Brüel & Kjær

Phase Meter

Type 2971

Valid from serial no. 491 771

0037—0185

Service

Phase Meter

Type 2971

Valid from serial no. 491 771

0037–0185

Consisting of:

Trouble Shooting

If any faults should occur please check the instrument according to the "Checking Procedure".

When a fault has been traced and corrected the voltage and adjustments influenced by the correction must be rechecked.

The complete instrument should then be rechecked according to the "Checking Procedure" to make sure that all basic functions are operative.

The tolerances in these notes are intended for use as a guide for adjustment.

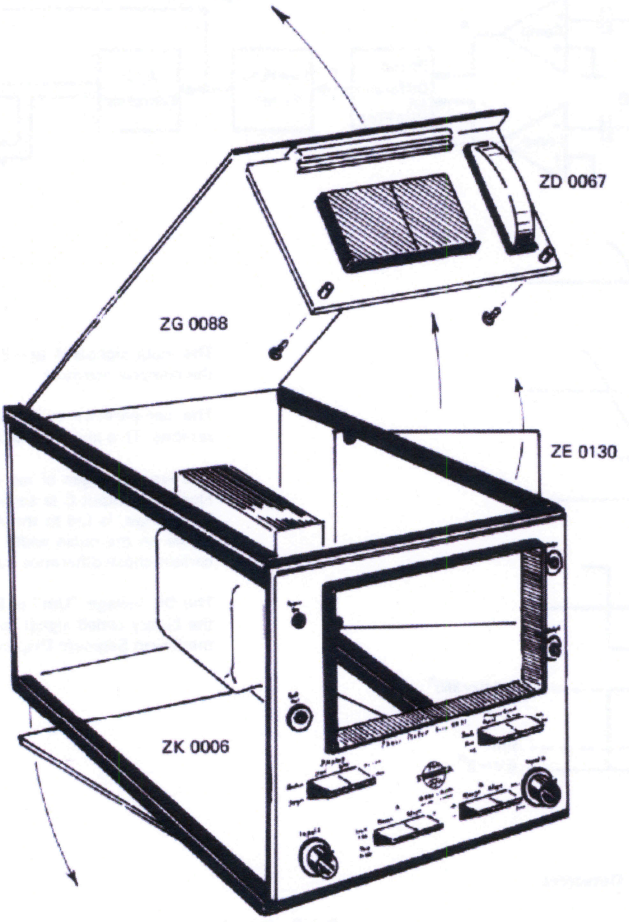
Before correcting any apparent deviation make sure that the measuring instrument has tolerances small enough not to affect the measurement.

Spare Parts

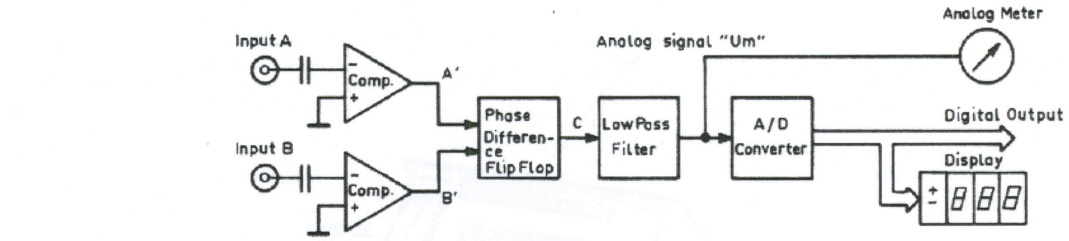
Please state type and serial number of the Phase Meter when ordering spare parts.

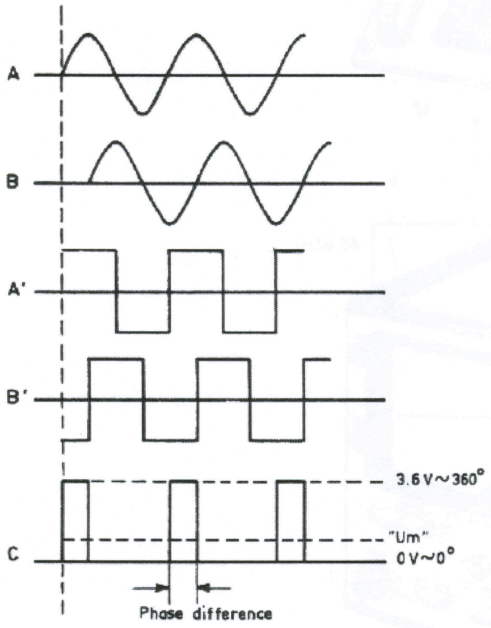
Notice!

When opening the instrument for repair only unscrew the screws without red paint.



The principle of the Phase Meter Type 2971





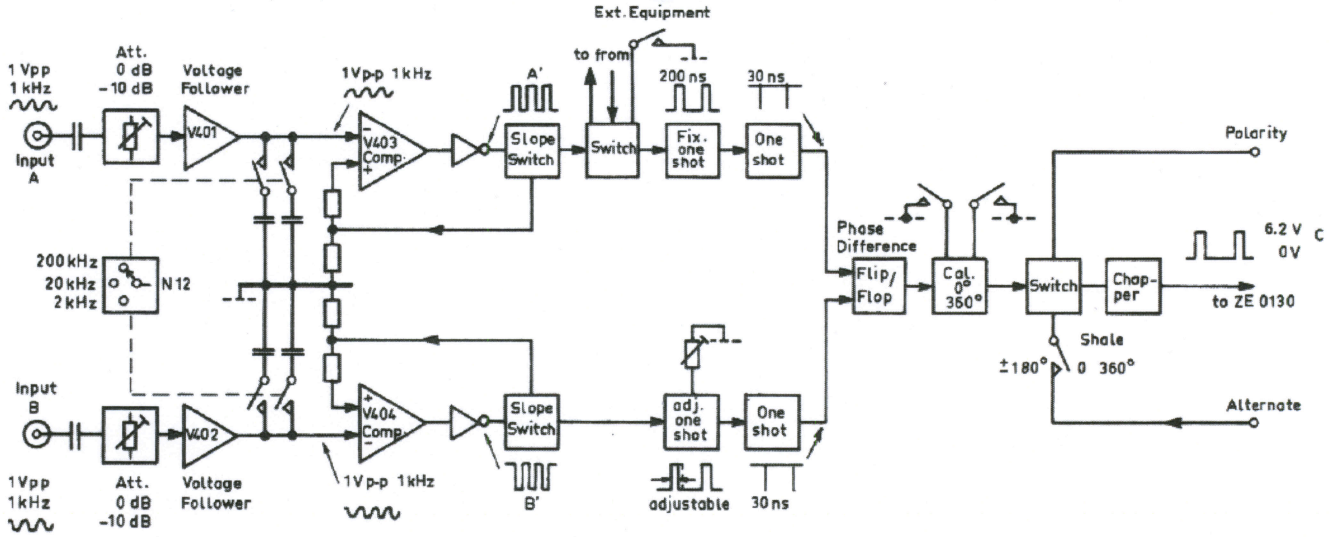
The input signals A and B which are chosen to be sinewaves, are fed to the compcomparators.

The comparators switch-over every time the input signals passes the zeroline. This gives the signals A' and B', which are squarewave signals.

The leading edges of signal A' and B' trigger the Phase Difference Flip Flop. The output C is applied to a Low-pass Filter, the output of which, a DC voltage, is fed to the Analog Meter. The value of the DC voltage depends on the pulse width of the signal C, which again corresponds to a certain phase difference between the two input signals.

The DC voltage "Um" is fed to the A/D Converter as well, which gives the binary coded signal to the "Digital Output" socket and the signal for the Seven Segment Display.

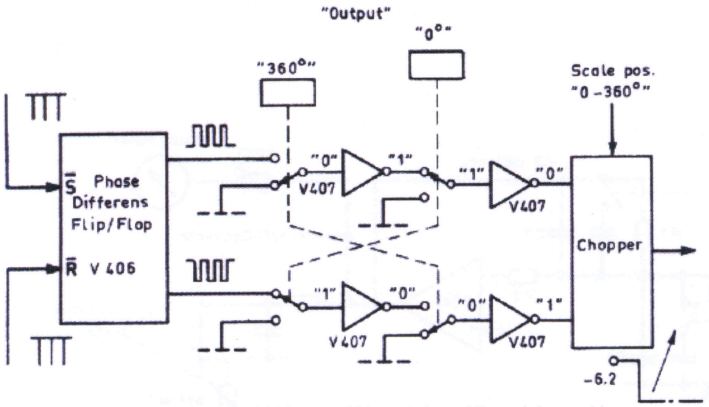
ZK 0006 Zero Crossing and Level Detectors



The signal fed to the input "A" proceed either directly to the voltage follower V401 or through the —10 dB attenuator. After V401 the upper limiting frequency can be chosen by means of the selector N12.

The comparator V403 transforms the waveform of the input signal to a squarewave signal, generating a leading edge whenever the negative going part of the input signal is passing the zero line.

By means of the Slope switch N9 it is possible to invert the squarewave signal which allows measurement around 0° and on unsymmetrical signals.



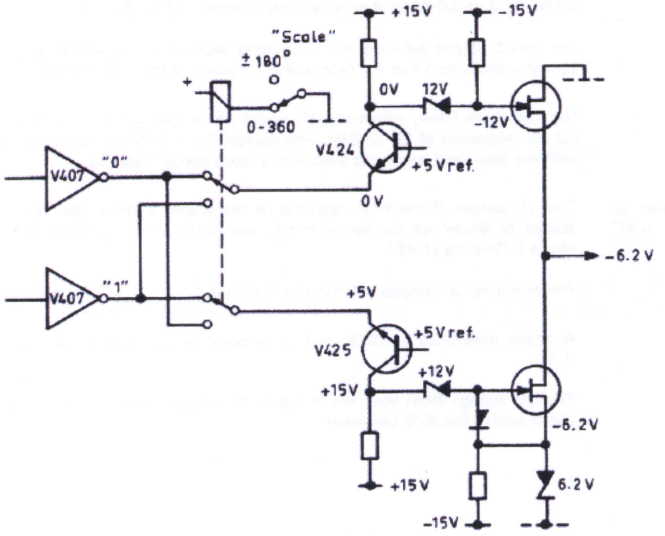
Principle of the "Output 360° and 0°" switches. Viewed in position "Output 360°".

The Ext. Equipment switch gives the possibility to use a delay line which can be necessary for acoustic measurements. In order to compensate for different delay times in the TTL circuits in channel A and B an adjustable one shot is built-in in channel B. The fixed one in channel A uses a pulse width of 200 ns.

The following one shot has a pulse width of 30 ns. This narrow pulse is necessary in order to avoid hazard problems, in the following Phase Differens Flip Flop, at measurement around 0°.

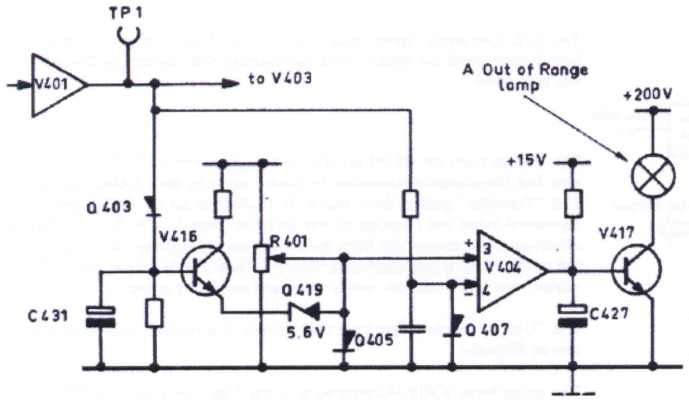
The calibration circuit 0°—360° can be used to calibrate the zero and the top level on a Level Recorder or a X-Y Recorder.

As can be seen on the shown diagram, the pulses cannot affect the switch circuit when "Output" is in position "360°" or "0°".



If the "Output 360°" is still activated and the "Scale" switch is in pos. "0—360°" the Chopper will work as can be seen.

The output from the chopper will be negative (—6,2 V) but the signal will be three times inverted (twice in the LP filter, once in the DC output ampl.) which gives a signal at the "DC Output" up to 3,6 V in "Degree" and 6,28 V in "Radian" depending of the pulse width.



The "Out of Range" circuit for channel A receives the signal from V401 output.

If the input voltage to this circuit is below 14,1 mV peak (10 mV RMS) the fixed voltage on V404 pin 3 (adjusted by R401 to 14,1 V peak) will cause a positive voltage on the output of V404, which in turn will switch transistor V417 on and "Out of Range" lamp will light up.

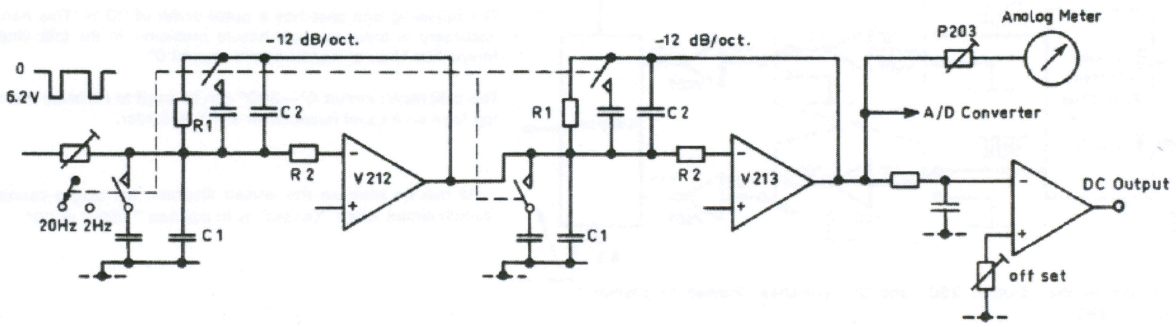
If the output signal of V401 increase above 14,1 V peak the output of V404 will change to a negative value. This will switch off the V417 and switch off the lamp as well.

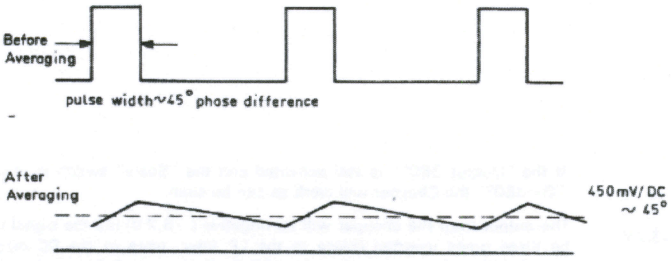
Due to the capacitor C427 the positive pulses on V404 output will not be able to switch on the lamp.

If the output signal of V401 increases to more than 7,2 V peak (5 V RMS) the transistor V416 will conduct. The voltage across the diode Q405 will be about 100 mV more positive than the voltage across Q407. This means that the output of V404 will be positive and the lamp will be switched on.

The above description is for the detector circuit for positive peaks. The circuit for the negative peaks is working in the same way except that the voltages have opposite polarity.

ZE 0130 Low Pass Filter and A/D Converter





The Low Pass Filter is made as a 4 pole Bessel filter with a cut off frequency of 2 or 20 Hz, and an amplitude decrease of 24 dB/oct.

The result of the filtering and averaging will be a DC voltage where 10 mV represents 1° or 1 V represents 1 Radian at the "DC Output".

The Low Pass Filter, which actualy works as an Averaging Circuit, has a cut off frequency of 20 or 2 Hz. The switch 20 — 2 Hz can be compared with the fast-slow averaging switch in a more simpel detector.

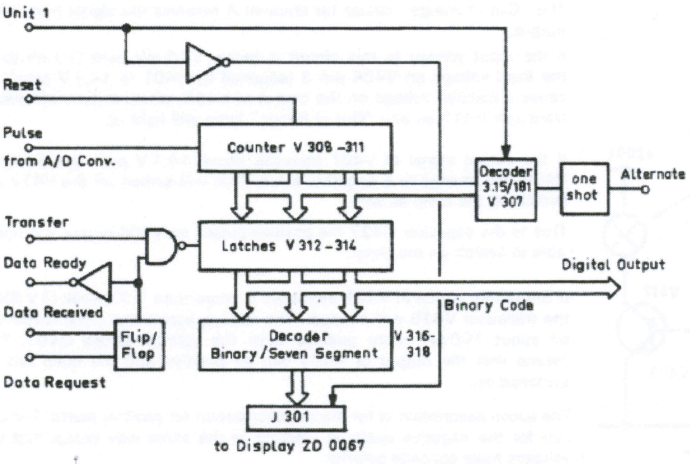
The DC output of the filter depends of the width of the pulses. For instance as shown on the figure at left, where the pulses correspond to a phase difference of 45°.

The resulting DC voltage will then be 450 mV.

A phase difference of 360° will correspond to an "output" voltage of 3,6 V.

The DC voltage from the filter is fed to the Analog meter, to the DC amplifier and to the A/D converter.

ZG 0088 Power Supply and Logic



The A/D Converter, which has a built-in clock generator, works on 24 V. Great care must be taken when measuring the voltage as the 24 V are not grounded.

The pulses from ZE 0130 are fed to the counters V308-311. The counters fed the signal information in binary code to the Latches V312-314. The "Transfer" pulses from the A/D Converter on ZE 0130 step the information from the Latches to the Decoder circuits V316-318. Here the information is converted from binary to seven segment information and fed to the Sperry gas discharge display. Then a pulse from the A/D Converter resets the counter and a new read out takes place.

The "Unit 1" information tells the counter if a readout should be in Radians or Degrees.

The pulse from V303 (Alternate) tells the Flip Flop circuit on ZK 0006, if the signal should be inverted in order to measure, using ± 180° ~ 3,14 as zero or not. The level change will take place at 181° and 3,15 rad.

2.1. Function check

a. DISPLAY UNIT: "Degree"
DISPLAY SCALE: "0—360"
FREQUENCY LIMIT UPPER: "2 kHz"
FREQUENCY LIMIT LOWER: " 20 Hz"
A RANGE: "10 mV—5 V"
A SLOPE: "+"
B RANGE: "10 mV—5 V"
B SLOPE: "+"

Input signal to "Input A" and "Input B": 1 V—1 kHz.
(The signals must be exactly in phase).

Check that the display reads + 360° or 0°.

b. A SLOPE: to "—"

Reading on the display: + 180°.

c. A SLOPE to "+"
B SLOPE to "—"

Reading on the display: + 180°.

d. DISPLAY UNIT to "Radian"

Reading on the display: + 3,14 rad.

If the instrument cannot fulfil the above mentioned specifications the following items must be checked:

e. DISPLAY UNIT to "Degree"

Remove the input signals.
Activate the "Output 360" push button.
The display should read 360.

Activate the "Output 0" push button.
The display should read 0.

If the above mentioned check can be done the fault must be on ZK 0006.
If the check cannot be done check as follows:

f.

Activate the "Output 360" push button.
The voltage on "DC Output" socket should be 3,6 V DC.
Activate the "Output 0" push button.
The voltage on "DC Output" socket should be 0 V DC.

If this can be done the fault must be on ZG 0088.

If not the fault must be on ZE 0130 or in the chopper and switching circuits on ZK 0006.

3.1. DC Voltages

Check the 200 V.

Check the ± 15 V on ZG 0088.
Tolerance: ± 0,6 V.

Check the + 5 V. Tolerance: ± 0,2 V.

Check the 24 V. Tolerance ± 0,02 V. If necessary adjust by means of P301.

Notice! The 24 V are not grounded and great care must be taken in order not to damage the A/D Converter.

3.2. Input Off-set

a. A RANGE: "10 mV—5 V"
B RANGE: "10 mV—5 V"

Apply a signal of 2,5 mV, 100 Hz to the inputs "A" and "B".

Adjust P405 (ZK 0006) for equal AC voltage in TP3, when changing "Slope A" from positive to negative and back.
Tolerance: ± 10 mV. (Voltage approx. 1,7 V).

b.

Repeat the adjustment for channel B using P406 and TP.4.

3.3. Out of Range

a. A RANGE: "10 mV—5 V"
B RANGE: "10 mV—5 V"

Input signal to the inputs "A" and "B" 10 mV, 100 Hz.

Turn the potentiometers P401, 402, 403 and 404 fully clockwise, viewed from the printed side.

Adjust P401 to a position just before the "A Out of Range" lamp switches on. Repeat using P402.

Repeat the adjustment using P403, P404 and the "B Out of Range" lamp.

b.

Connect an oscilloscope to TP 1.
Input signal to the inputs "A" and "B": 5 V.
Check that the "A Out of Range" lamp flashes within ± 0,5 V of this condition.

Check that the signal in TP 1 starts positive and negative limiting when increasing the input signal 1 — 2 dB.

Repeat item b using TP 2 and "B Out of Range" lamp.

3.4. Upper Frequency Limit

a. FREQUENCY LIMIT UPPER: "200 kHz"

Input signal to the inputs "A" and "B" 3,8 V, 40 kHz.
Connect an oscilloscope to the point C436, C438, C451.

FREQUENCY LIMIT UPPER: to "20 kHz"

Check on the oscilloscope that the signal decreases 6 dB.

b.

Input signal to the inputs "A and B": 3,8 V, 4 kHz.

FREQUENCY LIMIT UPPER: to "2 kHz"

Check that the signal decreases 6 dB on the oscilloscope.

Repeat item a and b for channel B using the point C437, C439, C452 as connection to the oscilloscope.

3.5. DC Output

a. DISPLAY UNIT: "Radian"

Connect a DC voltmeter to the "DC Output" socket.

Check if is possible to vary the voltage more than 1 V by means of the "Output Off-Set" potentiometer on the back of the instrument.

Turn the potentiometer to minimum output.

Activate the "Output 0°" push button.

Note the voltage on the output of V213.
Adjust P201 to the noted voltage with opposite sign on the "DC Output" socket.

Adjust the "Off set" potentiometer on ZE 0130 to exactly 0 V on "DC Output". (Activated "Output 0°").

Release "Output 0°" and activate "Output 360°").
Adjust P202 to 6,28 V on "DC Output".

Repeat the above mentioned adjustments as they influence each others.

b. DISPLAY UNIT: to "Degree"

Activate "Output 360°".
Adjust P206 to 3,60 V on "DC Output".

3.6. A/D Converter

a. DISPLAY UNIT: "Degree"

Activate "Output 0°".
Adjust P204 to the display, read 000°.
Release "Output 0°" and activate "Output 360°".
Adjust P205 to the display read 360°".

b. DISPLAY UNIT: to "Radian"

Activate "Output 360°".
Adjust P207 to the display read 6,28 rad.

Repeat item a and b as the adjustments influence each others.

3.7. Analog Meter

DISPLAY UNIT: "Degree"

Activate "Output 0°" and adjust to zero deflection on the Analog Meter.

Activate "Output 360°" and adjust to a deflection of 360° by means of P203.

3.8. Range

a. DISPLAY UNIT: "Degree"
A RANGE: "10 mV—5 V"
A SLOPE: "+"
B RANGE: "10 mV—5 V"
B SLOPE: "+"
DISPLAY SCALE: "0—360°"

Apply a signal of 15 kHz ± 10 Hz, 3,8 V to "Input A" via a 291,57 kΩ resistor, and directly to "Input B".

Adjust C446 for a display reading of 45°.

b. A RANGE: to "30 mV—15 V"
B SLOPE: to "—"

Connect "Input A" direct and "Input B" through the 291,57 kΩ resistor.

Adjust C449 for a display reading of 180°.

c. B SLOPE: to "+"

Connect "Input A" through the resistor and "Input B" directly.

Adjust C445 for a display reading of 45°.

d. DISPLAY SCALE: "± 180°"

Repeat item a, b and c using "Input B" as "Input A".

Adjust on the trimmers C448, C450 and C447.

3.9. Int. Delay

A SLOPE: "+"
B SLOPE: "—"
DISPLAY SCALE: "± 180°"

Input signal to the Input "A" and "B" 200 kHz 3,8 V.
Turn P407 fully clockwise.

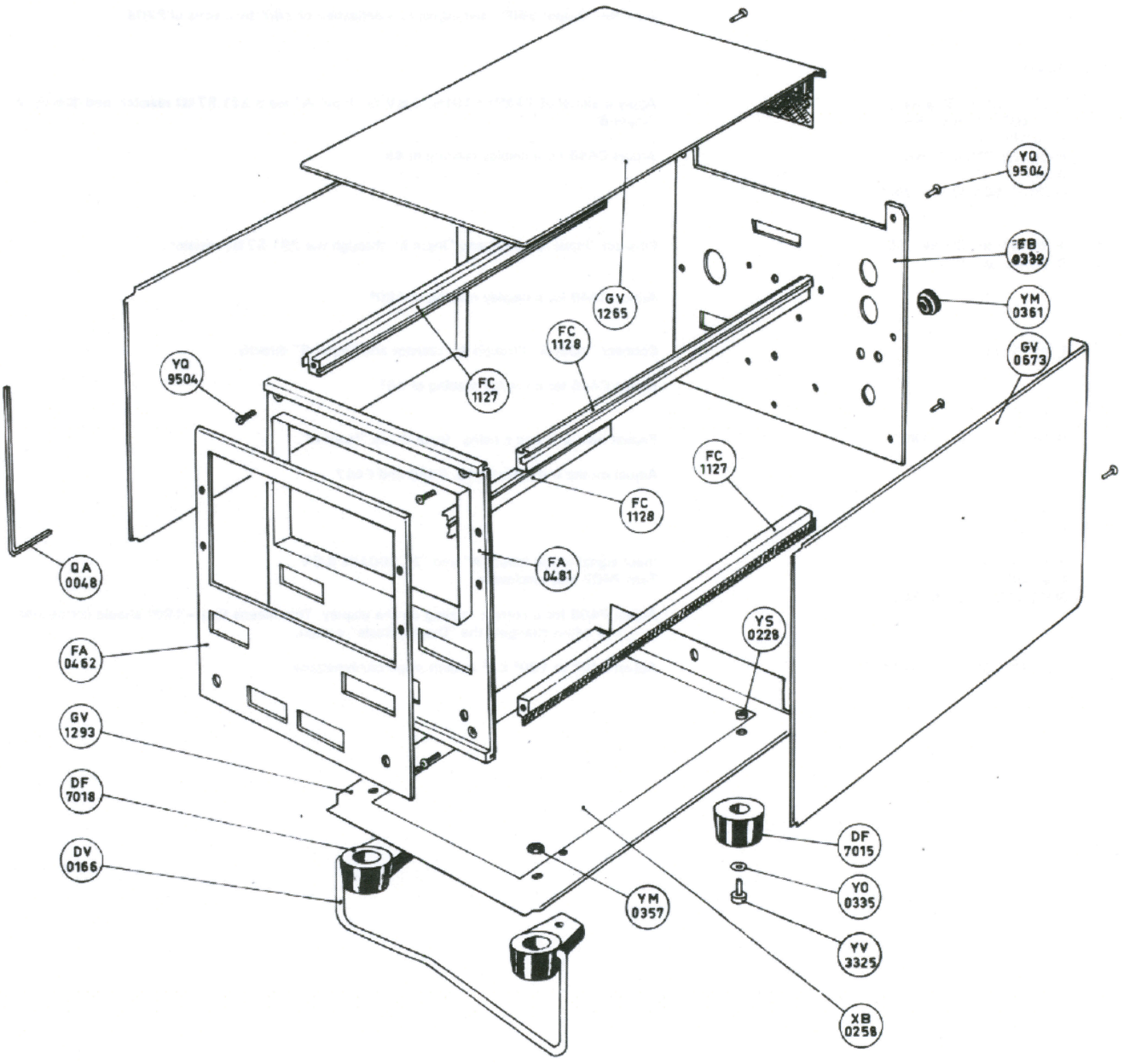
Adjust P408 for a correct reading on the display. This means that + 189° should correspond to —171 when changing the "Display Scale" switch.

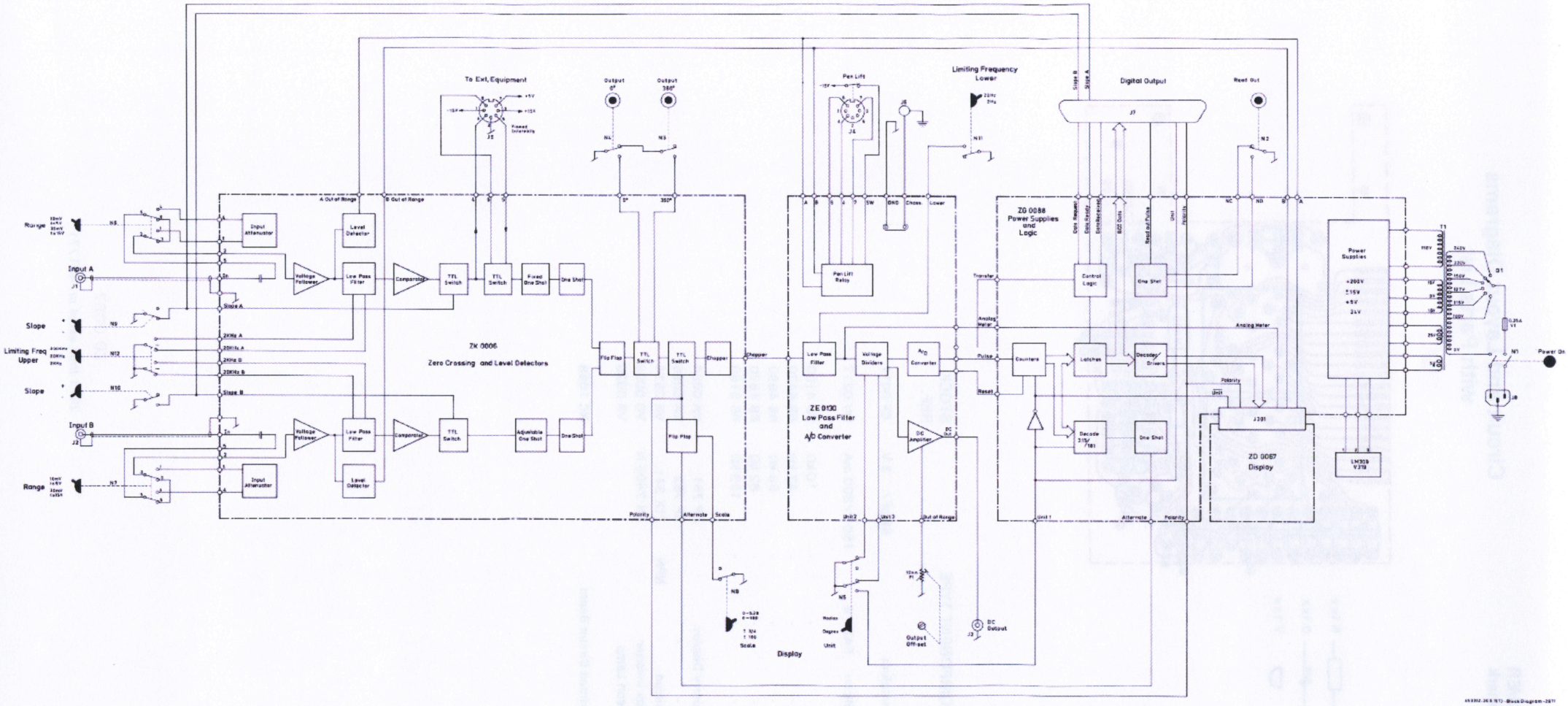
DISPLAY SCALE: to "0—360°"

Adjust P407 to 180° ± 2° in both slope combinations.

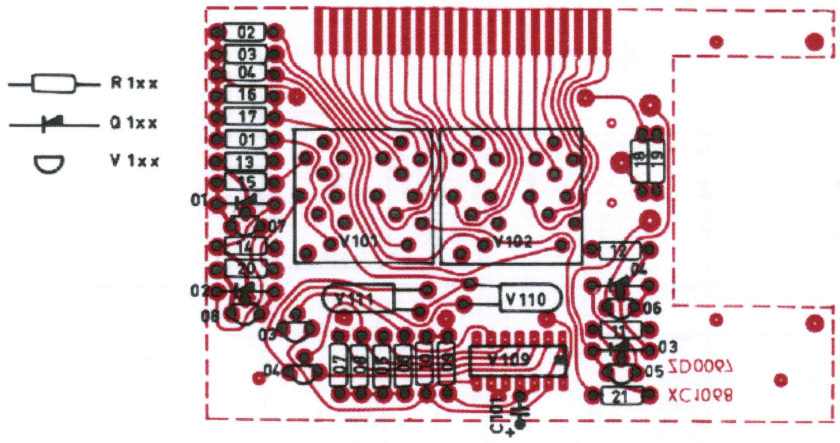
CIRCUIT DIAGRAM REF.	COMPONENT TYPE	STOCK REF.
	Power Cord. EUR	AN 0010
I 101	Analog Meter	IM 0057
J 1-3	BNC socket	JJ 0130
J 4	"Pen Lift" socket	JJ 0716
J 5	"Ext. Equipment" socket	JJ 0709
J 6	Banana socket	JT 6204
J 7	25 pin multi socket	JJ 2500
J 8	Mains socket	OA 0037
N 1	"Power" switch	NN 0036
N 2-4	Micro switch	NT 0029
N 5-7	Selector	NN 0049
N 8-11	-	NN 0045
N 12	-	NN 0046

CIRCUIT DIAGRAM REF.	COMPONENT TYPE	STOCK REF.
O 1	Power Voltage Selector	JS 0001
P 1	"Output Off-set" 10 kΩ	PG 3115
T 1	Mains Transformer	TN 0082
V 1	Fuse 0,25 A	UF 0031
V 319	Power Reg. LM 309 k	VE 0022
	Circuit Boards with Components:	
	Display	ZD 0067
	Low Pass Filter and A/D Converter	ZE 0130
	Power Supplies and Logic	ZG 0088
	Zero Crossing and Level Detectors	ZK 0006

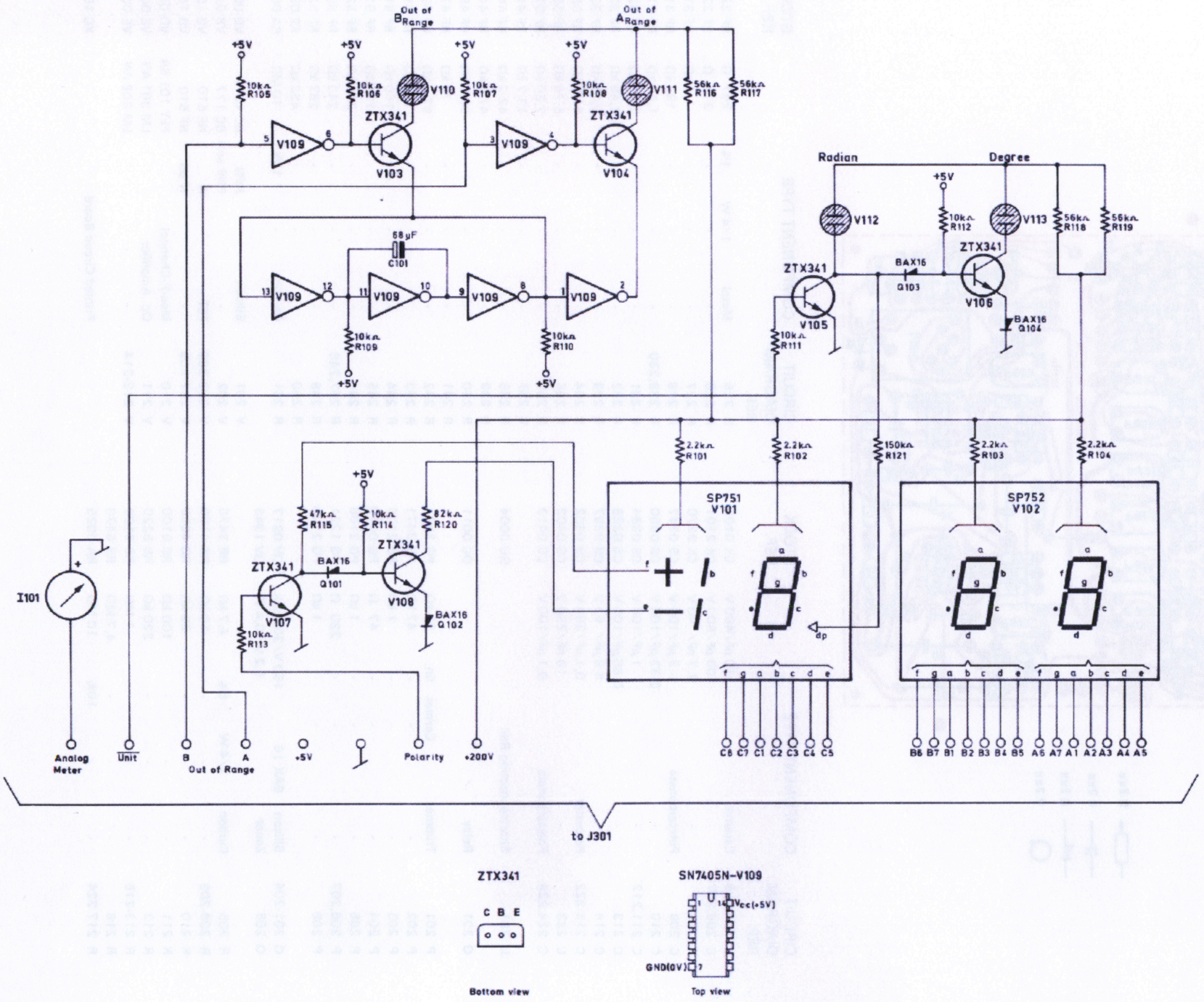



To Ext. Equipment
Output 0°
Output 360°
Pen Lift
Limiting Frequency Lower
Digital Output
Reset Out
Range
Input A
Slope
Limiting Freq Upper
Slope
Input B
Range
Input Attenuator
Level Detector
Voltage Follower
Low Pass Filter
Comparator
TTL Switch
Fixed One Shot
One Shot
Adjustable One Shot
Flip Flop
Chopper
ZK 0006
Zero Crossing and Level Detectors
Pen Lift Relay
ZG 0088
Power Supplies and Logic
Control Logic
Power Supplies
ZE 0130
Low Pass Filter and A/D Converter
Voltage Dividers
A/D Converter
DC Amplifier
Counters
Latches
Decoder Drivers
Decade 315/783
ZD 0067
Display
LM309 V378
Transfer
Analog Meter
Pulse
Reset
Polarity
Unit
Alternate
Scale
Out of Range
Power On
DC Output
Output Off-set

Circuit and Layout Diagrams with Parts List



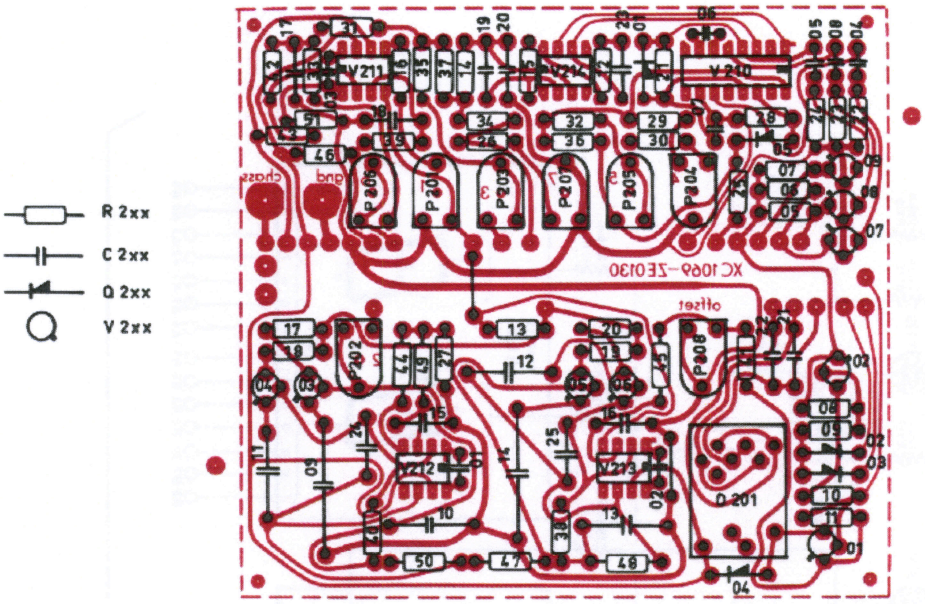
CIRCUIT DIAGRAM REF.	COMPONENT TYPE			STOCK REF.
C 101	Tantalum		68 µF/ 3 V	CF 0011
Q 101-104	Silicon	BAX 16	150 V/300 mA	QV 0217
R 105-114	-	- -	10 kΩ	RB 4100
R 115	-	- -	47 kΩ	RB 4470
R 116-119	-	- -	56 kΩ	RB 4560
R 120	-	- -	82 kΩ	RB 4820
R 121	-	- -	150 kΩ	RB 5150
V 101	Sperry Display		SP 751	VA 0094
V 102	-	-	SP 752	VA 0095
V 103-108	Silicon	NPN	ZTX 341	VB 0514
V 109	Hex Inverter		SN 7405 N	VD 0005
V 110-113	Neon Lamp			VS 0030
	Printed Circuit Board			XC 1068


Out of B Range
Out of A Range
+5V
10kΩ R105
10kΩ R106
10kΩ R107
10kΩ R108
56kΩ R116
56kΩ R117
V110
V111
ZTX341
V103
V104
V109
68µF C101
10kΩ R109
10kΩ R110
Radian
Degree
V112
V113
10kΩ R112
56kΩ R118
56kΩ R119
BAX16 Q103
V106
V105
BAX16 Q104
10kΩ R111
2.2kΩ R101
2.2kΩ R102
150kΩ R121
2.2kΩ R103
2.2kΩ R104
SP751 V101
SP752 V102
47kΩ R115
10kΩ R114
82kΩ R120
BAX16 Q101
V107
V108
BAX16 Q102
10kΩ R113
I101
Analog Meter
Unit
B
Out of Range
A
+5V
Polarity
+200V
C8 C7 C1 C2 C3 C4 C5
B6 B7 B1 B2 B3 B4 B5 A6 A7 A1 A2 A3 A4 A5
to J301
ZTX341
C B E
Bottom view
SN7405N-V109
GND(0V)
Vcc(+5V)
Top view
453312-13.9.1973-ZD0067-2971

Circuit and Layout Diagrams with Parts List

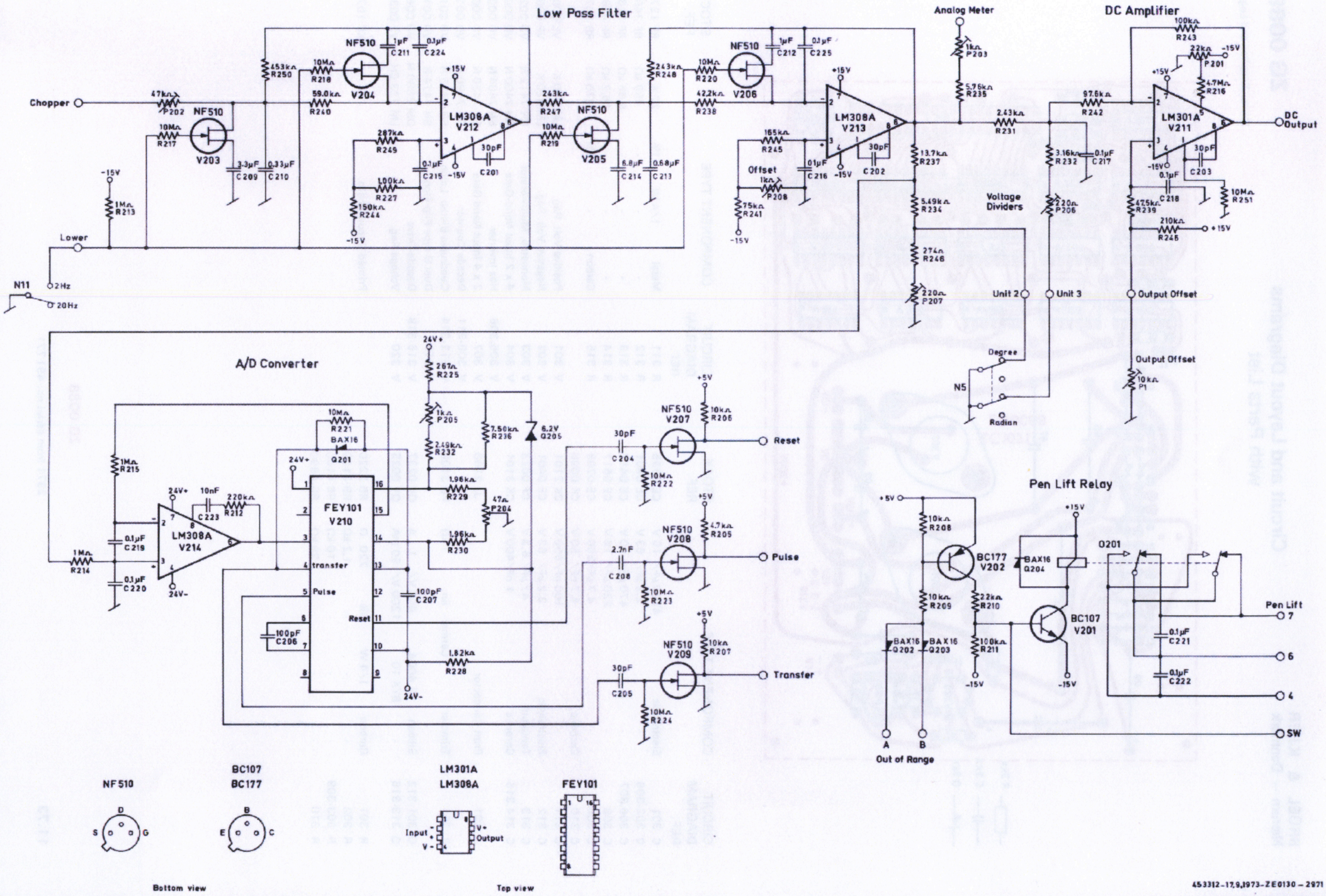
ZE 0130

Low Pass Filter and A/D Converter

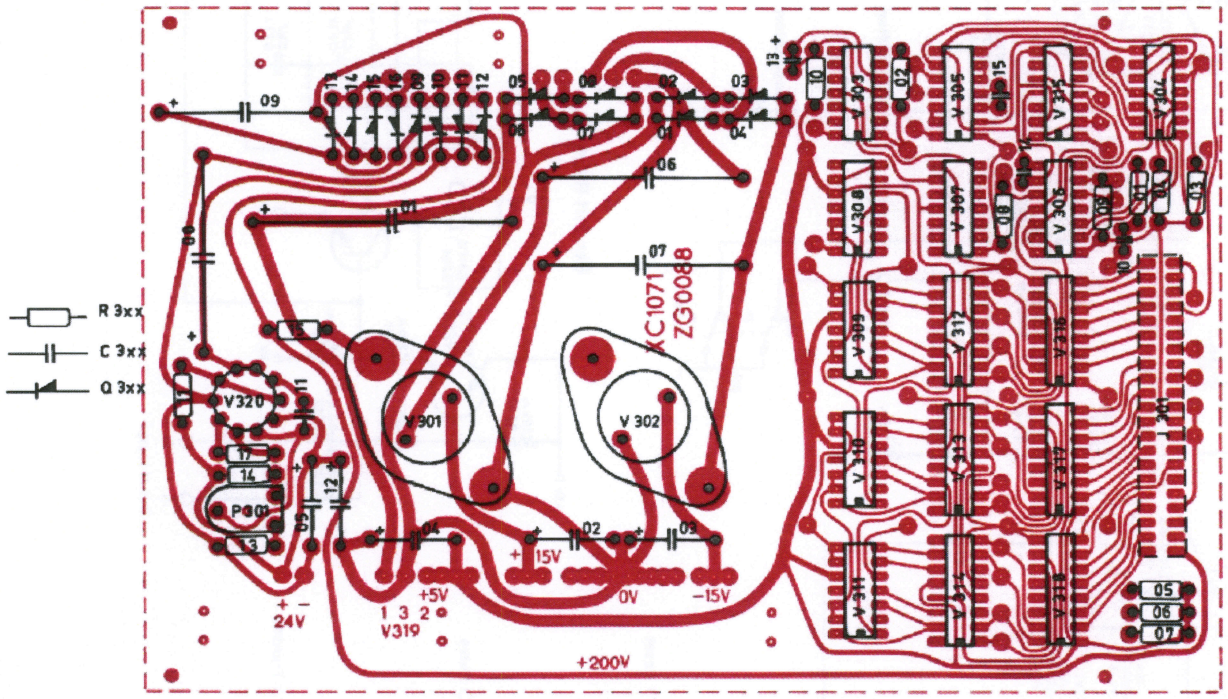


CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
C 201-295	Ceramic			30 pF/400 V	CK 0105
C 206,207	-			100 pF/500 V	CK 2101
C 208	-			2,7 nF/ 40 V	CK 3270
C 209	Polycarbonate			3,3 µF/100 V	CS 0347
C 210	-			0,33 µF/100 V	CS 0350
C 211,212	-			1 µF/100 V	CS 0384
C 213	-			0,68 µF/100 V	CS 0388
C 214	-			6,8 µF/ 63 V	CS 0397
C 215-222	Polyester			0,1 µF/250 V	CS 0402
C 223	-			10 nF/250 V	CS 0403
C 224,225	Polycarbonate			0,1 µF/100 V	CS 0413
L 201	Shortconnecting Rail				GU 0004
O 201	Relay				OC 0011
P 201	Trimmer	Cermet	lin.	22 kΩ	PG 3221
P 202	-	-	-	47 kΩ	PG 3471
P 203	-	-	-	1 kΩ	PG 2108
P 204	-	-	-	47 Ω	PG 0470
P 205	-	-	-	1 kΩ	PG 2108
P 206,207	-	-	-	220 Ω	PG 1221
P 208	-	-	-	1 kΩ	PG 2108
Q 201-204	Silicon	BAX 16		150 V/300 mA	QV 0217
Q 205	Zener			6,2 V/ 0,4 W	QV 1346
R 205	Carbon	1/4 W	5%	4,7 kΩ	RB 3470
R 206-209	-	-	-	10 kΩ	RB 4100
R 210	-	-	-	22 kΩ	RB 4220
R 211	-	-	-	100 kΩ	RB 5100
R 212	-	-	-	220 kΩ	RB 5220
R 213-215	-	-	-	1 MΩ	RB 6100
R 216	-	-	-	4,7 MΩ	RB 6470
R 217-224	-	-	10%	10 MΩ	RA 0025

CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
R 225	Metal	1/4 W	1%	267 Ω	RF 2267
R 226	-	-	-	274 Ω	RF 2274
R 227	-	-	-	1 kΩ	RF 3100
R 228	-	-	-	182 kΩ	RF 3182
R 229,230	-	-	-	1,96 kΩ	RF 3196
R 231	-	-	-	2,43 kΩ	RF 3243
R 232	-	-	-	2,49 kΩ	RF 3249
R 233	-	-	-	3,16 kΩ	RF 3316
R 234	-	-	-	5,49 kΩ	RF 3549
R 235	-	-	-	5,76 kΩ	RF 3576
R 236	-	-	-	7,50 kΩ	RF 3750
R 237	-	-	-	13,7 kΩ	RF 4137
R 238	-	-	-	42,2 kΩ	RF 4422
R 239	-	-	-	47,5 kΩ	RF 4475
R 240	-	-	-	59,0 kΩ	RF 4590
R 241	-	-	-	75 kΩ	RF 4750
R 242	-	-	-	97,6 kΩ	RF 4976
R 243	-	-	-	100 kΩ	RF 5100
R 244	-	-	-	150 kΩ	RF 5150
R 245	-	-	-	165 kΩ	RF 5165
R 246	-	-	-	210 kΩ	RF 5210
R 247,248	-	-	-	243 kΩ	RF 5243
R 249	-	-	-	287 kΩ	RF 5287
R 250	-	-	-	453 kΩ	RF 0272
R 251	Carbon	-	10%	10 MΩ	RA 0025
V 201	Silicon		NPN	BC 107	VB 0032
V 202	-		PNP selc	BC 177	VB 0104
V 203-206	FET		N	NF 510	VB 1021
V 207-209	-		N sel.	NF 510	VB 1059
V 210	Mos-P-Channel			FEY 101 BA	VD 0063
V 211	Op. Amplifier			LM 301 AN	VE 0017
V 212-214	-	-		LM 308 AN	VE 0046
	Printed Circuit Board				XC 1069

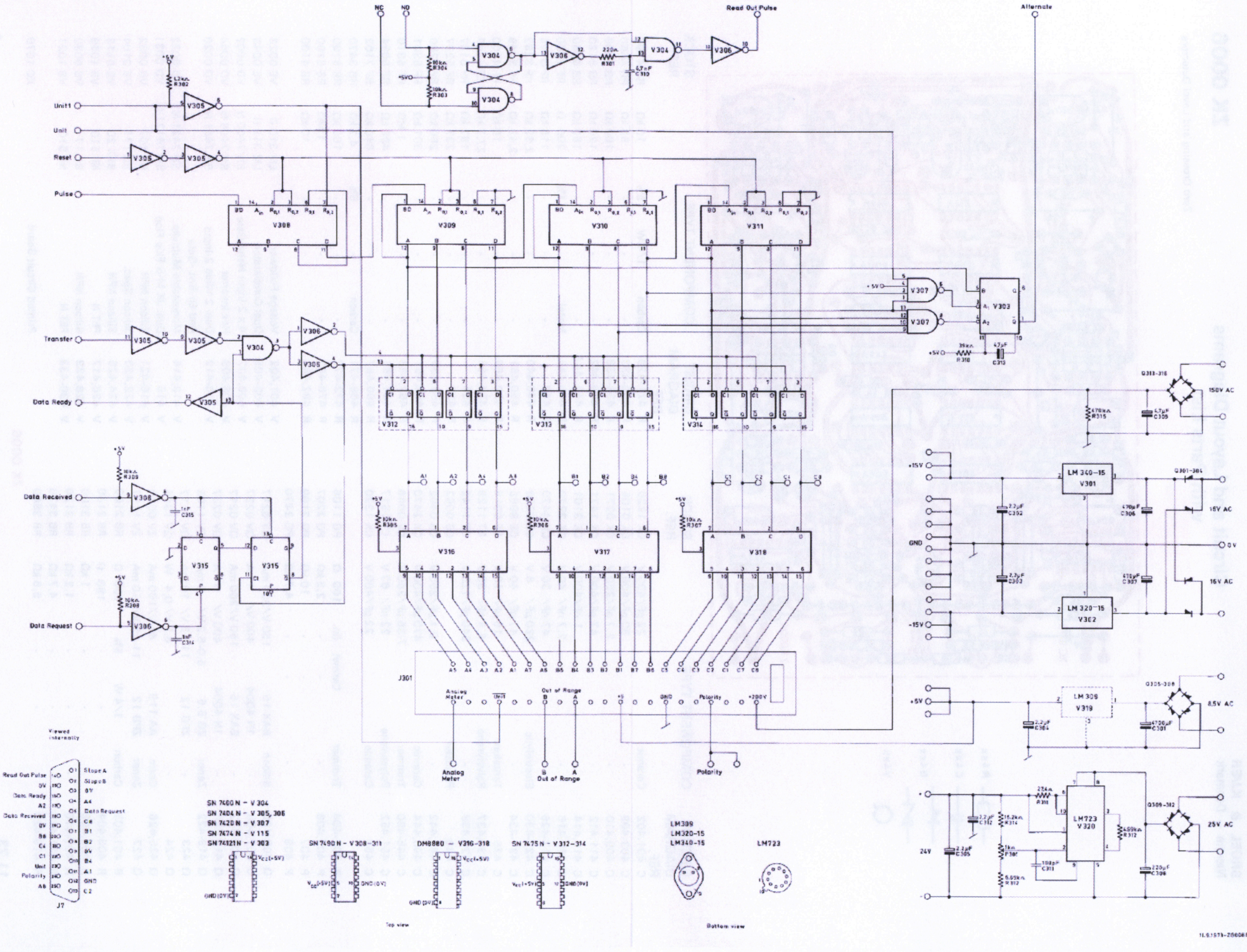

Low Pass Filter
Analog Meter
DC Amplifier
Chopper
Lower
N11
0.2Hz
20Hz
NF510
V203
V204
V205
V206
LM308A
V212
LM308A
V213
LM301A
V211
Offset
Voltage Dividers
Unit 2
Unit 3
Output Offset
Degree
Radian
N5
DC Output
A/D Converter
FEY101
V210
LM308A
V214
transfer
Pulse
Reset
24V+
24V-
NF510
V207
NF510
V208
NF510
V209
Reset
Pulse
Transfer
Pen Lift Relay
BC177
V202
BC107
V201
BAX16
Q204
Q201
BAX16
Q202
BAX16
Q203
Pen Lift
Out of Range
NF510
BC107
BC177
LM301A
LM308A
FEY101
Bottom view
Top view
453312-17.9.1973-ZE0130-2971

Circuit and Layout Diagrams with Parts List



CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
C 301	Electrolytic			4700 µF/ 16 V	CE 0335
C 302-306	-			2,2 µF/ 63 V	CE 0401
C 306,307	-			470 µF/ 40 V	CE 0417
C 308	-			220 µF/ 16 V	CE 0617
C 309	-			4,7 µF/350 V	CE 0708
C 310	Ceramic			4,7 nF/ 50 V	CK 0096
C 311	-			100 pF/500 V	CK 2101
C 312	Electrolytic			2,2 µF/ 63 V	CE 0401
C 313	Tantalum			47 µF/ 6,3 V	CF 0023
C 314,315	Ceramic			1 nF/400 V	CK 3101
J 301	Print Connector				JJ 2100
P 301	Trimmer		Cermet	lin. 1 kΩ	PG 2108
Q 301-312	Silicon	1N 4004		400 V/ 1 A	QV 0237
Q 313-316	-	BYX 10		1200 V/150 mA	QV 0025
R 301	Carbon	1/4 W	5%	220 Ω	RB 2220
R 302	-	-	-	1,2 kΩ	RB 3120
R 303-309	-	-	-	10 kΩ	RB 4100
R 310	-	-	-	39 kΩ	RB 4390

CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
R 311	Metal	1/4 W	1%	27,4 Ω	RF 1274
R 312	-	-	-	499 kΩ	RF 3499
R 313	-	-	-	6,65 kΩ	RF 3665
R 314	-	-	-	16,2 kΩ	RF 4162
R 315	Carbon	-	5%	470 kΩ	RB 5470
V 301	Positive Volt. Reg.			LM 340 K	VE 0056
V 302	Negative Volt. Reg.			LM 320 K	VE 0055
V 303	Monostab. Multivibrator			SN 7412 N	VD 0022
V 304	4 x 2 Input Nand-Gate			SN 7400 N	VD 0002
V 305,306	Hex Inverter			SN 7404 N	VD 0004
V 307	2 x 4 Input Nand Gate			SN 7420 N	VD 0007
V 308-311	Decade Counter			SN 7490 N	VD 0013
V 312-314	Quadruple Bistab. Latch			SN 7475 N	VD 0015
V 315	Dual D-type Flip-Flop			SN 7474 N	VD 0018
V 316-318	Decode-Drive			DM 8880 N	VD 0060
V 320	Voltage Reg.			LM 723 CH	VE 0039
	Printed Circuit Board				XC 1071

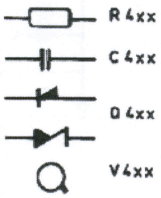

NC
ND
Read Out Pulse
Alternate
Unit1
Unit
Reset
Pulse
Transfer
Data Ready
Data Received
Data Request
V304
V305
V306
V307
V308
V309
V310
V311
V312
V313
V314
V315
V316
V317
V318
V303
LM 340–15 V301
LM 320–15 V302
LM 309 V319
LM723 V320
J301
J7
Analog Meter
Unit
Out of Range B
Out of Range A
+5
GND
Polarity
+200V
+15V
-15V
+5V
24V
0V
15V AC
16V AC
150V AC
8,5V AC
25V AC
Viewed internally
Read Out Pulse
0V
Data Ready
A2
Data Received
0V
B8
C4
C1
Unit
Polarity
A8
Slope A
Slope B
0V
A4
Data Request
C8
B1
B2
B4
A1
GND
C2
SN 7400 N – V 304
SN 7404 N – V 305, 306
SN 7420 N – V 307
SN 7474 N – V 115
SN 74121 N – V 303
SN 7490 N – V 308–311
DM8880 – V 316–318
SN 7475 N – V 312–314
LM309
LM320–15
LM340–15
LM723
Top view
Bottom view

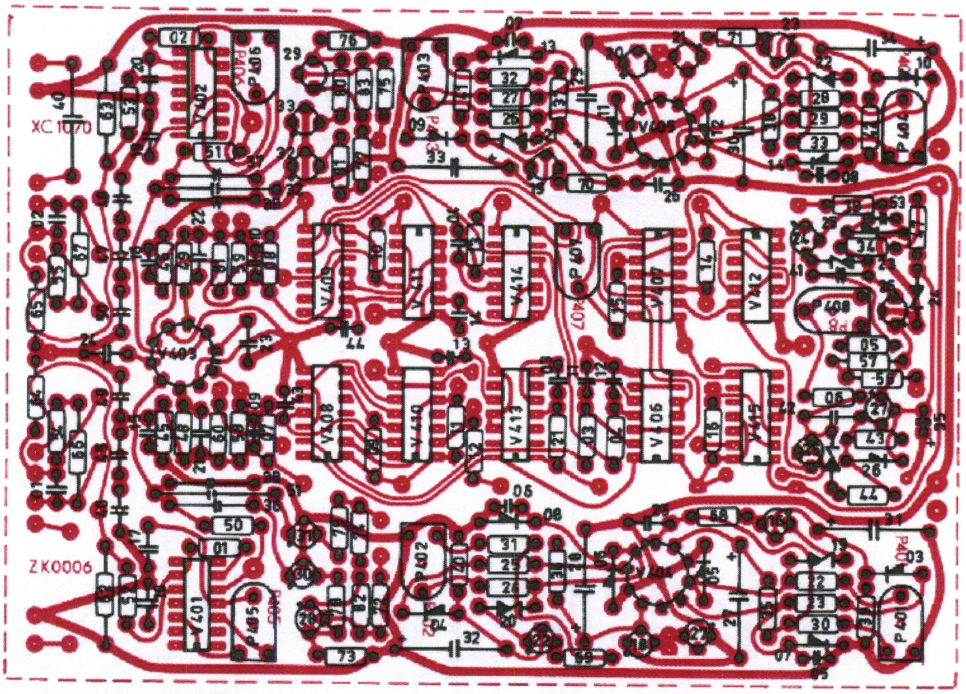
BRÜEL & KJÆR
Nærum – Denmark

Circuit and Layout Diagrams with Parts List

ZK 0006

Zero Crossing and Level Detectors



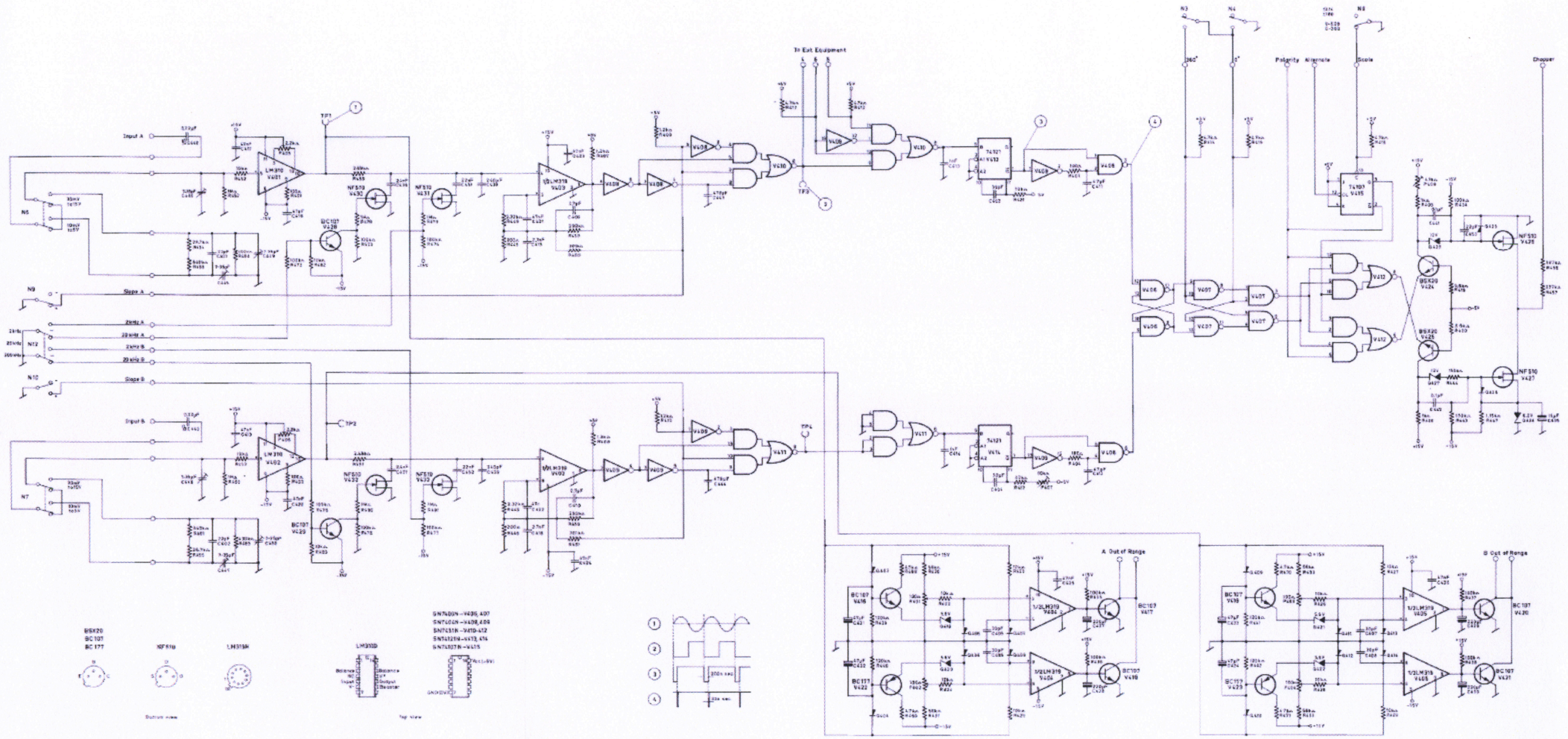


CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
C 401,402	Ceramic			22 pF/400 V	CK 1220
C 403-408	-			30 pF/400 V	CK 0105
C 409,410	-			2,7 pF/250 V	CK 0271
C 411,412	-			47 pF/400 V	CK 1471
C 413,414	-			1 nF/400 V	CK 3101
C 415,416	-			2,7 nF/ 40 V	CK 3270
C 417-426	-			47 nF/ 30 V	CK 4470
C 427-430	Electrolytic			220 µF/ 6 V	CE 0208
C 431-434	-			47 µF/ 40 V	CE 8965
C 435	Tantalum			15 µF/ 10 V	CF 0016
C 436,437	Polystyrene			2,4 nF/ 63 V	CT 1129
C 438,439	-			240 pF/125 V	CT 1142
C 440	Polyester				CS 0062
C 441,442	-			0,1 µF/250 V	CS 0402
C 443,444	Ceramic			470 pF/400 V	CK 2470
C 445-450	Trimmer			7-35 pF/250 V	CV 0046
C 451,452	Polystyrene			22 nF/ 63 V	CT 1517
C 453	Ceramic			22 pF/400 V	CK 1220
P 401-404	Trimmer	Cermet	lin.	100 Ω	PG 1105
P 405,406	-	-	-	2,2 kΩ	PG 2207
P 407	-	-	-	10 kΩ	PG 3109
P 408	-	-	-	4,7 kΩ	PG 2470
Q 403-406	Silicon	BAX 16		150 V/300 mA	QV 0217
Q 407,408	-	1N 4004		400 V/ 1 A	QV 0237
Q 409-412	-	BAX 16		150 V/300 mA	QV 0217
Q 413,414	-	1N 4004		400 V/ 1 A	QV 0237
Q 419-422	Zener	ZG 5,6		5,0-6,2 V/ 5 mA	ZV 1105
Q 423	-	ZPD 12		11-13 V/ 10 mA	QV 1117
Q 424	-			6,2 V/ 0,4 W	QV 1346
Q 425,426	Germ.	AA 119		45 V/100 mA	ZV 0079
Q 427	Zener	ZPD 12		11-13 V/ 10 mA	ZV 1117
R 401,402	Carbon	1/4 W	5%	100 Ω	RB 2100
R 403,404	-	-	-	180 Ω	RB 2180
R 405,406	-	-	-	1 kΩ	RB 3100
R 407-410	-	-	-	1,2 kΩ	RB 3120
R 411-416	-	-	-	4,7 kΩ	RB 3470
R 419-420	-	-	-	5,6 kΩ	RB 3560

CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
R 421-429	Carbon	1/4 W	5%	10 kΩ	RB 4100
R 430-433	-	-	-	56 kΩ	RB 4560
R 434-438	-	-	-	100 kΩ	RB 5100
R 439-442	-	-	-	120 kΩ	RB 5120
R 443, 444	-	-	-	150 kΩ	RB 5150
R 445,446	Metal	-	1%	200 Ω	RF 2200
R 447	-	-	-	115 kΩ	RF 3115
R 448,449	-	-	-	2,32 kΩ	RF 3232
R 450,451	-	-	-	2,49 kΩ	RF 3249
R 452,453	-	-	-	10 kΩ	RF 4100
R 454,455	-	-	-	27,7 kΩ	RF 4267
R 456	-	-	-	187 kΩ	RF 5187
R 457	-	-	-	237 kΩ	RF 5237
R 458,459	-	-	-	280 kΩ	RF 5280
R 460,461	-	-	-	301 kΩ	RF 5301
R 462,463	-	-	-	1 MΩ	RF 6010
R 464,465	-	-	-	499 kΩ	RF 6034
R 466,467	-	-	-	640 kΩ	RF 7102
R 468-471	Carbon	-	5%	4,7 kΩ	RB 3470
R 472-477	-	-	-	100 kΩ	RB 5100
R 478-481	-	-	-	1 MΩ	RB 6100
R 482,483	-	-	-	10 kΩ	RB 4100
V 401,402	Voltage Follower			LM 310 D	VE 0023
V 403-405	Dual Comparator			LM 319 H	VE 0049
V 406,407	4 x 2 Input Nand Gate			SN 7400 N	VD 0002
V 408,409	Hex Inverter			SN 7404 N	VD 0004
V 410-412	Dual 2 Wide 2-Input And-Or-Invt.-Gate			SN 7451 N	VD 0020
V 413,414	Monostable Multivibr.			SN 7421 N	VD 0022
V 415	Dual JK M-S Flip Flop			SN 74121 N	VD 0031
V 416-421	Silicon NPN			BC 107	VB 0032
V 422,423	Silicon Spec.			BC 177	VB 0104
V 424,425	Silicon NPN			BSX 20	VB 0513
V 426,417	FET N			NF 510	VB 1059
V 428,429	Silicon NPN			BC 177	VB 0032
V 430-433	FET N			NF 510	VB 1021
	Printed Circuit Board				XC 1070

ZK 0006

2971 from serial nr. 491771


To Ext Equipment
Input A
Input B
Slope A
Slope B
2kHz A
20kHz A
2kHz B
20kHz B
Polarity
Alternate
Scale
Chopper
A Out of Range
B Out of Range
BSX20
BC 107
BC 177
NF 610
LM 319 N
LM 393 D
SN 74 00 N – V 405, 407
SN 74 04 N – V 408, 409
SN 74 51 N – V 410-412
SN 74 121 N – V 413, 414
SN 74 H 21 N – V 415