWIN	GB	
	1120		(D3)	1,000	KPL	VE	0981 3705	MIKROPIIRIKANTA	D 2824Z01	24-NAP.	HARWIN	GB	
	1130		3	4,000	KPL	VE	3506 4958	VIRTAKISKO	M 025 17 10	500VDC 5A	MEKTRO	DE	
	1140		4	1,000	KPL	VE	3506 4796	KODDAUSRIMA,UROS	926495-4		AMP	US	

ABB STRÖMBERG DRIVES OY FINLAND

ALKUP. A	TSTO	EXF	
FVM 880901	SUUNN.	JUHA SUOMINEN	
VIIM. A	TSTO	EXF	
FVM 880901	SUUNN.	SUOMINEN	
FVM	TARK.		
FVM 880901	HYV.	SUOMINEN	

TUNNUS
KÄYTTÖKOHDE SAMI F
LISÄTIEDOT
SAMI F VASTARINNANSILLAN OHJAUSKORTTI

NIMITYS: OHJAUSKORTTI
TYYPPI: SAFT 185 TBC
TEKN.ARVOT

PLKA	85610
LEHTI	3 (3) KOKO A3
KIELI	FI VERSIO A
KOODI	VE 5011 9687

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M	RIVI	TUNNUS	MÄÄRÄ	YKS	DI KOODI	OSAN NIMITYS	TYYPPI	TEKNISET ARVOT	VALMI.	MAA	HUOM
	10	D2	1.000	KPL	VE 0981 8596	MUISTIPIIRI	D 2764 A	EPROM 8KX8BIT	INTEL	US	
	20		1.000	KPL	VE 5708 6963	TARRA OHJELM. PIIRIT	PDL19 WINYL GMC	25.4X12.7MM	PANDUI	US	

STROMBERG OY FINLAND

ALKUP.	A	TSTO	EXF
PVM	880831	SUUNN.	SUOMINEN
VIIM.	A	TSTO	EXF
PVM	880831	SUUNN.	SUOMINEN
PVM		TARK	

TUNNUS D2
KÄYTTÖKOHDE SAMI F
LISATIEDOT
SAMI F VASTARINNANSILLAN OHJELMAMUISTI KORTILLE SAFT 185 TBC

NIMITYS OHJELMOITU MUISTIP.
TYYPPI SAFRGU 1.01A
TEKN. ARVOT 2764A 8K EPROM

PLKA 85610
LEHTI 1 (1) KOKO A3
KIELI FI VERSIO A

03-16-89
R.Ahola

CONTENTS:

1. Block diagram

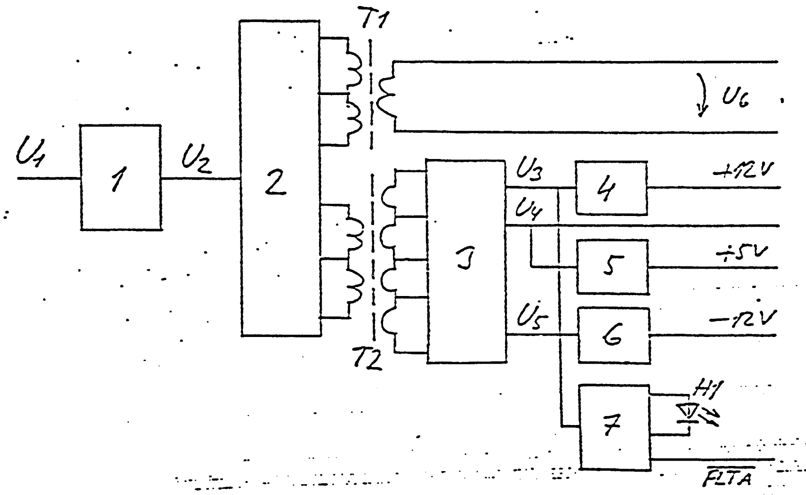


Figure 1. SAMC 11 POW block diagram

- block 1: Stabilized transformer. Input voltage U1 = 30...55V. Output voltage U2 = 55V.
- block 2: Push-pull inverter to the transformers T1 and T2
- block 3: Rectifies and filters the secondary voltages from transformers T1 and T2. Output voltages U3 = + 15 V, U4 = + 8.5 V and U5 = - 15 V
- blocks 4,5 and 6:
  Integrated voltage requlators. Output voltages:
  - block 4 = + 12 V
  - block 5 = + 5 V
  - block 6 = - 12 V
- block 7: Control voltage supervision; if level of the voltage U3 is too low this block will sen a fault signal FLTA to the control unit and it will turn off the LED H1

- from the transformer T1 a 25V 35kHz square wave voltage for the pulse amplifier cards

2. Stabilized power supply

2.1 Operation principible

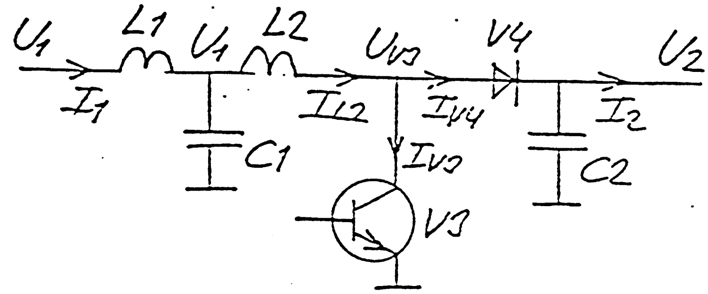


Figure 2.

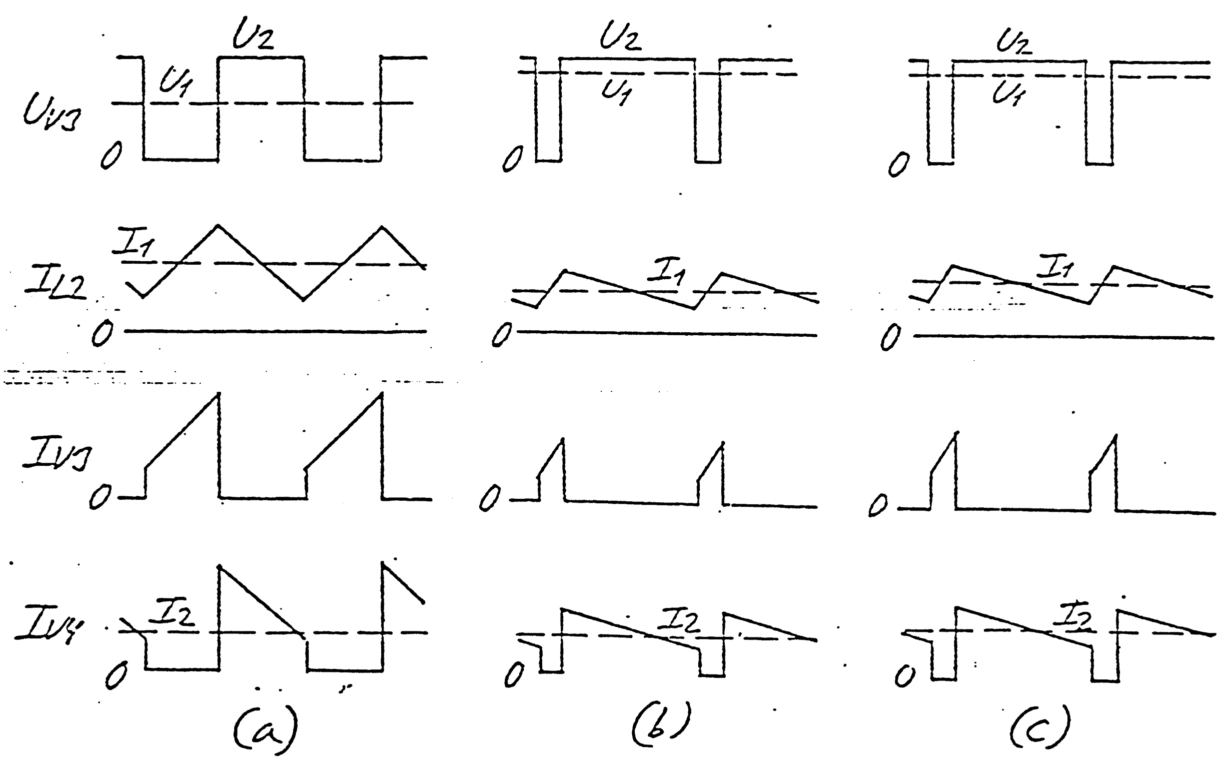


Figure 3.

Stabilized power supply main circuit diagram is in figure 1 and current and voltage wave shapes related to it in figure 2:

- choke L1 and capacitor C1 are used to reduce the noise level reflected back to the supply side and produced by the switching of V3
- stabilized power supply L2, V3, V4 and C2 operation:
    - when V3 is turned on the current through it increases based approximatel to the time constant of L2 and the voltage level of U1
    - when V3 is turned off current starts to flow through the diode V4 and current decreases based to the voltage difference U2-U1. Capacitor C2 is charged during this period; C2 is large enough to keep the voltage level constant
    - by controlling the operating cycle of V3 so that average value of current IV4 equals the load current the voltage of C2 will remain constant

- figure 3a; operation with low input voltage
- figure 3b; same load current as in figure 3a, but with a higher input voltage
- figure 3c; same input voltage as in figure 3b, but with a higher load current
- automatic control system will produce a constant 55Vdc voltage (= UC2)

2.2 Control circuitry operation

Control circuit diagram in figure 4 and wave shapes related to it in figure 5.

- actual voltage U52 (= output voltage U2 scaled by resistors R17 and R19) is compared to a constant reference 2.86 and these to voltages are used as inputs to the differential amplifier in the integrated regulator circuit A5

- voltage U45 (= output from the integrated regulator circuit A5 modified by zener diode V18) and voltage U44 (= function of the input voltage U1 and the current IV3 of the transistor V3) are used as inputs to the comparator A4
- every other rising edge of the clock oscillator (oscillator frequency = 70kHz) switches the output of the flip-flop D2 to "1"-state:
    - transistors V2 and V3 are turned on and voltage U44 value will increase
    - when voltage U44 exceeds the value of U45 the output of flip-flop D2 will change from "1"- to "0"-state and transistors V2 and V3 will be turned off
- if voltage U2 starts to decrease differential amplifier will increase the level of U45 which allows U44 to reach higher values before V2 is turned off. This means that the input power increases and voltage U2 remains constant regardless of the higher loading. Similar operation when load decreases.

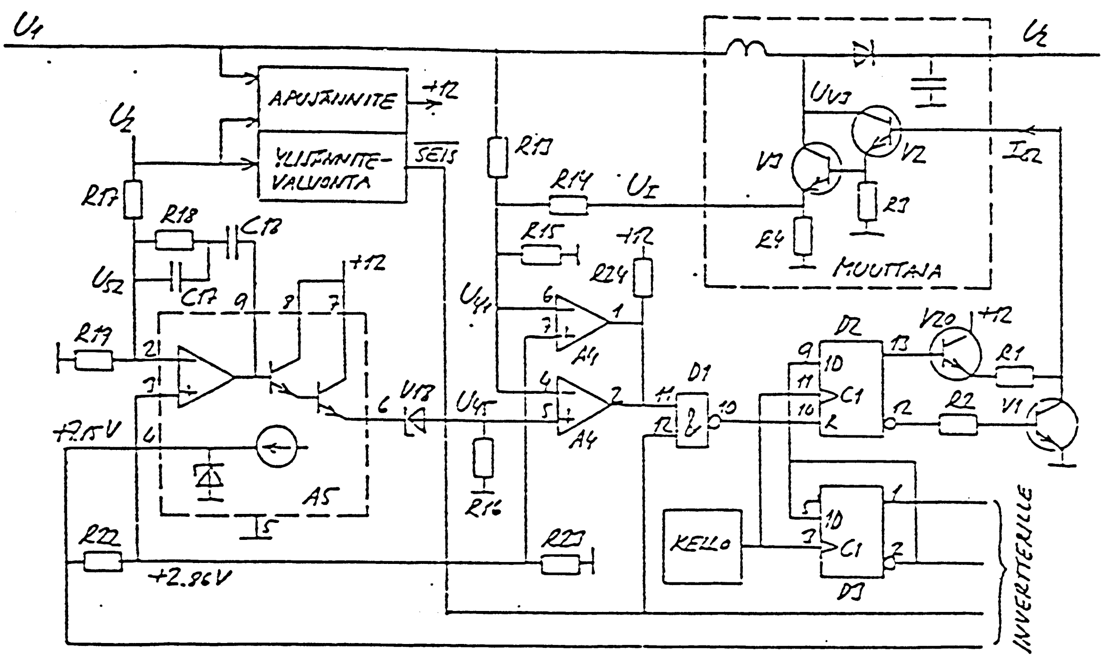
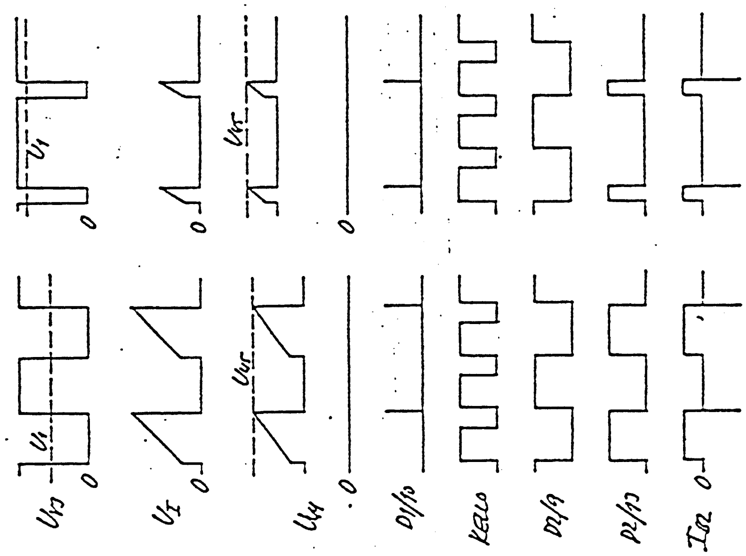


Figure 4. SAMC 11 POW control circuitry



- figure 5a: wave shapes with low input voltage (30 V)
- figure 5b: wave shapes with high input voltage (48 V)

Figure 5. SAMC 11 POW control circuit signals

Current is limited based to the voltage U44; if U44 value exceeds 2.86 volts (equals 2A output current) an additional comparator will force the output of D2 to zero. Current limiting will operate only when U2 >= U1 and because of this U2 isn't short circuit protected by this controller but with current limiting in the inverter section (check chapter 3.2).

Fault in the control circuitry can cause output voltage to increase to a high value, which could cause damage to the semi-conductors in the main circuitry. To inhibit possibility of circuit failures an additional overvoltage limit has been added which will turn off pulses and control from the inverter if safe operation area of U2 is exceeded.

3. Push-pull power supply

3.1 Operation princible

In figure 6 is the main circuitry of the inverter and in figure 7 the signal wave shapes related to it. Signals UV21 and UV22 control power fets V5 (IV5 in figure 7) and V6 (IV6 in figure 7) to form a square wave input voltage to the transformers T1 and T2.

Secondary voltages of T1 and T2 are rectified and filtered:

T1 output	T2 output
U3 = + 15 V	U6 = 25V 35kHz (I6 in figure 7)
U4 = + 8.5 V	
U5 = - 15 V	

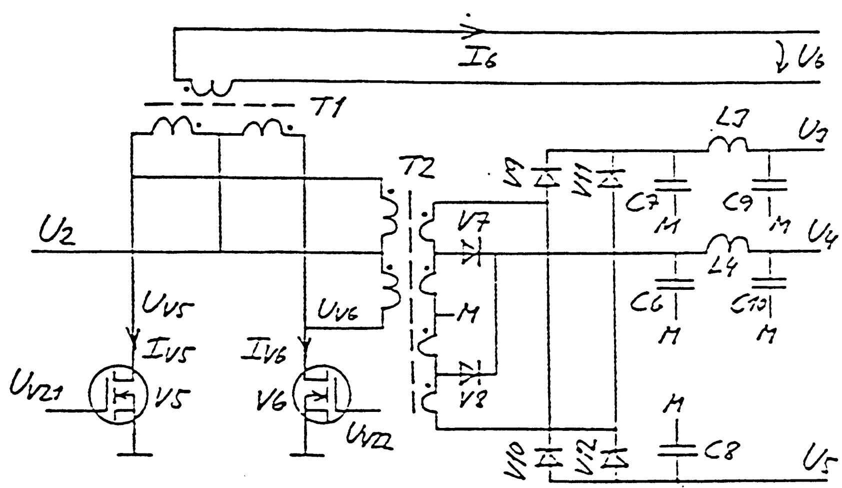


Figure 6. Push-pull inverter

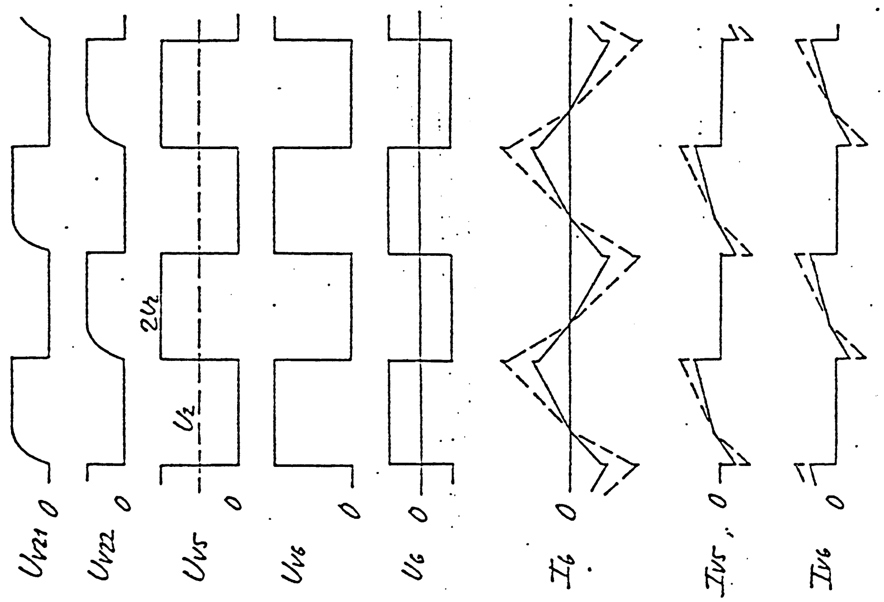


Figure 7. Signal wave shapes in the push-pull inverter

3.2 Control circuitry operation

Inverter control circuit diagram in figure 8 and signal wave shapes related to it in figure 9a.

Components A4, C20, R34...R36 form the 70kHz oscillator circuit (output = A4/13). With the flip-flop D3 this 70kHz is used to produce two opposite phase 35kHz signals, which via the NAND circuits D1 control transistors V21 and V22. Collector voltages of these transistors control the power FETs V5 and V6 in the main circuit.

Oscillator circuit includes also compensation to take care of different resistance values in the power FETs.

Voltage U49 is formed by the resistors R7...R10 from currents IV5 and IV6; if this voltage exceeds reference level U48 the output of flip-flop D3 (D3/12) will remove the ON-signal from corresponding FET for the rest of the cycle. This signal has also an effect to the reference level U48 via resistor R54; earlier the D3/12 goes to zero the lower the level of U48. In figure 9b wave shapes during current limiting period.

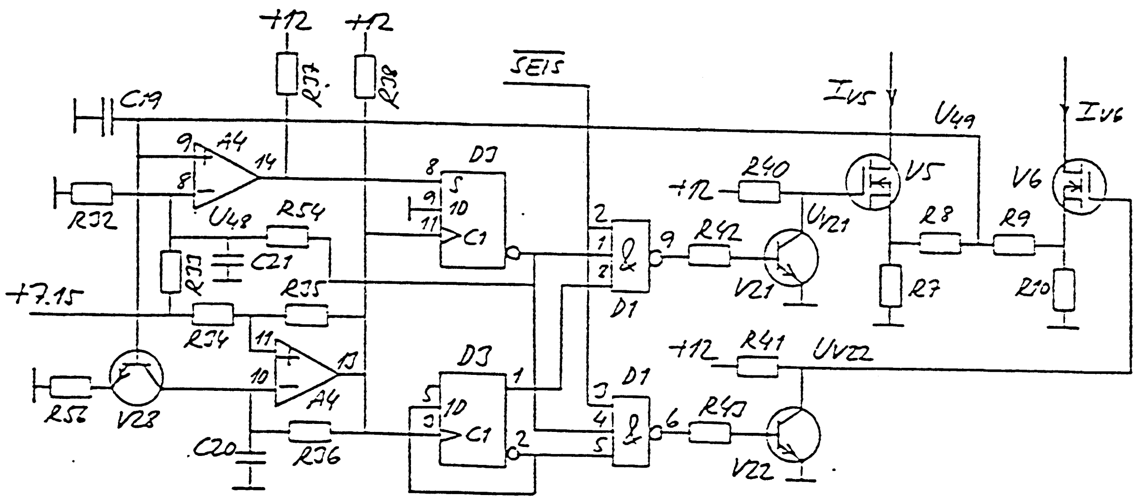


Figure 8. Control circuit of the push-pull inverter

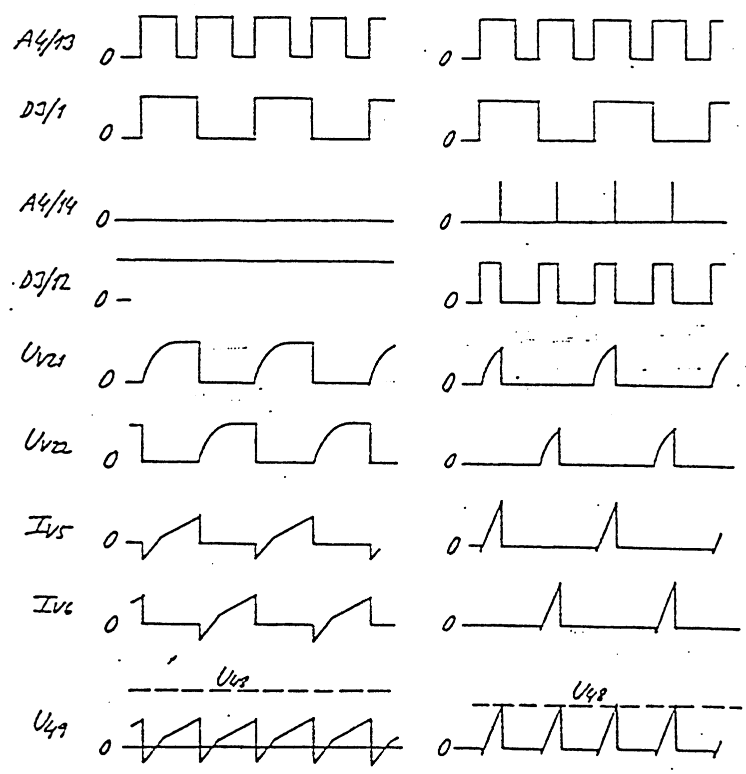


Figure 9. Signal wave shapes in the push-pull inverters control circuitry:
a: normal operation b: current limiting operation

4. Output circuits

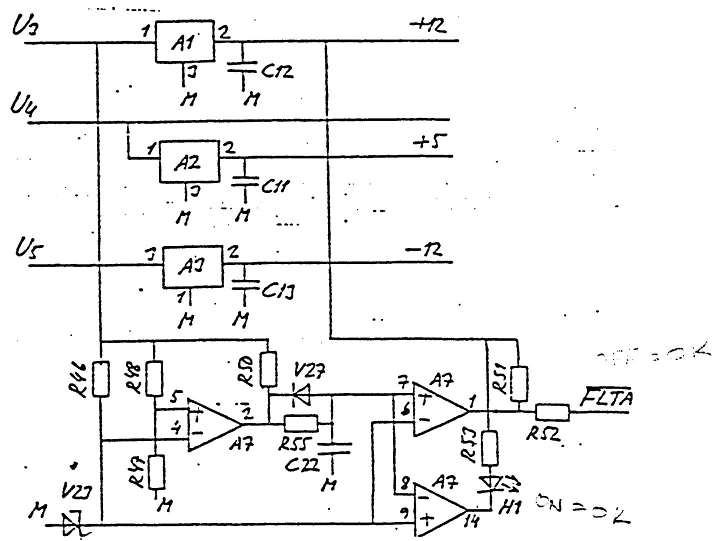


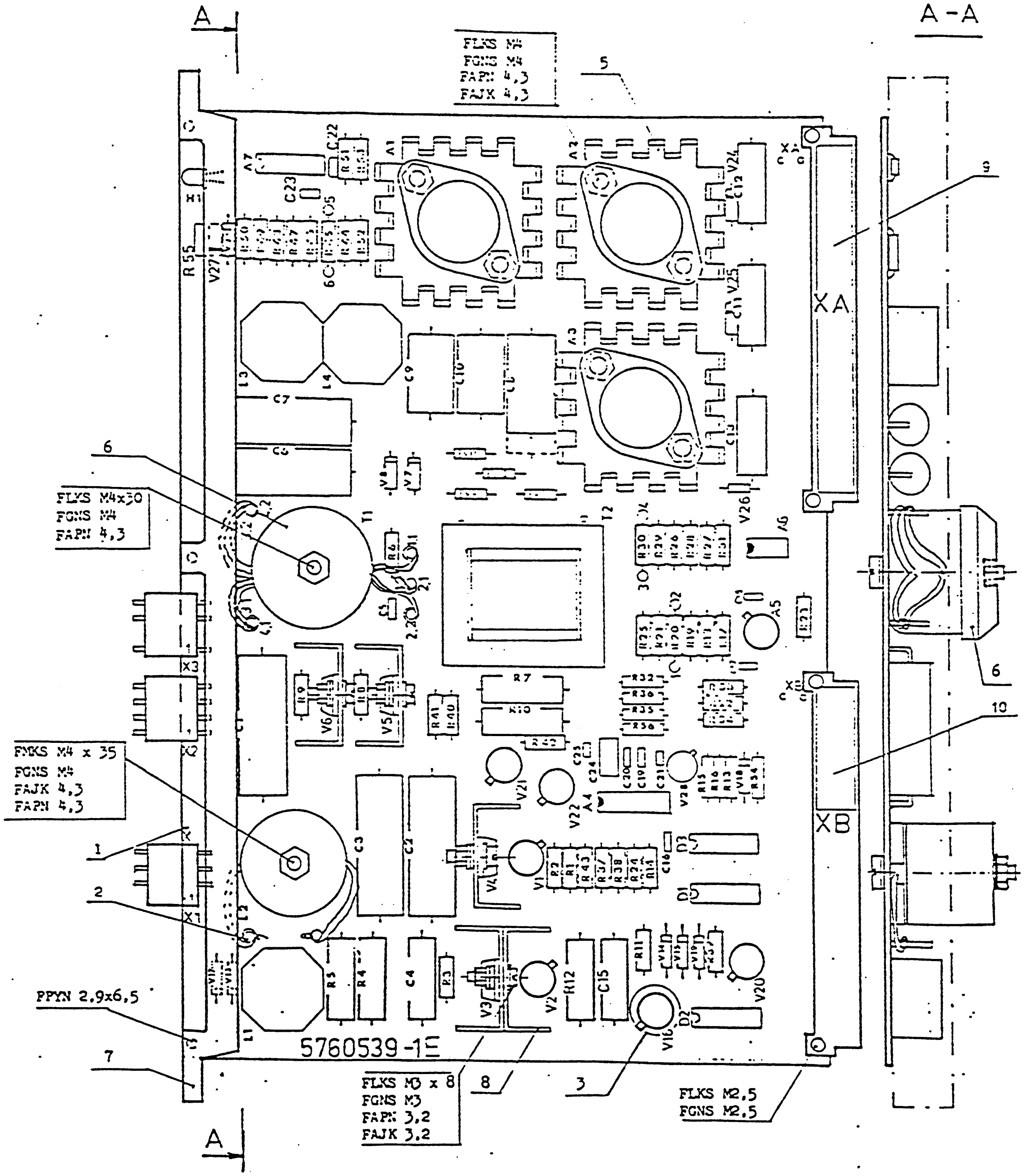
Figure 10. Output circuits

Secondary voltages of transformers T1 and T2 are rectified and filtered and then stabilized by integrated regulators; output voltages: U3 = + 15 V, U4 = + 8.5 V and U5 = - 15 V.

If voltage level of U3 goes too low fault signal $\overline{\text{FLTA}}$ will be send to the control unit and LED H1 will be turned off. If voltage level returns above the threshold level the fault signal will be removed after 0.15 seconds and LED H1 will be turned on again.

5. Characteristics

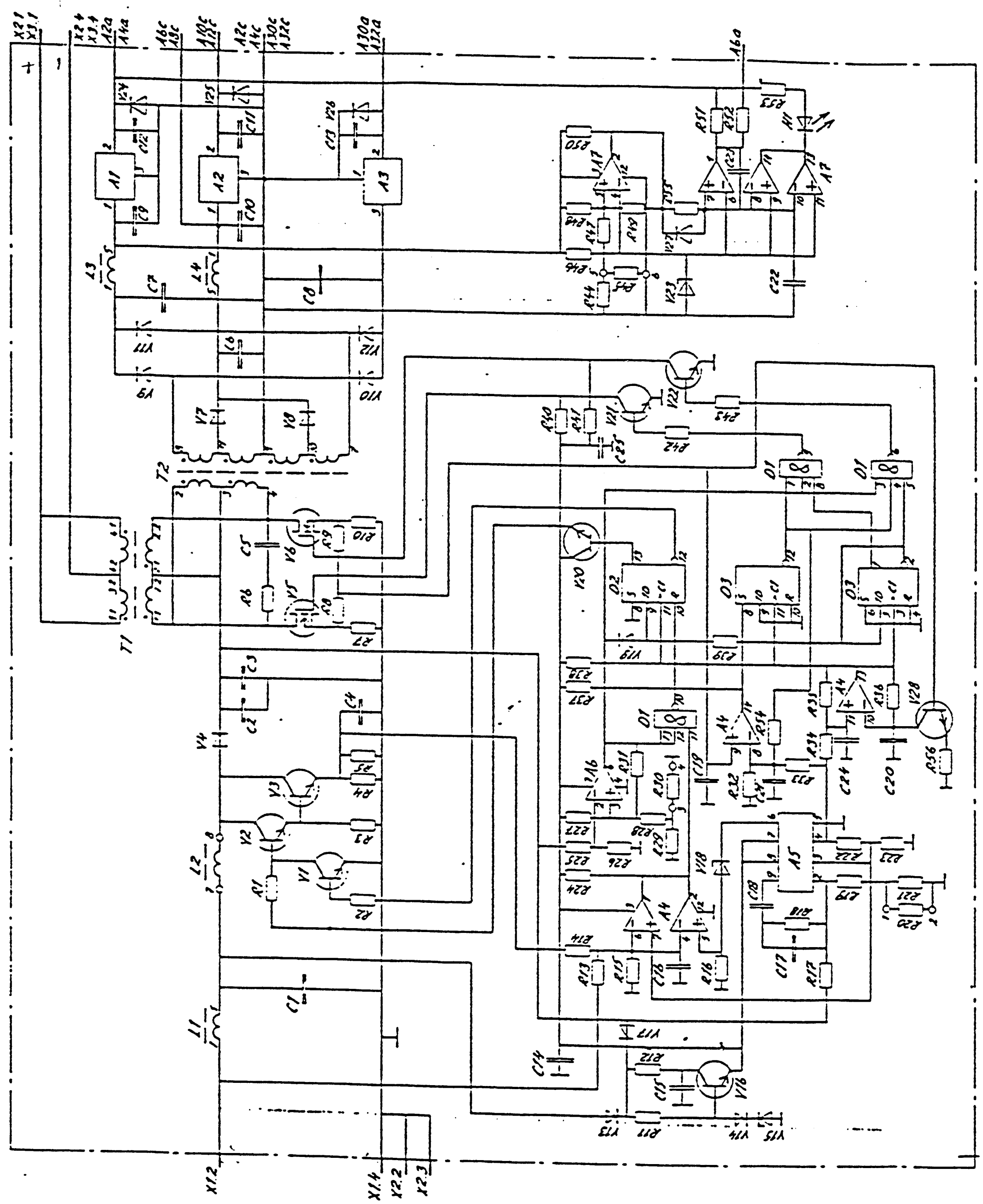
Input voltage	30...55V	
Output voltages	+12V	1.0A
	+ 5V	1.5A
	-12V	0.5A
	+25V	30W (50W instant.)
		35kHz square wave
Rated input power	80W	
Rated ambient temperature	+5...+55 °C	


A
A-A
FLKS M4
FGNS M4
FAPN 4,3
FAJK 4,3
5
9
XA
6
FLKS M4x30
FGNS M4
FAPN 4,3
10
FMKS M4 x 35
FGNS M4
FAJK 4,3
FAPN 4,3
XB
1
2
PPYN 2.9x6,5
7
5760539-1E
FLKS M3 x 8
FGNS M3
FAPN 3,2
FAJK 3,2
8
3
FLKS M2,5
FGNS M2,5
A

Allen-Bradley/Stromberg
03-16-89
R.Ahola

SAMC 11 POW
circuit diagram

APPENDIX3/1



5152559-1   82-02-15

M	RIVI		TUNNUS	MÄÄRÄ	YKS	KOODI	OSAN NIMITYS	LAJIMERKKI	TEKNISET ARVOT	VALMIST.	MAA	PIIR.	SIJ.
B	510		C15	1	KPL	09831568	KONDENSAATTORI	MKC 1.51	0,22UF 63V 10%	ARCO	IT		
B	520		C5	1	KPL	09830154	KONDENSAATTORI	2222 563 02471	470 PF 500V 20%	PHILIP	NL		
B	530		C6,7,8	3	KPL	09831657	KONDENSAATTORI	MKC 1.51	4,7 UF 63V 10%	ARCO	IT		
B	540		C9,10,13	3	KPL	09831631	KONDENSAATTORI	MKC 1.51	2,2UF 63V 10%	ARCO	IT		
B	550	X	C14				KONDENSAATTORI						
B	560		C16,17,19	3	KPL	35050892	KONDENSAATTORI	3418 100A 101K	100PF 100V 10%	AVX	US		
B	570		C18,21,22	3	KPL	09830219	KONDENSAATTORI	CW20 C 473 MC	47 NF 50V 20%	USCC	US		
B	580		C25	1	KPL	09830219	KONDENSAATTORI	CW20 C 473 MC	47 NF 50V 20%	USCC	US		
B	590		C20	1	KPL	35050906	KONDENSAATTORI	3429 100A 102K	1000PF 100V 10%	AVX	US		
B	600		C23	1	KPL	35050922	KONDENSAATTORI	3429 100A 471K	470PF 100V 10%	AVX	US		
B	610		C24	1	KPL	09831029	KONDENSAATTORI	2222 630 06221	220PF 63V +-20%	PHILIPS	NL		
	619												
	629												
E	630		H1	1	KPL	09809554	LOISTEDIODI+KAULUS	MV5253+MP52	IF=20MA 1,5MCD TYP	MONSANTO	US		
B	640		V4	1	KPL	35063102	DIODI	BYW80-150	150V AV7A 50NS	SESCOSEM	FR		
C	650		V7,8	2	KPL	35064486	DIODI	BYW98-100	100V AV1A 50NS	SESCOSEM	FR		
B	660		V9-12	4	KPL	09803238	DIODI	1N4936	400V AV1A 200NS	FAIRCHILD	US		
D	670		V13,17,24	3	KPL	09803718	DIODI	1N4004	400V AV1A		US		
D	671		V25,26	2	KPL	09803718	DIODI	1N4004	400V AV1A		US		
D	680		V14,19,27	3	KPL	09803190	DIODI	1N4148	75V AV0.15A 4NS		US		
B	690		V15	1	KPL	09808264	ZENERDIODI	IN 759 A	12 V 0,4W	PHILIPS	NL		
B	700		V18	1	KPL	09808213	ZENERDIODI	IN 750 A	4,7V 0,4W	PHILIPS	NL		
B	710		V23	1	KPL	09808230	ZENERDIODI	IN 754 A	6,8V 0,4W	PHILIPS	NL		
B	720		V1,20-22	4	KPL	09806601	TRANSISTORI	2N 2219 A	NPN 0,5 A 40 V		FR		
B	730		V2,16	2	KPL	09806482	TRANSISTORI	BSW 68	NPN 1 A 150 V		DE		
B	740		V3	1	KPL	35064460	TRANSISTORI	BU 406	NPN 5A 200V	SGS	IT		
H	745		V28	1	KPL	09806458	TRANSISTORI	2N 2369	NPN 0,1 A 15 V	MOTOROLA	US		
B	750		V5,6	2	KPL	35064478	MOS-TRANSISTORI	IRF 632	5A 200V 0,6 OHM	IR	US		
B	760		A1	1	KPL	09813616	REGULAATTORI	SG7812CK	POSIT 12V 1A	SIL GEN	US		
B	770		A2	1	KPL	09813420	JÄNN. REGULAATTORI	309	5 V 1A		US		
B	780		A3	1	KPL	09813624	REGULAATTORI	SG7912CK	NEGAT 12V 1A	SIL GEN	US.		
B	790		A4,7	2	KPL	09813365	4 X KOMPARAATTORI	CA 139 G	IOS 25 NA	RCA	FR		
B	800		A5	1	KPL	09813403	JÄNN. REGULAATTORI	723	2...37V 0,15A		US		
B	810		A6	1	KPL	09813489	OPER. VAHVISTIN	101 A	IOS 10 NA		FR		
B	820		D1	1	KPL	09816372	MIKROPIIRI	MC 14023 BAL	CMOS 3X3-INPUT NAND		US		
B	830		D2,3	2	KPL	09816275	MIKROPIIRI	MC 14013 BAL	CMOS DUAL D FLIP-FLOP		US		
	839												
	849												
B	850					51521901	TARKASTUSOHJE						
G	860		9	1	KPL	57162465	ARVOKILPI	*	82X10	MAIN+ETIK	FI		
G	870		10	1	KPL	35055398	SARJANUMEROKILPI	*	10 X 30 MM TARRAKILPI		FI		
	899												
J	900		20	2	KPL	57168901	LUKITUSRUUVI	*	M4	NOMET	FI		
J	910		21	2	KPL	35064982	PIDATINLAATTA	FSTJ/B 4	6,5/3,2X0,5		FI		

15

21

O S A L U E T T E L O	TEKN. ARVOT	NIMITYS JANNITELÄHDE	
	KÄYTTÖKOHDE SAMI B	LAJIMERKKI SAMC 11 POW	
ALKUP. VERSIO A OSASTO	LISÄTIEDOT		JAKELU
PVM 810305 SUUNN. LOUNILA			LEHTI 2(2) KOKO A3
VIIM. VERSIO J OSASTO EXP			
PVM 811214 SUUNN. LASSILA			

Allen-Bradley/Stromberg
03-16-89
R.Ahola

SAMC 11 POW
parts list

M	RIVI	TUNNUS	MÄÄRÄ YKS	KOODI	OSAN NIMITYS	LAJIMERKKI	TEKNISET ARVOT	VALMIST.	MAA	PIIR.	SIJ.
B	10			57171855	PIIRIKAAVIO						
B	20			57171863	KOKOONPANO						
B	30	1	1 KPL	57605391	PIIRILEVY	5760539-1	REV. E		FI		
B	40	X1,2,3	3 KPL	09883231	KORTTILIITIN	2420-4A MOLEX		MOLEX	US		
B	50	XA,XB	2 KPL	09882111	KORTTILIITIN KOIRAS	32-NAP.	32-NAP.	HART	DE		
B	60	2	13 KPL	09878858	JUOTOSTAPPI	RM 1,3/3,5/9,7,002	CUZN,AG		DE		
B	70	3	1 KPL	09880160	JÄÄHD. ELEM. TO5:LLE	SKK 5B	12,5/8X8	FISCHER	DE		
B	80	4	5 KPL	09880178	JÄÄHD. ELEM. TO220:LLE	FK 216/SA-CB	25,4X30X12,7	FISCHER	DE		
B	90	5	3 KPL	09880143	JÄÄHDYTYSELEMENTTI	K 42-3		AUSTER	DE		
B	100	L1,3,4	3 KPL	57580445	SAMI-KURISTIN		50UH 3,5A				
B	110	L2	1 KPL	57171812	SAMI-KURISTIN		150UH 5A				
B	120	T1	1 KPL	57171910	PULSSIMUUNTAJA						
B	130	T2	1 KPL	57171839	SAMI-MUUNTAJA						
H	140	-									
B	150	7	1 KPL	57163445	ETUTUKI	CXB		STR	FI		
	159										
B	160	R1	1 KPL	09911154	VASTUS	CR 37	150 OHM 0,5 W 5%	PHILIP	NL		
B	170	R2,42,43	3 KPL	09912711	VASTUS	MR 25	6,8K 0,3W 2%	PHILIPS	NL		
B	180	R3	1 KPL	09911057	VASTUS	CR 37	22 OHM 0,5 W 5%	PHILIP	NL		
B	190	R4,5	2 KPL	09914471	VASTUS	B10	1,0 OHM 4 W 5%	DIPLOH	DK		
B	200	R6	1 KPL	09911138	VASTUS	CR 37	100 OHM 0,5 W 5%	PHILIP	NL		
B	210	R7,10	2 KPL	09914421	VASTUS	B10	0,39 OHM 4 W 5%	DIPLOH	DK		
B	220	R8,9	2 KPL	09912657	VASTUS	MR 25	2,2K 0,3W 2%	PHILIPS	NL		
B	230	R19,40,41	3 KPL	09912657	VASTUS	MR 25	2,2K 0,3W 2%	PHILIPS	NL		
B	240	R11	1 KPL	09911359	VASTUS	MR 30	6,8 K 0,5 W 2%	PHILIP	NL		
B	250	R12	1 KPL	09915435	VASTUS	B10	560 OHM 4 W 5%	DIPLOH	DK		
B	260	R13,33,35	3 KPL	09912771	VASTUS	MR 25	22 K 0,3W 2%	PHILIPS	NL		
B	270	R14,53	2 KPL	09912622	VASTUS	MR 25	1,2K 0,3W 2%	PHILIPS	NL		
B	280	R15,47	2 KPL	09912681	VASTUS	MR 25	3,9K 0,3W 2%	PHILIPS	NL		
B	290	R16,23,52	3 KPL	09912614	VASTUS	MR 25	1,0K 0,3W 2%	PHILIPS	NL		
B	300	R17,25	2 KPL	09912819	VASTUS	MR 25	47 K 0,3W 2%	PHILIPS	NL		
B	310	X R20	1 KPL		VASTUS		VALITAAN				
B	311	-									
B	320	R21	1 KPL	09912592	VASTUS	MR 25	680 OHM 0,3W 2%	PHILIPS	NL		
H	330	R22,44,56	3 KPL	09912631	VASTUS	MR 25	1,5K 0,3W 2%	PHILIPS	NL		
B	340	R24,37,39	3 KPL	09912738	VASTUS	MR 25	10 K 0,3W 2%	PHILIPS	NL		
B	350	R50	1 KPL	09912738	VASTUS	MR 25	10 K 0,3W 2%	PHILIPS	NL		
B	360	R26,27,46	3 KPL	09912690	VASTUS	MR 25	4,7K 0,3W 2%	PHILIPS	NL		
B	370	R48	1 KPL	09912690	VASTUS	MR 25	4,7K 0,3W 2%	PHILIPS	NL		
B	380	R28	1 KPL	09912665	VASTUS	MR 25	2,7K 0,3W 2%	PHILIPS	NL		
B	390	R29	1 KPL	09912649	VASTUS	MR 25	1,8K 0,3W 2%	PHILIPS	NL		
B	400	X R30	1 KPL		VASTUS		VALITAAN				
B	401	-									
B	410	R31	1 KPL	09912851	VASTUS	MR 25	100 K 0,3W 2%	PHILIPS	NL		
B	420	R32,38,51	3 KPL	09912673	VASTUS	MR 25	3,3K 0,3W 2%	PHILIPS	NL		
B	430	R34,18	2 KPL	09912703	VASTUS	MR 25	5,5K 0,3W 2%	PHILIPS	NL		
B	440	R36	1 KPL	09912754	VASTUS	MR 25	15 K 0,3W 2%	PHILIPS	NL		
B	450	X R45	1 KPL		VASTUS		VALITAAN				
B	451	-									
B	460	R49	1 KPL	09911553	VASTUS	CR 37	330 K 0,5 W 5%	PHILIP	NL		
B	470	R54	1 KPL	09912835	VASTUS	MR 25	68 K 0,3W 2%	PHILIPS	NL		
F	480	R55	1 KPL	09912983	VASTUS	2322 241 13475	4,7M 0,25W 5%	PHILIPS	NL		
	489										
B	490	C1,2,3	3 KPL	09831601	KONDENSAATTORI	MKC 1.51	10 UF 63V 10%	ARCO	IT		
B	500	C4,11,12	3 KPL	09831568	KONDENSAATTORI	MKC 1.51	0,22UF 63V 10%	ARCO	IT		

5752559-1 82-02-16 15 22.12.81

O S A L U E T T E L O

ALKUP. VERSIO A   OSASTO
PVM 810305 SUUNN. LOUNILA
VIIM. VERSIO J   OSASTO EXP
PVM 811214 SUUNN. LASSILA

TEKN. ARVOT
KÄYTTÖKOHDE GAMI B
LISÄTIEDOT

NIMITYS JÄNNITELÄHDE
LAJIMERKKI SAMC 11 POW

JAKELU
LEHTI 1(2) KOKO A3

CONTENTS:

1. Block diagram

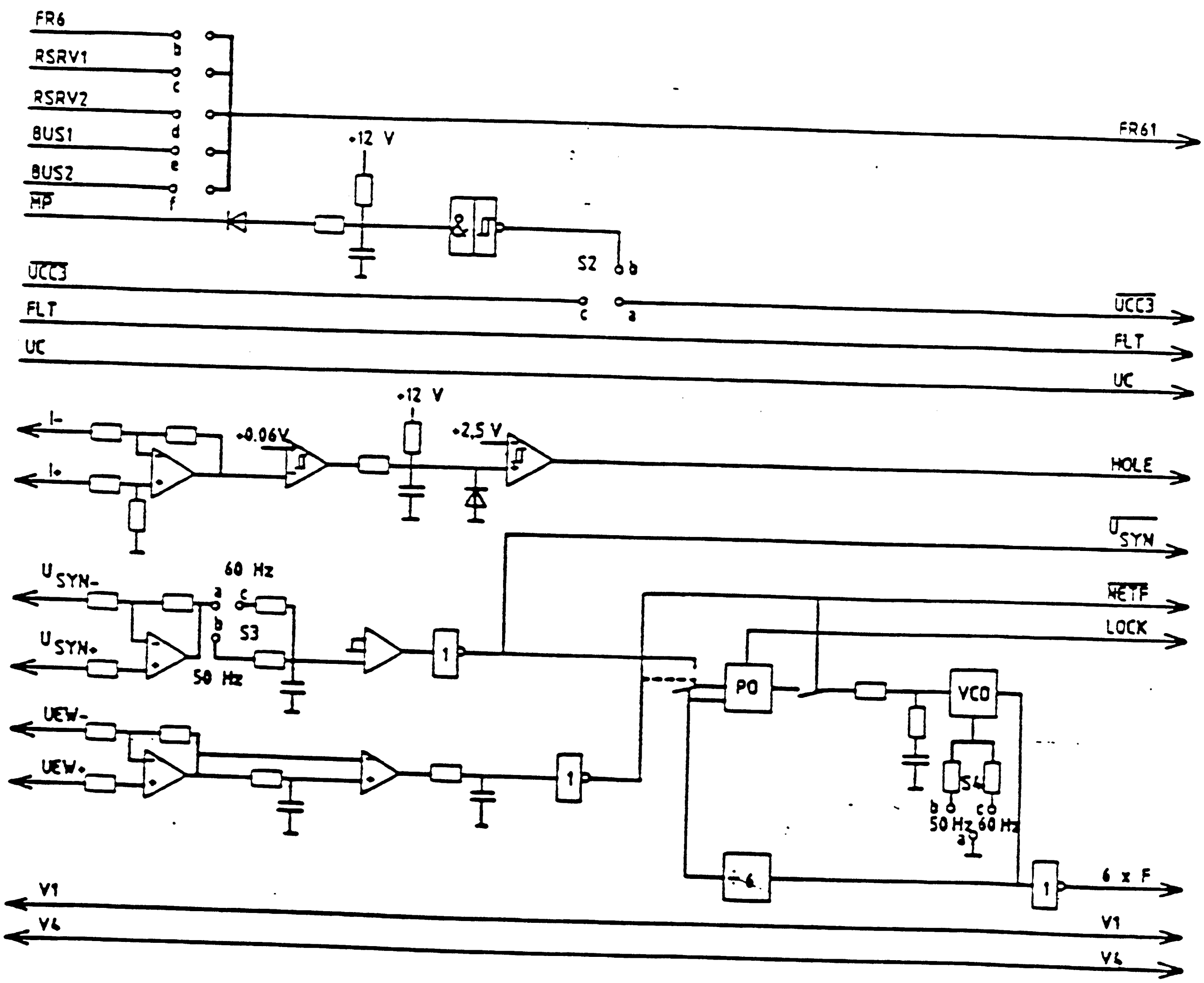


Figure 1. Block diagarm of the interface card SAMC 19 INF

2. General

Interface card SAMC 19 INF is located in the control rack (card position A04) and is connected through the mother board to the standard control unit and through two "front" connectors to the pulse amplifier and to the control board SAFT 185 TBC.Card takes care of five main operations:

- forms syncronizing signals
- netfail indication
- forms information about the current continuity/ uncontinuity (= signal HOLE)
- selection of frequency reference

Synchronizing:

Synchronizing signal times the operation of the bridge to the AC-line frequency. UV-main voltage measured by the synchronizing transformer and scaled by the pulse amplifier card is used as an input to the synchronizing circuits; outputs from this circuitry are:

- 50 (60) Hz digital synchronizing signal
- 300 (360) Hz digital synchronizing signal
- netfail signal
- phase failure in synchronizing

Current measurement:

Phase currents U and V are measured by the current transformers and rectified and changed to voltage signal by burden resistors on the pulseamplifier card. From this voltage signal interface card forms the signal HOLE (= current discontinuity signal).

Frequency reference selection:

Start/Stop signal is formed from the signals $\overline{\text{UCC3}}$ and $\overline{\text{RUN2}}$; control card SAFT 185 TBC will get the information via the interface card.

Firing orders to the thyristors V1 and V4 are wired from the control card through the interface card to the pulse amplifier.

3. Operation of the card

3.1 Syncronizing

Synchronizing signals time the operation of the bridge to the AC-line frequency. U-phase voltage measurement from (pulse amplifier circuit diagram 1(4)) the synchronizing transformer is used as an input to the synchronizing circuits.

Synchronizing transformer (660V / 25V) output is scaled on the pulse amplifier card (figure 2).

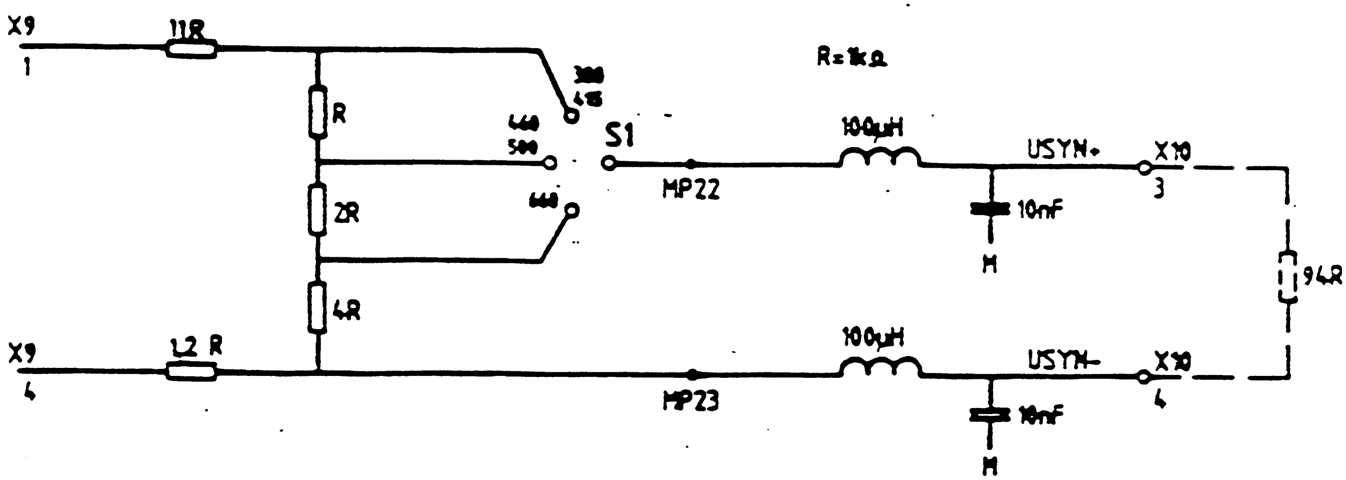


Figure 2. Scaling of synchronizing signal

S1 jumper is used to select the correct scaling for the AC-line voltage used. Scaled line voltage can be measured from between the measuring points MP22 and MP23; LC-circuits are used for filtering of signals USYN+ and USYN-.

On the interface card (Appendix 2/1):

- filtered signal goes to differential amplifier A2; gain is one and -3dB frequency is 34Hz
- jumper S3 is used to select either 50Hz (a-b) or 60Hz (a-c) operation:
  - S3 = a-b: syncronizing is done by RC-circuit R60, C11
  - S3 = a-c: syncronizing is done by RC-circuit R62, C11
  - during manufacturing testing of the card synchronizing is tuned to be accurate by the potentiometers R60 and R62

3.1.1 50Hz (60Hz) synchronizing signal (Appendix 2/1)

Delayed sinusoidal synchronizing voltage goes to comparator A5:
- threshold level is +-0V
- hysteresis is done by the resistors R40 and R23; real threshold levels are -0.57V and +0.62V
- buffer D3 is used to form digital synch. signal $\overline{USYN}$

In figure 3 is an example of synchronizing signal forming.

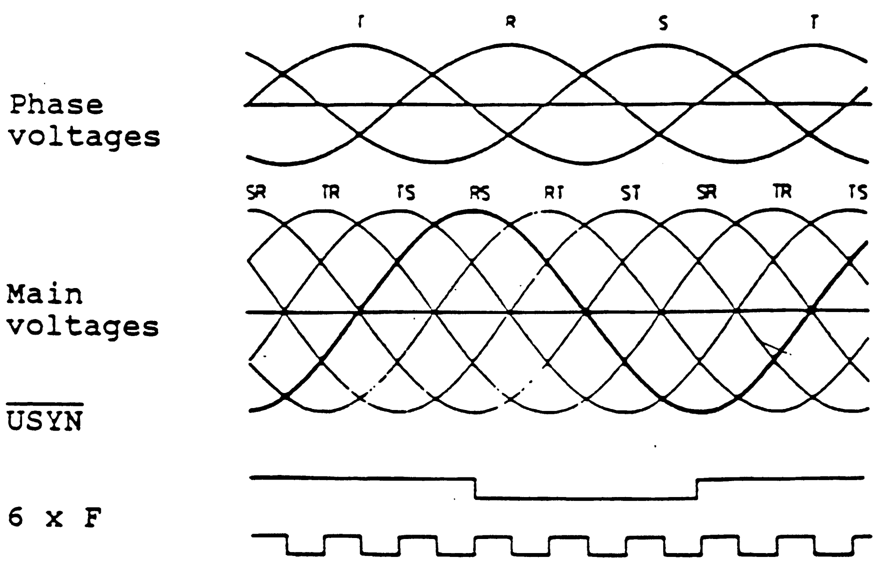


Figure 3. Formation of synchronizing signal

3.1.2 300Hz (360Hz) synchronizing signal (Appendix 2/1)

Thyristor bridge needs six firing pulses during one AC-line cycle and because of this a [6xF(AC-line)] synchronizing signal is formed. Phase difference of this signal compared to AC-line phase voltage must be zero; 300(360)Hz signal is done by a phase locked loop (figure 4).

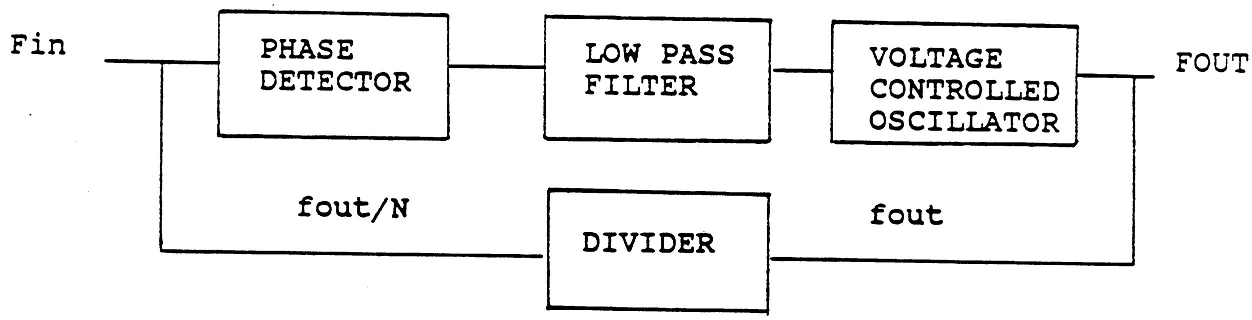


Figure 4. Phase locked loop

Phase locked loop is formed from:

- phase detector
- low pass filter
- voltage controlled oscillator
- divider

Output of the phase detector depends from the phase difference of the input signals:

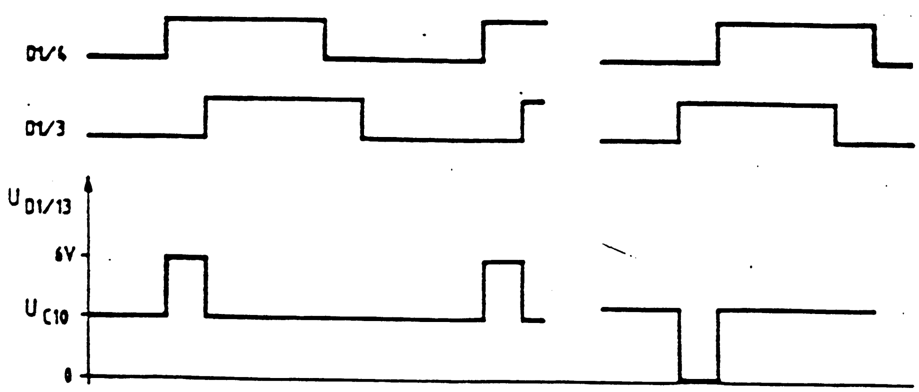
- If input signal phase precedes the signal from the divider (rising edges are compared) the output of the phase detector will increase the control voltage to the voltage controlled oscillator and vice versa
- low pass filter determines the control features of the system, for example response time

Phase detector and voltage controlled oscillator (VCO) are in one circuit D1 (in the circuit diagram Appendix 2/1 detector and VCO are drawn separately).

Operation:

- the input of the phase detector is wired through the selection circuits D4 and D5; selection circuits are controlled by the NETF signal (D4/6):
    - when $\overline{\text{NETF}}$ is one $\overline{\text{USYN}}$ is selected
    - when NETF is zero (failure in AC-line) output from the "divide by 6" is selected; so during a netfail two identical signals are compared. At the same time low pass filter is isolated from the phase detector by V1
    - "comparator" D1/14(input 1) & D1/3(input 2):
        - input 2 is always the 50(60)Hz signal from the divider D2

Phase detector D1(1,2,3,13 and 14) controls the low pass filter (R58,C2,R51 and C10) only when phase difference is detected, otherwise the output of the detector is in high impedance state. Example of the operation in figure 5.



a: AC-phase phase voltage leads b: AC-phase voltage lags

Figure 5. Operation of the phase detector

DC-voltage output of the lowpass filter controls the output frequency of the VCO (D1). Frequency range of the VCO is determined by components C9, R41, R63 and R65 or R64:

- R65 is used with 50Hz ac-line (S4 = a-b) to set the operation point of VCO so that when there's no phase difference between the two frequencies compared the voltage across C10 will be approximately 3.5V
- R64 is used with 60Hz ac-line (S4 = a-c) to set the operation point of VCO so that when there's no phase difference between the two frequencies compared the voltage across C10 will be approximately 3.5V

This output of the VCO is used as an input to the divide by 6 circuit D2 the output of which is used as the other frequency input to the comparator D1.

3.1.3 Synchronizing information LOCK (Appendix 2/1)

This signal is normally in "1"-state. When in"0"-state a phase difference in the frequency is detected.

3.2 Indication of network failures (Appendix 2/2)

Network failure must be detected as fast as possible to save time for the control system to operate, but still it ought to be immune for the glitches and short time disturbances in the AC-phase voltage.

The voltage from the synchronizing transformer is rectified with a 6-pulse bridge on the pulse amplifier board; this rectified voltage UEW- UEW+ is wired to differential amplifier on the SAMC 19 INF interface card (amplifier gain = 1); this signal goes directly to the netfail detection comparator A5/4 (negative input). Same input signal is wired also to the same comparator A5/5 (positive input), but this signal is dampened (A=0.85) and filtered (T=68msec).

Operation of the detection circuit (Appendix 2/2):

- A5/4 value changes fast from "1" to "0" and the output of the comparator A5 goes from "1" to "0".
  A5/5 input will follow the change, but with a delay of approximately 68msec.
- signal NETF follows the change in A5 output with a 1msec delay (filtering of glitches is approximately 1 msec)
- diode V24 takes care of correct operation when AC-line is disconnected

3.3 Current uncontinuity information

Control system of the thyristor bridge requires a feedback from the output voltage of the bridge (DC-voltage). Voltage is calculated from the firing angle and from the current transition time; current transition time can be calculated by measuring the uncontinuity of the current.

Current is measured by to current transformers and rectified on the pulse amplifier board.

Operation of the measurement circuit (Appendix 2/2):

- signal to the differential amplifier A1 (amplifier gain = 1)
- output of the amplifier A1 is filtered by R9 and C7
- filtered signal to comparator A6/8 (negative side)
- reference voltage to the comparator tuned by potentiometer R61 to 60 mV in SAMI BQ and 80mV in SAMI BG.
- resistors R1 and R49 are used for hysteresis
- output of the comparator controls the voltage across capacitor C8; when current feedback is above the reference value voltage across capacitor C8 will decrease from +4.7V to -0.6V
- when voltage across C8 goes below 2.4V HOLE-signal will go to "0"
- when voltage across C8 goes above 2.6V HOLE-signal will go back to "1"
- in figure 6 is an example of the operation

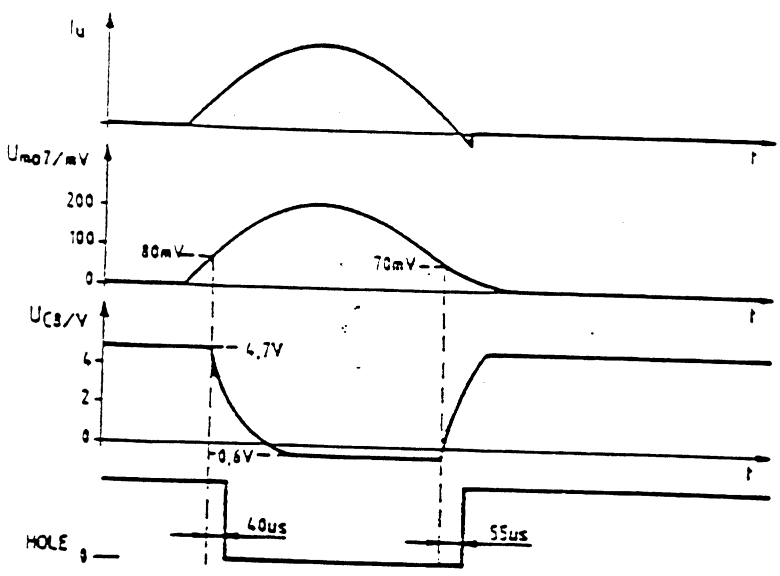


Figure 6. Operation of the current uncontinuity measurement

3.4 Selection of the frequency reference

In the thyristor braking bridge the DC-voltage is constant 100 % when load current is above 50%. When load current decreases below 50% also DC-voltage will decrease towards 90% value, which is also used when operating on the regenerative mode.

- S1 = a-b (-FR6 = -FR61).

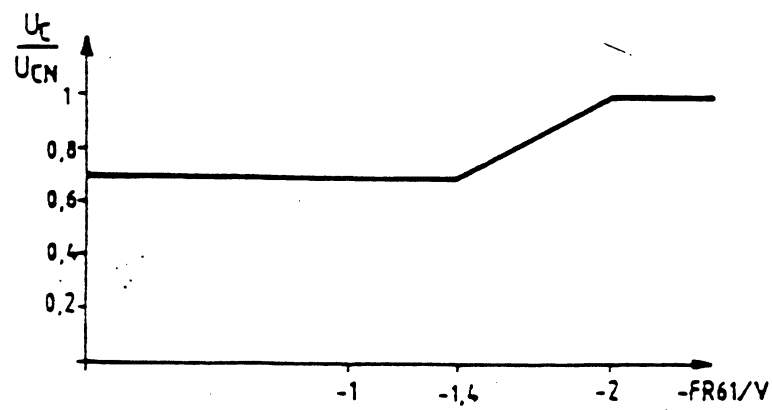


Figure 7. DC-voltage as a function of -FR61

3.5 Start command

In the thyristor braking bridge S2 = a-c, so START command is controlled only by UCC3-signal.

$\overline{RUN3}$	$\overline{UCC3}$	$\overline{UCC3}$ out
0	0	0
0	1	1
1	0	0
1	1	1

4. Jumper settings

S1 = a-b
S2 = a-c
S3 = a-c (with 60Hz AC-line)
S4 = a-c (with 60Hz AC-line)

5.1 Tuning of the synchronization (60Hz AC-line)

If synchronization of the bridge doesn't work proberly it can be tuned:

Equipments needed:

- oscilloscope
- isolation transformer to isolate the scope ground from the supply line ground

With 60Hz AC-line S4 = a-c:

Measurement:

- channel 1 y-gain 2V/DIV (zero in the middle)
- channel 2 y-gain 5V/DIV (zero in the middle)
- sweep time 0.83msec/DIV (check with pulsegenerator)
- triggering LINE, HFREJ rising or faling edge
- channel 1 connected to pulse amplifier card SAMT11:
  - channel 1 ground lead to MP23 and channel 1 to MP22
- channel 2 to the control card SAFT 185 TBC MP4
- tune either with TRIGGERING LEVEL or X-SHIFT the half cycle of the synchronizing voltage (positive or negative) to the middle of the screen in the x-direction; after doing this the zero crossings of the synchronizing voltage are excatly in the corners of the screen.
- R62 must be tuned so that the falling edge of the channel 2 signal is 150usec before the center of the screen
- check, that USYN signals (SAMC 19 INF MP2) falling edge is in the middle of the screen (positive half cycle of the synchronizing voltage)
- lock the potentiometers R60 and R62

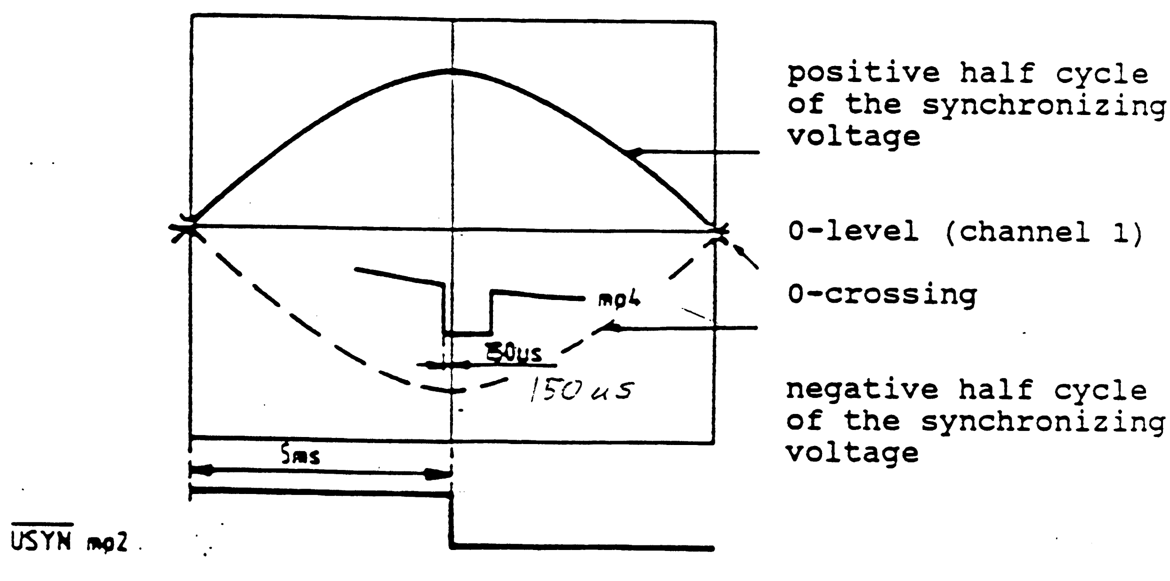


Figure 8. Tuning of the synchronizing

5.2 Tuning of the current limit

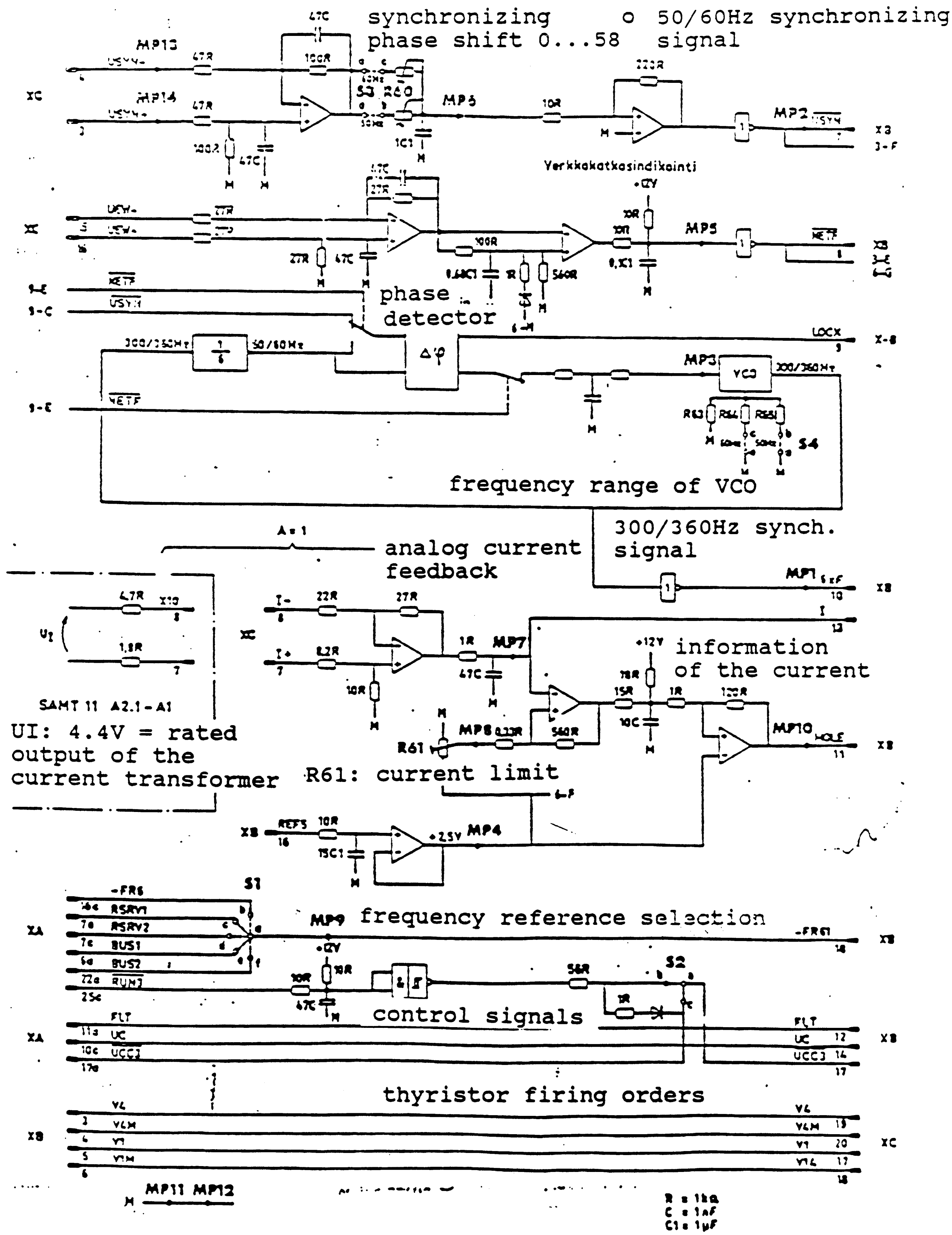
Current limit is related to the uncontinuity information signal HOLE. Current value lower than the current limit equals zero current to the control system. Tuning is done by the trimmer R61; initial setting 60mV (???) between MP8 and MP11.

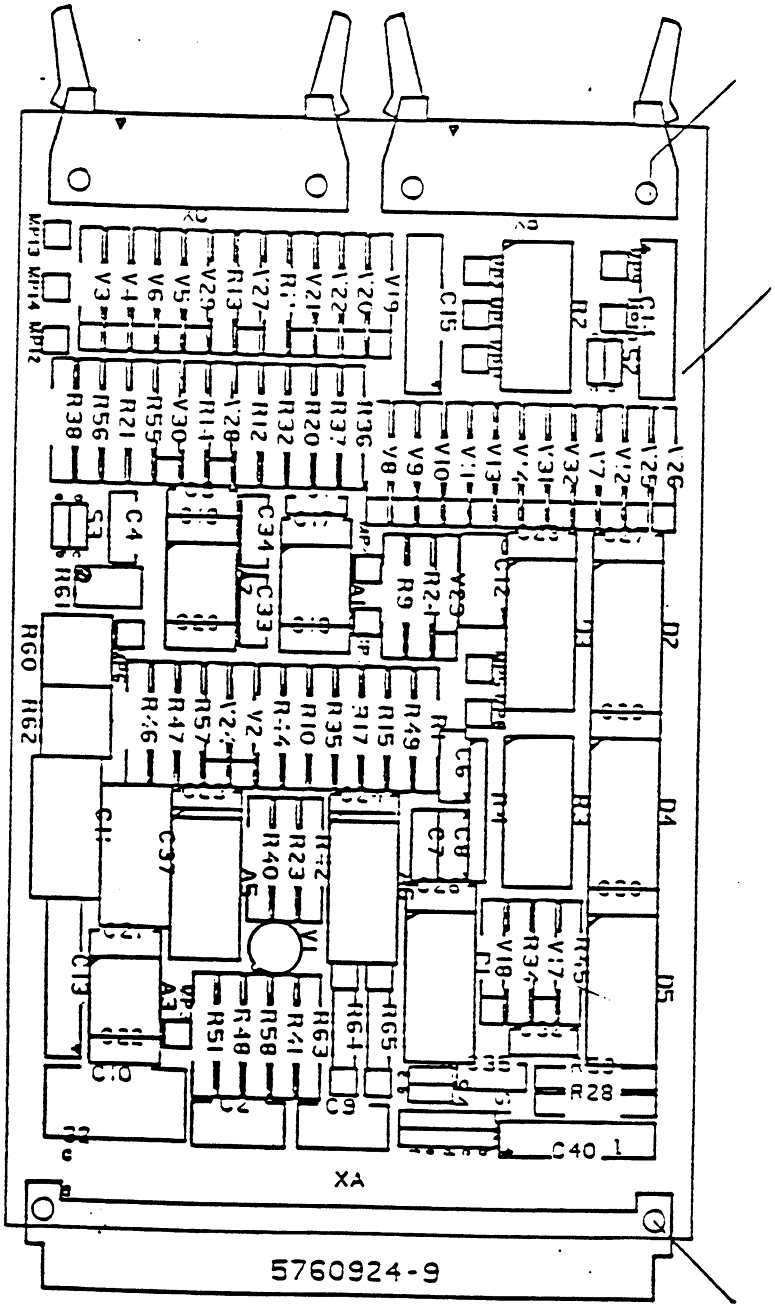
6. Internal values / delays

- temperature range	$-25\,^{\circ}C$... $+70\,^{\circ}C$
- synchronizing signal	6 * AC-line frequency
- sync. signal error	$\pm 1^{\circ}$ (+- 50 usec)
- current uncontinuity signal	HOLE
- delay in signal HOLE	+- 100 usec
- nominal ref. voltage -FR61	+ 2 V
- control voltage	+ 12 V (25mA) - 12 V (22mA)

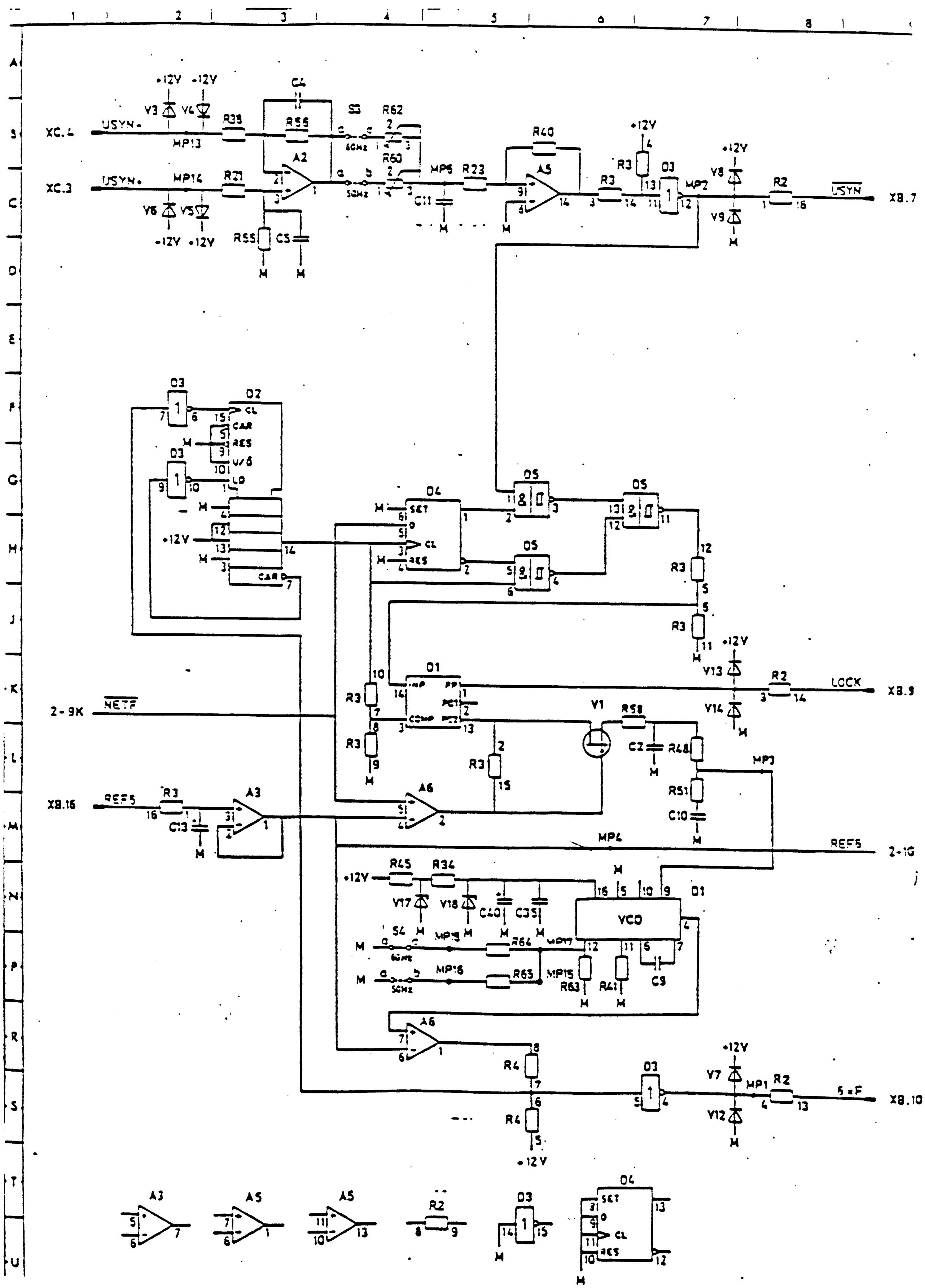
SAMC 19 INF BLOCK DIAGRAM

Appendix 1/1

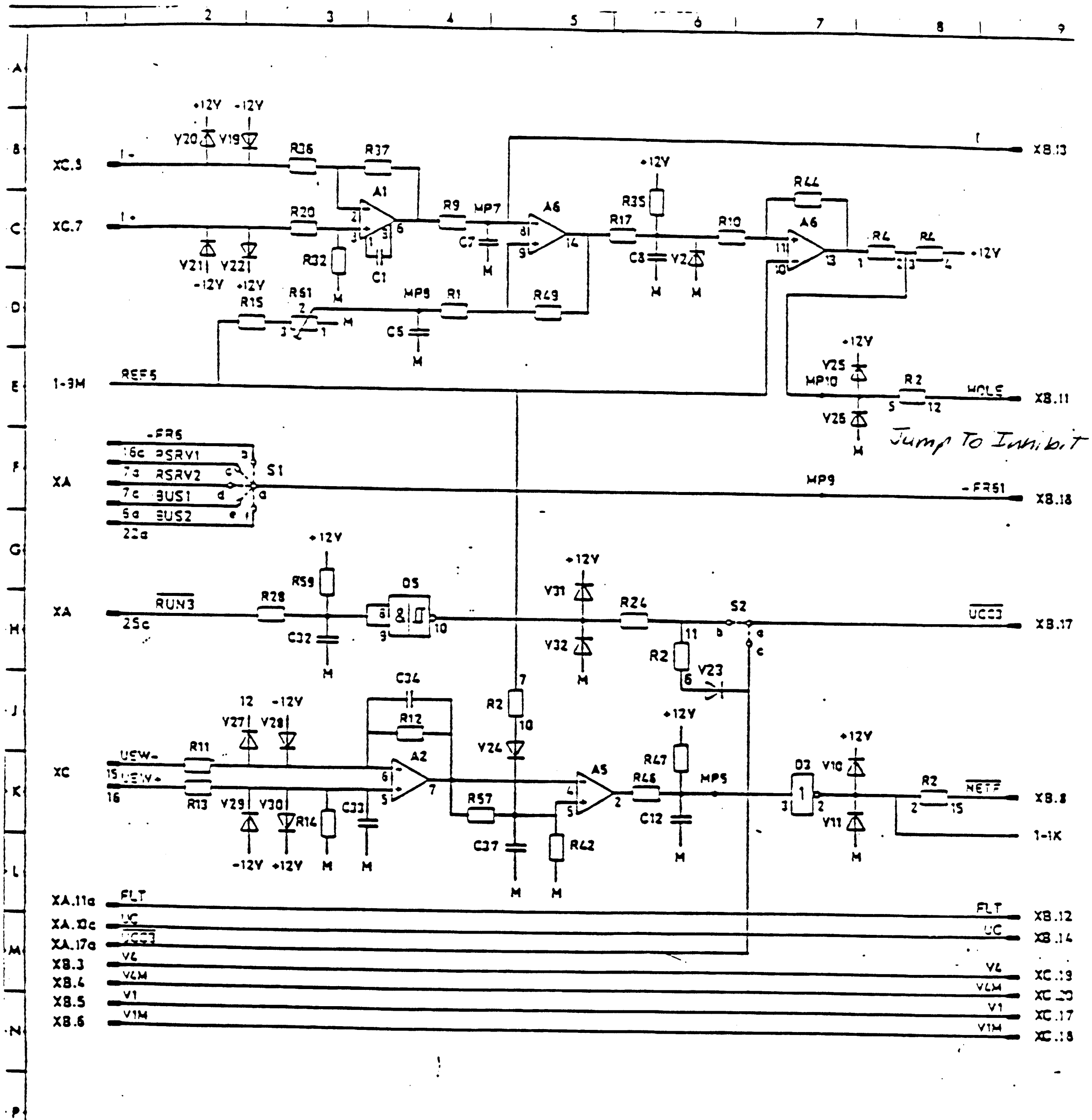




SAMC 19 INF CIRCUIT DIAGRAM



SAMC 19 INF CIRCUIT DIAGRAM



	+12V	±0V	-12V	
D1		8		6,2V/16
D2	16	8		
D3	1	8		
D4,5	14	7		
A1	7		4	
A2,A3	8		4	
A5,6	3		12	

M	RIVI	TUNNUS	MÄÄRÄ	YKS	DI	KOODI	OSAN NIMITYS	TYYPPI	TEKNISET ARVOT	VALMI.	MAA	HUOM
D	5											
	10			KPL		5740 1419	KOKOONPANO					
	20					5740 1401	PIIRIKAAVIO					
	22	X					TOIMINTASELOSTUS					535097/
	24	X					KOESTUSOHJE					535097/
	25											
	30	B	1,000	KPL	VE	5760 9249	PIIRILEVY	5760924-9	REV.D 1E 2-LAYER		FI	
	32		1,000	KPL	VE	5716 2465	TARRA PIIRILEVYT	PDL111 GMY LOGOLLA	50,8X9,5MM (ID-5233)	PANDUI	US	
	33		1,000	KPL	VE	3505 5398	SARJANUMEROKILPI	SARJANUMERO	10X30MM	MAINOS	FI	
	35											
	40	XA	1,000	KPL	VE	0988 2154	EUR.LIITIN	C064MS-C1A-1,25/5	64-NAP. KOIRAS JUOT.	FERLOS	FI	
	50	XB,XC	2,000	KPL	VE	0988 2286	NAUHAKAAPELILIITIN	FAP-2001-1202-0AS	20-NAP. KOIRAS 90AST	YAMAIC	JP	
	89											
	90	MF1-MF18	18,00	KPL	VE	0987 8858	JUOTOSTAPPI	RTM1,3/3,5/9,7.002	CuZn, Sn	STOCKO	DE	
C	110	S1,4	4,000	KPL	VE	0988 2031	OIKOSULKUPALA	FL-10-0,8-1	2-NAP.	FERLOS	FI	
C	120	S1,4	0,350	KPL	VE	0988 2103	PIIKKIRIMA	FMH 6-2X36-0,8/5	72-NAP. 2-RIV. SUORA	FERLOS	FI	
	159											
	160	D1	1,000	KPL	VE	0981 6488	MIKROPIIRI	CD4046BE	CMOS PHASE LOCKED LOOP	RCA	US	
	170	D2	1,000	KPL	VE	0981 6704	MIKROPIIRI	CD4510BE	CMOS BCD-UP/DOWN COUNTER	RCA	US	
	180	D3	1,000	KPL	VE	0981 6496	MIKROPIIRI	CD4049UBE	CMOS HEX INVERTER/BUFFER	RCA	US	
	190	D4	1,000	KPL	VE	0981 6275	MIKROPIIRI	CD 4013BE	CMOS DUAL D FLIP-FLOP	.	US	
	195	D5	1,000	KPL	VE	0981 6623	MIKROPIIRI	CD4093BE	CMOS QUAD SCHMITT TRIGGER	RCA	US	
	209											
	210	A1	1,000	KPL	VE	0981 3489	OPER. VAHVISTIN	LM101AJ	IOS 10 NA EOS 2 MV	NS	US	
	220	A2-A3	2,000	KPL	VE	0981 3497	2X OP AMP	CA1558E	EOS 5 MV IOS 200 NA	RCA	US	
	230	A5,A6	2,000	KPL	VE	0981 3365	4XCOMPARATOR	LM139J	IOS 30 NA EOS 6 MV	NS	US	
	279											
	280	V1	1,000	KPL	VE	0980 7802	FET	2N4393	5MA 40V 100OHM.	PHILIP	NL	
	300	V2	1,000	KPL	VE	0980 8213	ZENERDIODI	BZX79C4V7	4,7V 0,4W	PHILIP	NL	
	330	V3-14	12,00	KPL	VE	0980 3190	DIODI	1N4148	75V AVO.15A 4NS	PHILIP	NL	
	340	V19-V32	14,00	KPL	VE	0980 3190	DIODI	1N4148	75V AVO.15A 4NS	PHILIP	NL	
	350	V17	1,000	KPL	VE	0980 8248	ZENERDIODI	BZX79C8V2	8,2V 0,4W	PHILIP	NL	
	360	V18	1,000	KPL	VE	0980 8906	ZENERDIODI	1N 821	6,2V 5 %	PHILIP	NL	
	369											
	370	R2	1,000	KPL	VE	0991 0085	VASTUSVERKKO DIL	898-3-R1K	8X1K PR=0,2 W PT=1,6W	BECKMA	US	
	375	R3	1,000	KPL	VE	0991 0/15	VASTUSVERKKO DIL	898-3-R10K	8X10K PR=0,2W PT=1,6W	BECKM	US	
	380	R4	1,000	KPL	VE	0990 9907	VASTUSVERKKO SIL	L08-3-C103M2	4X10K PR=0,11W PT=0,44W	BECKMA	US	
	389											
	390	R34	1,000	KPL		0991 2517	VASTUS	SMA0207S	150 OHM 0,5 W 1% 50PPM	DRALOR	DE	
	395	R45	1,000	KPL		0991 2525	VASTUS	SMA0207S	182 OHM 0,5 W 1% 50PPM	DRALOR	DE	
	400	R1	1,000	KPL		0991 2550	VASTUS	SMA0207S	332 OHM 0,5 W 1% 50PPM	DRALOR	DE	
	410	R9,10	2,000	KPL		0991 2614	VASTUS	SMA0207S	1,00K 0,5 W 1% 50PPM	DRALOR	DE	
	429											
	430	R20	1,000	KPL		0991 2720	VASTUS	SMA0207S	8,25K 0,33W 1% 50PPM	DRALOR	DE	
D	440	R23,28	2,000	KPL		0991 2738	VASTUS	SMA0207S	10,0K 0,33W 1% 50PPM	DRALOR	DE	
B	445	R32,46,47	3,000	KPL		0991 2738	VASTUS	SMA0207S	10,0K 0,33W 1% 50PPM	DRALOR	DE	
B	447	R59	1,000	KPL		0991 2738	VASTUS	SMA0207S	10,0K 0,33W 1% 50PPM	DRALOR	DE	
	450	R17	1,000	KPL		0991 2754	VASTUS	SMA0207S	15,0K 0,33W 1% 50PPM	DRALOR	DE	
	455	R35	1,000	KPL		0991 2762	VASTUS	SMA0207S	18,2K 0,33W 1% 50PPM	DRALOR	DE	
	458											

ABB STRÖMBERG DRIVES OY FINLAND

TUNNUS: KÄYTTÖKOHDE SAMI B,F(V/R-SI
LISÄTIEDOT

NIMITYS: TBC-VÄLIKORTTI
TYYPPI: SAMC 19 INF
TEKN.ARVOT

ALKUP. A TSTO EXH2
PVM 831012 SUUNN. TORKKELI
VIIM. E TSTO EXX1
PVM 851010 SUUNN. KYLLÖNEN
PVM TARK.
PVM 851023 HYV. DAHLSTRÖM

BG:N KÄY-TIETO OTETTU RUH3:STA JA UCC3:STA
VAIHELUKON TAHDISTUMISNOPEUTTA PARANNETTU
TAHDISTUS SEKÄ 50 ETTÄ 60 HZ:LLE

PIKA 85150
LEHTI 1 ( ) KOKO A3
KIELI FI VERSIO E
KOODI VE 5740 1309

* * * * * * * * J A T K U U * * * * * * * *

SAMC 19 INF PARTS LIST

Appendix 4/2

M	RIVI	TUNNUS	MÄÄRÄ	YKS	DI	KOODI	OSAN NIMITYS	TYYPPI	TEKNISET ARVOT	VALMI.	MAA	HUOM
	459											
	460	R36	1,000	KPL		0991 2771	VASTUS	SMA0207S	22,1K 0,33W 1% 50PPM	DRALOR	DE	
	465	R11-15,37	6,000	KPL		0991 2789	VASTUS	SMA0207S	26,7K 0,33W 1% 50PPM	DRALOR	DE	
B	466	R48	1,000	KPL		0991 2801	VASTUS	SMA0207S	39,2K 0,33W 1% 50PPM	DRALOR	DE	
	470	R21,38	2,000	KPL		0991 2819	VASTUS	SMA0207S	47,5K 0,33W 1% 50PPM	DRALOR	DE	
D	480	R24,41	2,000	KPL		0991 2835	VASTUS	SMA0207S	68,1K 0,33W 1% 50PPM	DRALOR	DE	
B	490	R55-58	4,000	KPL		0991 2851	VASTUS	SMA0207S	100 K 0,33W 1% 50PPM	DRALOR	DE	
	495	R44	1,000	KPL		0991 2860	VASTUS	SMA0207S	121 K 0,33W 1% 50PPM	DRALOR	DE	
	499											
B	505	R40,51	2,000	KPL		0991 2894	VASTUS	SMA0207S	221 K 0,33W 1% 50PPM	DRALOR	DE	
	510	R42	1,000	KPL		0991 2967	VASTUS	SMA0207S	562 K 0,33W 1% 50PPM	DRALOR	DE	
E	520	R49	1,000	KPL	VE	0991 3971	VASTUS	SMA0207S	1,0 M 0,5W 1% 50PPM	DRALOR	DE	
	579											
C	580	R60,62	2,000	KPL	VE	0982 7617	TRIMMERIPOT.METRI	3306P-1-202	2 K 0,5W 10% 100 PPM	BOURNS	US	
E	590	R61	1,000	KPL	VE	0982 7561	TRIMMERIPOT.METRI	3296W-1-103	10K 0,5W 10% 100PPM	BOURNS	US	
E	595 X	R63					EI KÄYTÖSSÄ					
E	600 X	R64,65	2,000	KPL			VASTUS					
E	601	R64,65					ASENNETAAN KOESTUKSEN YHTEYDESSÄ					
	625											
	626											
	630											
	640	C1	1,000	KPL		0983 0049	KONDENSAATTORI	2222 679 34339	33 PF 100V 20%	PHILIP	NL	
	650	C8,17-30	15,00	KPL	VE	0983 0359	KONDENSAATTORI	MD01 1C103MAA	10NF 100V 20% DIP	AVX	GB	
	670	8 C4-7,32-35	8,000	KPL	VE	0983 0219	KONDENSAATTORI	MKT 1.85	47NF 63V 10%	ARCOTR	IT	
	690	C2,9,12	3,000	KPL	VE	0983 4541	KONDENSAATTORI	MMK10 0,1/10/100	0,1UF 100V 10%	EVOX	FI	
	700											
	720	C37	1,000	KPL	VE	0983 4583	KONDENSAATTORI	MMK15 0,68/10/100	0,68UF 100V 10%	EVOX	FI	
	725	C10,11	2,000	KPL	VE	0983 4591	KONDENSAATTORI	MMK15 1,0/10/100	1,0UF 100V 10%	EVOX	FI	
	730	C13-15,40	4,000	KPL	VE	3502 3798	TANTAALIKONDENSAATT.	TAS156M020P1C	15UF 20V +-20%	MALLOR	US	

ABB STRÖMBERG DRIVES OY FINLAND

ALKUP. A TSTO EXH2
PVM 831012 SUUNN. TORKKELI
VIIM. E TSTO EXX1
PVM 851018 SUUNN. KYLLÖNEN
PVM TARK.
PVM 851023 HYV. DAHLSTRÖM

TUNNUS: KÄYTTÖKOHDE SAMI B,F(V/R-SI
LISÄTIEDOT

BG:N KÄY-TIETO OTETTU RUN3:STA JA UCC3:STA
VAIHELUKON TAHDISTUMISNOPEUTTA PARANNETTU
TAHDISTUS SEKÄ 50 ETTÄ 60 HZ:LLE

NIMITYS: TRC-VÄLIKORTTI
TYYPPI: SAMC 19 INF
TEKN.ARVOT

PLKA 85150
LEHTI 2 (2) KOKO A3
KIELI FI VERSIO E
KOODI VE 5740 1309

* * * * * * * * L O P P U * * * * * * * *

CONTENTS:

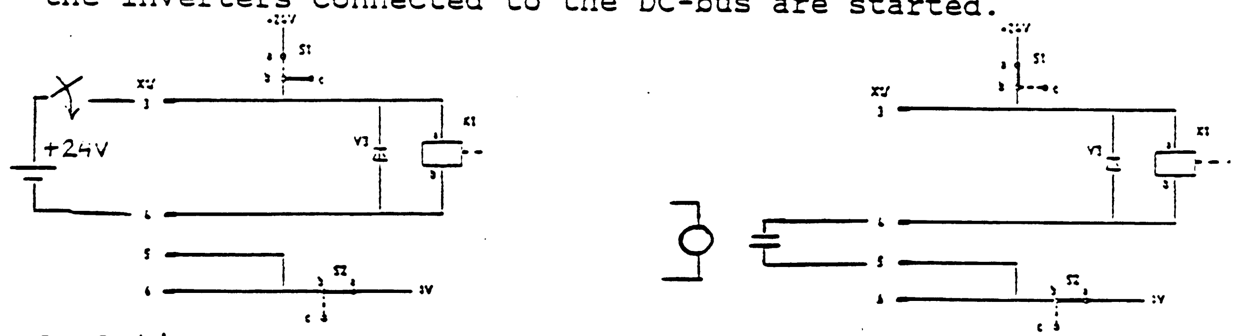
1. General information

SAFT 181 INF is used as a link between the external controller(s)/relays and control board SAMC 185 TBC. Also all boards in TBU are connected to SAFT 181 INF.

2. SAFT 181 INF operation

2.1 Start commmand

Start to the TBU can be wired at two different ways; figure 1. Start command to the TBU must be sent 3 seconds before any of the inverters connected to the DC-bus are started.



A. Active +24V Start-signal
S1:b-c, S2:b-a

B. Passive Start-signal
S1:b-a, S2:b-a

Figure 1. Start command to the TBU

2.2 External fault

For example overtemperature- and fan overload relay contactors are chained between X1.7 and X1.8. In the case of a fault optoisolator V1 pin 4 will change from +12V to 0V and signal FLT (XA.11a) will change from 0V to +12 causing a unmasked interrupt to the uP on SAMC15TBC board. Also LED V2 is on during a fault.

If a RESET-button is added between X1.7 and X1.8 an additional relay is required to inhibit unnecessary uP-interrupts which can cause a loss of fuses if TBU is running; figure 2.

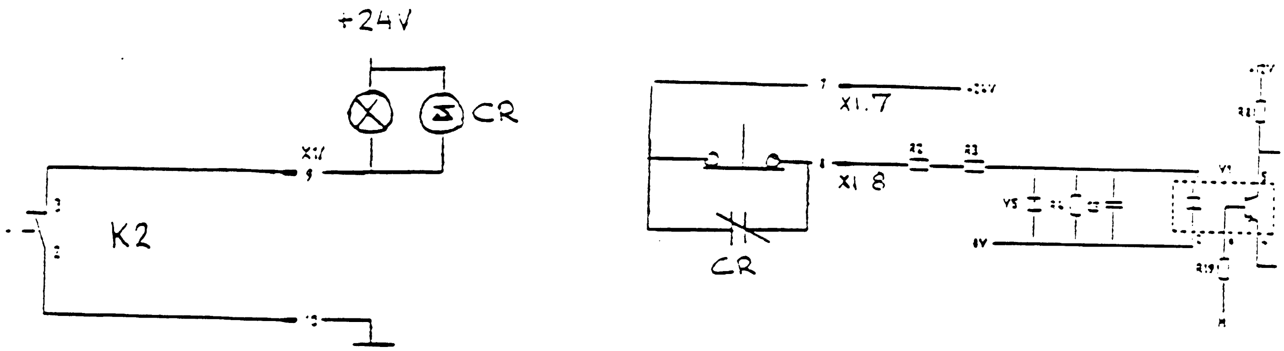


Figure 2. External RESET-button

External fault will cause also the relay K2 to trip, which will turn on the external alarm light (figure 3)

2.3 Internal faults

In the case of control power failure SAMC11POW power supply will pull the signal RESET (XA.26c) down and V15 will be turned off causing contactor K2.2-3 to close. In stand alone drives connection is normally like in figure 2 light will be on in the case of a fault.

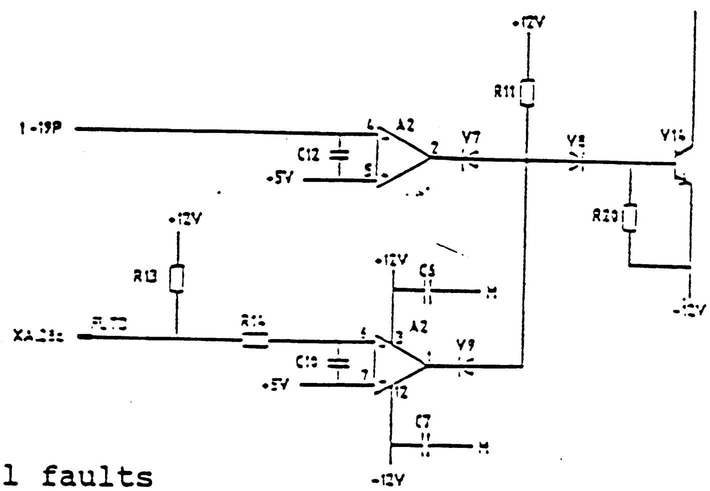


Figure 3. Internal faults

Internal faults in the control board SAMC15TBC will cause FLTD (XA.28c) to toggle and this will blink the light in the figure 2.

2.4 Precharge selection

If TBU is equipped with a precharge system S3 ought to be in position b-c; constant 50 degree angle during precharge.

If precharge system is not used S3 ought to be in position a-b; precharge starts with 111 degree angle. After precharge is done and if no START command is received angle will automatically be changed to 50 degrees; START-command will release the angle controller.

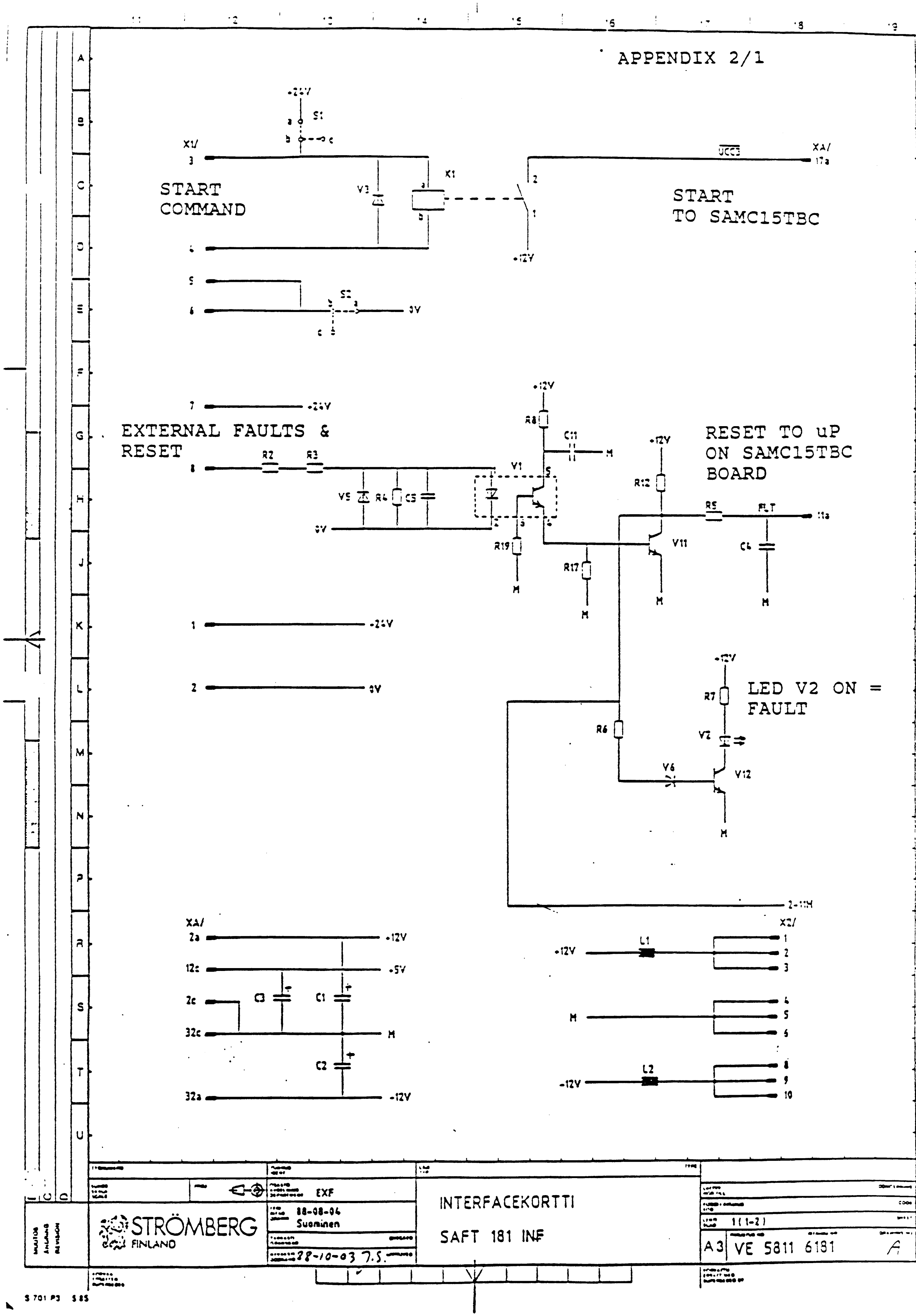
2.5 DC-voltage measurement

Isolated (isolation done on SAFT 183 VMC board) DC-voltage measurement from SAFT 183 VMC is inverted; inverted signal is used on SAMC19INF and SAMC15TBC boards.

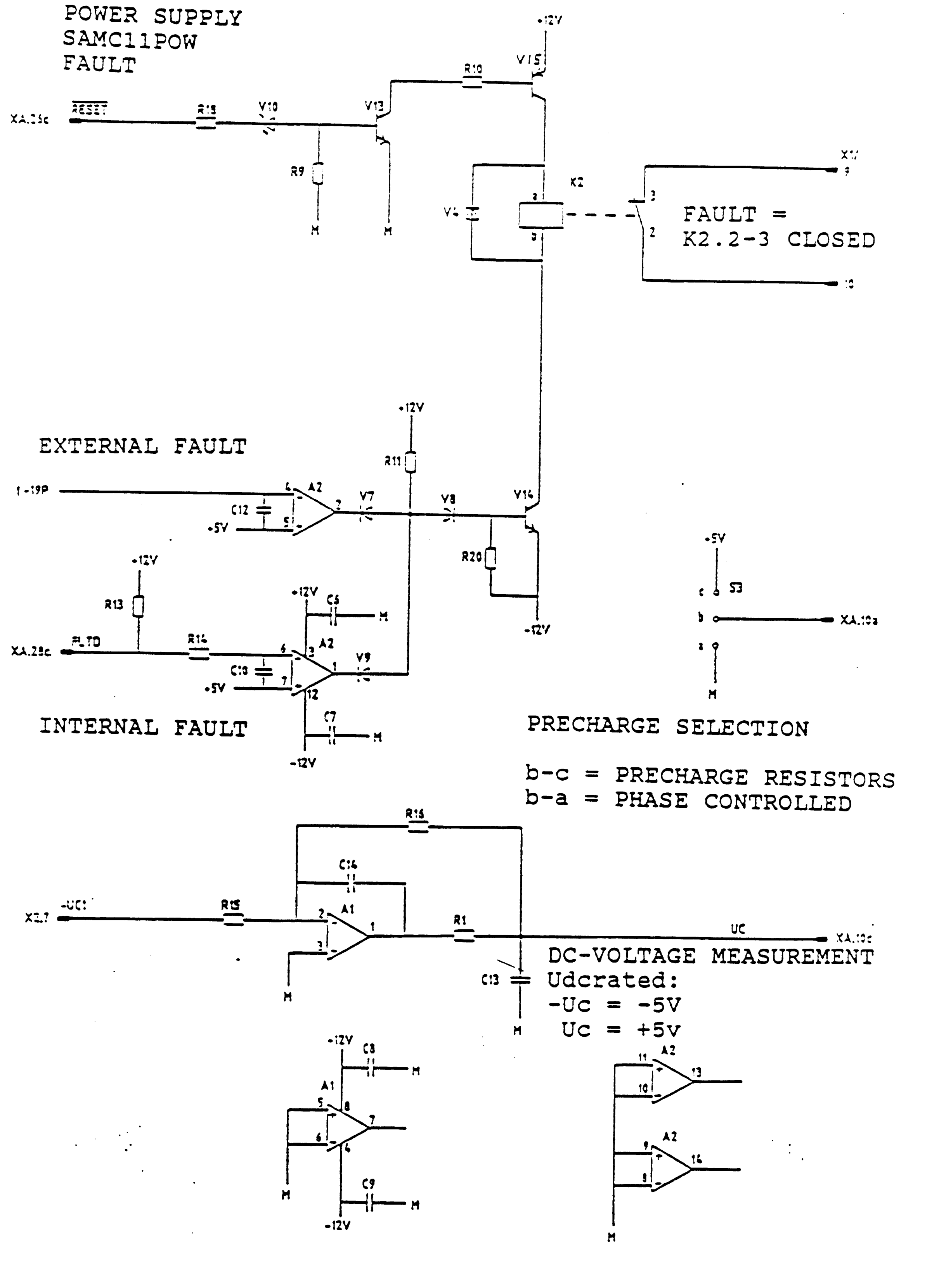
Table 1. Signals on SAFT 181 INF

Connector/s SAFT181INF	signal name	connected to (X1 and X2 are TBU module terminal blocks)
X1.1	+24V	X2.1, X2.3
X1.2	+-0V	X2.2, X2.4(FLT2)
X1.3	RUN1	X2.6
X1.4	RUN2	X2.7
X1.5	RUN3	X2.8
X1.6	RUN4	X2.9
X1.7	FLT1 :	bridge overtemp. relay S1.1, S1.2 ! ! fan motor overload relay F6.14, F6.13 ! ! X1.2 ! ! External Reset ! !
X1.8	FLT2	X1.1
X1.9	FLTL1	X2.4
X1.10	FLTL2	X2.5

Connector/s SAFT181INF	signal name	connected to	
X2.1	+12V	SAFT183VMC X2.1	
X2.2	+12V	SAFT183VMC X2.2	
X2.3	+12V	SAFT183VMC X2.3	
X2.4	0V	SAFT183VMC X2.4	
X2.5	0V	SAFT183VMC X2.5	
X2.6	0V	SAFT183VMC X2.6	
X2.7	-Uc	SAFT183VMC X2.7	
X2.8	-12V	SAFT183VMC X2.8	
X2.9	-12V	SAFT183VMC X2.9	
X2.10	-12V	SAFT183VMC X2.10	
XA.2a	+12V	SAMC11POW XA.2a	
		SAMC11POW XA.4a	
XA.10a	ADTE	SAMC15TBC XA.10c	
XA.10c	Uc	SAMC19INF XA.10C	
XA.11a	FLT	SAMC19INF XA.11a	
XA.12c	+5V	SAMC15TBC XA.4a	SAMC11POW XA.10c
		SAMC15TBC XA.30a	SAMC11POW XA.12c
		SAMC15TBC XB.30c	
XA.16c	-FR6	SAMC19INF XA.16c	
XA.17a	UCC3	SAMC19INF XA.17a	
XA.26c	FLTA2	SAMC15TBC XA.6a	SAMC11POW XA.6a
XA.28c	FLTD	SAMC15TBC XA.28c	
XA.32a	-12V	SAMC15TBC XA.32a	SAMC11POW XA.30a
			SAMC11POW XA.32a
XA.32c, XA.2c	0V	SAMC15TBC XA.2c	SAMC11POW XA.2c
		SAMC15TBC XB.32a	SAMC11POW XA.4c
		SAMC15TBC XA.32c	SAMC11POW XA.30c
		SAMC15TBC XB.32c	SAMC11POW XA.32c


APPENDIX 2/1
START COMMAND
START TO SAMC15TBC
EXTERNAL FAULTS & RESET
RESET TO uP ON SAMC15TBC BOARD
LED V2 ON = FAULT
X1/
XA/
X2/
+24V
+12V
0V
-12V
+5V
S1
S2
K1
V1
V2
V3
V5
V6
V11
V12
R2
R3
R4
R5
R6
R7
R8
R12
R17
R19
C1
C2
C3
C4
C5
C11
L1
L2
FLT
UCC3
2-11H
EXF
88-08-04
Suominen
88-10-03 7.S.
STRÖMBERG FINLAND
INTERFACEKORTTI
SAFT 181 INF
1(1-2)
A3
VE 5811 6181
A
S 701 P3 5 85

APPENDIX 2/2



STRÖMBERG FINLAND

EXF

88-08-04 Suominen

88-10-03 7.5.

INTERFACEKORTTI

SAFT 181 INF

2 (1-2)

A3 VE 5811 6131 A

CONTENTS:

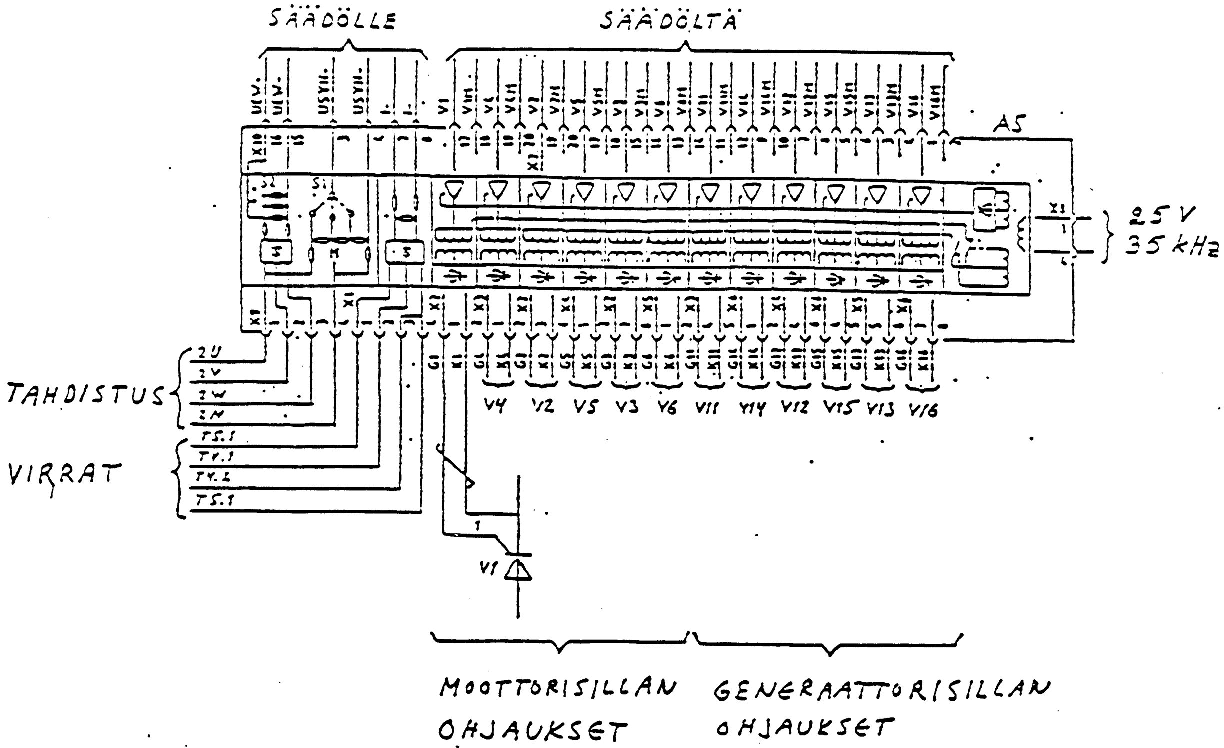


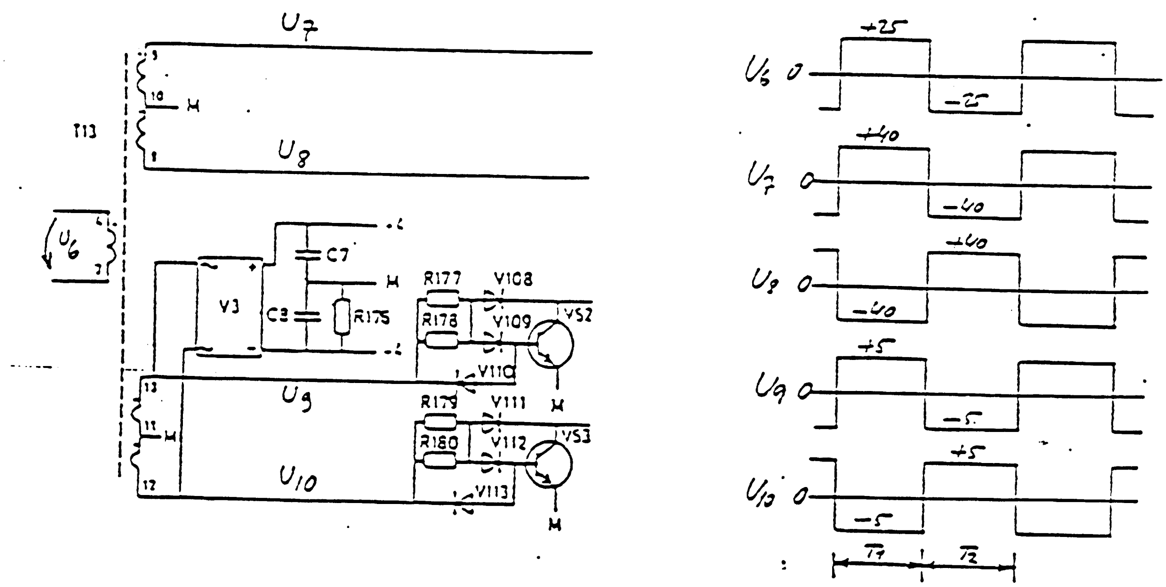
Figure 1. Block diagram of the pulse amplifier card

Main function:
- produce galvanicly isolated gate pulses to the thyristors from the control card firing orders.

Additional functions:
- 3-phase synchronizing transformer is connected to the card; used for timing of firing pulses and for measuring of line voltage
- 2 current transformers connected to U- and V-phases; used for load calculation

2. Power supply portion

Connection and wave forms of the power supply in figure 2.



T1 = V52 on & V53 off
T2 = V53 on & V52 on

Figure 2. Power supply portion of SAMT 11

Input to the power supply:
- 25V 35kHz square wave U6

Output from the power supply:
- two 40 V square waves (180 degrees phase shift) U7 and U8
- +- 4Vdc from the voltages U9 and U10; voltages U9 and U10 control also the transitors V52 and V53

3. Pulse amplifier portion

One phase of the pulse amplifier in figure 3 and wave forms related to the pulse amplifier in figure 4.

During OFF pulse transistor V24 (figure 3) conducts and V23 is OFF and capacitor C9 will charge up through the diodes V114, V115 and through the choke L7. No power to the input of the transformer T7 which also means that gate current Ig is zero.

During ON pulse V24 is OFF and V23 is ON. C9 will be discharged through R140, V23, T7 primary winding and transistors V52 or V53. Secondary current caused by primary currents IV117 and IV119 is rectified and this rectified current is used as a gate pulse to the thyristor.

Static level of the base current is limited by the choke L7. In the beginning of the turn on pulse the level of Ig is higher than the static level to reduce the turn on losses; gate current spike value is limited by resistor R140.

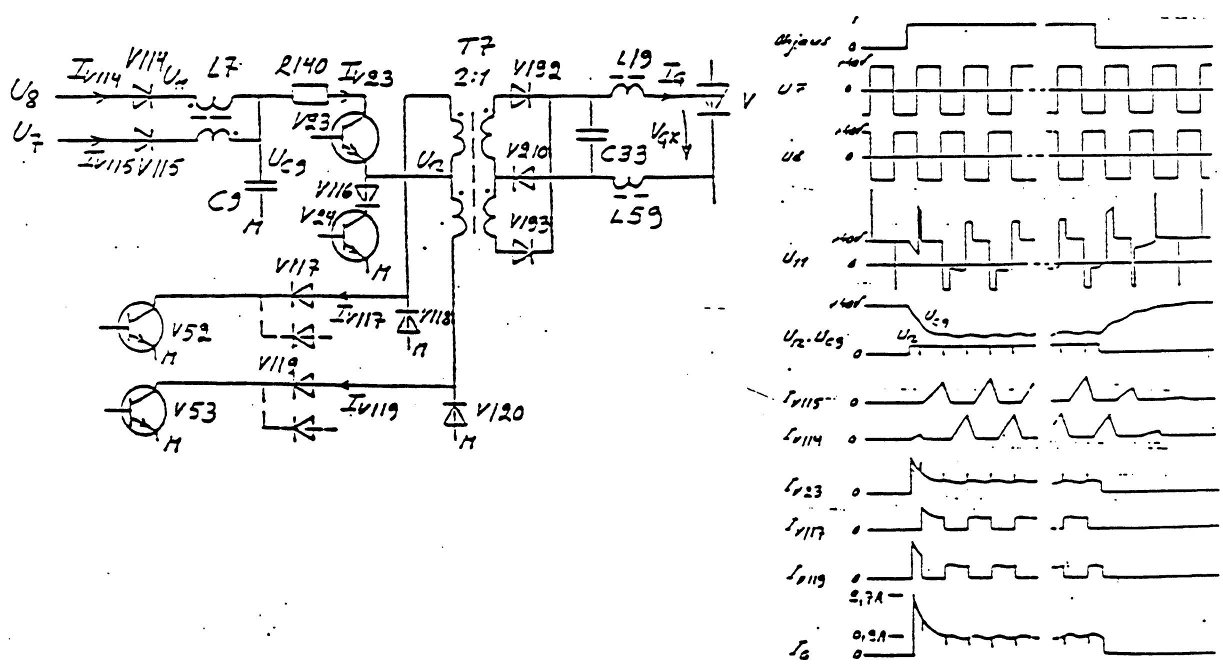


Figure 4. Wave shapes of the pulse amplifier currents and voltages (Ig value is measured with a 1 ohm resistive load)

Because transistors V52 and V53 are common for all channels, it is a must to isolate transformers of different phases by diodes. In figure 5 is the control portion of the pulse amplifier card. Zener diode V60 and resistors R110 and R122 set the threshold level of the control signal to 6.5V.

If control signal is below 6.5V:
- V46 is OFF
- V24 will get base current through R86 and V169
- V22 and V23 are OFF

If control signal is above 6.5V:
- V46 is ON
- V24 is OFF
- V22 and V23 are on

Resistor R89 will keep V24 in ON-state during START- and FAULT-situations where voltage UC9 is high, but control voltage +4 is lower than normally.

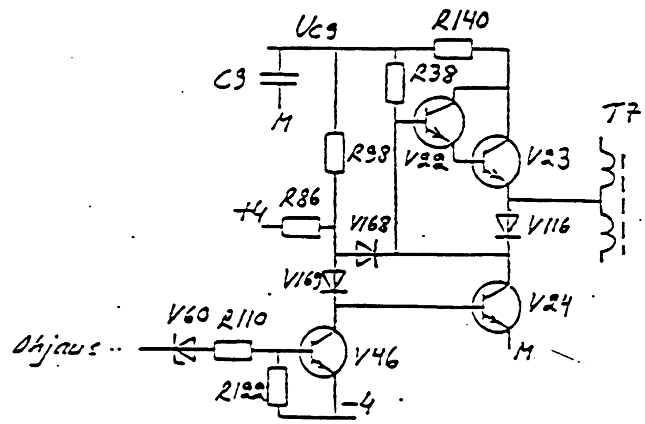


Figure 5. Control portion of the pulse amplifier

4. Connection of synchronizing transformer

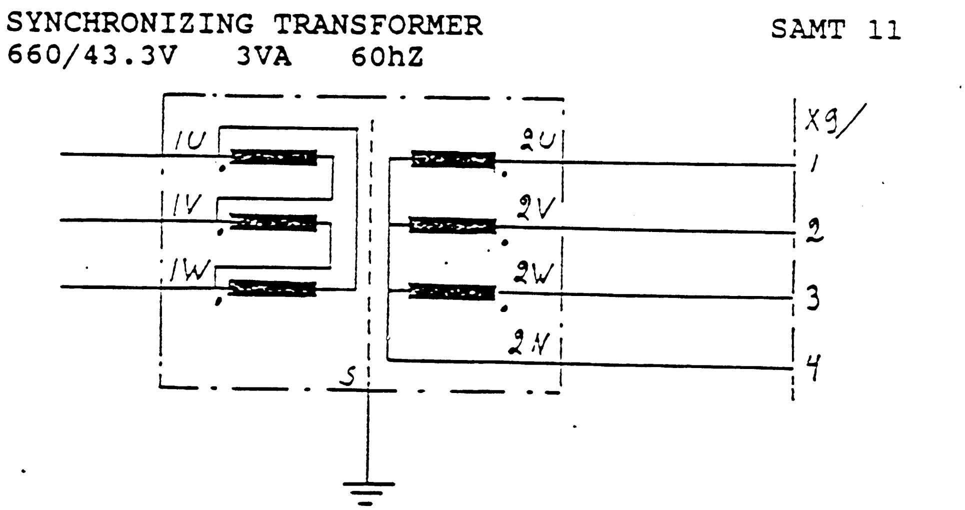


Figure 6. Synchronizing transformer connection

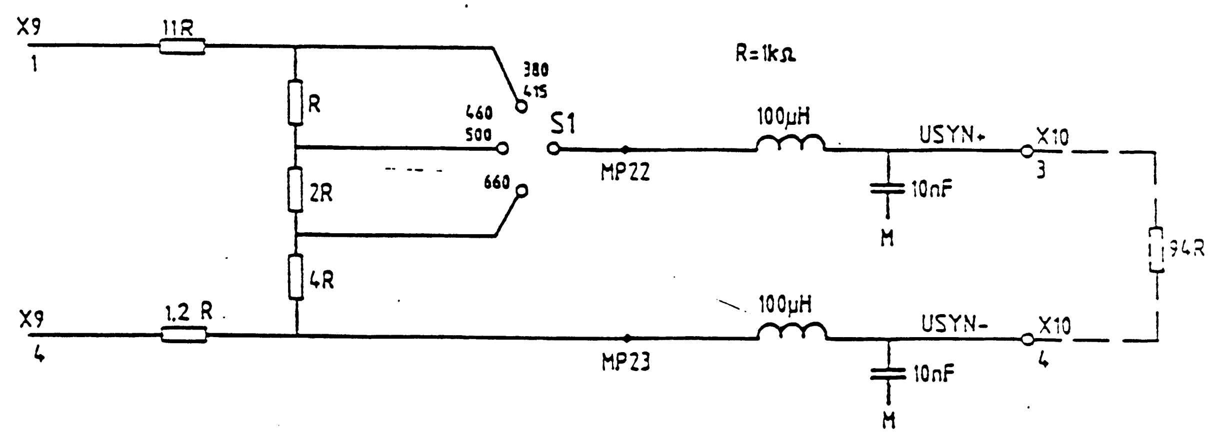


Figure 7. Scaling of the synchronizing voltage on the pulse amplifier card

Jumper S1 is used to select the scaling of the synchronizing voltage according to the main AC-line voltage. Synchronizing voltage can be measured between measurement points MP22 and MP23. Synchronizing voltage is filtered before taking it to the SAMC 19 INF card.

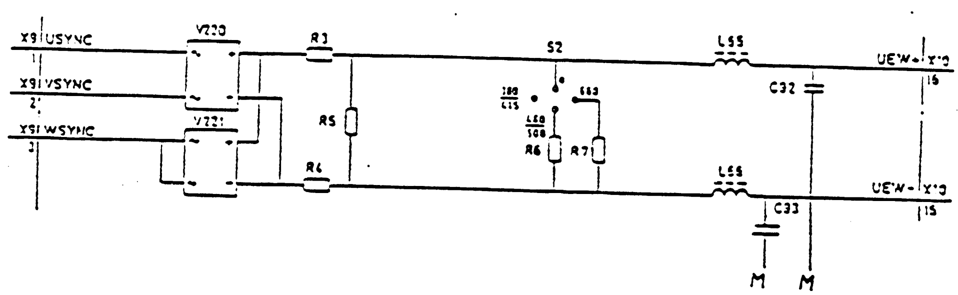


Figure 8. Scaling circuits of the line voltage

Rectified line voltage is scaled according to the position of the jumper S2. Scaled voltage is used on the SAMC 19 INF card for indication of netfailures.

5. Current measurement

Current transformers connection in figure 9. Resistance values R13...R19:

- with the current transformers nominal secondary current voltage between I+ and I- is 4.36V

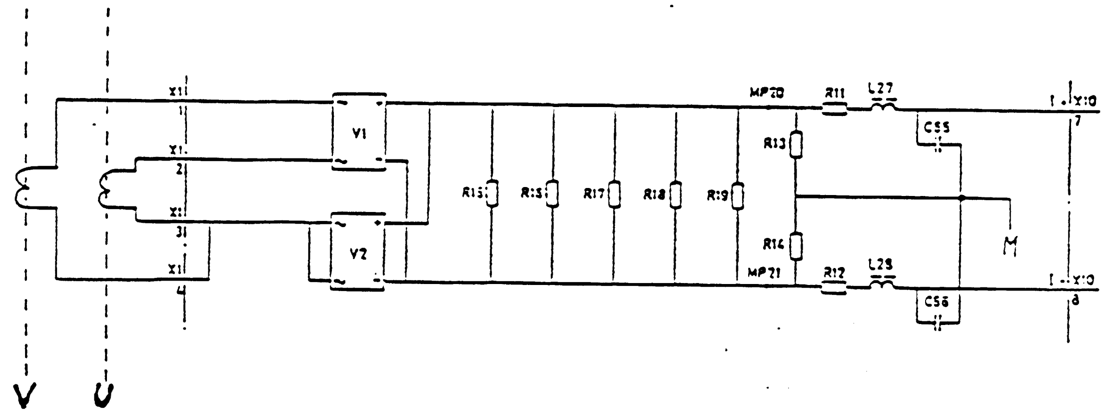


Figure 9. Connection of current transformers

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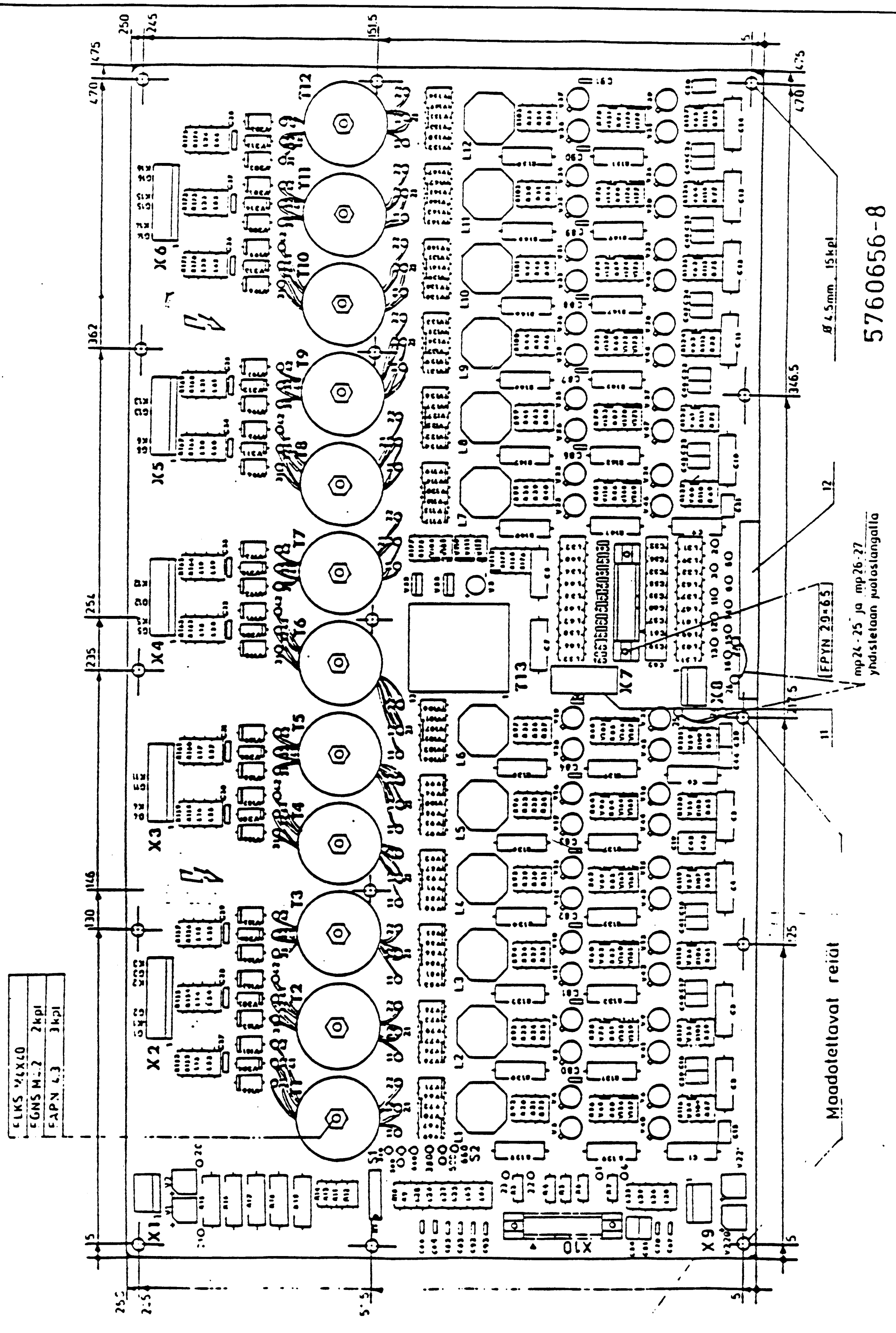
SAMT 11
layout

APPENDIX 2/1



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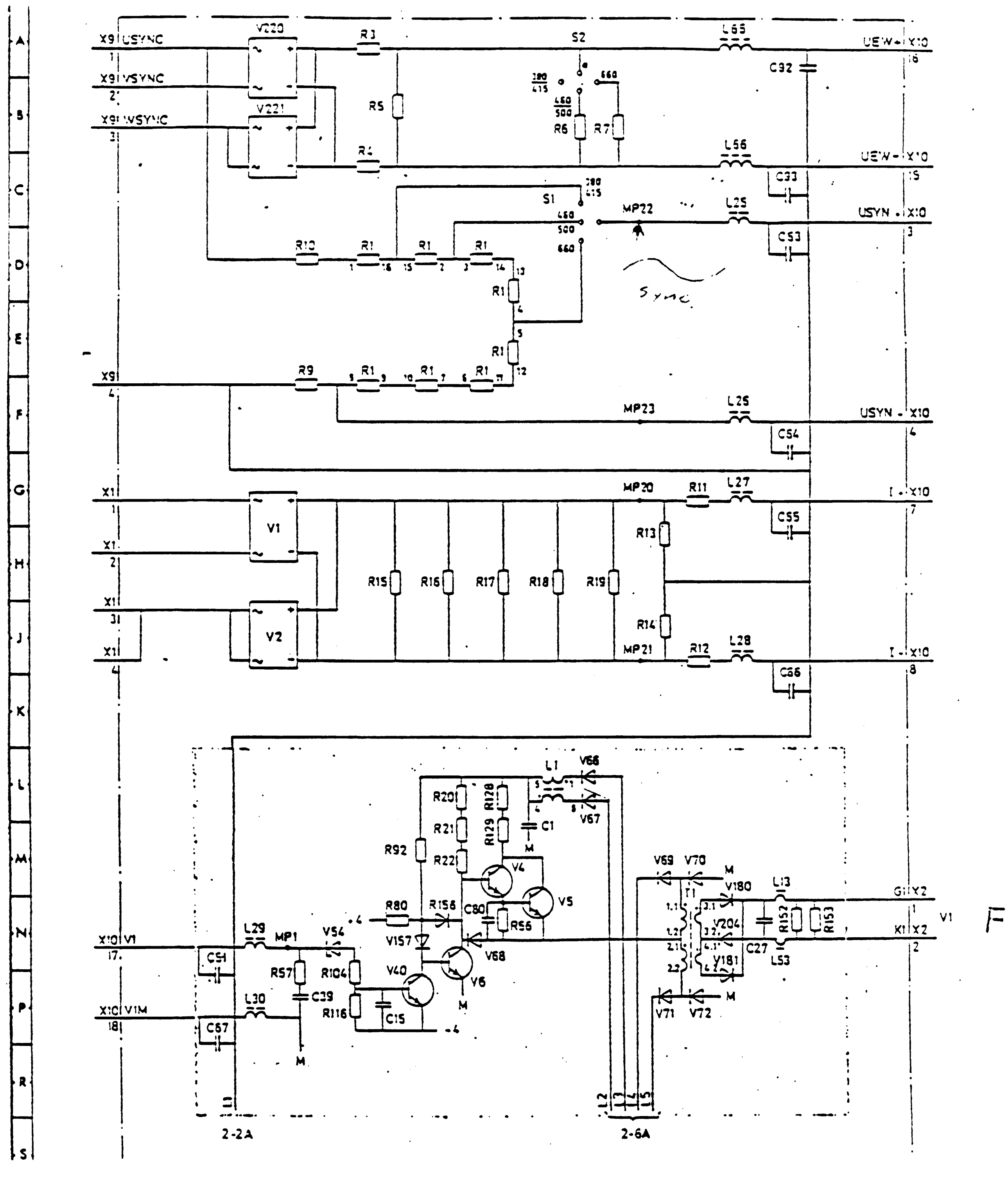
SAMT 11
circuit diagram

APPENDIX 3/1



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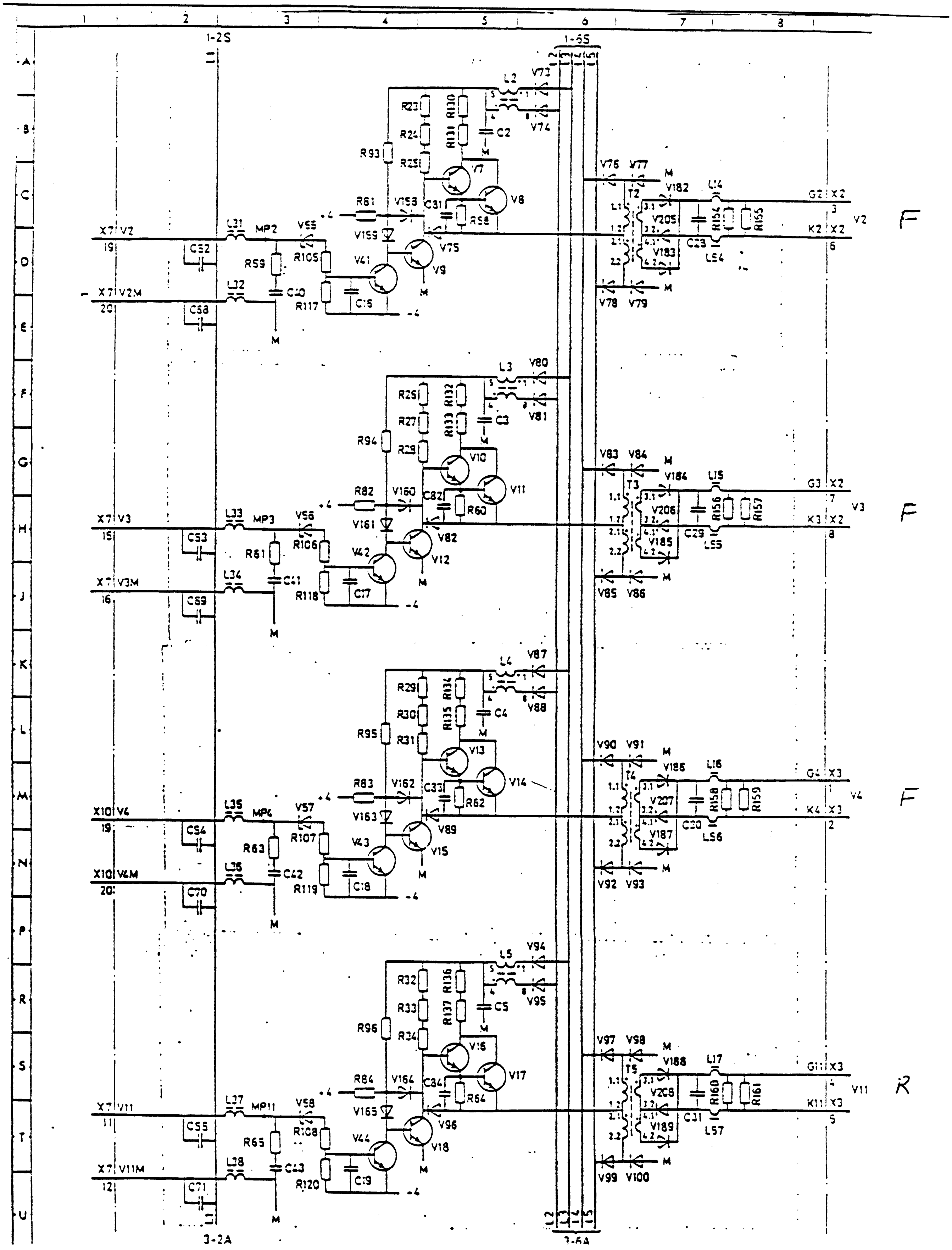
SAMT 11
circuit diagram

APPENDIX 3/2



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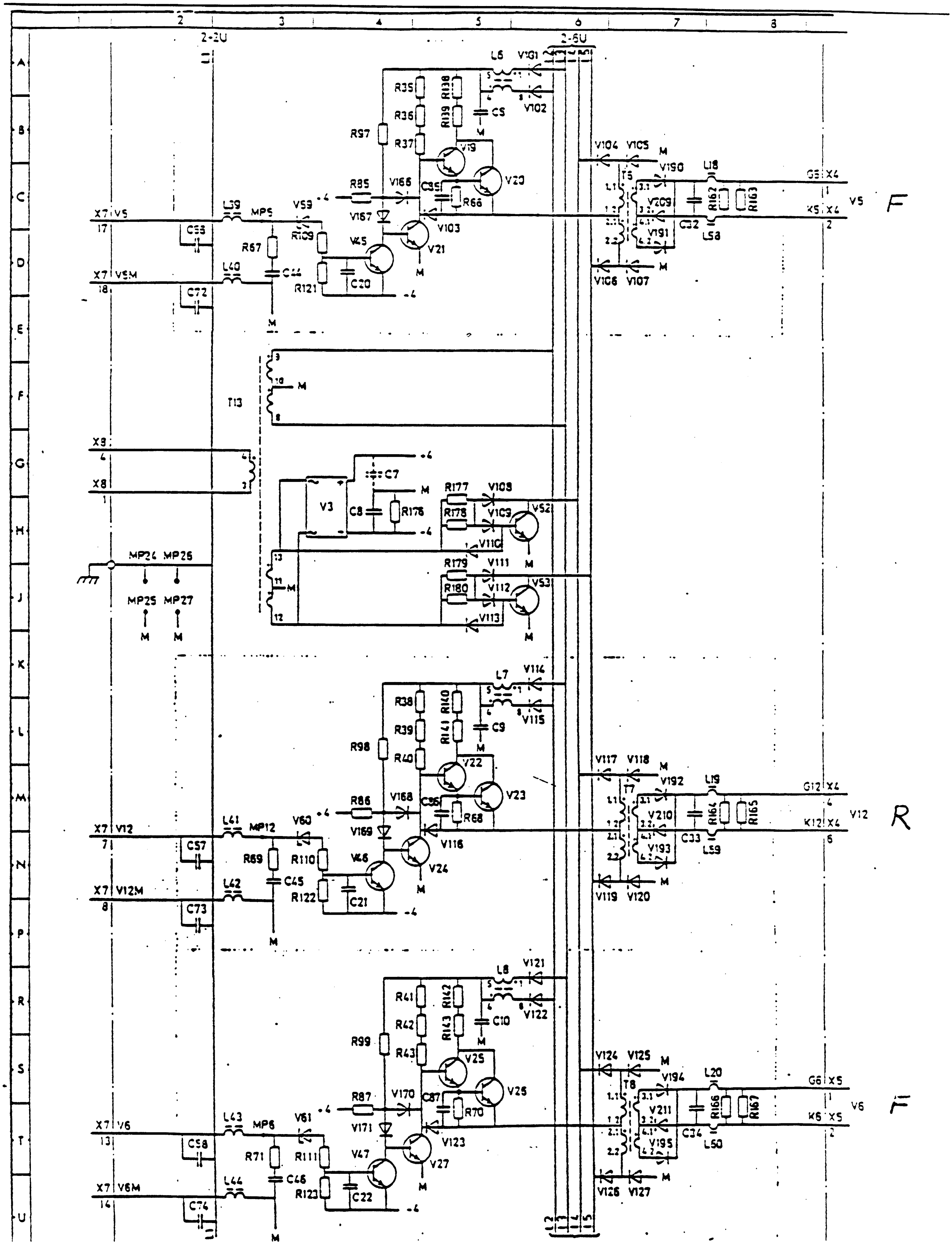
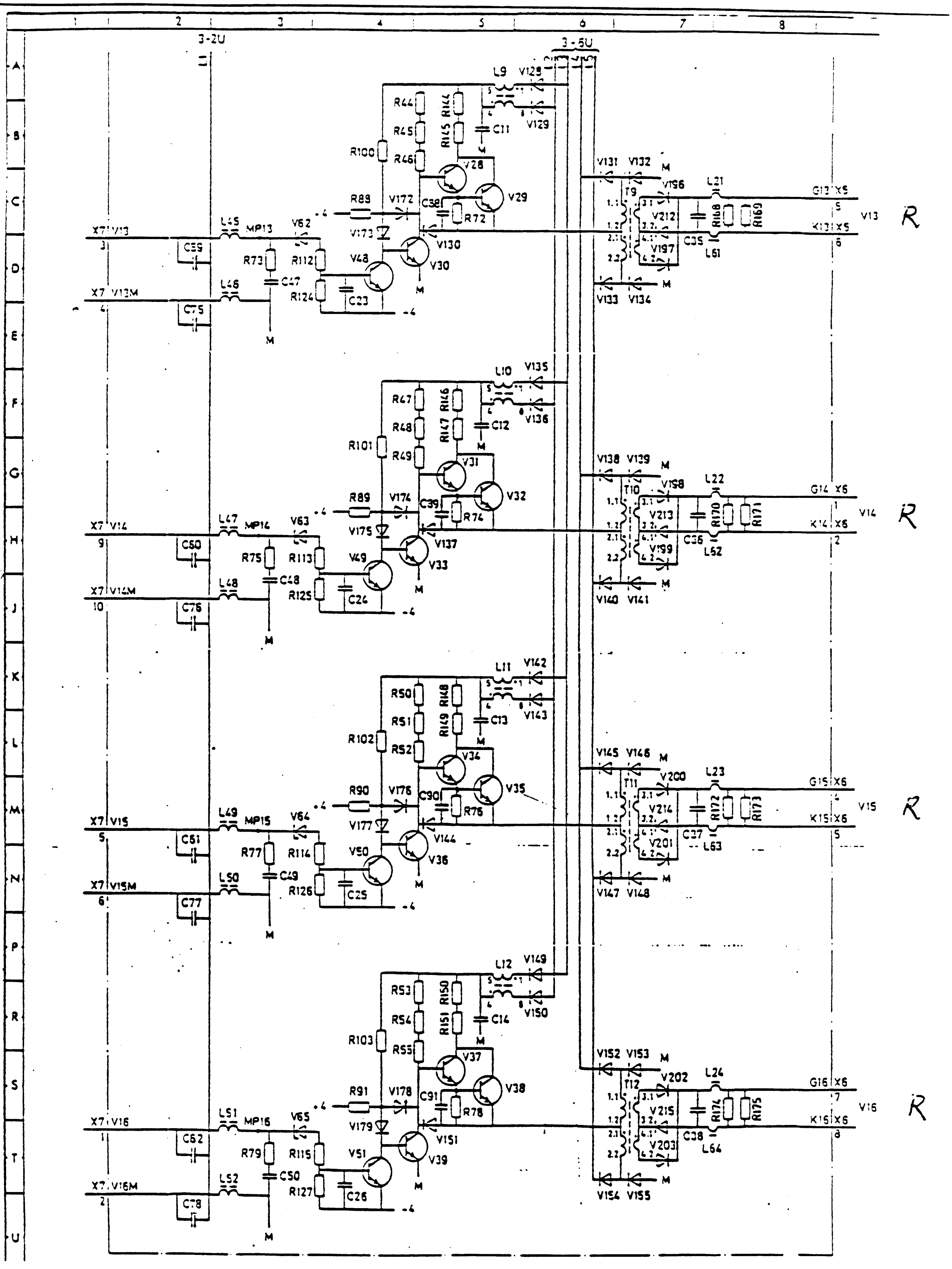
SAMT 11
circuit diagram

APPENDIX 3/3




3-2U
3-6U
X7 V13
X7 V13M
X7 V14
X7 V14M
X7 V15
X7 V15M
X7 V16
X7 V16M
G13 X5
K13 X5
G14 X6
K14 X6
G15 X6
K15 X6
G16 X6
K16 X6
V13
V14
V15
V16
R
R
R
R

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SAMT 11
parts list

APPENDIX 4/1

M	RIVI	TUNNUS	MÄÄRÄ	YKS	DI	KOODI	OSAN NIMITYS	TYYPPI	TEKNISET ARVOT	VALMI.	MAA	HUOM
	10					5719 7145	KOKOONPANO					
	19											
	20					5721 1377	PIIRIKAAVIO					
H	21	X					KOESTUSOHJE					
	29											574030/
	30	8 1	1,000	KPL	VE	5760 6568	PIIRILEVY	SAMT 11	REV.H 250X475 2-LAYER		FI	
	40	12	1,000	KPL	VE	5716 2465	TARRA PIIRILEVYT	FDL111 GHY LOGOLLA	50,8X9,5MM (ID-5233)	FANDUI	US	
	50	11	1,000	KPL	VE	3505 5398	SARJANUMEROKILPI	SARJANUMERO	10X30MM	MAINOS	FI	
	99											
	100	X1,8,9	3,000	KPL	VE	3506 4290	LIITIN,KORTTI	2630-04A 09-74-1041		MOLEX	US	
	110	X2-6	5,000	KPL	VE	3506 4311	LIITIN,KORTTI	2630-08A 09-74-1081		MOLEX	US	
	140	X7,10	2,000	KPL	VE	0988 2057	NAUHAKAAPELILIITIN	FAP-2001-1204-0AS	20-NAP. KOIRAS SUORA	YAMAIC	JP	
F	160		92,00	KPL	VE	0987 8858	JUOTOSTAPPI	ATM1,3/3,5/9,7.002	CuZn, Sn	STOCKO	DE	
H	170	S1,2	2,000	KPL	VE	0987 8700	OIKOSULKUPISTOKE	461-2071-01-03-12	D=1.02MM,0.8 UM AU,BRASS	CAMBIO	GB	
H	180		8,000	KPL	VE	0987 8696	OIKOS.PISTOKEHOLKKI	450-3704-01-03	HOLKKI 0.3 UM AU/ CU	CAMBIO	GB	
	199											
	200	6 T1-12	12,00	KPL	VE	5717 1910	PULSSIMUUNTAJA	SAMI-			FI	
	240	T13	1,000	KPL	VE	5717 1936	MUUNTAJA	SAMI-MUUNTAJA		STR/VA	FI	
	300	L1-12	12,00	KPL	VE	5717 1901	KURISTIN	SAMI-KURISTIN	2X270UH 1,5A	SIR	FI	
B	310	L13-24	12,00	KPL	VE	0985 0091	KURISTIN	B78108-S1102-K	1UH 10% 0,8A	SIEMEN	DE	
	320	L25-52	28,00	KPL	VE	0985 0104	KURISTIN	B78 108-S1104-J	100 UH +-10% 160MA	SIEMEN	DE	
H	321	L65,66	2,000	KPL	VE	0985 0104	KURISTIN	B78 108-S1104-J	100 UH +-10% 160MA	SIEMEN	DE	
F	330	L53-64	12,00	KPL	VE	0985 0091	KURISTIN	B78108-S1102-K	1UH 10% 0,8A	SIEMEN	DE	
	359											
	360	V1,2	2,000	KPL	VE	0981 3209	DIODISILTA	SKB 1,2/04	0,9A 400V	SEMIKR	DE	
H	361	V220,221	2,000	KPL	VE	0981 3209	DIODISILTA	SKB 1,2/04	0,9A 400V	SEMIKR	DE	
	370	8 V3	1,000	KPL	VE	0981 3187	DIODISILTA	VE28X	1A 200V	VARO	US	
	399											
	400	V4-39	36,00	KPL	VE	0980 6482	TRANSISTORI	BSW 68 A	NPN 1 A 150 V	PHILIP	NL	
	410	V40-51	12,00	KPL	VE	0980 6601	TRANSISTORI	2N2219A	NPN 0,5 A 40 V	SI	FR	
	420	V52,53	2,000	KPL	VE	3506 4460	TRANSISTORI	BU 406	NPN 5A 200V	SGS	IT	
	499											
	500	V54-65	12,00	KPL	VE	0980 8248	ZENERDIODI	BZX79C8V2	0,2V 0,4W	PHILIP	NL	
	559											
C	560	V66-68,70	4,000	KPL	VE	0980 3238	DIODI	BYV 95 B	400V AV1A 200NS	PHILIP	NL	
C	561	V72-75,77	5,000	KPL	VE	0980 3238	DIODI	BYV 95 B	400V AV1A 200NS	PHILIP	NL	
C	562	V79-82,84	5,000	KPL	VE	0980 3238	DIODI	BYV 95 B	400V AV1A 200NS	PHILIP	NL	
C	563	V86-89,91	5,000	KPL	VE	0980 3238	DIODI	BYV 95 B	400V AV1A 200NS	PHILIP	NL	
C	564	V93-96,98	5,000	KPL	VE	0980 3238	DIODI	BYV 95 B	400V AV1A 200NS	PHILIP	NL	
C	565	V100-103	4,000	KPL	VE	0980 3238	DIODI	BYV 95 B	400V AV1A 200NS	PHILIP	NL	
C	566	V105,107	2,000	KPL	VE	0980 3238	DIODI	BYV 95 B	400V AV1A 200NS	PHILIP	NL	
C	567	V109,110	2,000	KPL	VE	0980 3238	DIODI	BYV 95 B	400V AV1A 200NS	PHILIP	NL	
C	568	V112-116	5,000	KPL	VE	0980 3238	DIODI	BYV 95 B	400V AV1A 200NS	PHILIP	NL	
C	569	V118,125	2,000	KPL	VE	0980 3238	DIODI	BYV 95 B	400V AV1A 200NS	PHILIP	NL	
C	570	V120-123	4,000	KPL	VE	0980 3238	DIODI	BYV 95 B	400V AV1A 200NS	PHILIP	NL	
C	571	V127-130	4,000	KPL	VE	0980 3238	DIODI	BYV 95 B	400V AV1A 200NS	PHILIP	NL	
C	572	V132,139	2,000	KPL	VE	0980 3238	DIODI	BYV 95 B	400V AV1A 200NS	PHILIP	NL	
C	573	V134-137	4,000	KPL	VE	0980 3238	DIODI	BYV 95 B	400V AV1A 200NS	PHILIP	NL	
C	574	V146,153	2,000	KPL	VE	0980 3238	DIODI	BYV 95 B	400V AV1A 200NS	PHILIP	NL	
C	575	V141-144	4,000	KPL	VE	0980 3238	DIODI	BYV 95 B	400V AV1A 200NS	PHILIP	NL	

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ALKUP.	A	TSTO	EOX
FVM	811116	SUUNN.	SAARINEN
VIIM.	J	TSTO	EXX
FVM	840510	SUUNN.	TARHANEN
FVM		TARK.	
FVM	840510	HYV.	SAARINEN

TUNNUS
KAYTTÖKOHDE SAMI B,F V/R SI
LISÄTIEDOT
VASTARINNANKYTKETYN SILLAN PULSSIVAHVISTIN
MF24,25 JA MF26,27 YHDISTETÄÄN JUOTOSLANGALLA

NIMITYS PULSSIVAHV.KORTTI
TYYPPI SAMT 11
TEKN.ARVOT

FIKA	05150
LEHTI	1 ( ) KOKO A3
KIELI	FI VERSIO J
KOODI	VE 5721 1369

* * * * * * * * J A T K U U * * * * * * * * *

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03-16-89
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SAMT 11
parts list

APPENDIX 4/2

H	RIVI	TUNNUS	MÄÄRÄ	YKS	DI	KOODI	OSAN NIMITYS	TYYPPI	TEKNISET ARVOT	VALMI.	MAA	HUOM
C	576	V155	1,000	KPL	VE	0980 3238	DIODI	BYV 95 B	400V AV1A 200NS	PHILIP	NL	
C	577	V148-151	4,000	KPL	VE	0980 3238	DIODI	BYV 95 B	400V AV1A 200NS	PHILIP	NL	
	590	V156-179	24,00	KPL	VE	0980 3190	DIODI	1N4148	75V AV0.15A 4NS	PHILIP	NL	
D	609	V69,71,76	3,000	KPL	VE	3506 7825	DIODI	BYV27-150	150V AV1A 50NS	PHILIP	NL	
C	610	V78,83,85	3,000	KPL	VE	3506 7825	DIODI	BYV27-150	150V AV1A 50NS	PHILIP	NL	
C	611	V90,92,97	3,000	KPL	VE	3506 7825	DIODI	BYV27-150	150V AV1A 50NS	PHILIP	NL	
C	612	V99,104	2,000	KPL	VE	3506 7825	DIODI	BYV27-150	150V AV1A 50NS	PHILIP	NL	
C	613	V106,108	2,000	KPL	VE	3506 7825	DIODI	BYV27-150	150V AV1A 50NS	PHILIP	NL	
C	614	V111,117	2,000	KPL	VE	3506 7825	DIODI	BYV27-150	150V AV1A 50NS	PHILIP	NL	
C	615	V119,124	2,000	KPL	VE	3506 7825	DIODI	BYV27-150	150V AV1A 50NS	PHILIP	NL	
C	616	V126,131	2,000	KPL	VE	3506 7825	DIODI	BYV27-150	150V AV1A 50NS	PHILIP	NL	
C	617	V133,138	2,000	KPL	VE	3506 7825	DIODI	BYV27-150	150V AV1A 50NS	PHILIP	NL	
C	618	V140,145	2,000	KPL	VE	3506 7825	DIODI	BYV27-150	150V AV1A 50NS	PHILIP	NL	
C	619	V147,152	2,000	KPL	VE	3506 7825	DIODI	BYV27-150	150V AV1A 50NS	PHILIP	NL	
C	620	V154	1,000	KPL	VE	3506 7825	DIODI	BYV27-150	150V AV1A 50NS	PHILIP	NL	
C	621	V180-203	24,00	KPL	VE	3506 7825	DIODI	BYV27-150	150V AV1A 50NS	PHILIP	NL	
	650	V204-215	12,00	KPL	VE	0980 3718	DIODI	1N4004	400V AV1A	GI	US	
	699											
J	700	B C1-6	6,000	KPL	VE	0983 1584	KONDENSAATTORI	MKC 63	0,47UF 63V 10% +150PPM	CF	CH	
J	705	B C8-14	7,000	KPL	VE	0983 1504	KONDENSAATTORI	MKC 63	0,47UF 63V 10% +150PPM	CF	CH	
	710	C15-26	12,00	KPL	VE	0983 1037	KONDENSAATTORI	2222 630 53471	470PF 100V 10%	PHILIP	NL	
	720	B C27-38	12,00	KPL	VE	0983 0219	KONDENSAATTORI	MKT 1.85	47NF 63V 10%	ARCOTR	IT	
	730	C39-62	24,00	KPL	VE	0983 1045	KONDENSAATTORI	2222 630 63102	1NF 100V 10%	PHILIP	NL	
E	740	C63,64	2,000	KPL	VE	0983 0359	KONDENSAATTORI	MD01 1C103MAA	10NF 100V 20% DIP	AVX	GB	
D	750	B C67-78	12,00	KPL	VE	0983 0219	KONDENSAATTORI	MKT 1.85	47NF 63V 10%	ARCOTR	IT	
H	755	B C80-93	14,00	KPL	VE	0983 0219	KONDENSAATTORI	MKT 1.85	47NF 63V 10%	ARCOTR	IT	
B	760	C65,66	2,000	KPL	VE	0983 0359	KONDENSAATTORI	MD01 1C103MAA	10NF 100V 20% DIP	AVX	GB	
	799											
	800	R1	1,000	KPL	VE	0991 0085	VASTUSVERKKO DIL	898-3-R1K	8X1K PR=0,2 W PT=1,6W	BECKMA	US	
H	820	R5	1,000	KPL		0991 2673	VASTUS	SMA0207S	3,32K 0,33W 1% 50PPM	DRALOR	DE	
H	830	R6	1,000	KPL		0991 2754	VASTUS	SMA0207S	15,0K 0,33W 1% 50PPM	DRALOR	DE	
H	860	R9	1,000	KPL		0991 2622	VASTUS	SMA0207S	1,21K 0,33W 1% 50PPM	DRALOR	DE	
H	870	R3,4,10	3,000	KPL		0991 2730	VASTUS	SMA0207S	10,0K 0,33W 1% 50PPM	DRALOR	DE	
G	900	R11	1,000	KPL		0991 2649	VASTUS	SMA0207S	1,82K 0,33W 1% 50PPM	DRALOR	DE	
H	910	R12,7	2,000	KPL		0991 2690	VASTUS	SMA0207S	4,75K 0,33W 1% 50PPM	DRALOR	DE	
	920	R13,14	2,000	KPL		0991 1171	VASTUS	SMA0207S	221 OHM 0,5 W 1% 50PPM	DRALOR	DE	
	930	R15-19	5,000	KPL	VE	0991 5265	VASTUS	KH 206-815	22 OHM 4 W 5%	VITROH	DE	
	940	R20-55	36,00	KPL		0991 1235	VASTUS	SMA0207S	681 OHM 0,5 W 1% 50PPM	DRALOR	DE	
	950	R56-79	24,00	KPL		0991 2517	VASTUS	SMA0207S	150 OHM 0,5 W 1% 50PPM	DRALOR	DE	
G	960	R80-91	12,00	KPL		0991 2525	VASTUS	SMA0207S	182 OHM 0,5 W 1% 50PPM	DRALOR	DE	
	970	R92-103	12,00	KPL		0991 2771	VASTUS	SMA0207S	22,1K 0,33W 1% 50PPM	DRALOR	DE	
	980	R104-115	12,00	KPL		0991 2631	VASTUS	SMA0207S	1,50K 0,33W 1% 50PPM	DRALOR	DE	
	990	R116-127	12,00	KPL		0991 2584	VASTUS	SMA0207S	562 OHM 0,5 W 1% 50PPM	DRALOR	DE	
	1000	R128-151	24,00	KPL	VE	0991 5231	VASTUS	KH 206-815	10 OHM 4 W 5%	VITROH	DE	
	1010	R152-175	24,00	KPL		0991 1171	VASTUS	SMA0207S	221 OHM 0,5 W 1% 50PPM	DRALOR	DE	
G	1020	R176	1,000	KPL		0991 0964	VASTUS	SMA0207S	100 OHM 0,5 W 1% 50PPM	DRALOR	DE	
G	1030	R177-180	4,000	KPL		0991 0921	VASTUS	SMA0207S	22,1OHM 0,5 W 1% 50PPM	DRALOR	DE	

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ALKUP. A TSTO EOX
PVM 811116 SUUNN. SAARINEN
VIIM. J TSTO EXX
PVM 840510 SUUNN. TARHANEN
PVM TARK.
PVM 840510 HYV. SAARINEN

TUNNUS
KÄYTTÖKOHDE SAMI B,F V/R SI
LISÄTIEDOT
VASTARINNANKYTKETYN SILLAN PULSSIVAHVISTIN
HP24,25 JA HP26,27 YHDISTETÄÄN JUOTOSLANGALLA

NIMITYS PULSSIVAHV.KORTTI
TYYPPI SAMT 11
TEKN.ARVOT

PLKA 85150
LEHTI 2 (2) KOKO A3
KIELI FI VERSIO J
KOODI VE 5721 1369

* * * * * * * * * L O P P U * * * * * * * *

CONTENTS:

Appendix 1/1 SAFT 183 VMC layout
Appendix 2/1 SAFT 183 VMC circuit diagram

1. General information

SAFT 183 VMC is used for DC-voltage measurement. Flow of the scaled and isolated signal:

SAFT181INF (X2.7)---SAFT181INF (XA.10c)----
SAMC19INF (XA.10c)--SAMC19INF (XB.14)------
SAMC15TBC (X3.14)

2. Operation

Resistors R1...R8 will scale the DC-voltage between 0...5V:

- Example 660VAC:
  DC-voltage is Udc = 1.35x660VAC = 891VDC
  Voltage across R8 is $5.6 \times 10^{-3} \times Udc = 5V$

A1 will isolate the signal from the DC-bus potential.

With different AC voltages different gains can be selected by the jumpers S1...S8 to scale -UC1 signal to be approximately -5V with nominal AC-line voltage (S8 normally in position a-b).

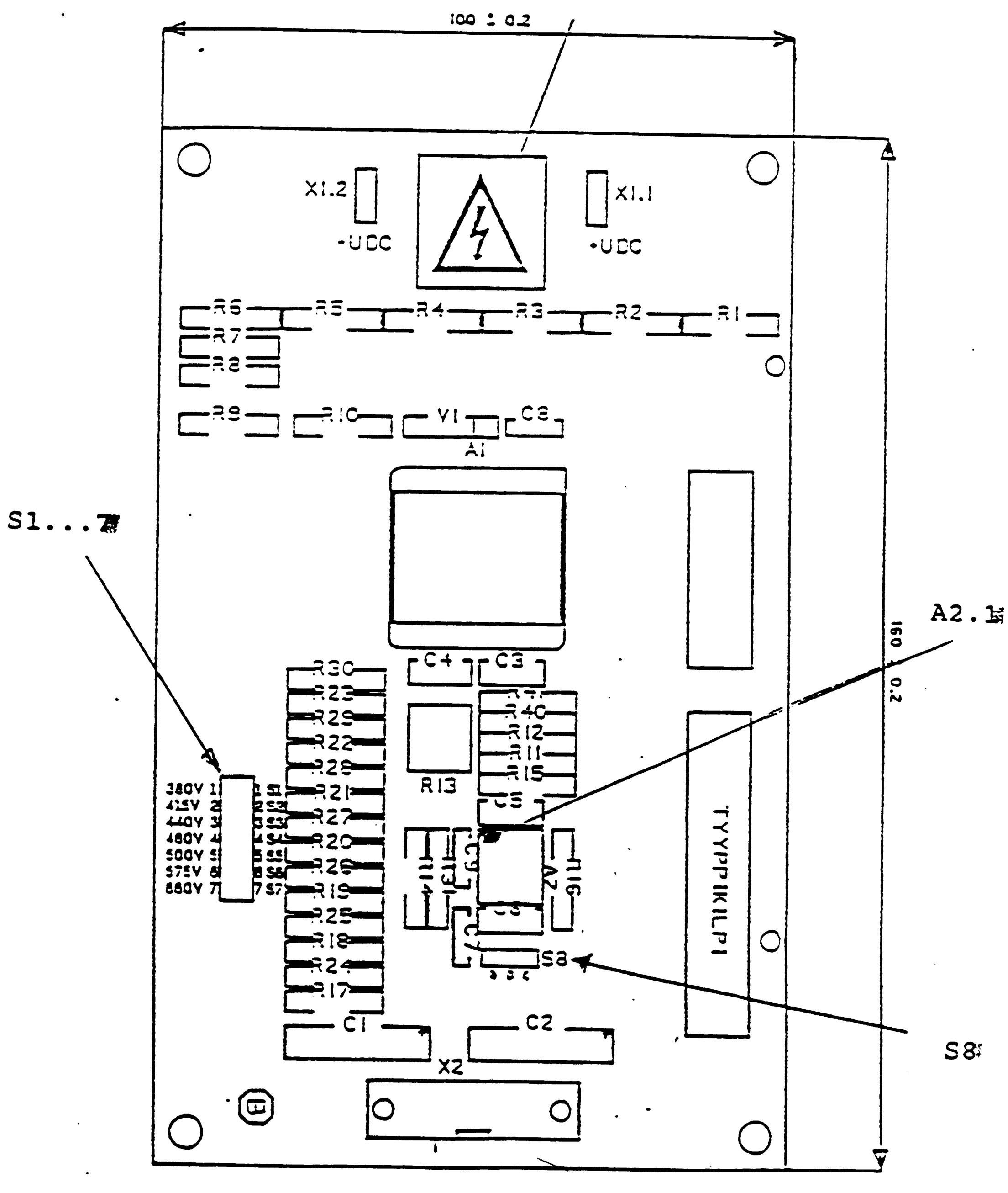
Table 1. -UC1 signal level with different nominal voltages

jumper	gain	-UC1 (nominal AC voltage)
- S1	1.730	-4.99V (380VAC)
- S2	1.574	-4.96V (415VAC)
- S3	1.484	-4.96V (440VAC)
- S4	1.430	-4.99V (460VAC)
- S5	1.310	-4.97V (500VAC)
- S6	1.126	-4.92V (575VAC)
- S7	1.000	-5.01V (660VAC)

3. Trouble shooting

If there is no faults the motoring bridge pulses can be checked without charging the DC-bus by setting the jumper S8 to c-b position.

APPENDIX 1/1



5761640-7

-UC ACROSS C7 (-5V = RATED)

-UC BETWEEN A2.1 - A2.3 (-5V = RATED)

KOKOONPANO
ASSEMBLY

SAFT 183 YMC

1:1

EXF

88-08-04

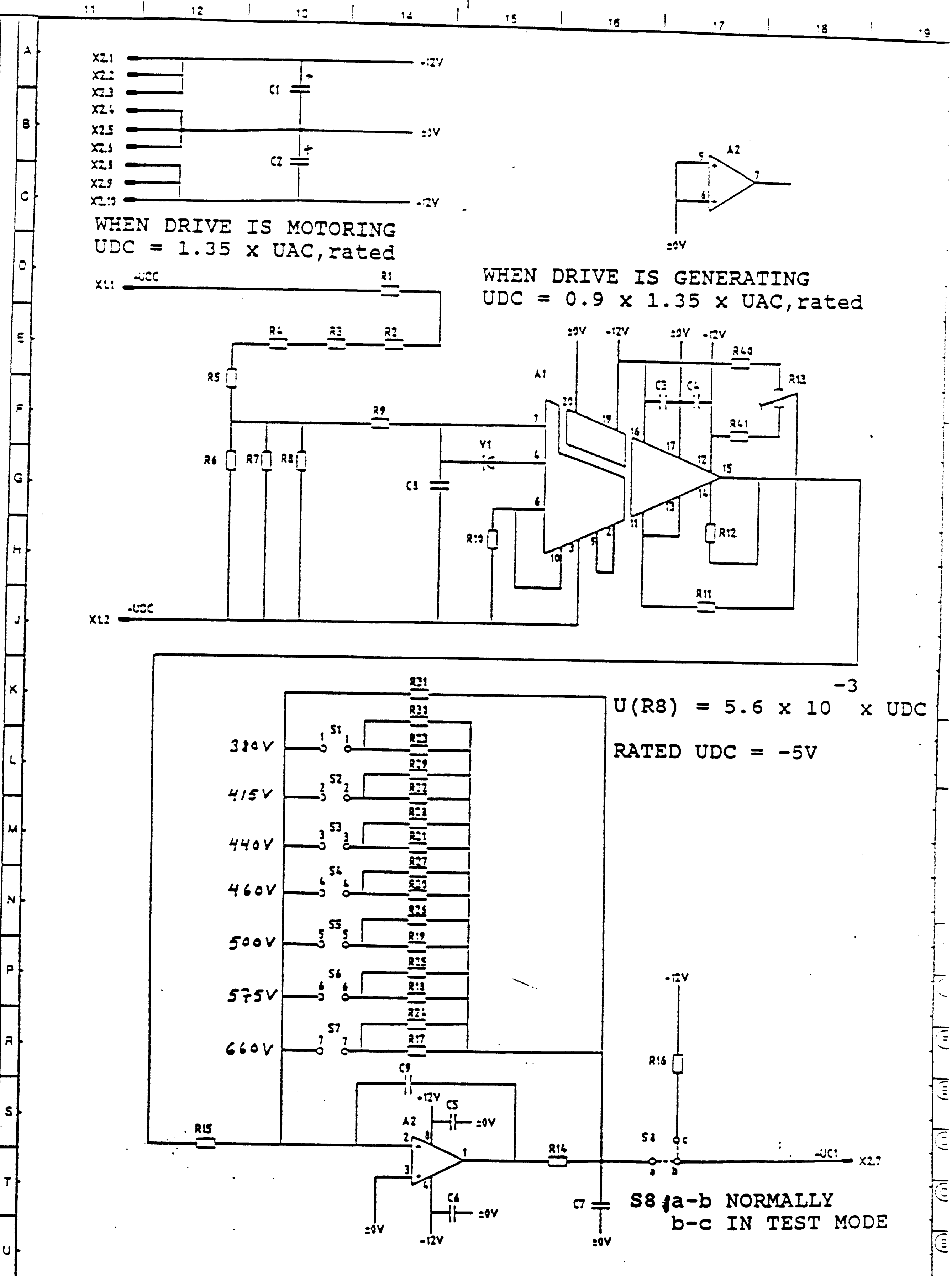
J. SUOMINEN

88-08-04 J.S.

STRÖMBERG
FINLAND

A4 5811924-5 A

S7C0P4 4 85



STRÖMBERG FINLAND

EXF

88-08-04 Suominen

88-10-03 7.5.

MITTAUSKORTTI

SAFT 183 VMC

1 (1)

A3 VE 5811 5487 A

S 701 P3 5 85