

Nederlands Meetinstituut

Type approval certificate

Number : **T5754** revision 4
Project number : 611627
Page : 1 of 1

Issued by NMI Certin B.V.
Hugo de Grootplein 1
3314 EG Dordrecht
Nederland

In accordance with Article 6, first paragraph, of the "Metrologiewet"

Applicant Endress + Hauser GmbH + Co., KG
Hauptstrasse 1
Maulburg
Germany

In respect of A model of a **tank level gauge**

Characteristics

Make	:	Endress + Hauser GmbH + Co. KG
Type	:	Micropilot S , designs FMR 530; FMR 531; FMR 532; FMR 533
Environmental temperature range	:	-25 °C ... +55 °C
Measuring height	:	Type FMR 530: 25 m Type FMR 531: 10 m Type FMR 532: 20 m Type FMR 533: 25 m

Other characteristics are represented in the Description T5754 revision 4.

Description and Documentation The tank level gauge is described in the description nr. T5754 revision 4 and documented in the Documentation Folder nr. T5754-3, belonging to this Approval document.

Remark This T5754 revision 4 was made because of the application of a new HF unit, and replaces the previous revision 3. The Documentation Folder nr. T5754-3 replaces the previous Documentation Folder nr. T5754-2.

Dordrecht, 27 March 2007
NMI Certin B.V.


Ing. C. Oosterman
Manager Product Certification

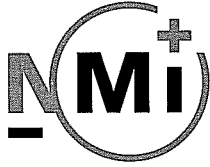
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Parties concerned can lodge objection against this decision, within six weeks after the date of submission, to the general manager of NMI (see "Regulation objection and appeal against decisions of NMI")

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1 General information concerning the tank level gauge

All properties, whether mentioned or not, of this indicating device shall neither violate the "Metrologiewet" (the Dutch Weights and Measures law), nor the Dutch Weights and Measures regulations for automatic liquid level gauges.

1.1 Essential parts

1.1.1 Electronics part;

1.1.1.1 software version 2.00, 2.02.

1.1.2 Antenna;

1.1.2.1 type FMR 530 DN150;

1.1.2.2 type FMR 530 DN 200;

1.1.2.3 type FMR 530 DN 250;

1.1.2.4 type FMR 531 Teflon 1,5" (Rod);

1.1.2.5 type FMR 533 DN 450 (Parabolic);

1.1.2.6 type FMR 532 DN150;

1.1.2.7 type FMR 532 DN200;

1.1.2.8 type FMR 532 DN250;

1.1.2.9 type FMR 532 DN300.

1.2 Essential characteristics

1.2.1 The characteristics as specified on the first page of this Type Approval certificate.

1.2.2 Nominal power supply voltage = 24 Vdc.

1.2.3 Indication;

1.2.3.1 indication of the measured level, in m, in units of 0.001 m or 0.0001 m;

1.2.3.2 indication of the way of measuring (innage or ullage);

1.2.3.3 indication of status messages, error messages and alarm messages.

1.2.4 Protection legal parameters against alterations.

1.2.5 Application of the level gauge is allowed on the following products.

1.2.5.1 Liquids, stored under atmospheric conditions, with the restriction that no heavy foam is present.

1.2.5.2 Liquids of which the vapour influence does not affect the legal aspects of the accuracy. The maximum error caused by the vapour influence may be calculated using the following formulas.

If the dielectric constant of the product is known the formula is:

$$\delta l = \left[\frac{P_{m,gas}^{(t)}}{P_0} \varepsilon_m^{1/2} + \frac{P_0^{(t)} - P_{m,gas}^{(t)}}{P_0} \varepsilon_{air}^{1/2} - \varepsilon_{air}^{(20)^{1/2}} \right] \times 1000 \quad [\text{mm/m}]$$

If the breaking index is known the formula is:

$$\delta l = \left(\frac{P_{m,gas}^{(t)}}{P_0} n_{m,gas}^{(t)} + \frac{P_0 - P_{m,gas}^{(t)}}{P_0} n_{air}^{(t)} - n_{air}^{(20)} \right) \times 1000 \quad [\text{mm/m}]$$

In the above given formulas the meaning of the variables is as follows:

δl	=	length error, in mm/m
$P^{(t)}_{m,gas}$	=	vapour pressure at the given vapour temperature, in torr
P_0	=	pressure in the tank, in torr
$\epsilon^{1/2}_{m}$	=	dielectric constant of the vapour at the given vapour temperature
$\epsilon^{1/2}_{air}$	=	dielectric constant of the air at the given vapour temperature
$\epsilon^{(20)1/2}_{air}$	=	dielectric constant of the air at 20 °C (reference value)
$n^{(t)}_{m,gas}$	=	breaking index of the vapour at the given vapour temperature
$n^{(t)}_{air}$	=	breaking index of the air at the given vapour temperature
$n^{(20)}_{air}$	=	breaking index of the air at 20 °C (reference value)
t	=	vapour temperature, in °C
1 torr	=	133,3224 Pa
1 bar	=	750,0617 torr

If the product is not stored at the reference temperature (20 C°), the dielectric constant of product and air may be determined using the following formula:

$$\epsilon_{air}^{(t,p)} = \left(\epsilon_{air}^{(20,1.Atm)} - 1 \right) \cdot \frac{P}{760[1 + 0.00341(t - 20)]} + 1$$

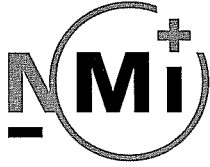
In an analogous way the breaking index may be determined using the following formula:

$$n_{air}^{(t)} = \frac{(n_{air}^{(20)} - 1) \cdot p}{760(1 + 0.00341(t - 20))} + 1$$

In the above given formulas the meaning of the variables is as following:

$\epsilon^{(t,p)}_{air}$	=	dielectric constant of the air at given temperature and pressure
$\epsilon^{(20,1Atm)}_{air}$	=	dielectric constant of the air at 20 °C and 1 Atm (reference value)
$n^{(t)}_{air}$	=	breaking index of the air at given temperature
$n^{(20)}_{air}$	=	breaking index of the air at 20 °C (reference value)
P	=	actual pressure, in torr
t	=	actual temperature, in °C
1 torr	=	133,3224 Pa
1 bar	=	750,0617 torr

In the given application at the **maximum height of the vapour part inside the tank** the maximum error in the level measurement must not be exceeded. At a liquid level lower than or equal to 5 m this maximum error has a value of plus or minus 2,6 mm; for liquid levels higher than 5 m the



maximum error is determined using the formula [plus or minus (2,1 mm + 0,1 · L mm)], in which L is the liquid level, rounded up to an integer number of meters.

For 236 products the manufacturer has determined the dielectric constant or the breaking index, at a given pressure and temperature. These values are available in "Anhang; Physikalisch-Chemische Konstanten und Parameter für ausgewählte Substanzen".

1.3 Essential shapes

1.3.1 Kind of measuring tanks

Application of the level gauges FMR 530, FMR 531 and FMR 533 is allowed on vertical cylindrical tanks with a fixed roof and on vertical cylindrical tanks with an inner floating roof. Application of the level gauges FMR532 is allowed on tanks with a stilling well of DN150 (6"), DN200 (8"), DN250 (10") or DN300 (12").

1.3.2 Measuring range

The maximum measuring range of the level gauge, measured from the antenna top is equal to:

- for type FMR 530: 25 m;
- for type FMR 531: 10 m;
- for type FMR 532: 20 m;
- for type FMR 533: 25 m.

It should be noted that certain applications are possible if and only if a correctly functioning system is implemented for temperature compensation for expansion of the tank shell or stilling well. The actual maximum measuring height is determined per application. Prior to that the manufacturer shall prove, by calculation and by measurements, that the intended application can be considered legal.

1.3.3 Mounting on the measuring tank

The level gauge shall be mounted following one of the following methods.

- Directly on the fixed roof of the measuring tank.
- On a trunk such that the antenna is positioned in the free space of the measuring tank.
- On a stilling well of DN150 (6"), DN200 (8"), DN250 (10") or DN300 (12").

Basically the maximum measuring range, measured from the antenna top, is as indicated before. The actual maximum measuring height however is also determined by the material the tank shell is constructed of. So, the actual measuring height is determined for each individual application. Also refer to paragraph 1.3.2.

The level gauge must be installed in conformity with the manufacturers demands.

1.3.4 Sealing of the Weights & Measures switch.

The Weights & Measures switch is sealed with a sealing mark.
When the Weights & Measures switch is sealed the legal parameters cannot be altered.

1.3.5 Sealing of the name plate.

The name plate is sealed with a legal stamp.



- 1.3.6 Inscriptions on the name plate
 - 1.3.6.1 Manufacturer's name or logo.
 - 1.3.6.2 The number of this approval: T5754.
 - 1.3.6.3 Year of manufacture.
 - 1.3.6.4 Manufacturing number, i.e. a serial number.
 - 1.3.6.5 The text: Het nulpunt van de vloeistofhoogtemeter ligt mm beneden het referentiepunt.
 - 1.3.6.6 The identification of the measuring tank the level gauged is mounted upon.
 - 1.3.6.7 A description of the symbols on the display, or a reference where this description can be found.

1.4 Conditional characteristics

- 1.4.1 Error messages.
In the following situation signals the display that the level is not legal.
 - 1.4.1.1 A memory problem or computer problem exists.
 - 1.4.1.2 The HF-module or the quartz crystal are defective or do not function in a correct way.
 - 1.4.1.3 The Weights and Measures switch is not set to "legal".
 - 1.4.1.4 Phase measurement and amplitude measurement are inconsistent.
 - 1.4.1.5 A defective amplifier or antenna, or no return signal exists.

Also refer to chapter "Error-Messages" in the manual.

1.4.2 Legal parameter settings

parameter	description	setting
002	tank shape	correct shape
003	dielectric constant	Refer to remark 1.
004	process conditions	"standard" or "calm surface"
005	empty calibration	distance from meter flange to minimum tank level
014	delay time	As short as possible; refer to remark 1.
015	safety distance	Refer to remark 1.
016	in safety distance	"alarm w. ackn."
031	auto correction	Refer to remark 1.
032	pipe diameter correction	"off" For a free space application. For a pipe-application refer to remark 1.
040	level or ullage	"lvl m, ft, in"
042	customer unit	"m"



parameter	description	setting
055	offset	Difference between indicated level and actual level.
057	blocking distance	Correct value; refer to remark 1.
060	communication address (when connecting to a central system)	address
093	back to home	"10"
094	format display	"x" or "x.x"
0C5	distance unit	"m"

Remark 1

These parameters are set and motivated by the manufacturer.

Remark 2

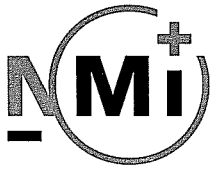
The parameters 33 up to and including 38 offer the possibility to the user to correct measuring errors not caused by the level gauge. The dip-table may or may not be switched on. All settings are protected by the Weights & Measures switch.

2 Conditions for legal granting

- 2.1 The level gauge shall be constructed in conformity with the description and documentation of this approval document.
- 2.2 The seals shall be attached as described in chapter 3.

3 Legal stamps and sealing stamps

- 3.1 The Weights & Measures switch is sealed with a sealing stamp.
- 3.2 The name plate is sealed with a legal approval stamp.



Appendix

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Tests carried out within the scope of this Approval

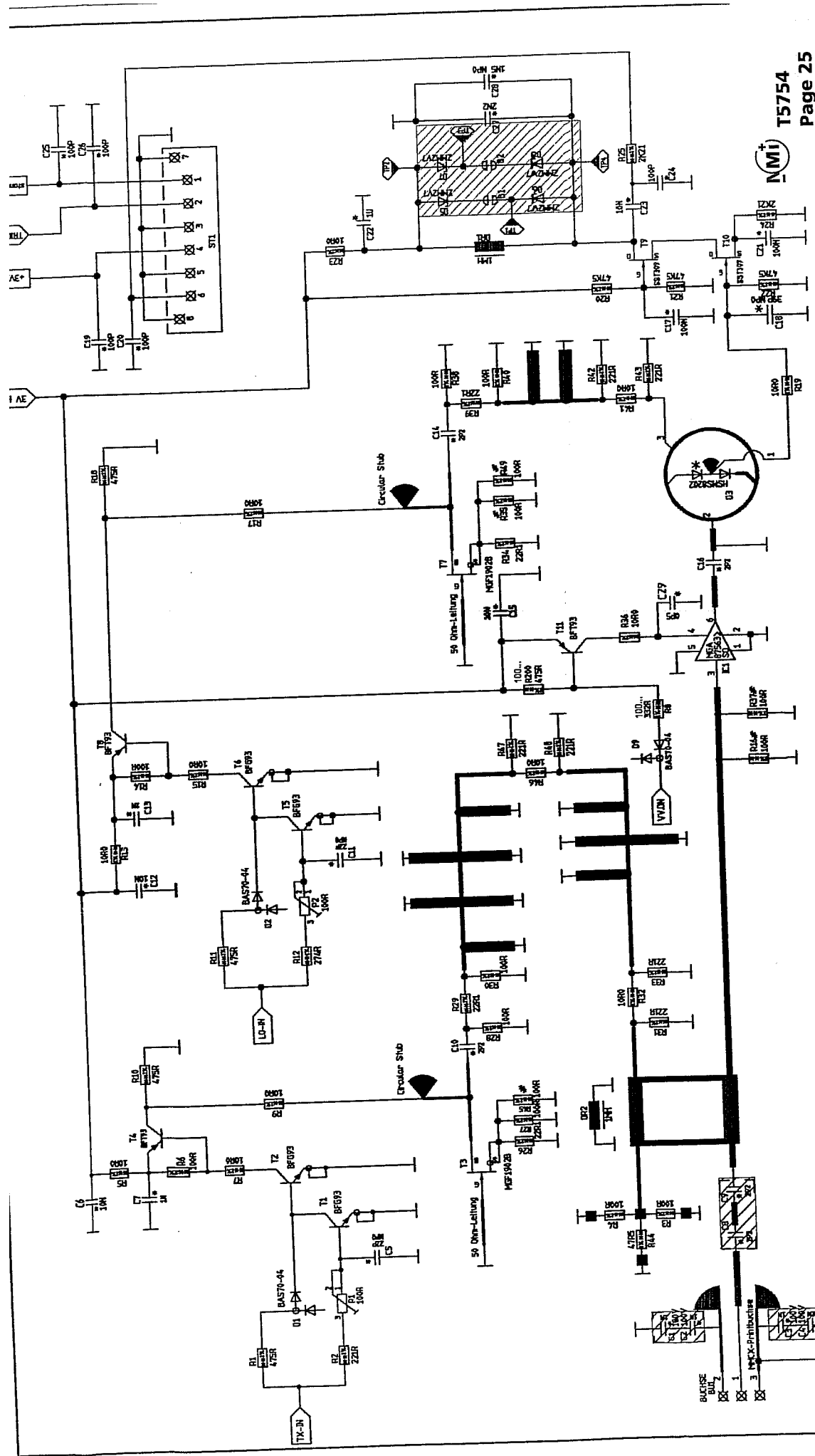
TEST	PART	TYPE	TEST REPORT	INSTITUTE
Dutch Weights and Measures regulations for tank level gauges. Functional tests. Environmental tests.	Tank level gauge make E+H.	FMR 530	Refer to the file belonging to the "Verklaring van toelating T5754, revisie 0" (=Dutch approval T5754, revision 0).	Nederlands Meetinstituut N.V.
Dutch Weights and Measures regulations for tank level gauges. Functional tests. Environmental tests.	Tank level gauge make E+H.	FMR 530 DN 150, FMR 530 DN 200, FMR 530 DN 250, FMR 531 1,5" Rod antenna FMR 532 DN 150, FMR 532 DN 200, FMR 532 DN 250, FMR 532 DN 300, FMR 533 DN 450 Parabolic antenna	Refer to the file belonging to the "Verklaring van toelating T5754, revisie 1" (=Dutch approval T5754, revision 1).	Nederlands Meetinstituut N.V.
Dutch Weights and Measures regulations for tank level gauges. Functional tests.	Tank level gauge make E+H.	FMR 530 DN 150, FMR 530 DN 200, FMR 530 DN 250, FMR 531 1,5" Rod antenna FMR 532 DN 150, FMR 532 DN 200, FMR 532 DN 250, FMR 532 DN 300, FMR 533 DN 450 Parabolic antenna	Refer to the file belonging to the "Verklaring van toelating T5754, revisie 2" (=Dutch approval T5754, revision 2).	Nederlands Meetinstituut N.V.
Dutch Weights and Measures regulations for tank level gauges. Functional tests. Electrical disturbance tests.	Tank level gauge make E+H.	FMR 530 DN 150, FMR 530 DN 200, FMR 530 DN 250, FMR 531 1,5" Rod antenna FMR 532 DN 150, FMR 532 DN 200, FMR 532 DN 250, FMR 532 DN 300, FMR 533 DN 450 Parabolic antenna	Refer to the file belonging to the Dutch Weights and Measures approval T5754, revision 3.	Nederlands Meetinstituut N.V. Endress + Hauser GmbH+Co. KG; EMC facility; DAR-registration number: DAT-P 036/93-03 *)
Dutch Weights and Measures regulations for tank level gauges. Climate tests and power voltage variation tests.	Tank level gauge make E+H.	FMR 530 DN 150, FMR 530 DN 200, FMR 530 DN 250, FMR 531 1,5" Rod antenna FMR 532 DN 150, FMR 532 DN 200, FMR 532 DN 250, FMR 532 DN 300, FMR 533 DN 450 Parabolic antenna	Refer to the file belonging to the Dutch Weights and Measures approval T5754, revision 4.	Nederlands Meetinstituut N.V.

*) DAR = Deutsche Akkreditierungs Rat
 File:T5754R4.doc



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number	description
page 2	Sealing of name plate and Weights & Measures switch
page 3	Total view
page 4	construction block diagram
page 5	Working principle block diagram
page 6	application board (power supply) electronic schematics drawing
page 7	application board (CPU) electronic schematics drawing
page 8	application board (sample unit) electronic schematics drawing
page 9	application board side 1 board lay out drawing
page 10	application board side 2 board lay out drawing
page 11	main board (LIPS) electronic schematics drawing
page 12	main board (power supply, HART) electronic schematics drawing
page 13	main board (CPU) electronic schematics drawing
page 14	main board side 1 board lay out drawing
page 15	main board side 2 board lay out drawing
page 16	Ex-limiter electronic schematics drawing
page 17	Ex-limiter board lay out drawing
page 18	radar module electronic schematics drawing
page 19	radar module board lay out drawing
page 20	antenna type 530 dimensional drawing
page 21	antenna type 531 dimensional drawing
page 22	antenna type 532 dimensional drawing
page 23	antenna type 533 dimensional drawing
page 24	pictures of the applied display units
page 25	HF - board electronics schematics; drawing nr. 960384-0063 E
page 26	HF - board component placing and board layers; drawings nr. 960384-0065 E and 960384-0067
2 numbered sheets	



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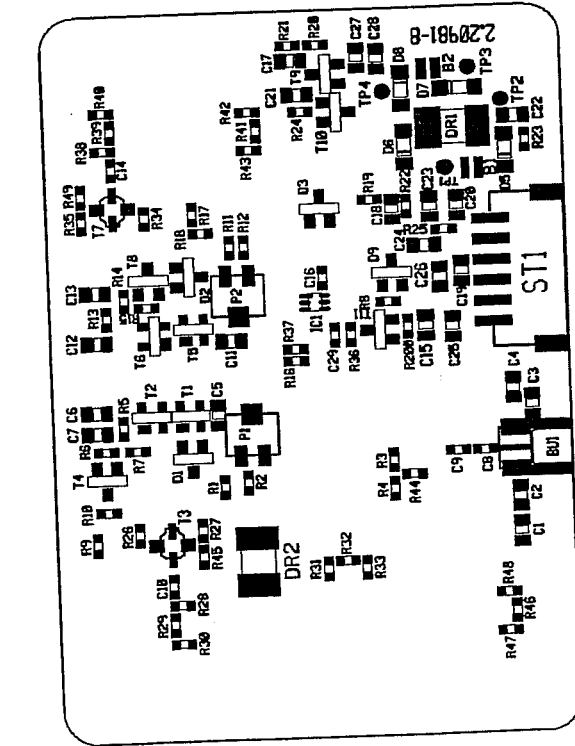
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C	ES 17.09.03	ES 17.09.03	ES 17.09.03	ES 17.09.03	ES 17.09.03
D	ES 28.10.97	ES 28.10.97	ES 28.10.97	ES 28.10.97	ES 28.10.97
E	ES 29.10.97	ES 29.10.97	ES 29.10.97	ES 29.10.97	ES 29.10.97
F					
G					
H					

Die schraffierten Bauteile, verantwortlich für die Eigensicherheit, dürfen nur durch gleichwertige Typen ersetzt werden.
 Andere Bauelemente dürfen nur durch Typen ersetzt werden, die zu keiner unzulässigen Oberflächentemperatur führen.
 The shaded components, responsible for intrinsic safety, may only be changed by similar types.
 The other elements may only be altered by types, which produce no unacceptable surface temperature.

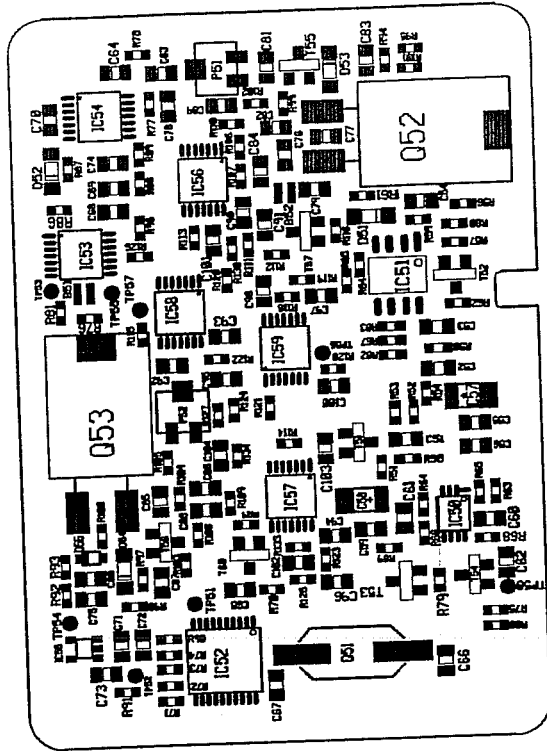
E+H special
 R8, R200: variabel im spezifizierten Bereich
 variable in specified range
 Agency controlled drawing.
 No changes without prior
 Agency approval.

Endress+Hauser
 Maulburg
 96036 EUD-63 E
 REPL. BY: A3

Bestückungsplan der Leiterplatte Radar Modul II.2
 gemäß Schaltplan 960384-0061 / -0063
 Component diagram pcb Radar-module II.2
 acc. circuit diagram 960384-0061 / -0063



Bestückungsseite, Lage 5
 Component side, layer 5
 Schaltplan / Circuit diagram 960384-0063



Bestückungsseite, Lage 1
 Component side, layer 1
 Schaltplan / Circuit diagram 960384-0061

(NMI) T5754

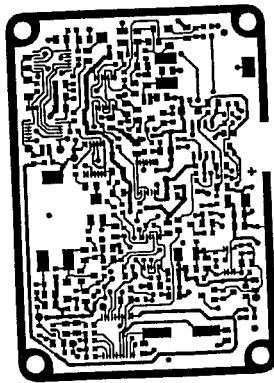
Page 26
 Sheet 4 of 2

H		G		F		E		D		C		B		A	
GEOMETRICAL TOLERANCING DIN ISO 1101 SURFACE TEXTURE DIN ISO 1302 EDGES OF WORKING PARTS DIN 6754															
NO. DRAWN APPD DATE															
TOLERANCE															
MATERIAL															
DESIGN		DATE		NAME		DRAWN		APPROVED		DATE		SCALE		TITLE	
DRAWN		14.10.97		fb		14.10.97		ES		ES		2:1		Bestückungsplan HF-Mod II.2 Component diagram HF-mod II.2	
APPROVED		14.10.97		ES		ES		ES		ES		ES		ES	
DRAWING NUMBER 960384-0067 E															
Entwickler Mautburger															
SHEET SIZE C A3															
REPL FOR 2.20981-3															
REPL BY															

Agency controlled drawing.
 No changes without prior
 Agency approval.

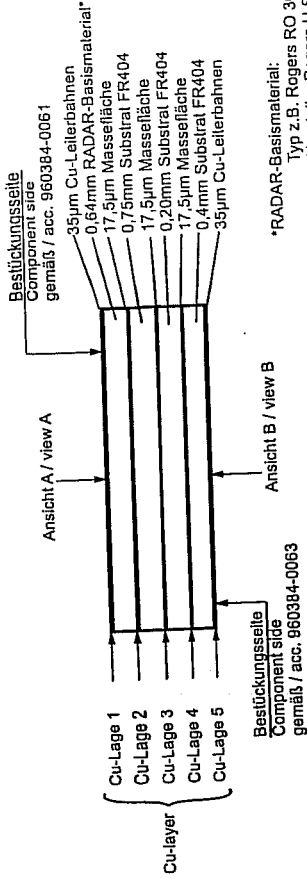
Layout RADAR-Modul II.2 gemäß 960384-0061
 Layout RADAR-module II.2 acc. 960384-0063

Layout Microwave/entail RADAR Modul II.2
 gemäß Schallplan 960384-0061
 Layout μ wave part, module II.2
 acc. circuit diagram 960384-0061



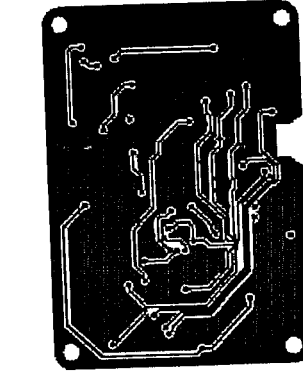
Bestückungsseite, Lage 1 / Component side, layer 1
 Ansicht A / view A

Multilayer assy. RADAR-Modul II.2

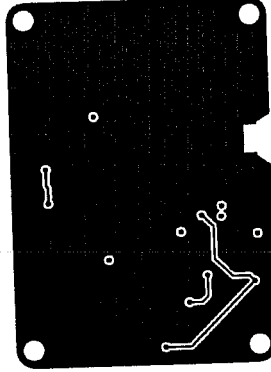


*RADAR-Basismaterial:
 Typ z.B. Rogers RO 3010 (25mi)
 Hersteller Rogers U.S.A.

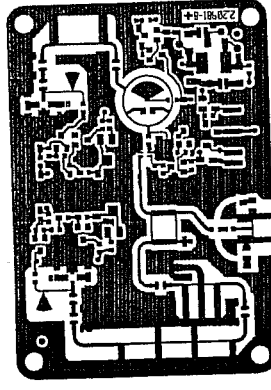
Layout Frequenzerzeugung RADAR Modul II.2
 gemäß Schallplan 960384-0063
 Layout frequency excitation, module II.2
 acc. circuit diagram 960384-0063



Lage 3 (Innenlage) / Layer 3 (inner layer)
 Ansicht A / view A

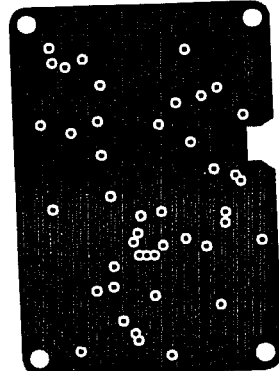


Lage 4 (Innenlage) / Layer 4 (inner layer)
 Ansicht A / view A



Bestückungsseite, Lage 5 / Component side, layer 5
 Ansicht B / view B

Lage 2 (Innenlage) / Layer 2 (inner layer)
 Ansicht A / view A



Agency controlled drawing.
 No changes without prior
 Agency approval.

Each component side coated with lacquer with
 continuous service temperature $\geq 130^{\circ}\text{C}$ CTI ≥ 100

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 960384-0065 E

DESIGN	DATE	NAME	DOCUMENT PROTECTED BY
DRAWN	14.10.97	fb	DIN 34
APPROVED	14.10.97	ES	

TITLE
 Leiterplatte RADAR-Modul II.2
 Trace layout RADAR-module II.2

SCALE
 1:1

NO.	DRAWN	APPRD	DATE
fb	ES	17.09.03	
fb	ES	040501	
fb	ES	050598	
fb	ES	280198	

TOLERANCE

MATERIAL

REPL. FOR 2.20384-B

SHEET SIZE
 C A3

REP. BY