

5. Maintenance/adjustment

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Manual for TRX3001	TN	08-09-04	TN	30-11-00	1	PA

5.1 Environmental maintenance

5.1.1 Troubleshooting

The following points should be controlled in case of trouble:

- power supply: have the fuses blown? Check first external, then internal fuse.
- connection cables: are the connectors firmly fixed and the cables connected?
- are the cables damaged?

if not, return to supplier for service.

5.1.2 Adjustments

There are almost no adjustments to be made, but different microphones have different sensitivities.

5.1.2.1 Microphone sensitivity

The microphone sensitivity may be adjusted on the connection board. Establish a connection with another radio and adjust the sensitivity until it is just large enough. Too high sensitivity will not bring better sound, but the background noise will be amplified and transmitted.

5.2 Calibration

The following data shall be calibrated in a TRX 3001 radio:

- Frequency
- RF power
- Audio deviation
- Tone signalling deviation
- Squelch level
- Audio receiver level
- Battery warning level

To do this you need the following equipment:

- Test box (LF, Mic.) NIROS No. N3090
- DC power supply. 13.2 V / 10 A
- DC current meter.
- DC volt meter.
- Radio test setup. Stabilock, Marconi, etc.
- Test cable with TNC male.
- Test cables with BNC male.

To calibrate the radio you must bring it into what is termed '**service mode**'. This mode is protected against unwanted intrusion by a certain access method and a code. The service mode is menu driven to guide you to the various alignment procedures. If you have changed the calibration data you must store these explicitly in the calibration menu before you leave the service mode. You will be prompted with a '**Sto**' command to do this and the sequence is '**Sto**', '**Yes**'. If you do not store, the new data are lost when you leave the service mode.

You will see more menus in the radio than explained here. They are not used for normal calibration, so do not use them.

Any time you can change settings with 'B' or 'A' softkeys, you may just as well use the turnswitch

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(volume control) on the front. Turn clockwise to increase and anticlockwise to decrease settings. Values stated in adjustment tables are guideline values.

5.2.1 Entering service mode

Turn off the radio and then back on.

The radio normally display the sign on message for about 3 seconds and DEFORE this message disappear, press and hold BOTH the ON/OFF and the RED ALARM bottom.

When the display change release both bottom and the display shows :



- FileName** : The name of the current user configuration file programmed to the radio
- User** : The ID code/license for PC program that programmed the radio.
- BBBB** : The build number for the firmware.
- DDMMYY** : Date stamp for the firmware.
- FFFF** : SW version for control unit.

Enter the code '10011704' followed by "↵". The radio has now entered service mode. The display shows the main menu, the two text lines are shown:



At this point the radio is in service mode with the user configuration active, meaning the user defined channels, tonesystem and other settings is active, and this may conflict the calibration process. To achieve this problem a build in test configuration and setup should be selected. This will enable/disable all relevant functions and selecting a set of test channels, tonesekvenses etc..

IT IS IMPORTANT TO INITIATE THE TEST SETUP IF YOU WANT TO CALIBRATE THE RADIO.

Press "S" to activate the test set-up. You get the following display:



The current test frequency is taken from the test program which has three predefined frequencies: the lowest, one in the middle and the highest. The transmit frequencies are on the exact frequencies, whereas the receive frequencies are offset 100 kHz upwards. The test frequency is selected with the 'CH+' key, the number increases.

Example:

Channel	TX [MHz]	RX [MHz]
CH 1	146.000	146.100
CH 2	160.000	160.100
CH 3	174.000	174.100

The loudspeaker may be switched on and off using “LS”. The “LS” symbol toggles.
 SQ may be switched ON and Off using “3”.
 High, medium and low RF power may be selected using “2”

5.2.2 Alignment overview

In the main menu you press ' Cal ':



If you press ' Def ', you reset the radio to default parameters. It may not be completely correct, but it will be workable. To continue with the calibration you press ' Adj ' and get the ' ADJ Cal ' menu:



Menu	Sub-menu	Function
D/A	Sq	Squelch threshold and hysteresis
	Pa	H, M, L RF output power
	Ref	Frequency of reference oscillator
A/D	BAT	Low bat. voltage
Af	Rx	AF output level
	Tx	Tx modulation
	Ton	Tone system modulation

A standard sequence of alignment is:

- Battery low voltage
- Reference frequency
- RF power
- Tx deviation
- Tone system deviation if applicable
- Rx level
- Squelch threshold and hysteresis

Battery low and reference frequency shall only be performed if all data has been lost. On the other hand, these values are important before any other calibration is performed.

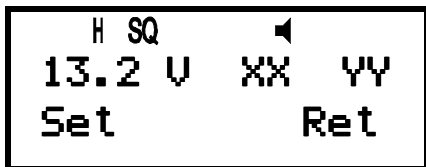
5.2.3 Battery low voltage

The value is predefined relative to 13.2 V, so the calibration is done by supplying the radio with exact 13.2 V and storing the measured value.

- Place the radio in service mode
- Select ' Cal ' for calibration
- Select ' Adj ' for adjustment
- Select ' A/D ' to get access to the A/D converter

You have now the following display:

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$V_{in} = 13.2 V \pm 0.1 V$

Adjust the external supply voltage to $13.2 V \pm 0.1 V$ measured at the power connector. 'YY' shows the current voltage in hex format, 'XX' shows the stored value. Check that 'YY' changes when the voltage is adjusted. Select 'Set' to store battery level and see that 'XX' is changed to the 'YY' value. Return to 'ADJ Cal' menu. To be sure to keep data, press 'END' and store data with 'Sto' and 'Yes':



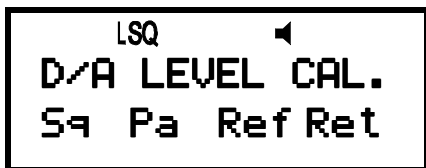
If you want to stop, press 'END'. Else continue with 'Adj' to adjust a new parameter.

5.2.4 Set reference frequency

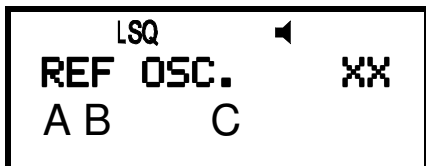
Connect the RF output to a frequency counter. Either the counter shall be able to withstand the full RF power, or the output must be attenuated before the counter. Select low RF power as this minimizes the heating effects. You do it with the "2" key. It is assumed that you start in the 'ADJ Cal' menu:



Select 'D/A'



Select 'Ref'



Adjust with 'A' and 'B' until the frequency on the counter shows the nominal Tx frequency. See that the 'XX' value changes. Return to 'ADJ Cal' menu. To be sure to keep data, press 'END' and store data with 'Sto' and 'Yes':



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If you want to stop, press ' **END** '. Else continue with another parameter.

5.2.5 Set RF output power

Connect the radio to a power meter. Select the middle channel. It is assumed that you start in the ' **ADJ Cal** ' menu:

```

LSQ      ◀
ADJ CAL. LEVEL
D/A A/D Af END
    
```

Select ' **D/A** '

```

LSQ      ◀
D/A LEVEL CAL.
S9 Pa Ref Ret
    
```

Select ' **Pa** '

```

LSQ      ◀
PA LEVEL      XX
A B D C
    
```

The PA level shall be adjusted to the High, Medium and Low power setting. Adjust the PA level with 'A' and 'B' until the reading is correct. The value ' **XX** ' shows the hex internal data and changes during the adjustment. Select 'D' and get the display:

```

LSQ      ◀
SET H/M/L      ?
H M L Ret
    
```

	2M/4M	DL			DH		
Power		CH1	CH2	CH3	CH1	CH2	CH3
H = High	23-30W	16-30W	22-30W	21-30W	21-30W	22-30W	21-30W
M = Medium	8-13W	8-13W	8-13W	8-13W	8-13W	8-13W	8-13W
L = Low	0,7-1,4W	0,7-1,4W	0,7-1,4W	0,7-1,4W	0,7-1,4W	0,7-14W	0,7-1,4W

The actual level will be stored in the selected position, and the radio returns to a new adjustment. Press ' **Ret** ' if you are unsure of the wanted setting, or the value is wrong. When the measurements are finished, press 'C' in the adjustment menu. Return to the ' **ADJ Cal** ' menu. To be sure to keep data, press ' **END** ' and store data with ' **Sto** ' and ' **Yes** '.

5.2.6 Calibrate Tx deviation

Select ' **L** ' (Low power) using "2" as this minimizes the heating effects.

The deviation sensitivity varies across the frequency band so the deviation must be calibrated at the lowest and the highest frequency. Select CH1 in the main menu and return to the ' **ADJ Cal** ' menu:

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```

LSQ      ◀
ADJ CAL. LEVEL
D/A A/D Af END
    
```

Select ' Af ':

```

LSQ      ◀
SET Af    LEVEL
Rx Tx Ton Ret
    
```

Select ' Tx ':

```

LSQ      ◀
SET TX CONTROL
P/F Lim Pk Nxt
    
```

The selection of phase or frequency modulation is made automatically. It shall only be changed in very specific circumstances where you want to verify the calibration.

The limiting circuit in the radio has a hard limiter and a soft limiter. First you must adjust the hard limiter with a high level signal to the maximum allowed deviation. After this, you must adjust the deviation level with a nominal input signal level to a deviation of 60% of maximum allowed deviation. The soft limiter works with a peak detector and adjusts the gain to avoid continuous distortion. To set the hard limiter, the peak detector must be switched off.

Select ' Pk ':

```

LSQ      ◀
TX PEAK DET.
On Off Ret
    
```

Set peak detector ' Off '. The menu returns automatically. Select ' Nxt ' and get:

```

LSQ      ◀
Af-Tx LEVEL
InP Pro Mod Ret
    
```

Select ' Mod ' and in the next menu always select "1". "2" is not used!

```

LSQ      ◀
LEVEL/OFFS CC
Lev Off Ch Ret
    
```

The sequence of channels is important. Start with the lowest frequency. Select ' Ch ' and select the lowest frequency using ' Ch- ' and ' Ch+ '. The channel number is shown in ' CC ' and shall read ' 01 '. Select ' Mod ' and select ' Yes ' to align the VCO at base offset. Select ' Ret ':

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```

LSQ
LEVEL/OFFS 01
Lev Off Ch Ret
    
```

If not done before, now is the time to connect the modulation signal and the deviation meter. The modulation input signal shall be set at 1 kHz and 50 mV. The output impedance of the generator must be less than 10 ohm or you must measure the level. Select ' **Lev** ':

```

LSQ
Af-Tx M1Lev XX
A B C
    
```

Channel spacing	Deviation
12.5 kHz	2.2 - 2.5 kHz
25 kHz	4.5 - 5.0 kHz

Adjust the deviation with 'A' and 'B' until the deviation is just below the maximum allowed deviation. ' **XX** ' shows the internal calibration value in the range 00 – 1F. Select ' **C** ' and return to the **LEVEL/OFFS** ' menu. Select ' **Ch** ' and adjust the channel to the highest frequency (03). Return with ' **Ret** ' to the **LEVEL/OFFS** ' menu. Select ' **Off** ':

```

LSQ
Af-Tx Offs 03
A B C
    
```

Adjust deviation with 'A' and 'B' until the deviation is just below the maximum allowed deviation. Return with 'C' to the **LEVEL/OFFS** ' menu. Press ' **Ret** ' again 3 times until the following menu appears:

```

LSQ
SET Af LEVEL
Rx Tx Ton Ret
    
```

Adjust the modulation signal to 5 mV. Select ' **Tx** ' and enable peak detector with ' **Pk** ' and ' **On** '. Press ' **Nxt** '. Select ' **Inp** ':

```

LSQ
Af-Tx IPLev X
A B D C
    
```

Channel spacing	Deviation 5mV	Deviation 50mV peak on
12.5 kHz	1.35 - 1.65 kHz	1.65 - 2.25 kHz
25 kHz	2.7 - 3.3 kHz	3.3 - 4.5 kHz

Adjust the deviation with 'A', 'B' keys to obtain 60% of maximum allowed deviation. ' **X** ' shows the internal data with a value between 0 and F. Increase input signal to 50 mV and check that modulation is between 65 and 90% of maximum allowed deviation. Select ' **C** ' and ' **Ret** ' until you reach the the ' **ADJ Cal** ' menu. Select ' **END** ' and store data with ' **Sto** ' and ' **Yes** ':


```

LSQ      ◀
CALIBRATION?
Adj Def Sto END
    
```

If you want to stop, press ' END '. Else continue with another parameter.

5.2.7 Tone system deviation

When the speech deviation is calibrated the basic modulation sensitivity is found. The tone deviation may then be adjusted. You start in the ' ADJ Ca1 ' menu:

```

LSQ      ◀
ADJ CAL. LEVEL
D/A A/D Af END
    
```

Select ' Af ':

```

LSQ      ◀
SET Af LEVEL
Rx Tx Ton Ret
    
```

Select ' Ton ':

```

LSQ      ◀
TONE MODULA.
FM PM Ctc Nxt
    
```

Select tone modulation as ' FM ' or ' PM '. See what is defined in the user program. **FM** is normally used.

```

LSQ      ◀
Test tone
500 1k 2k Ret
    
```

Select ' 1k ' and the transmitter starts automatically with a 1 kHz modulation tone.

```

LSQ      ◀
Af-Ton PLev X
A B      C
    
```

Channel spacing	FM	PM
12.5 kHz	1.4 - 1.75 kHz	0.85 - 1.0 kHz
25 kHz	2.8 - 3.5 kHz	1.7 - 2.0 kHz

Adjust with 'A', 'B' until deviation is as shown in the above table. Select 'C'. Select ' Ret ' until this menu appears:

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```

LSQ      ◀
SET Af LEVEL
Rx Tx Ton Ret
    
```

To adjust CTCSS, select ' Ton ' and ' Ctc ':

```

LSQ      ◀
Test tone
75 150 250 Ret
    
```

Select ' 150 ' to adjust the modulation of the 150 Hz tone:

```

◀● LSQ      ◀
Af-Ctcss Lev X
A B      C
    
```

Channel spacing	FM	PM
12.5 kHz	0.35 - 0.45 kHz	0.35 - 0.45 kHz
25 kHz	0.65 - 0.85 kHz	0.65 - 0.85 kHz

Adjust the deviation according to the above table. Press 'C'. When you have selected a CTCSS frequency, the receiver is activated to detect the same and open the loudspeaker. In this way it is possible to check the correct function of the receiving CTCSS system.

To return to the ' ADJ Cal ' menu, select ' Ret ' and ' Ret ' to obtain:

```

LSQ      ◀
ADJ CAL. LEVEL
D/A A/D Af END
    
```

To be sure to keep data, press ' END ' and store data with ' Sto ' and ' Yes ':

```

LSQ      ◀
CALIBRATION?
Adj Def Sto END
    
```

If you want to stop, press ' END '. Else continue with another parameter.

5.2.8 Rx level

The received audio is adjusted to produce maximum output level when the deviation is maximum. The necessary test equipment is an RF generator with modulation, with the following settings:

RF frequency	one of the test frequencies
RF level	-50 dBm
AF modulation freq.	1 kHz
Deviation	1.65 kHz @ 25 kHz channel spacing, 1 kHz @12.5 kHz

The speaker microphone should not be connected to the control unit. Connect the test box to the LS-output, and connect the LS signal to an AC voltmeter.

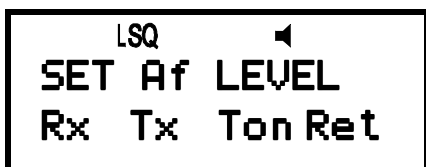


Ensure that the LS symbol is present. If not, press the key with the loudspeaker symbol.

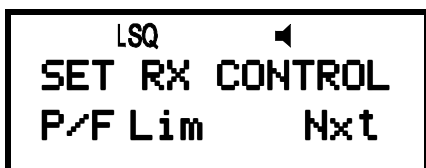
Go to the 'ADJ Cal' menu: press 'CAL', 'Adj'.



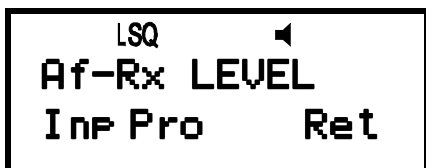
Select 'Af':



Select 'Rx' and turn the volume control to maximum level.

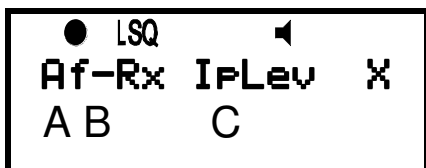


Select 'Nxt'. 'P/F' is chosen automatically.



The 'Pro' parameter should not be changed. It determines the processor global gain. The default value is 5.

Select 'InP'. Adjust the output level until the loudspeaker voltage is 3.8 V. The distortion shall be less than 10%, which means that it shall not be clipped:



3.5 – 4.1 V

Return with 'C', 'Ret' and 'Ret' to the 'ADJ Cal' menu. If you want to calibrate other data you may do this, or Select 'END' and store data with 'Sto' and 'Yes':

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```

LSQ      ◀
CALIBRATION?
Adj Def Sto END
    
```

If you want to stop, press ' END '. Else continue with another parameter.

5.2.9 Squelch threshold and hysteresis

Connect an RF generator, set at an RF test frequency, modulated with 1 kHz, and a deviation of 1.5 kHz at 12.5 kHz channel spacing, 3 kHz at 25 kHz channel spacing.. Enable the loudspeaker with the "LS" key if necessary. Enable SQ (if not enabled, press "3").

```

LSQ      ◀
ADJ CAL. LEVEL
D/A A/D Af END
    
```

Select ' D/A ' and get:

```

LSQ      ◀
D/A LEVEL CAL.
S9 Pa Ref Ret
    
```

Select ' S9 '.

```

LSQ      ◀
SQUELCH SET.
Lev Hys T91 Ret
    
```

Closing point to Ref. level	-3.7 - -2.3 dB
Opening point to closing point	+1.0 - +2.0 dB

Adjust the RF level until you obtain a SINAD of 12 dB. This is the reference level. Select ' Lev ' and set it to '99'. A higher value means a lower RF level for the squelch setting.

Select ' Hys ' and set it at '16'. A higher value means a larger hysteresis. Do a squelch measurement: Start above the reference level and decrease the value until the squelch closes. Closing point should be appr. -3 dB below the reference level. Increase the RF signal again until the squelch opens. This level should be appr. 1.5 dB above the closing point.

If the limit values shown above are not correct, you must adjust the settings. Remember that a higher squelch **Level** value means a lower closing point, and a higher squelch **Hysteresis** value means a larger squelch hysteresis.

Return to store and exit.