Technical Description RE 529 VHF 2m

The basic functions of the main stages of the RE 529 are described below. The main board together with the sub-board constitute a functional unit. The complete board assembly is combined on a printed circuit board assembly jig and passes along the complete assembly process through to the adjustment and check of the data content. The pair of printed circuit boards are tuned together by means of the common learning process and can be treated as a self-contained functional unit.

Contents:

1 MAIN BOARD RE529

The main board is designed as a 4 layer printed circuit board and is mounted with SMD components. The functional units and stages described below are contained on this board.
One important functional group comprises the HF input stage, oscillator and mixer up to the first IF signal processor. Another functional group combines the µP with clock generator, EEPROM, tone decoder, reference voltage and the push-button boards. The AF output amplifier with loudspeaker, indicator LEDs, vibrator and LCD are mounted on the reverse side of the main boad.

1.1 Power source and DC supply

The accumulator (nom. voltage= 1.26 V) or a battery serve as the power source.

The main board requires the following supply voltages:

V_{BAT} = 1.26V /DC	for the AF amplifier, vibrator, lamps, voltage monitor and supply of various transistor stages
V_{DD} = 3 V/DC	for the µP, correlator and EEPROM
V+ = 1V/regulated	for the HF-transistors.

Both the supply voltages V_{DD} =3 V and V+=1V are generated in the receiver using the DC/DC converter and the IF-IC (both on the sub-board).
If the accumulator voltage falls below 1.2V the battery alarm is activated via the µP (periodic beeping). From this moment on, the equipment is able to function for approximately five more hours. If the voltage drops below 1V DC for a short period, the equipment switches to the startup condition.

NiCd accumulators should be preferably used for the power source. It should be noted that when using a battery, the receiver recognizes it as a battery and therefore it cannot be charged.

1.2 Antenna / Amplifier / Filter

The signal is picked up via the ferrite antenna L1. The antenna is tuned to resonance using capacitors C1,C2,C3 and C4. The signal is then amplified by transistor T1 which operates in the common base mode. The desired frequency band is selected using a coupled filter comprising the two shunt resonant circuits L11/ C11/ Y12 and L13/C13/C14.

1.3 Crystall oscillator

The oscillator uses the Colpitts configuration. The coupled bandpass filter with the two inductors L22 and L23 is necessary for selection of the oscillator signal. The crystal frequency is doubled in the collector circuit for operation in the 2 m band. The oscillator output is coupled to the mixer via coupling capacitor C25.

The oscillator frequency is 21.4 MHz higher than the received signal the lower and middle 2 m bands (A, B, C bands). For the upper 2 m band (D band), the oscillator frequency is 21.4 MHz lower than the received signal.

1.4 First mixer / Filter

The dual gate MOSFET T51 mixes the amplified input signal from the antenna with the local oscillator signal to generate the first IF signal at a frequency of 21.4 MHz. The resonant circuit formed by L51/C51 forms the load for this stage.

The IF-signal is then filtered by the crystal filter F51 after the mixer stage. The necessary impedance matching for the crystal filter is achieved using components R54, L51 and C51, together with R55, L52 and C55 as well as the input capacitance of IC201.

The IF-signal appears at the connector ST1 on the sub-board for further processing.

1.5 µP Microprocessor / µP-Clock / Reference voltage

The microprocessor uP78F9488 (IC41) is used for processing the tone sequence and control of the equipment.

The microprocessor validates the recepted calls and controlls the pager itself. Control routines are started by interrupts and run during time periods such that a valid call recognition is not affected.

The microprocessor requires two clock frequencies in addition to the supply voltages. Q41 supplies it with a 2.54 MHz operating clock and Q46 provides a 32.768 kHz clock for the Ecomode, LCD and an internal clock.

The voltage reference diode ZRA25 (IC42) provides the 2.5 V voltage rail which is used by the µP for monitoring the operating voltage.

To save power, the reference voltage is switched via pin 37 of the µP and is therefore only available at predetermined times.

1.6 EEPROM

In addition to the internal ROM of the µP, the equipment uses the 6 kBit EEPROM AT2564 (IC91) for data storage of the operating mode, call addresses etc. The data are loaded into the pager using a PC together with the PSW529 two tone software and the PGM 300/429 progammer.

1.7 Tone Decoder

The tone decoder CMX823 (IC92) is able to detect any frequencies in the range from 280 to 3,500 herz.for any detected frequency, the CMX823 initializes an interrupt to the micro processor.

1.8 AF-Amplifier

The AF amplifier NJM2076M (UC91) operates from V_{BAT} =1.26V and is switched by transistor T95. The volume is set by the voltage divider R82/R83/R84 and R85 which is controlled by the µP. The output power is typically 50 mW (level 3). The AF-amplifier receives signals from the µP (beeper tone signal) or via connector ST1 from the sub-board (AF-signal)

1.9 Visual and audio indicators

Visual signalling is achieved using both the red LED D70 and the display of the input address on the LCD display LCD1.

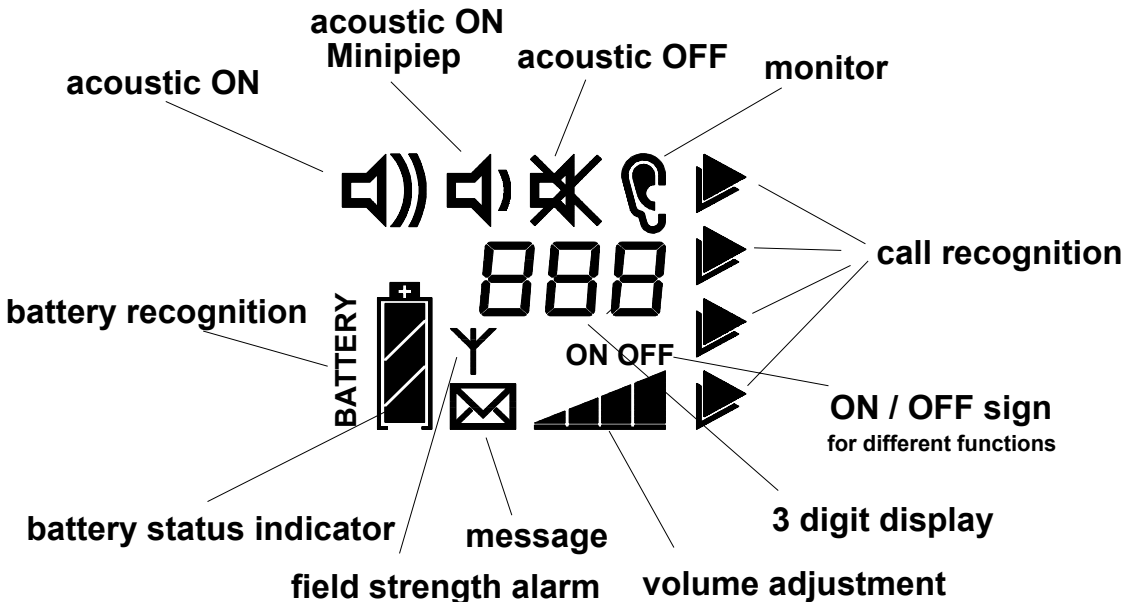
Audible signalling is made using the loudspeaker LS1. This signal lasts for 5 sec. for each address. Its tone (2 programmable frequencies) and beep pattern are selectable.

1.10 LCD Liquid Crystal Display

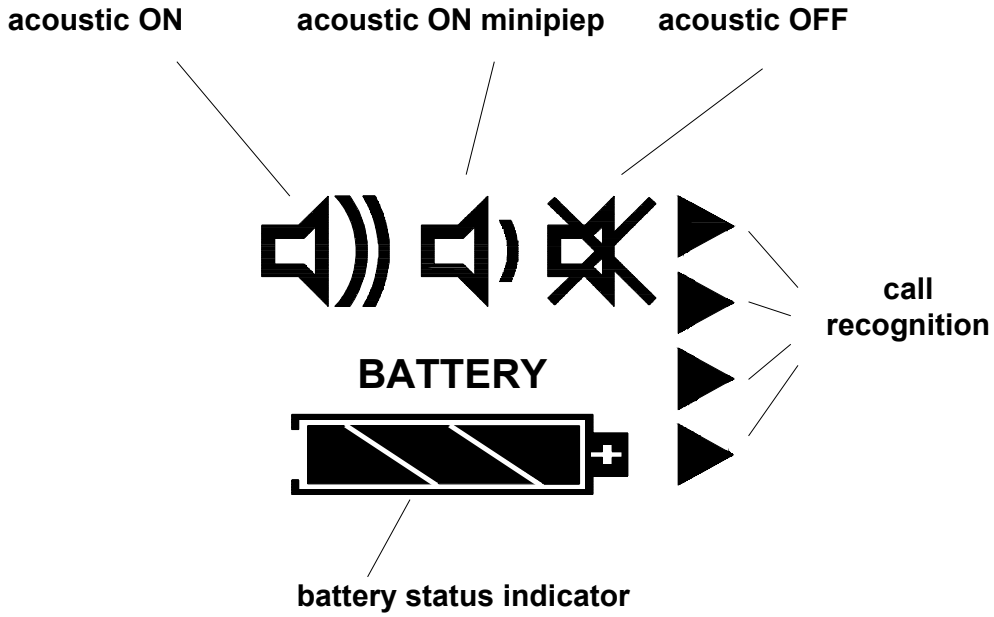
The LCD displays the different operating modes of the equipment for the user. The LCD is also visible at night using the lamp G61.
Significance of the different symbols:

View of RE429NT+ Displays:

Quattrino (Voice, memo)



Quattrino (eco, tone)



1.11 Vibrator

In addition to the visual and audible signals, the vibrator M72 also indicates the presence of an incoming call. The vibration pattern is the same for all addresses and is controlled from pin 50 of the µP.

1.12 Key functions

The following functions are executed by the keys labelled "EXECUTE" (right hand button):

-acknowledge call signalling
-call query
-call clear
-acknowledge battery alarm

Changes in the operating mode of the equipment are executed using the two buttons labelled "SELECT" and "EXECUTE". The "SELECT" push button (left hand button) switches between the different functions.
Only the released and programmed functions from the programming are displayed.
A flashing display on the LCD indicates to the user which function has been selected.

The following settings can be selected via the push buttons:

- Acoustic ON - mini beep - acoustic OFF

Monitor operation ON / OFF

Volume of the speech message

Field strength alarm ON / OFF

When both buttons are pushed simultaneously this

-switches ON
or
-switches OFF the pager (after approx. 4 secs.).

Various sub-functions are described in more detail elsewhere in this documentation.

2 SUBPRINT RE529

The sub-board is a four layer printed circuit board. The following stages are found on the sub-board: IF-amplifier, demodulator, AF-filter, squelch stage, DC/DC converter and speech memory as well as the associated clock generators. The circuit board interface is provided by a 24 pin socket array.

2.1 DC-Voltage

The following supply voltages are required by the sub-board:

V_{BAT}= 1.26 V for the DC/DC converter, IF IC, various transistors

V_{DD}= 3V Speech memory

V+= 1V IF-IC, squelch (transistors)

The required voltages V_{DD}= 3V and V+= 1V are generated by the DC/DC converter and IF-IC.

2.2 DC/DC-Converter

The ML 4861 DC/DC converter (IC 181) is used to generate the voltage V_{DD} = 3V from the supply voltage V_{BAT}. In addition to this IC, external components L181, C182 and C186 are also required.

If the speech memory is in operation, the DC/DC converter supplies 3.5 V as the output voltage during the record and playback period (switched via R182 from the µP).

If the V_{BAT} voltage drops below 1 V, the DC/DC converter activates the reset at the µP. The threshold is set by the voltage divider R186/R187.

2.3 ZF- IC

At the second mixer stage the 21.4 MHz signal on the sub-board is down converted to 455 kHz. The oscillator frequency of 20.945 MHz is generated by the crystal Q101. The conversion to 455 kHz requires an integrated mixer in the IF device MC3367 (IC101).

The signal is then filtered twice and amplified (approx. 80 dB). The amplification stages are integrated into the IF-IC. The filtering is done using two external ceramic filters F101 and F102 which also define the channel spacing (25 kHz /12.5 kHz) for the receiver.

The last step involves demodulation of the second IF signal to the baseband signal (AF) using a quadrature detector. The quadrature detector and the low pass filter which proceeds it are also integrated into the IF-IC.

The necessary phase inversion of the signal is achieved by the shunt circuit comprising L111/C111.

The mixed baseband signal then passes through a 3rd order low pass filter which is formed using R131,R132, R133, C132,C133, C134 together with an amplifier stage integrated in the IF-IC. This achieves the necessary attenuation of 20 dB at 6 kHz. R134 and C136 are defined according to whether the type of modulation is FM or

PM. For PM a further reduction in the pass band of 6 dB/octave (de-emphasis) takes place.

The signal then passes to the tone decoder located on the main board for further processing (AF/CMX). The AF signal is then fed to the speech memory and main board via the amplifier T171. The lower and upper 3 dB frequencies for the AF signal are at approximately 300 and 3 kHz respectively.

In addition, the IF-IC provides a regulated voltage of 1 V at the V_{REG} output (pin 17) which can source a current of typically 3 mA. Further signal processing stages are provided by an additional amplifier and comparator, also included in the IF-IC, which are used for the generation of the squelch signal.
To save power the IF block can be powered down using the transistor T121.

2.4 Squelch

The AF output signal sourced by the IF-IC passes through a high pass filter and is amplified twice. The high pass filter is a second order stage and is formed using components R142, R143, C141, C142 and an amplifier integrated in the IF-IC. The second amplification stage is realized using the external transistor T141.

The noise signal which results, lies in the frequency band from approx. 8-20 kHz is fed to a comparator which is also integrated in the IF-IC. The comparator threshold is set by resistor R146. The output of the comparator is smoothed by R148 and C144 and is then fed to the AD converter input of the µP (pin 45) as an analog voltage with a magnitude corresponding to the received noise level (squelch).

At the µP, the squelch determination is made from the average of two measurements which has an additional low pass filtering effect.

The programming defines at what level of the averaged squelch signal the AF amplifier is switched in. A hysterisis function is implemented (two different values for the on and off switching) which prevents the AF amplifier from being continuously switched on and off due to a varying squelch voltage. In practice this hysterisis corresponds to a level difference of 2-4 dB in the HF signal.

2.5 Speech memory

The speech memory is realized using the chip ISD 4003 (IC161). This chip is controlled by the 6 control lines MISO, MOSI, SCLK, SS, RAC and INT.

The record period of 240 secs in total can be selected into portions of 80 secs 40 secs, 20 secs or in dynamic modus. The speech memory can be enabled or disabled for specific addresses via programming. Messages which have been recorded can be replayed as often as required as long as they have not been erased and only recalled.

After each call input, the memory area with the earliest input time is overwritten. The last call always remains with the speech information as long as it will be overwritten.

3 PRINT INTERFACES OF RE529

3.1 Connection from Main board - Subprint

The main board and sub-boards are connected together with a 24 pin plug and socket.

Pin	Symbol		Connection	Function
1	V+	Sub	> Main	1 Volt supply
2	ZF	Main	> Sub	ZF-signal
3	GND	Main	= Sub	Ground
4	GND	Main	= Sub	Ground
5	NF/CMX	Sub	> Main	NF Signal for Correlator
6	SQ	Sub	> Main	Squelch signal
7	RE	Main	> Sub	Eco mode (Receiver Enable)
8	REC/PL	Main	> Sub	Select record/ play mode
9	NF	Sub	> Main	NF Signal
10	GND	Main	= Sub	Ground
11	GND	Main	= Sub	Ground
12	GND	Main	= Sub	Ground
13	SCLK	Main	> Sub	Speech memory control
14	MISO	Main	< Sub	Speech memory control
15	MOSI	Main	> Sub	Speech memory control
16	$\overline{SS}$	Main	> Sub	Speech memory control
17	VDD	Sub	> Main	3 V Supply voltage
18				
19	VDD	Sub	> Main	3 V Supply voltage
20	BAT+	Main	> Sub	1,26 V Accu /Battery voltage
21	RAC	Main	< Sub	Speech memory control
22	BAT+	Main	> Sub	1,26 V Akku /Battery voltage
23	$\overline{INT}$	Main	< Sub	Speech memory control
24	RESET	Main	< Sub	Reset for µP

4 CONNECTION FROM RECEIVER TO PERIPHERAL UNIT

The connection between the **LGxx 300/429 charger** and the **PGM 300/429 programmer** is made via the 6 pole edge connector on the main board. The access to this interface is possible through an opening in the casing. This interface may be used to update the firmware (OS) of the pager (flash memory)

The following signals appear on the edge connector:

Symbol	**Function**
HF/AF/RES	Input HF signal/ output AF signal/ reset flash mode
GND	Common ground
GND/S	Fixed ground (precontact)
RX	Communication with charger/programmer
TX	Communication with charger/programmer
CHARGE	Charge the accumulator, external supply operation