

Technical Manual  
DOPPLER RADAR ANTENNA DRS-2  
for MULTANOVA RADAR 6F

## C O N T E N T S

1. TECHNICAL DATA
2. MICROWAVE MODULE
3. LOW NOISE PREAMPLIFIER
4. SECOND PREAMPLIFIER

### APPENDIX

- Circuit diagrams
- Component layout diagrams

## 1. Technical Data

Transmission frequency	34.3 GHz +/- 100 MHz
Power radiated from antenna	500 mW EIRP max.
Half-power beamwidth vertical	approx. 5°
horizontal	approx. 5°
Side-lobe suppression	better than 20 dB
Antenna gain relative to isotropic radiator	30 dB max.
Measuring angle relative to direction of traffic	22°
Angle of measuring beam	Can be set as required. The spatial measuring angle of 22° is always preserved
Measuring range	30 to 250 km/h
Measuring distance	max. 40 m approx. (corresponds to lateral distance of 15 m)

## 2. Microwave module

A Gunn diode is placed in a resonant cavity to generate a microwave power in the Ka-band. The frequency of the power coupled out by an iris diaphragm is 34.3 GHz.

The supply voltage for the Gunn diode is provided by printed circuit 238,423-00100, which is equipped with a voltage regulator LM 317T. This series regulator converts the voltage of 8 V from the control unit to that required by the Gunn diode.

A further printed circuit 238,424-00100 contains an RC-network and a zener diode in parallel with the Gunn diode. These components are provided to prevent oscillations in the supply voltage to the Gunn diode.

Part of the oscillator output is coupled out of the resonator by an iris diaphragm, fed via the mixer block and radiated from a parabolic antenna. A small fraction of the transmitted power is absorbed by the mixer diodes and serves as reference signal (LO).

The signal reflected from the vehicle being measured and collected by the antenna is fed to the mixer diodes where it is mixed with the reference signal (LO). The resulting difference frequency is proportional to the speed of the vehicle moving within the antenna beam (Doppler frequency).

The two mixer diodes are mounted in the waveguide in such a way that the amplitudes of the two Doppler signals generated are approximately the same.

The position of the two diodes is selected so that the direction of motion of the vehicles detected can be reliably determined from the phase relationship of the two Doppler signals. The absolute value of the displacement is approx. 90°. The direction of motion of the measured vehicle is given by the sign of the phase shift (+90° or -90°).

### 3. Low noise preamplifier (238,421-00100)

The Doppler signals originating from the microwave diodes are amplified in separate initial amplifier stages. The integrated circuit LM281A used for this purpose has 2 amplifiers and has excellent noise characteristics. In order to generate as little noise as possible in the first stage, the circuit has the following characteristics:

- a) The inverting input is not used for negative feedback, but is taken to earth. This prevents unnecessary additional noise from the internal transistor at the inverting input.
- b) The noise in the first stage is reduced to a minimum by optimising the collector current of the first transistor. This collector current flows through resistors R5 and R6 or R13 and R14 respectively. According to data from the manufacturer this current must be approx. 160  $\mu$ A.

The typical input noise voltage is approx. 0.4  $\mu$ V<sub>rms</sub> for the Doppler frequency range of 1700 Hz to 16 kHz used.

The negative feedback of the amplifier is made at the emitter of the first transistor. Resistors R4 and R7 or R12 and R15 ensure a stable working point (DC negative feedback) for the circuit. The AC voltage gain of 100 (40 dB) is set with network R4, R7, R1 and C1 or in the lower channel with R12, R15, R9 and C8. Capacitor C1 or C8 is selected sufficiently large not to attenuate the lowest cut-off frequency of the overall amplifier chain.

Signals of approx. 30  $\mu$ V<sub>pp</sub> can appear at the input and be processed by the unit. This high input sensitivity results in special precautionary measures when feeding from an external generator instead of the microwave unit. In order to avoid earth currents through the ground conductors of the preamplifier, the signal from an external generator should only be fed in with an additional small transformer and an attenuator of 1000:1.

#### 4. Second preamplifier stage (238,422-00100)

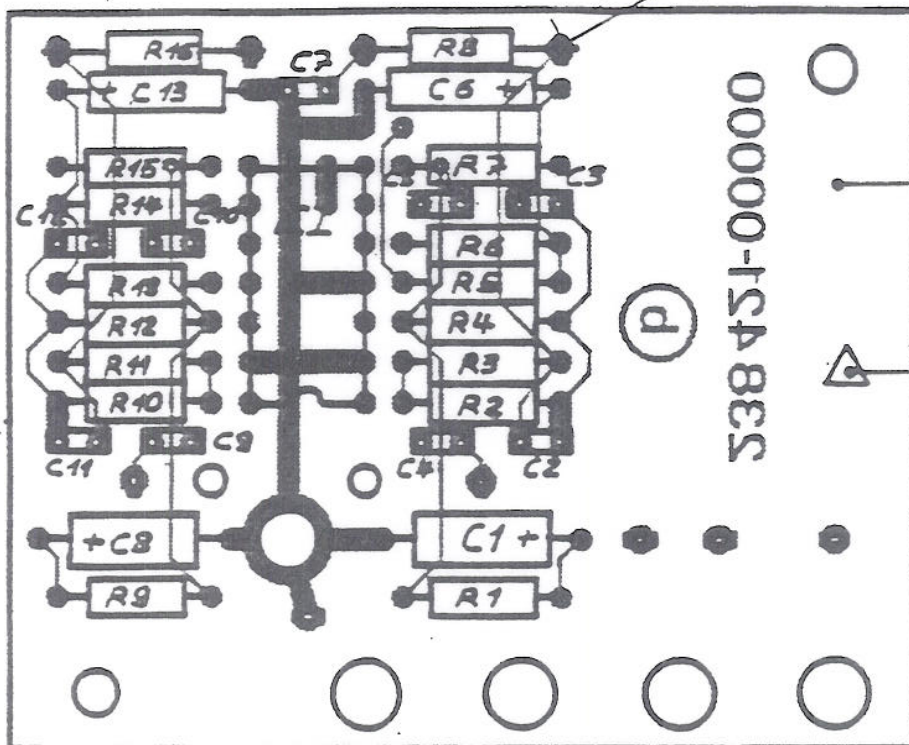
The two Doppler signals are further amplified 36-times (31 dB) in further separate amplifiers IC 1. The bandwidth of IC 1 is so large that only little attenuation takes place at the upper cut-off frequency of 16 kHz.

The integrated circuit IC 2 contains 4 amplifiers. The signal is converted in each of the two channels to 2 signals mutually displaced by  $180^\circ$  and fed to the control unit via outputs +I and -I or +II and -II via a balanced line. The advantage of a balanced line is its low sensitivity to common mode interference. The upper amplifier is the non-inverting, the lower the inverting amplifier in each case for generating the phase shift of  $180^\circ$ . The gain of each of these stages is 1.

When the response level of the unit is just reached the signal at output IC 2 is approx. 0.1 V<sub>pp</sub> with respect to earth. (Sensitivity at remote position.) The antenna can process a signal without distortion which is 280 times greater than the response level of the unit.



die dem Empfänger persönlich anvertraut und verbietet jeder, dass unsere Firma, ohne unsere schriftliche Genehmigung, diesen aus nicht kopiert oder vervielfältigt auch jemandem dritten Personen mitgeteilt oder zugänglich gemacht werden.



238421-00000

22-07097

beidseitig

both sides

GND

Kanal I

Kanal I

+15V

channel II

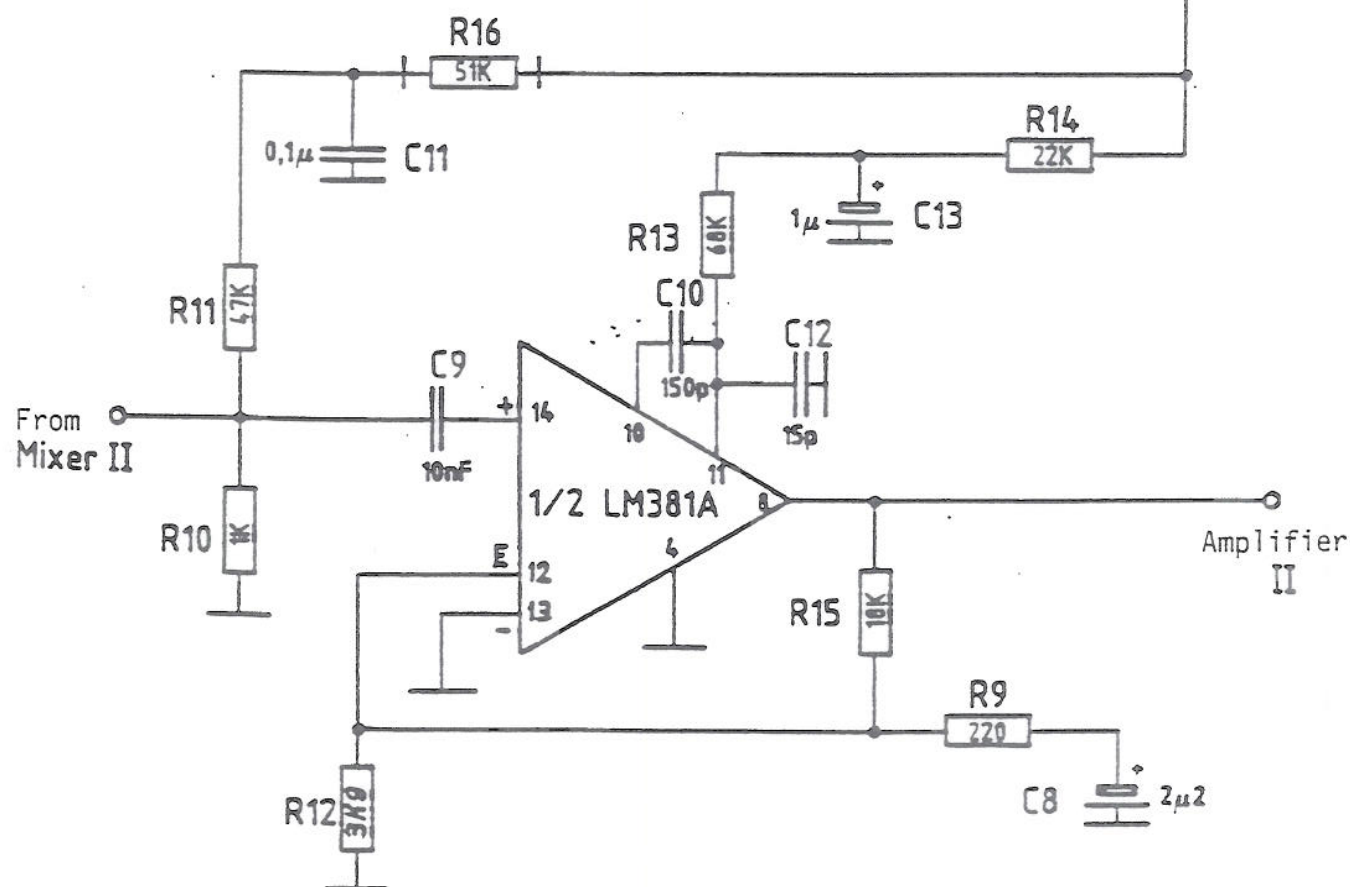
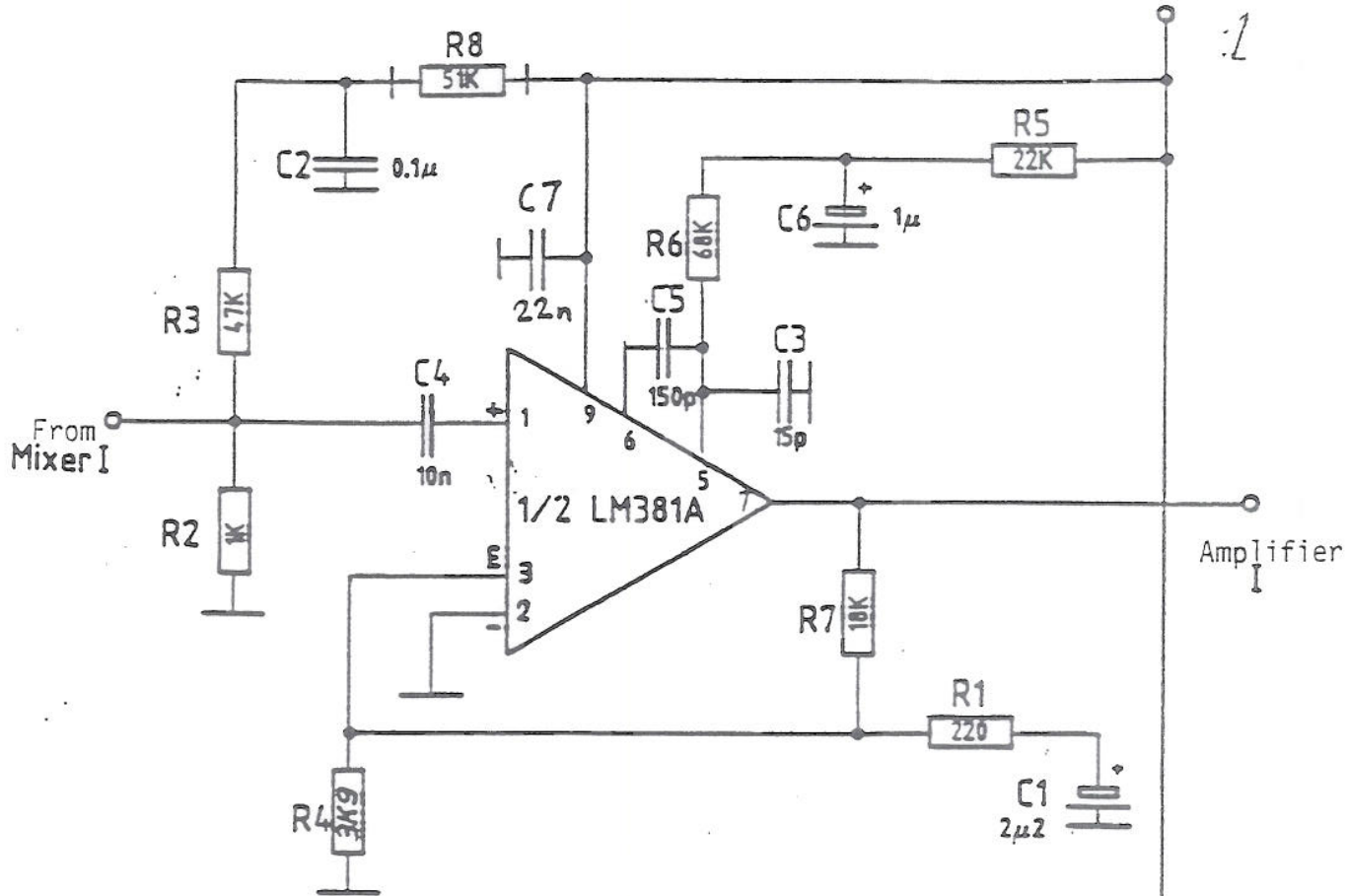
channel I

Functional check in test section VE

Board size: 59 x 48 x 12

± 1/2 IT14	±
1	10%
3	0.12
6	0.15
10	0.18
18	0.21
30	0.26
50	0.31
80	0.37
120	0.43
180	0.50
250	0.57
315	0.65
400	0.70
500	0.77

Oberfl. ....		Mat. ....		Klass. ....	
Masse ohne Toleranzangabe mittel: js 14 / JS14 / ± 1/2 IT14		Gez.	18.4.85	Maßstab	2:1
Ausführungsregeln, Form- und Lagegenauigkeit nach N201.30		Geprüft	KB 19.4.85	2:1	Printed circuit Preamplifier
Ersetzt für :		Avor	3.5.85	2:1	
Ges.		Referenz		238421-00000	Type DRS-2
Zellweger Uster		Zellweger Uster AG CH-8610 Uster / Schweiz		Index B 00	Blatt 2(3)
				Nr	238421-00100



1.7.10.100

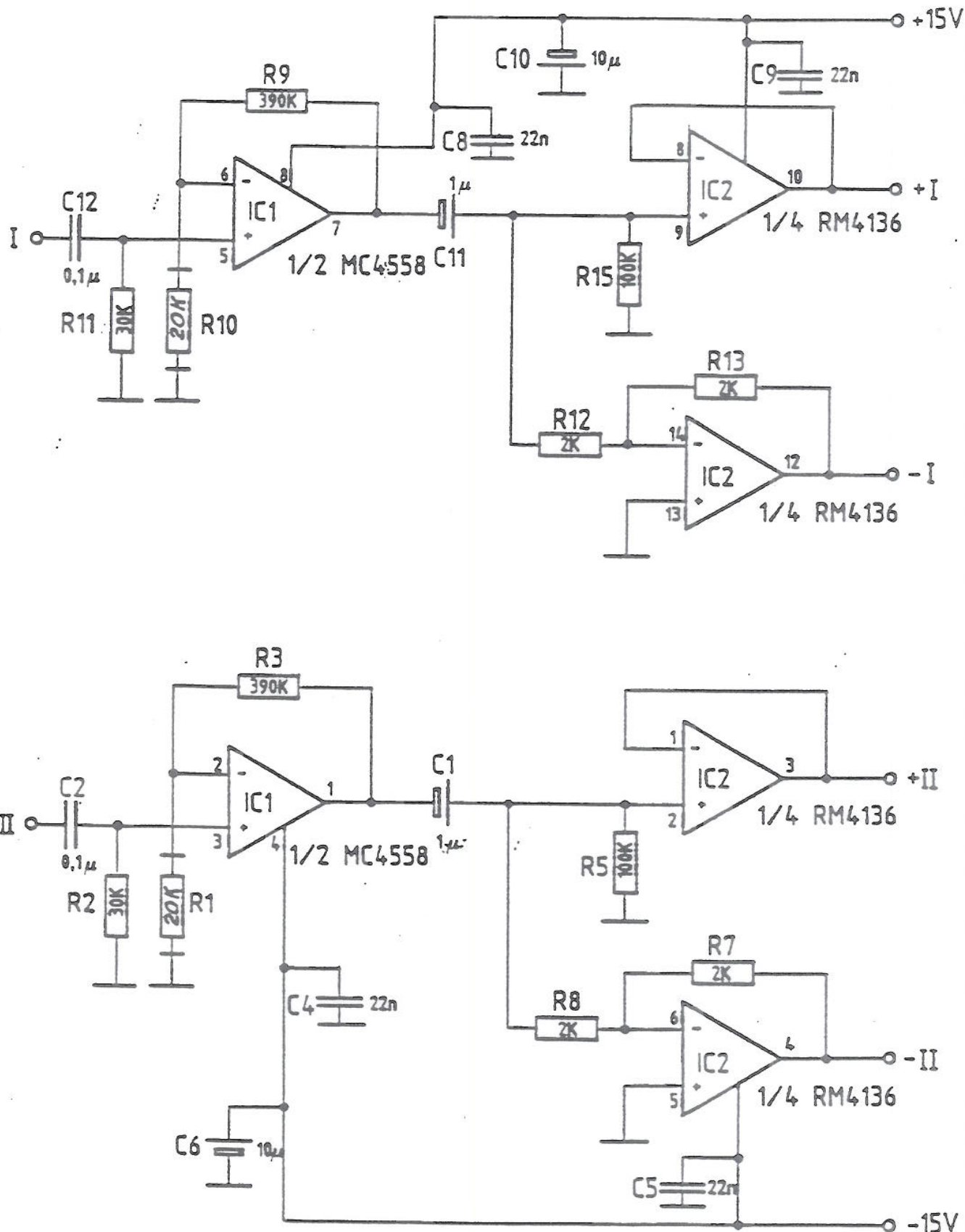
Ers. I.	Maßstab %	Gez.:	23.3.84	helag	<u>Connection diagram</u> for DRS-2 (preamplifier)		
Ers. d.		Geo.:	27.4.85	<del>h</del>			
OK. v.		Geo.:	29.4.85	<del>h</del>			
Zellweger Uster AG CH-8610 Uster/Schweiz		Index	B <sup>00</sup>	Blatt	3(3)	Nr. 238 421-00100	



which are entrusted to a person's care always remain the property of our firm. The must not be copied or duplicated nor shown to or placed at the disposal of third persons without our written consent.

sur ces dessins et annexes, toutes personnalités au destinataire. Ils ne doivent pas, sans notre autorisation écrite, être copiés, reproduits, communiqués à des tiers ou mis à leur disposition.

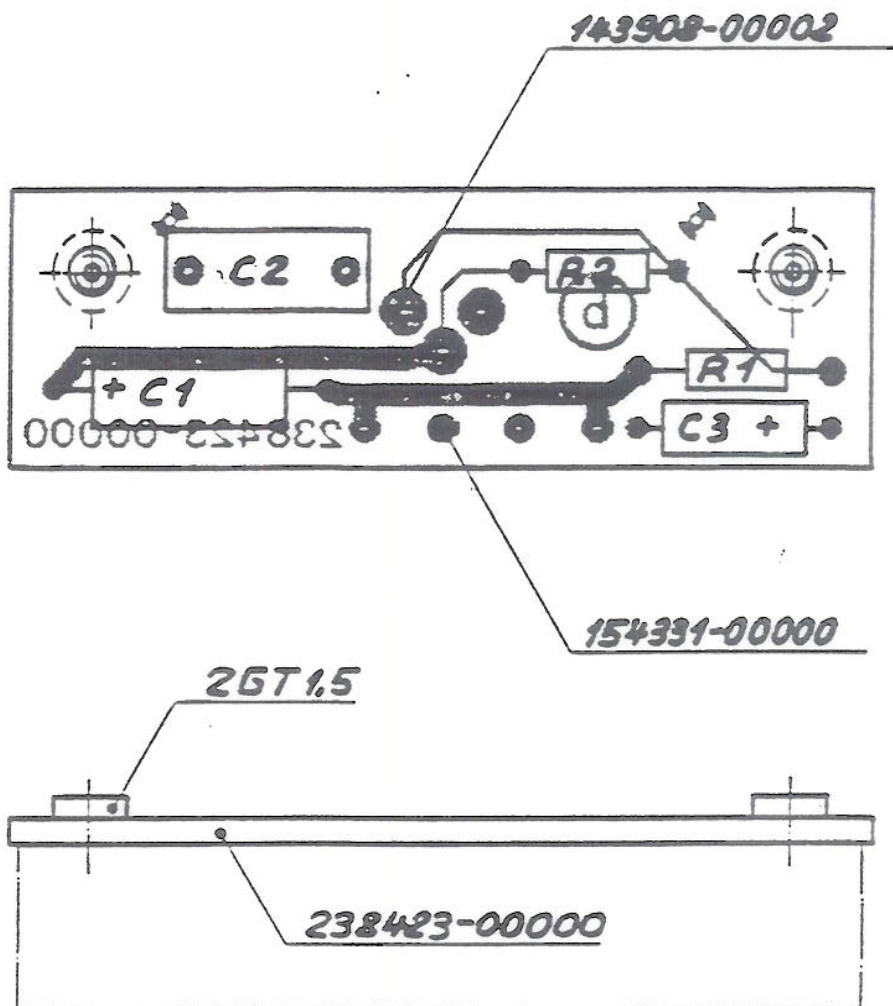
gen. die dem Empfänger persönlich anvertraut sind, verbleibt jederzeit unserer Firma. Ohne unsere schriftliche Genehmigung dürfen sie nicht kopiert oder vervielfältigt, an niemals dritten Personen mitgeteilt oder zugänglich gemacht werden.



22 07 088

Ers. I.	Meßstab 1/2	Gez.: 23.3.84	helaq	<u>Connection diagram</u> for DRS-2 (amplifier)		
Ers. d.		Gez.: 29.4.85	P.			
OK. v.		Gez.: 29.4.85	Y. M.			
Zellweger <b>USTER</b>		Zellweger Uster AG CH-8610 Uster/Schweiz		Index A00	Blatt 3(3)	Nr. 238 422-00100

Das Urheberrecht an diesen Zeichnungen und allen Beilagen, die dem Empfänger persönlich anvertraut sind, verbleibt jederzeit unserer Firma. Ohne unsere schriftliche Genehmigung dürfen sie nicht kopiert oder vervielfältigt, auch niemals Dritten Personen mitgeteilt oder zugänglich gemacht werden.



Board size: 57 x 18 x 15 mm

JS14 = ±1/2 IT14

V	bis	±
0	1	10%
1	3	0.12
3	6	0.15
6	10	0.18
10	18	0.21
18	30	0.26
30	50	0.31
50	80	0.37
80	120	0.43
120	180	0.50
180	250	0.57
250	315	0.66
315	400	0.70
400	500	0.77

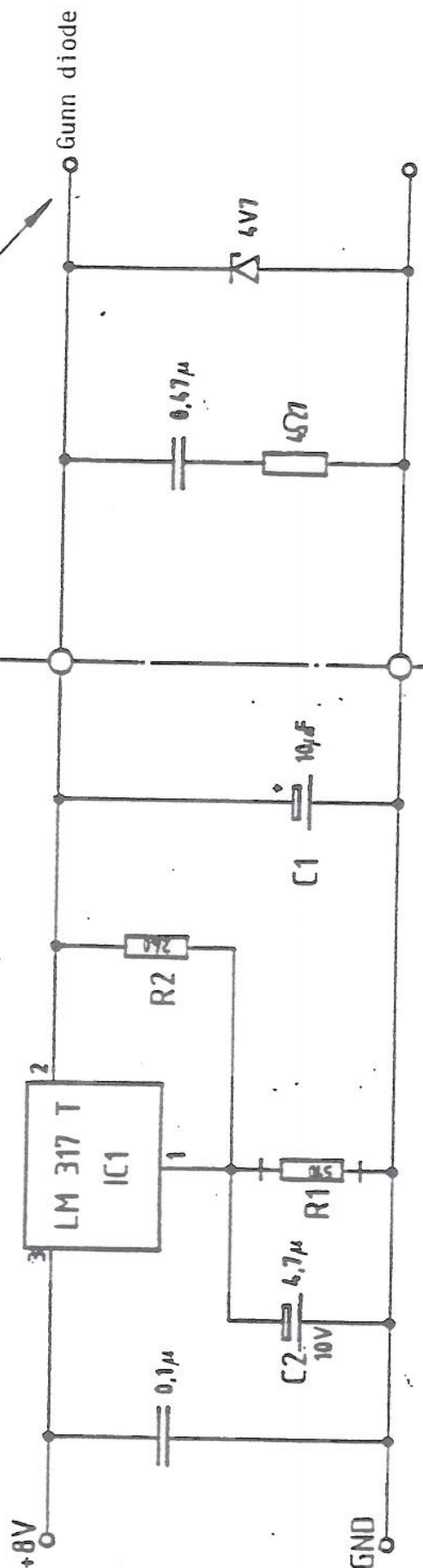
Oberfl. ....		Mat. ....		Klass. ....	
Messen ohne Toleranzangabe mittel: JS14 / JS14 / ±1/2 IT14		Gez. <u>283.85</u> <del>283.85</del> Maßstab		Printed circuit	
Ausführungsregeln, Form- und Lagengenauigkeit nach N201.30		Geprüft KB <u>1.4.85</u> <u>HL</u> Norm <u>2.4.85</u> <u>HL</u> Avor <u>2.4.85</u> <u>HL</u>		2:1 for <u>DRS 2</u>	
Ersatz für :		Ges.		Referenz <u>238420-01000</u> Type <u>MUVR/6F</u>	
Zellweger USTER		Zellweger Uster AG CH-8610 Uster / Schweiz		Index <u>B00</u> Blatt <u>2(2)</u> Nr <u>238423-00100</u>	

which are entrusted to a person to care always remain the property of our firm. The must not be copied or duplicated nor shown to or placed at the disposal of third persons without our written consent.


sur ces dessins et annexes, confidés personnellement au destinataire. Ils ne doivent pas, sans notre autorisation écrite, être copiés, reproduits, communiqués à des tiers ou mis à leur disposition.

bleibt jederzeit unserer Firma. Ohne unsere schriftliche Genehmigung dürfen sie nicht kopiert oder vervielfältigt, auch niemals dritten Personen mitgeteilt oder zugänglich gemacht werden.

Caution:  
This + connection is on the housing of the resonator block.  
Ensure correct polarity.



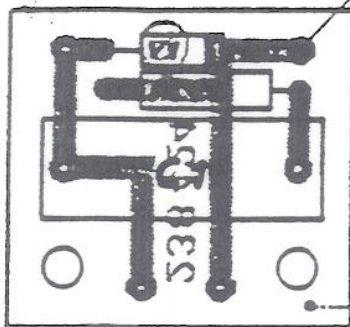
(238 423-00100) | (238 424-00100)

Err. f.	Maßstab	Gez.:	21.3.84	helag			
Err. d.		Gez.:					
OK. v.		Gez.:					
 Zellweger Uster AG CH-8610 Uster/Schweiz					Index	Blatt	Nr. 238 423-00100



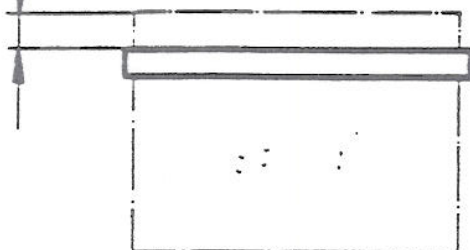
Das Urheberrecht an diesen Zeichnungen und allen Beilagen, die dem Empfänger persönlich anvertraut sind, verbleibt jederzeit unserer Firma. Ohne unsere schriftliche Genehmigung dürfen sie nicht kopiert oder vervielfältigt, auch niemals dritten Personen mitgeteilt oder zugänglich gemacht werden.

154331-00000



238424-00000

2.5 max



Board size: : 29 x 24 x 17 mm

JS14 = 2 1/2 IT14

>	bis	±
0	1	10%
1	3	0.12
3	6	0.15
6	10	0.18
10	18	0.21
18	30	0.26
30	50	0.31
50	80	0.37
80	120	0.43
120	180	0.50
180	250	0.57
250	315	0.65
315	400	0.70
400	500	0.77

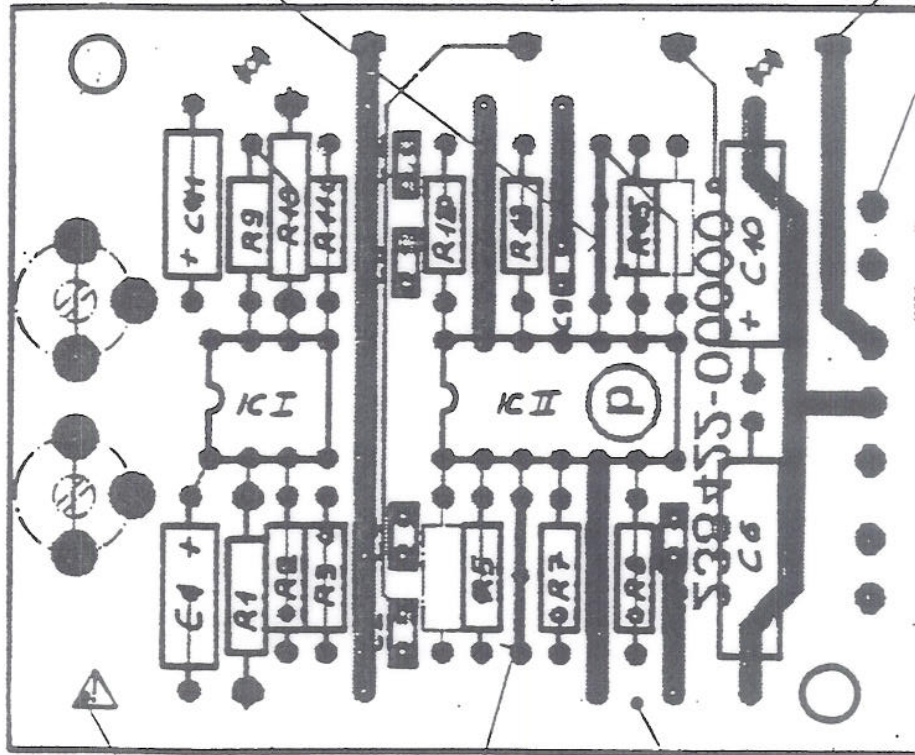
Oberfl. ....		Mat. ....		Klass. ....	
Masse ohne Toleranzangabe mittel: JS14 / JS14 / ± 1/2 IT14		Gez.	28385	Maßstab	2:1
Ausführungsregeln, Form- und Lagegenauigkeit nach N201.30		Geprüft	KB	1.4.85	Printed circuit for GUNN-OSZI.
			Norm	2.4. A5	
			Avor	2.4. P5	
Ersatz für :		Gez.		Referenz	238420-01200
Zellweger USTER		Zellweger Uster AG CH-8610 Uster / Schweiz		Index	300
				Blatt	2(2)
				Nr	238424-00100



Das Urheberrecht an diesen Zeichnungen und allen Beilagen, die dem Empfänger persönlich anvertraut sind, verbleibt jederzeit unserer Firma. Ohne unsere schriftliche Genehmigung dürfen sie nicht kopiert oder vervielfältigt, auch niemals Dritten Personen mitgeteilt oder zugänglich gemacht werden.

161854-00100

154331-00000



Channel I  
+15V  
GND  
-15V  
Channel II

22-07097  
beidseitig

both sides

238422-00000

161854-00100

Functional check

Board size: 59

Verde II+  
Guanillo II-  
Azul -15  
Negro GND  
Rojo +15  
Blanco I-  
Marron II+

JS14 = 1/2 IT14

V	bits	±
0	1	10%
1	3	0.12
3	6	0.15
6	10	0.18
10	18	0.21
18	30	0.26
30	50	0.31
50	80	0.37
80	120	0.43
120	180	0.50
180	250	0.57
250	315	0.68
315	400	0.70
400	500	0.77

Oberfl. ....		Mat. ....		
Messe ohne Toleranzangabe mittel: JS14 / JS14 / ± 1/2 IT14	Gez.	17.4.85	Medete 2:1	
	Geprüft	KB		19.4.85
		Norm		6.5.85
		Avor		3.5.85
Ausführungsregeln, Form- und Lagegenauigkeit nach N201 30		Gez.		
Ersatz für :				
Zellweger USTER		Zellweger Uster AG CH-8610 Uster / Schweiz		
Index A00		Blatt 2(3)	Nr 238422-00100	