

NIRA I7rp Injector Driver Handbook

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NIRA I7rp Injector driver must be installed by professional automotive technicians in accordance with the instructions in this manual.

NIRA I7rp Injector driver is not certified for use on vehicles subject to emission standards unless the appropriate waivers have been issued. Please check with the relevant authorities for more information.

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Overview

NIRA I7rp Injector driver is a sophisticated electronic engine management system developed specifically for racing. NIRA I7rp Injector driver controls fuel pressure, fuel injection, idle speed, boost pressure and several other engine functions. It can be used with many different types of engines.

1.1 Content of your NIRA I7rp Injector driver Package

When you purchased NIRA I7rp Injector driver, you should have received the following:

- NIRA I7rp Injector driver
- ZIP file with NIRA rk mapping software

1.1.1 NIRA I7rp Injector driver

NIRA I7rp is a highly sophisticated, microprocessor based engine management system designed for OE applications. It controls fuel pressure, fuel injection, boost pressure, idle speed and several other engine functions.

NIRA I7rp Injector driver uses the injector control functions within the unit with specially designed software.

Setup, configuration and programming of NIRA I7rp Injector driver is done via the NIRA rk software.

1.1.2 NIRA rk

NIRA rk is the mapping software that allows you to setup and configure a large number of parameters in NIRA I7rp Injector driver. It is designed to run

on a PC using the Windows operating system and communicates with NIRA I7rp Injector driver via a serial connection.

The many functions of NIRA rk are described in detail starting in chapter 3.

NIRA rk is protected by applicable software copyright laws in your country. You may not distribute this software without the express written consent of NIRA Control AB. You may not copy this software other than for personal use. Your purchase of NIRA I7rp Injector driver includes a single license to use NIRA rk together with NIRA I7rp Injector driver.

1.2 NIRA I7rp Injector driver Functionality

NIRA I7rp Injector driver reads six digital inputs, processes the data and sends output signals to the piezo injectors.

By using the NIRA rk software, you have the ability to modify charge and discharge tables and control the data processing and the output signals in NIRA I7rp Injector driver.

1.2.1 Inputs

- **Battery voltage** (4)
- **Battery gnd** (3)
- **Injector trigger inputs** (6)
- **CAN** (2)
- **RS232** (3)

1.2.2 Output Functions

NIRA I7rp Injector driver processes the input signals and controls the output signals in order to manage the following engine functions.

- **Fuel injectors** (6 high, 6 gnd)

.

2

Installing NIRA I7rp Injector driver

2.1 Nira i7rp Injector module mounting

The I7rp Injector driver module is designed to cope with the harsh environmental conditions often present in engine applications. It is however wise to try to find the best practically possible location with regard to environmental influence such as spray, heat and EMI.

Mount NIRA I7rp Injector driver securely in a protected place in the preferably in the passenger compartment. Avoid overly hot areas, maximum 70°C.

2.2 Cable harness

The cable length, especially those to the injectors, shall be held as short as possible. The twisted pairs should be kept twisted all along the extension of the cable. The cable harness should be covered by a protective hose or equivalent to avoid wearing. Correct tooling for crimping of contact sockets should be used. The injector's output activation order is always in ascending order 1-2-3-4-5-6-7-8. The actual cylinder firing order of the engine is set by the wiring. Output 1 must always be connected to injector 1 though. Pin and connector distribution is defined in the schematics below.

2.2.1 Cable data

| Connections | Area | Type | Outer diameter | Temperature | Voltage |
|-------------|------|------|-------------------|-------------|---------|
|-------------|------|------|-------------------|-------------|---------|

Nira will supply the necessary connector and pins .

2.2.2 Connector data

One connector with two pockets are used with a total of 196 pins. One 91 pin connector for vehicle functions and one 105 pin connector for engine functions.

2.3 *Injector trigger Inputs*

2.3.1 *Injector trigg 1-6 (6)*

Six individual inputs for injector trigg inputs. These inputs has a pull up to 5V and trigger the injector charge phase when pulled low. When the signal goes high again the injector discharge phase is started.

NOTE! There is a constant 20us delay from activation of input until start of injection, i.e. start of the charge phase see Figure 1 Piezo Injector phase description. This delay should be added into the main systems injection angle calculation to get the correct injection timing

| | |
|----------------|---------------|
| High level: | > 3.8 V (typ) |
| Low level: | < 3.0 V (typ) |
| PWM frequency: | Up to 1000 Hz |

User Configuration

No configuration needed

2.4 *Fuel Injectors*

The driver outputs are divided into two banks where bank 1 handles injectors 1,3,5,7, while bank 2 handles injectors 2,4,6 and 8. The actuation sequence for the injector outputs is always inj1-inj2-... -inj8. The actual cylinder firing order is determined by the wiring to the injectors. Four injections per cylinder can be handled.

Piezo-electric injectors

The piezo-electric crystal in the injector is charged by a high voltage causing the injector to open. The high voltage is maintained for the duration of the injection. This is followed by a discharge of the crystal causing the injector to close. Timings of the injection sequence can be programmed to fit different

types of injectors. The voltage and current values are dependant on the characteristics of the injectors used.

| | |
|-----------------------------|------------------------|
| Injector capacitance range: | TBD |
| Open state voltage: | 120-190V (typ) |
| Closed state voltage: | 10-20V (typ) |
| Opening/closing current: | $\pm 10\text{A}$ (typ) |
| Timing resolution: | 1 μs |

User Configuration

The injector profiles needs to be adjusted for the injectors used and the shape that is wanted.

Four operational modes of the injectors can be identified:

- Charge:
A preset number of charge pulses are generated, the number of pulses is programmable. The On- and is individually programmable for each pulse.
- Hold:
The Hold Phase starts immediately after the last charge pulse is completed. The duration is roughly the same as the injection time – the charge time and thus it varies depending on the amount of fuel to be injected.
- Discharge:
A preset number of discharge pulses are generated , The number of pulses is programmable. The On- and is individually programmable for each pulse
- Idle:
The Idle Phase starts immediately after the last discharge pulse and continues until the next fuel injection on this bank starts.

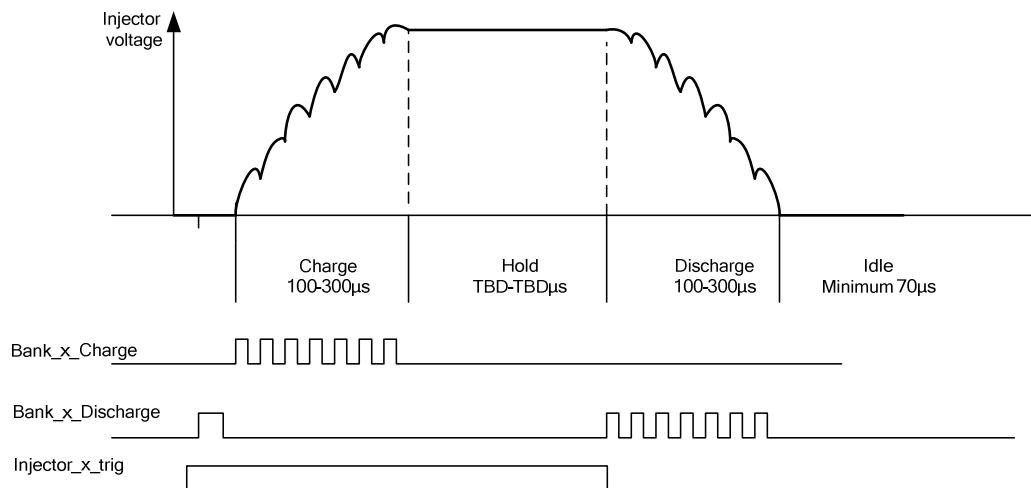


Figure 1 Piezo Injector phase description

There are 10 different voltage settings that can be used. Each setting consists of:

- Tpu Idp Charge Pulses x
- Tpu Idp Charge Profile x
- Tpu Idp Discharge Pulses x
- Tpu Idp Discharge Profile x

The choice between them are made with CAN message TBD, for more information see 2.5.3.

| Name | Resolution | Unit | Description |
|-----------------------------------|------------|------|---|
| Injector Conv | 1 | us | Injector map converting required fuel amount at a given pressure to injection time. |
| Pz Sup P Gain | 0.01 | % | Piezo voltage regulator P-term. |
| Pz Sup Pwm Max On Time | 0.1 | us | Maximum piezo voltage regulator on time |
| Pz Sup Pwm Min On Time | 0.1 | µs | Minimum piezo voltage regulator on time |
| Pz Sup Voltage Setpoint | 0.1 | V | Piezo voltage setpoint. Needs to be approx 20-30 volt higher that the Injector voltage. |
| Tpu Idp Charge Profile Duty1...10 | 0.01 | % | Injector charge voltage shape array. |
| Tpu Idp Charge Pulses1...10 | 1 | # | Number of charge pulses. Should be set to same number as the last item in the charge array that isn't |

| | | | |
|--------------------------------------|------|----|---|
| | | | equal to zero. |
| Tpu Idp Discharge Profile Duty1...10 | 0.01 | % | Injector discharge voltage shape array. |
| Tpu Idp Discharge Pulses1...10 | 1 | # | Numbe of discharge pulses. Should be set to same number as the last item in the discharge array that isn't equal to zero. |
| Tpu Idp Profile Period | 0.05 | µs | Injector charge/discharge signal period. |
| Tpu Pz Voltage Min | 0.1 | V | If the piezo voltage is lower than this value the injections are stopped. |

2.4.1 *Diagnostics*

The Nira i7rp measures the voltage on the active injector on each bank at:

- End of charge phase
- End hold phase
- End of discharge phase

If any of the above measurements are outside the mappable limits the injector is shut down and this can be reported back to the main unit with a can message, this implemented on customer demand.

To activate the injector again a power off cycle needs to be performed.

User Configuration

| Name | Resolution | Unit | Description |
|---------------------|------------|------|--|
| Tpu Idp Charge High | 1 | V | Maximum allowed voltage at the end of Charge phase |
| Tpu Idp Charge Low | 1 | V | Minimum allowed voltage at the end of Charge phase |

| | | | |
|------------------------|---|---|---|
| Tpu Idp Discharge High | 1 | V | Maximum allowed voltage at the end of Discharge phase |
| Tpu Idp Discharge Low | 1 | V | Minimum allowed voltage at the end of Discharge phase |
| Tpu Idp Hold High | 1 | V | Maximum allowed voltage at the end of Hold phase |
| Tpu Idp Hold Low | 1 | V | Minimum allowed voltage at the end of Hold phase |

Monitored Parameters

| Name | Resolution | Unit | Description |
|-------------------------|------------|------|---|
| Pz Sup Pwm Max On Time | 0.1 | us | Maximum allowed on time for piezo voltage regulator |
| Pz Sup Pwm On Time | 0.1 | µs | Calculated regulator on time |
| Pz Sup Voltage Error | 0.1 | V | Mesured Voltage |
| Pz Sup Voltage Setpoint | 0.1 | V | Mesured Voltage |
| Pz Supply Voltage | 0.1 | V | Mesured Voltage |
| Tpu Inj1 Charge Volt | 0.1 | V | Mesured Voltage |
| Tpu Inj1 Discharge Volt | 0.1 | V | Mesured Voltage |
| Tpu Inj1 Hold Volt | 0.1 | V | Mesured Voltage |
| Tpu Inj2 Charge Volt | 0.1 | V | Mesured Voltage |
| Tpu Inj2 Discharge Volt | 0.1 | V | Mesured Voltage |
| Tpu Inj2 Hold Volt | 0.1 | V | Mesured Voltage |
| Tpu Inj3 Charge Volt | 0.1 | V | Mesured Voltage |
| Tpu Inj3 Discharge Volt | 0.1 | V | Mesured Voltage |
| Tpu Inj3 Hold Volt | 0.1 | V | Mesured Voltage |
| Tpu Inj4 Charge Volt | 0.1 | V | Mesured Voltage |
| Tpu Inj4 Discharge Volt | 0.1 | V | Mesured Voltage |
| Tpu Inj4 Hold Volt | 0.1 | V | Mesured Voltage |
| Tpu Inj5 Charge Volt | 0.1 | V | Mesured Voltage |
| Tpu Inj5 Discharge Volt | 0.1 | V | Mesured Voltage |
| Tpu Inj5 Hold Volt | 0.1 | V | Mesured Voltage |
| Tpu Inj6 Charge Volt | 0.1 | V | Mesured Voltage |
| Tpu Inj6 Discharge Volt | 0.1 | V | Mesured Voltage |
| Tpu Inj6 Hold Volt | 0.1 | V | Mesured Voltage |
| Tpu Inj7 Charge Volt | 0.1 | V | Mesured Voltage |
| Tpu Inj7 Discharge Volt | 0.1 | V | Mesured Voltage |
| Tpu Inj7 Hold Volt | 0.1 | V | Mesured Voltage |
| Tpu Inj8 Charge Volt | 0.1 | V | Mesured Voltage |
| Tpu Inj8 Discharge Volt | 0.1 | V | Mesured Voltage |
| Tpu Inj8 Hold Volt | 0.1 | V | Mesured Voltage |



2.5 Non engine interface

The following inputs and outputs are primarily intended for interfacing to non-engine devices. They are all accessed from the B connector.

2.5.1 Power supply

Three input pins each are reserved for the positive and negative supply to the module. Normally the supply is sourced from a 12V battery. The power supply can be constant on since the Key input is used to activate/deactivate the unit.

Power supply should be between +9 and +16 Volt

2.5.2 Key input

The key input activates and deactivates the Nira i7rp unit.

2.5.3 CAN serial link

CAN communication link for communication with dashboard, other systems, diagnostic tools etc. SAE J1939 protocol is implemented.

| | |
|-----------------|---------------|
| Data Layer: | J1939 |
| Physical layer: | ISO11898-2. |
| Physical media: | twisted pair. |
| ID: | 29 bits |
| Speed: | 250kbps |

CAN Messages

Specification of the CAN messages used in the system.

| Transmitter | Identifier (hex) | Length (bytes) | Cycle time | Bit position | Bit length | Signal name | Description | Default value | Byte Format | Value range | Normalization | Resolution |
|-------------|------------------|----------------|------------|--------------|------------|-------------|-------------|---------------|-------------|-------------|---------------|------------|
|-------------|------------------|----------------|------------|--------------|------------|-------------|-------------|---------------|-------------|-------------|---------------|------------|

| | | | | | | | | | | | | |
|-----|------------|---|-------|----|---|----------------------|--|---|-------|---|--|---|
| i7r | 0x0CFF9584 | 8 | 100ms | | | I7R_INJECTOR | | | | | | |
| | | | | 0 | 8 | I7R_INJECTOR_STATUS | Indicates if the respective injector is ok=0 or if a fault is detected = 1. Bit 0 = injector 1 | 0 | Intel | 0= No Fault 1=Fault | | 1 |
| | | | | 8 | 8 | I7R_INJECTOR_FAULTS | The 4 highest bits shows fault on bank a, i.e. inj 1,3 and 5. The 4 lower bits shows error for bank B, i.e. injector 2,4 and 6. If several faults on each bank this byte shows last detected fault. | 0 | Intel | 0=No Fault 1=Charge Over 2=Charge Under 3=Hold Over 4=Hold Under 5=Discharge Over 6=Discharge Under | | 1 |
| | | | | 16 | 8 | I7R_INJECTOR_PROFILE | Indicates active injector profile | 1 | Intel | 1 to 10 | | 1 |

| | | | | | | | | | | | | |
|-----|------------|---|--|---|---|------------------|---|---|-------|---------|--|---|
| ECU | 0x0CFF9591 | 8 | | | | | | | | | | |
| | | | | 0 | 8 | MAIN_ECU_PROFILE | Sets wich injector profile to use. The change is activated at the next consecutive injection. | 1 | Intel | 1 to 10 | | 1 |

| | | | | | | | | | | | | |
|--|--|--|--|---|----|--------------|------------|---|-------|--|--|-----|
| | | | | 8 | 16 | MAIN_ECU_RPM | Engine RPM | 0 | Intel | | | 0,2 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

2.6 *Interface/ pin outline*

The I7rp Injector driver module is designed to cope with the harsh environmental conditions often present in engine applications. It is however wise to try to find the best practically possible location with regards to environmental influence such as spray, heat and EMI.

Mount NIRA I7rp Injector driver securely in a protected place in the passenger compartment. Avoid overly hot areas, maximum 70°C. For mounting in other areas please contact Nira for advise.

Connector1 = 105 pin Engine Connector

| | | | | | | | | | | | | | | | | | | | | |
|---------------------|---------------------|---------------------|---------------------|---------------|--------------|---------------|--------------------|----------------------|----------------------|--------------------|--------------------|--------------------|--------------------|--------------------|----------------|----------------------|-----------------------|----------------|--------------------|----------------------|
| 85 INJ1_LS | 86 INJ3_LS | 87 INJ5_LS | 88 INJ7_LS | 89 SPARE_1 | 90 HB1_M+ | 91 HB1_M- | 92 CKP_GN D | 93 CKP_SIG _I- | 94 CKP_SIG _I+ | 95 CKP_SUP | 96 KS1_A | 97 KS2_A | 98 KS3_A | 99 KS4_A | 100 T11_SIG | 101 T12_SIG | 102 T1112_G ND | 103 SPARE_2 | 104 CCO3_LS | 105 SWSUP1 _E1 |
| 64 INJ1_HS | 65 INJ3_HS | 66 INJ5_HS | 67 INJ7_HS | 68 SPARE_3 | 69 HB2_M+ | 70 HB2_M- | 71 CMP_GN D | 72 CKP_SIG _H | 73 CMP_SIG | 74 CMP_SU P | 75 KS1_B | 76 KS2_B | 77 KS3_B | 78 KS4_B | 79 T13_SIG | 80 T14_SIG | 81 T1314_G ND | 82 SPARE_4 | 83 CCO4_LS | 84 SWSUP1 _E2 |
| 43 INJ_SPA_ 1 | 44 INJ_SPA_ 2 | 45 INJ_SPA_ 3 | 46 INJ_SPA_ 4 | 47 SPARE_5 | 48 HB3_M+ | 49 HB3_M- | 50 HB1_GND | 51 HB2_GND | 52 HB34_GN D | 53 AS12_GN D | 54 AS34_GN D | 55 AS56_GN D | 56 HB34_SU P | 57 AS56_SU P | 58 T78_GND | 59 T910_GN D | 60 PULSE12 _GND | 61 SPARE_6 | 62 PWM7_L S | 63 PWM8_L S |
| 22 INJ2_HS | 23 INJ4_HS | 24 INJ6_HS | 25 INJ8_HS | 26 SPARE_7 | 27 HB4_M+ | 28 HB1_SUP | 29 HB1_POS 1 | 30 HB2_POS 1 | 31 HB3_POS | 32 AS1_SIG | 33 AS4_SIG | 34 AS5_SIG | 35 AS12_SU P | 36 T77_SIG | 37 T9_SIG | 38 PULSE1_ SIG | 39 PULSE3_ GND | 40 SPARE_9 | 41 PWM9_L S | 42 SWSUP2 _E1 |
| 1 INJ2_LS | 2 INJ4_LS | 3 INJ6_LS | 4 INJ8_LS | 5 SPARE_8 | 6 HB4_M- | 7 HB2_SUP | 8 HB1_POS 2 | 9 HB2_POS 2 | 10 HB4_POS | 11 AS2_SIG | 12 AS3_SIG | 13 AS6_SIG | 14 AS34_SU P | 15 T8_SIG | 16 T10_SIG | 17 PULSE2_ SIG | 18 PULSE3_ SIG | 19 SW1_SIG | 20 PWM10_L S | 21 SWSUP2 _E2 |

Connector2 = 91 pin Vehicle Connector

| | | | | | | | | | | | | | | | | | | |
|---------------------|-------------|---------------------|---------------|--------------|--------------------|------------------------|------------------------|---------------------|--------------------|--------------------|---------------------|--------------------|----------------------|----------------------|---------------------|--------------------|-------------------|-------------------|
| 5 KL15_1 | 6 KL31_1 | 75 SWSUP1 _V1 | 76 VCAN_H | 77 VCAN_L | 78 HFM1_G ND | 79 HFM1_MA SS_DG | 80 HFM1_MA SS_AN | 81 HFM1_TE MP | 82 LS1_CP | 83 LS1_VN | 84 LS2_CP | 85 LS2_VN | 86 PULSE4_ GND | 87 PULSE4_ SIG | 88 SPA_GND _1 | 89 MAINR_L S | 90 PWM1_L S | 91 PWM4_L S |
| 3 KL15_2 | 4 KL31_2 | 58 SWSUP1 _V2 | 59 ECAN_H | 60 ECAN_L | 61 HFM2_G ND | 62 HFM2_MA SS_DG | 63 HFM2_MA SS_AN | 64 HFM2_TE MP | 65 LS1_CA | 66 LS1_VG | 67 LS2_CA | 68 LS2_VG | 69 PULSE5_ GND | 70 PULSE5_ SIG | 71 SPA_GND _2 | 72 RLY1_LS | 73 PWM2_L S | 74 PWM5_L S |
| 1 KL15_3 | 2 KL31_3 | 41 KEY | 42 APP_TX | 43 APP_RX | 44 T12_GND | 45 T1_SIG | 46 T2_SIG | 47 AIN1_GN D | 48 APP_GND 1 | 49 APP_GND 2 | 50 AS7_GND | 51 AIN2_GN D | 52 PULSE6_ GND | 53 PULSE6_ SIG | 54 SPA_GND _3 | 55 RLY2_LS | 56 PWM3_L S | 57 PWM6_L S |
| 24 SWSUP2 _V1 | 25 LIN_2 | 26 LIN_1 | 27 T34_GND | 28 T3_SIG | 29 T4_SIG | 30 AIN1_SIG | 31 APP_POS 1 | 32 APP_POS 2 | 33 AIN2_SIG | 34 AS7_SIG | 35 SPA_GND _4 | 36 SW2_SIG | 37 SW4_SIG | 38 RLY3_LS | 39 CCO2_LS | 40 LS1_HT | | |
| 7 SWSUP2 _V2 | 8 LIN_3 | 9 APP_BOO T | 10 T56_GND | 11 T5_SIG | 12 T6_SIG | 13 SEN_SUP 1 | 14 APP_SUP 1 | 15 APP_SUP 2 | 16 SEN_SUP 2 | 17 AS7_SUP | 18 SPA_GND _5 | 19 SW3_SIG | 20 SW5_SIG | 21 SW6_SIG | 22 CCO1_LS | 23 LS2_HT | | |

NIRA rk Software

NIRA rk is used to map NIRA I7rp Injector driver. NIRA rk is also used to log data while the engine is running for later analysis. By using NIRA rk and applying your knowledge of engine tuning you can prepare for the mapping effort by entering certain parameters for your specific engine. This gives you a base mapping which will save you time later when you connect NIRA rk to NIRA I7rp Injector driver.

NIRA rk installs on a PC and connects to NIRA I7rp Injector driver via the COM port, or via a USB port with a USB-COM adapter.

3.1 *Installation of NIRA rk*


Minimum System Requirements:

- Pentium or Pentium compatible 450 MHz processor
- Windows 98/2000/XP/VISTA/WINDOWS 7/WINDOWS8
- 64 MB of RAM
- 20 MB disk space (100MB recommended)
- 800 x 600, SVGA color monitor (minimum 256 colors)
- 2X CD-ROM (4X recommended)
- Mouse
- One available COM port (or USB port if a USB-COM port adapter is available)

To install NIRA rk on your PC, execute the NIRA-rk.exe file on the CD. This will launch the NIRA rk Setup Wizard, which will guide you through the installation process. Follow the directions in the dialog boxes.




Picture 3-1: Setup Wizard used to install NIRA rk.

Once the installation is finished, you should have two new icons on your desktop. The NIRA rk icon  launches NIRA rk and the Engine Simulator icon launches an engine simulator program which can be used together with NIRA rk for development purposes. Operation of the Engine Simulator is covered in a separate manual.

3.2 *Getting Started*

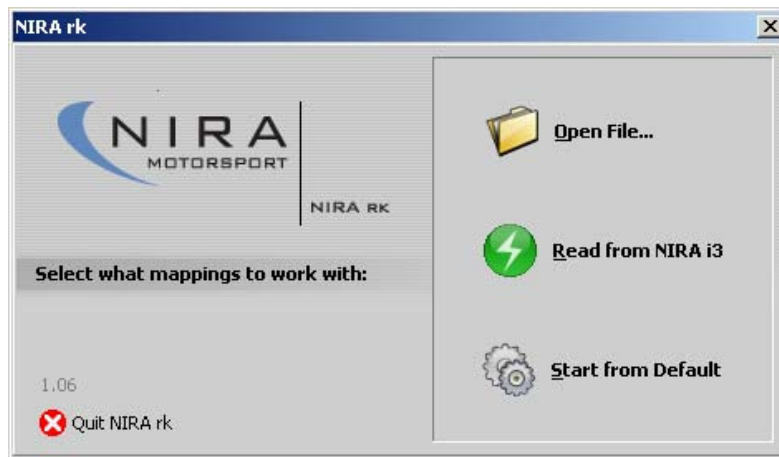
This chapter will give you an overview of NIRA rk and its functions. Do not connect NIRA I7rp Injector driver to NIRA rk until you've read this chapter and understand fully how NIRA rk operates.

3.2.1 *Launching NIRA rk*

Click on the NIRA rk icon  on your desktop, or choose Start → Programs → NIRA rk.

3.2.2 *Welcome Screen*

Once you have launched NIRA rk, you will see the Welcome Screen.

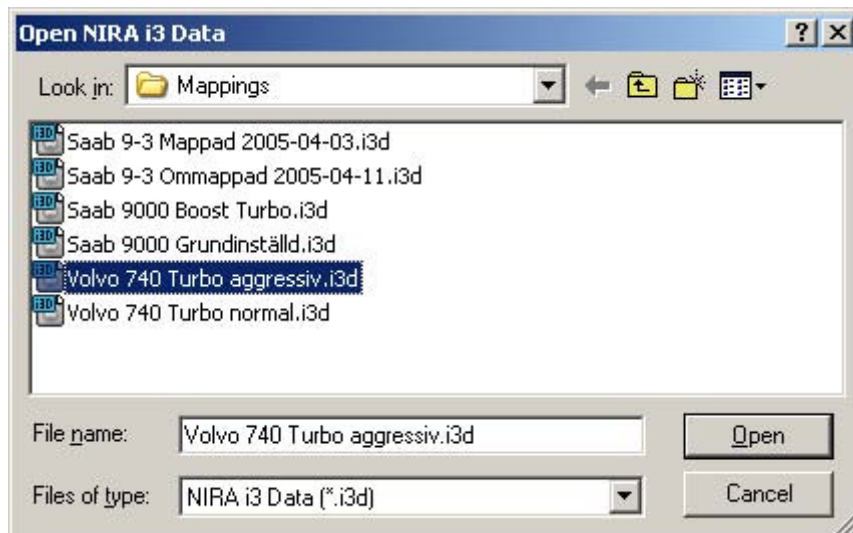


Picture 4-2. Welcome Screen

In this screen you can choose among several options. **Open File...** lets you open an existing i3d file (a file with mapping data.) **Read from NIRA I7rp Injector driver** loads mapping data from NIRA I7rp Injector driver into NIRA rk. **Start from Default** starts NIRA rk with default settings.

If you are using an i3d-file supplied by your NIRA dealer, it's recommended that you first make a copy of the file before making any changes. This way you can always return to the original file. Select one of the supplied i3d-files that fits your engine type the first time you launch NIRA rk.

If you select "Start from Default", NIRA rk will start in a default mode and all adjustments have to be done by you.



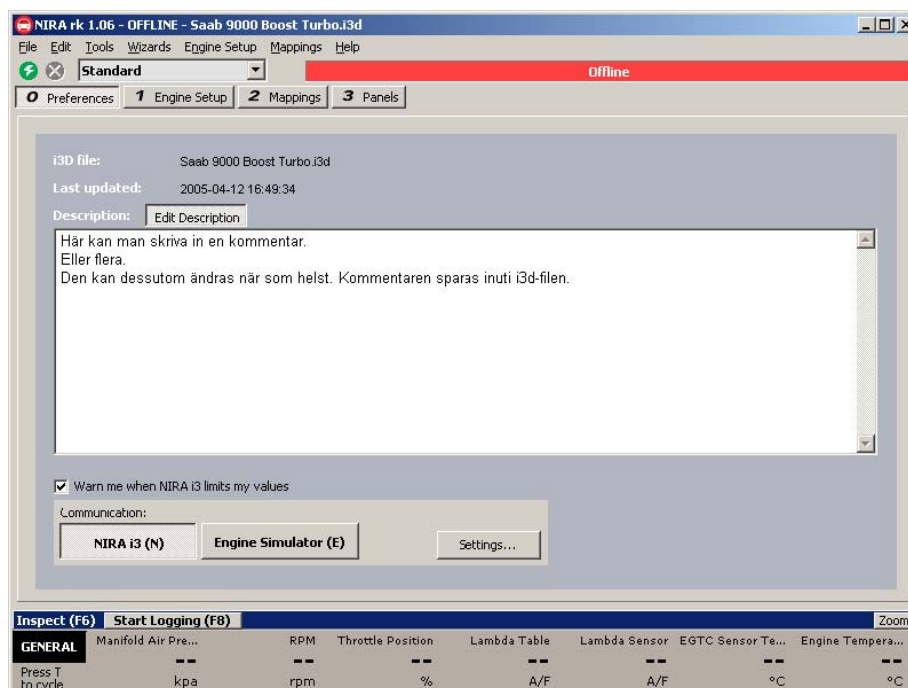
Picture 3-3: Opening an appropriate i3d.

3.3 Using NIRA rk

Once you have selected and loaded an i3d-file, NIRA rk takes you to the Preferences window (Picture 4-5.) This screen tells you when the i3d-file was last updated and you can add comments. You can also choose if you want NIRA rk to connect to NIRA I7rp Injector driver or Engine Simulator. Engine Simulator lets you simulate engine running parameters in software and doesn't require a physical connection to NIRA I7rp Injector driver

At the top of the main program window, below the main menu, is a red bar with the word Offline in it. This status bar shows the state of the connection to NIRA I7rp Injector driver. Connect by clicking the green circle in the top left corner or press "F9"

It's also possible to read any mappings already in NIRA I7rp Injector driver. ("Read from NIRA I7rp Injector driver" under "File" in the main menu.) Only use this option if you've previously gone online with NIRA I7rp Injector driver.

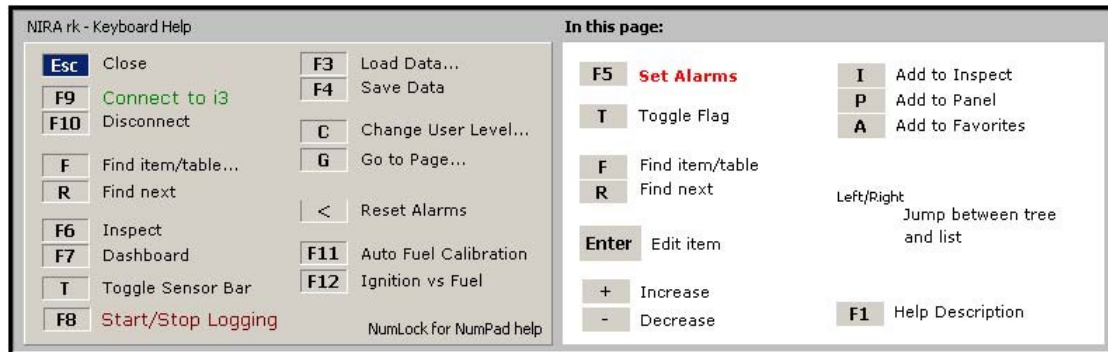


Picture 3-5: The "Preferences" tab lets you add comments and choose whether you want to simulate engine running values (Engine Simulator) or connect to NIRA I7rp Injector driver.

If you can't connect to NIRA I7rp Injector driver, check the connection settings by clicking on "Settings...". This lets you choose the port to which NIRA I7rp Injector driver is connected. You can also launch "Auto Find NIRA I7rp Injector driver", which searches all ports and selects the one to which NIRA I7rp Injector driver is connected.

3.3.1 Keyboard Help

A useful shortcut key to remember is **F2**. Holding down **F2** brings up the Keyboard Help dialog box. The dialog box shows what can be done in the current view (and thus, it changes depending on the view.)

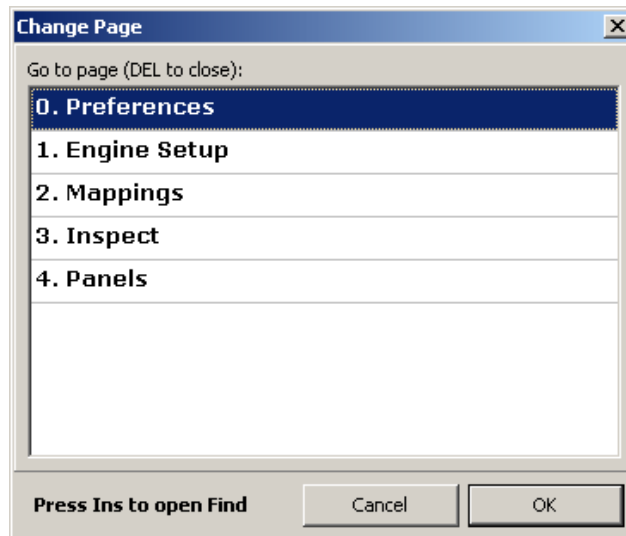


Picture 3-6: Holding down the F2 key brings up a window showing all available commands in the current view.

3.3.2 Tabs

NIRA rk uses tabs to organize different views of parameters, graphs, tables etc. When a new window is opened a new tab is added. This allows for quick switching among views. Each new tab gets a number in addition to a name.

You can switch tabs by clicking on the tab with the mouse or by hitting the **G** key on the keyboard, which brings up the Change Page dialog box (see below) and then selecting the desired tab using the up and down arrows on the keyboard. **Shift-G** takes you directly to the next tab in order.



Picture 3-7: 'G' (or '5' on the numeric keypad with NumLock off) brings up the "Change Page" dialog box.

You can close a tab by hitting **Esc** or right-clicking on the tab and selecting "Close". The first five tabs can never be closed.


While in the Change Page dialog box, you can also close a page by selecting it and hitting the **Del** key on the keyboard.

3.4 Parameters

Mapping of NIRA I7rp Injector driver is done by assigning values to parameters in NIRA rk.

There are three main types of parameters:

- **A monitor:** Monitors typically represent physical values, such as RPM, engine temp etc. These values come from inputs signals to NIRA I7rp Injector driver. Monitor values are written in black and are preceded by a blue arrow →. These parameter values cannot be changed. All monitors are available under the category called "Monitor Output".
- **A value:** Certain parameters are output signals from NIRA I7rp Injector driver, e.g. to the fuel injectors or the boost pressure control valve. Other parameters are constants used by NIRA I7rp Injector driver to calculate output signals. Both types of parameters are written in green and can be changed by the user.
- **A table:** Tables are the most powerful parameter type. They are used for output signals from NIRA I7rp Injector driver and allow for fine-tuning of the output signal value based on other parameters. A good example is the Lambda Table, where lambda values are entered based

on RPM and fuel mass. Tables are marked by a -icon in front of the name.

NIRA I7rp Injector driver has a number of tables dedicated to setting up the Aux outputs, including which input signals are used to control the outputs.

Parameter values written in green can be changed. Those written in black cannot.

At the left edge of the main window is a folder view of all possible parameters. The parameters are grouped into logical sets, such as Fuel, Ignition, Engine Start, etc. Subfolders further separate mapping parameters to make it easier to keep track of things.

NIRA rk starts in Standard mode. If you feel that variables are missing you can select Advanced mode from the drop down list at the top of the main window. This setting exposes more mapping variables. It's recommended that you leave the mode setting as Standard.


3.4.1 *Sorting and Parameter Descriptions*

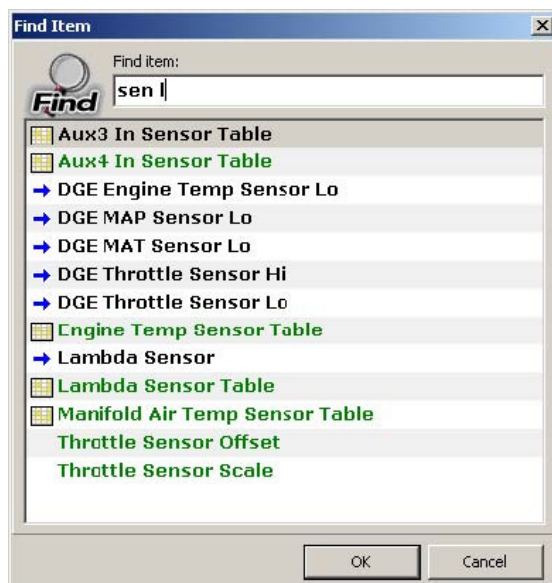
Parameters can be sorted alphabetically, numerically or according to unit by selecting Item Name, Value or Unit respectively at the top of the parameter list. When you move the mouse cursor over a parameter a small help bubble will appear with information about the parameter. You can also press **F1** to get the same information for any highlighted parameter.

| Item name | Value | Unit |
|--|----------------|------------------|
| CAM Signal | 360-720 | csd |
| Cyl 1 From 2 Lost | 86 | csd |
|  Cylinder Top Dead ... | | |
| Tillåtet intervall för vinkel, i grader, mellan 2-lost och Top Dead Center (TDC) för första cylindern i tändordningen. | | 428.9 cm3 |
| | | signal |

Picture 4-8: A small help bubble appears when the mouse cursor is placed over a parameter name.

3.4.2 *Searching*

You can search for a parameter by clicking on the magnifying glass icon () or by hitting **F** on the keyboard. To go to the next parameter matching your search criterion, hit **R**.



Picture 4-9: Searching for a parameter.

You can search for multiple parts of a parameter name by separating the search criteria with spaces. E.g. "th po" gives you a match for "Throttle Position" and "sens la" would give you a match for "Lambda Sensor". As you type in the letters, the search result is updated continuously.

3.4.3 Alarms

In addition to the built-in diagnostic alarms in NIRA I7rp Injector driver, which, among other things, check input signal levels, it's possible to set user alarms using NIRA rk. Hit **F5** or right-click on a parameter and choose "Set Alarm..."

It's only possible to set alarms on monitors (see section 3.4.) Monitors are identified by a blue arrow (→) in front of the parameter name. Once a monitor has an alarm associated with it, the arrow changes colors to red (→.)

3.4.4 Flags

| | | |
|-----------------------------|---------|---|
| EGTC Fuel Comp Factor Table | -- % |  |
| Fuel Injection Stop To Tdc | 210 csd |  |
| Fuel MatMap Comp Table | -- % | |
| Lambda Table | -- A/F | |
| Throttle to MAP Table | -- kPa | |

As a tool to mark parameters, e.g. which parameters still need mapping, there's a flag feature available. Flag a parameter either by clicking in the flag

column of the parameter or by clicking on the "Toggle Flag" button. Monitor parameters (see section 3.4) cannot be flagged.

All parameters that have been flagged can be viewed in the "Flagged Items" folder in the tree view to the left. Unflagged parameters can be viewed in the "Unflagged Items" folder.

3.4.5 Favorites

You can add parameters to a special folder called "Favorites." This lets you collect parameters of particular interest for quick access later.

3.4.6 Changing Parameter Values

In order to change a parameter value, highlight it and then hit **Enter** on the keyboard. Alternatively, double-click on the parameter name. If you're online with NIRA I7rp Injector driver at the time, any changes in the parameter value will be uploaded to NIRA I7rp Injector driver immediately. Otherwise, the changes will be uploaded next time you connect to NIRA I7rp Injector driver.


| | |
|------------------------|---------------------|
| RPM Limit Mode | Ignition cut |
| RPM Limit Range | 300.0 rpm |
| Rps Count | * |
| Rps Old | 0 * |
| Spare 1 | 0 * |

Picture 4-10: Double-clicking or hitting Enter lets you change a parameter value.

You can also change the value with the plus and minus keys. Enter the parameter addition/subtraction in the "+/-" box above the list.

The delta is unique for each parameter, so if you want the same delta to apply to a number of parameters, you need to enter this value for each parameter.

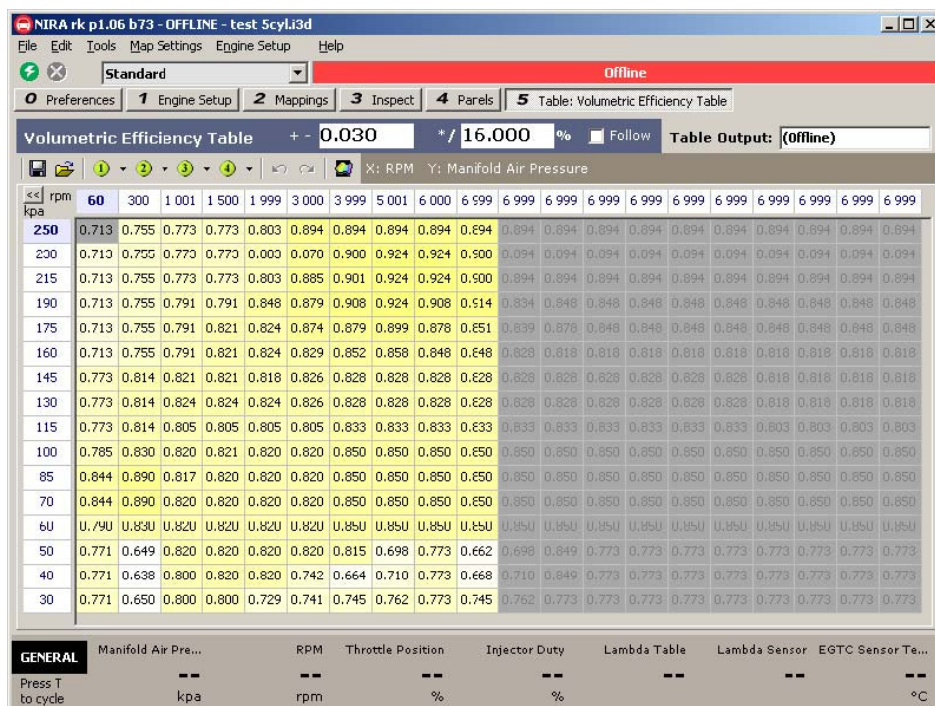
3.4.7 Tables

Some parameter names are preceded by a grid icon (). This icon indicates that the parameter is a table. Tables can be two- or three-dimensional.

Tables control output values from NIRA I7rp Injector driver based on other parameter values. Typically these parameter values are sensor values, such as rpm or MAP.

Depending on the number of parameter values, the table is one-, two- or three-dimensional. NIRA rk has only a few three-dimensional tables.

A typical one-dimensional table is the engine temperature sensor. The output is a function of a single parameter. When you map the temperature sensor you enter the temperature for different sensor signal voltages.



Volumetric Efficiency Table + - 0.030 * / 16.000 % Follow Table Output: (Offline)

X: RPM Y: Manifold Air Pressure

| rpm | 60 | 300 | 1 001 | 1 500 | 1 999 | 3 000 | 3 999 | 5 001 | 6 000 | 6 599 | 6 999 | 6 999 | 6 999 | 6 999 | 6 999 | 6 999 | 6 999 | 6 999 | 6 999 |
|-----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 250 | 0.713 | 0.755 | 0.773 | 0.773 | 0.803 | 0.894 | 0.894 | 0.894 | 0.894 | 0.894 | 0.894 | 0.894 | 0.894 | 0.894 | 0.894 | 0.894 | 0.894 | 0.894 | 0.894 |
| 230 | 0.713 | 0.755 | 0.773 | 0.773 | 0.803 | 0.894 | 0.894 | 0.894 | 0.894 | 0.894 | 0.894 | 0.894 | 0.894 | 0.894 | 0.894 | 0.894 | 0.894 | 0.894 | 0.894 |
| 215 | 0.713 | 0.755 | 0.773 | 0.773 | 0.803 | 0.885 | 0.901 | 0.924 | 0.924 | 0.900 | 0.894 | 0.894 | 0.894 | 0.894 | 0.894 | 0.894 | 0.894 | 0.894 | 0.894 |
| 190 | 0.713 | 0.755 | 0.791 | 0.791 | 0.848 | 0.879 | 0.908 | 0.924 | 0.908 | 0.514 | 0.834 | 0.848 | 0.848 | 0.848 | 0.848 | 0.848 | 0.848 | 0.848 | 0.848 |
| 175 | 0.713 | 0.755 | 0.791 | 0.821 | 0.824 | 0.874 | 0.879 | 0.899 | 0.878 | 0.851 | 0.839 | 0.878 | 0.848 | 0.848 | 0.848 | 0.848 | 0.848 | 0.848 | 0.848 |
| 160 | 0.713 | 0.755 | 0.791 | 0.821 | 0.824 | 0.829 | 0.852 | 0.858 | 0.848 | 0.848 | 0.828 | 0.818 | 0.818 | 0.818 | 0.818 | 0.818 | 0.818 | 0.818 | 0.818 |
| 145 | 0.773 | 0.814 | 0.821 | 0.821 | 0.818 | 0.826 | 0.828 | 0.828 | 0.828 | 0.828 | 0.828 | 0.828 | 0.828 | 0.828 | 0.828 | 0.828 | 0.818 | 0.818 | 0.818 |
| 130 | 0.773 | 0.814 | 0.824 | 0.824 | 0.824 | 0.826 | 0.828 | 0.828 | 0.828 | 0.828 | 0.828 | 0.828 | 0.828 | 0.828 | 0.828 | 0.828 | 0.818 | 0.818 | 0.818 |
| 115 | 0.773 | 0.814 | 0.805 | 0.805 | 0.805 | 0.805 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.803 | 0.803 | 0.803 |
| 100 | 0.785 | 0.830 | 0.820 | 0.821 | 0.820 | 0.820 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 |
| 85 | 0.844 | 0.890 | 0.817 | 0.820 | 0.820 | 0.820 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 |
| 70 | 0.844 | 0.890 | 0.820 | 0.820 | 0.820 | 0.820 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 |
| 60 | 0.790 | 0.850 | 0.820 | 0.820 | 0.820 | 0.820 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 |
| 50 | 0.771 | 0.649 | 0.820 | 0.820 | 0.820 | 0.820 | 0.815 | 0.698 | 0.773 | 0.662 | 0.698 | 0.849 | 0.773 | 0.773 | 0.773 | 0.773 | 0.773 | 0.773 | 0.773 |
| 40 | 0.771 | 0.638 | 0.800 | 0.820 | 0.820 | 0.742 | 0.664 | 0.710 | 0.773 | 0.668 | 0.710 | 0.849 | 0.773 | 0.773 | 0.773 | 0.773 | 0.773 | 0.773 | 0.773 |
| 30 | 0.771 | 0.650 | 0.800 | 0.800 | 0.729 | 0.741 | 0.745 | 0.762 | 0.773 | 0.745 | 0.762 | 0.773 | 0.773 | 0.773 | 0.773 | 0.773 | 0.773 | 0.773 | 0.773 |

GENERAL Manifold Air Pre... RPM Throttle Position Injector Duty Lambda Table Lambda Sensor EGTC Sensor Te...

Press T to cycle kpa rpm % % % °C

Picture 4-11: A two-dimensional table; it uses rpm and MAP as input variables.

A two-dimensional table uses two input signals; one on the x-axis and one on the y-axis. The output signal is a function of both input signals, e.g. rpm and MAP.

Finally, a three dimensional table uses three input signals. An example of a three-dimensional table in NIRA rk is the Boost Before Throttle table. (This table is used as part of the boost pressure control if there's no pressure sensor before the throttle. See section **Error! Reference source not found.**)

The Boost Before Throttle table is populated with the values that a real pressure sensor would have been outputting had it been present. The pressure is entered as a function of rpm, boost pressure and throttle position. Entering of values is done in multiple two-dimensional tables where each table represents a particular rpm value. NIRA I7rp Injector driver later interpolates between each rpm-specific table to create smooth transitions.

3.4.8 Editing Tables

To edit tables, double-click on the parameter name or highlight the name and hit **Enter**. A new tab will open up displaying the table contents.

As always, **F2** opens a window that lists all possible functions in this view.

There are multiple ways of changing table values. One way is to edit the content of each individual cell. Right-clicking on a table cell opens up a menu listing different options for editing the value.

Changing Multiple Cells

To edit multiple cells simultaneously, or have a formula affect multiple cells, the cells first have to be highlighted. See picture 4-13 below. Highlighting is done by holding down the left mouse button while moving the mouse, or by holding down the **Shift**-key while using the arrow keys to select the cells.

Increasing/Decreasing Cell Values

A simple, straightforward way of working with cell values is to use the **+**, **-**, ***** and **/** keys.



Picture 4-12: Enter the delta/ratio increase/decrease for the **+**, **-**, ***** and **/** keys.

The boxes above the table show the absolute increase/decrease of the cell values (for the **+** or **-** keys) or the %-age increase/decrease of the cell values (for the ***** or **/** keys.) In the case above, the value would increase with 0.1 if you hit the **+** key and increase 10% if you hit ***** key. If multiple cells are highlighted, they will all be affected.

Lambda Table + - **0.01** * / **10** %

1 2 3 4 X: RPM Y: Intake Air Mass

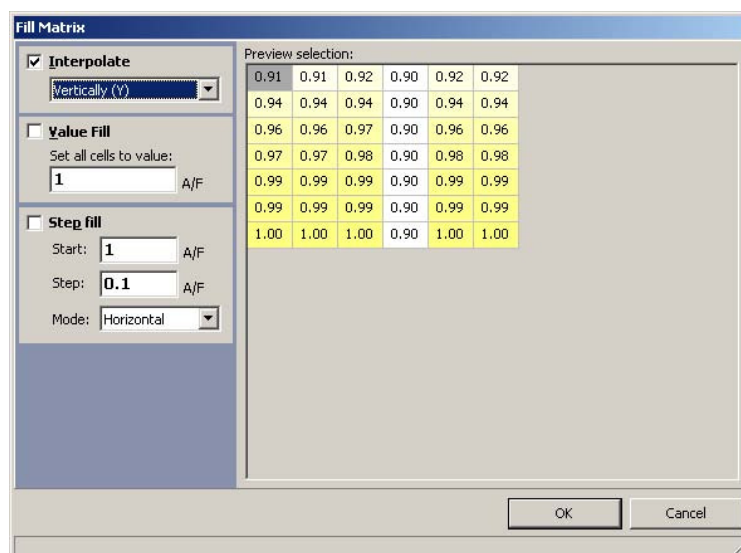
| << rpm mg/stroke | 99 | 212 | 324 | 437 | 549 | 6 000 | 6 099 | 6 501 | 6 900 | 6 999 | 6 999 | 6 999 |
|---------------------|------|------|------|------|------|-------|-------|-------|-------|-------|-------|-------|
| 1 800 | 0.92 | 0.92 | 0.92 | 0.91 | 0.91 | 0.90 | 0.90 | 0.89 | 0.89 | 1.00 | 0.88 | 0.88 |
| 1 500 | 0.92 | 0.92 | 0.92 | 0.91 | 0.91 | 0.90 | 0.90 | 0.89 | 0.89 | 1.00 | 0.88 | 0.88 |
| 1 400 | 0.92 | 0.92 | 0.92 | 0.91 | 0.91 | 0.90 | 0.90 | 0.89 | 0.89 | 1.00 | 0.88 | 0.88 |
| 1 200 | 0.92 | 0.92 | 0.92 | 0.91 | 0.91 | 0.92 | 0.90 | 0.92 | 0.92 | 1.00 | 0.91 | 0.91 |
| 1 000 | 0.92 | 0.92 | 0.92 | 0.91 | 0.91 | 0.92 | 0.90 | 0.92 | 0.92 | 1.00 | 0.91 | 0.91 |
| 800 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.90 | 0.98 | 0.98 | 1.00 | 0.96 | 0.95 |
| 700 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.90 | 0.99 | 0.99 | 1.00 | 0.98 | 0.98 |
| 600 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.90 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 547 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.90 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 493 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.90 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 440 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.90 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 387 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.90 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 333 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.90 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 280 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.90 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 240 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.90 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 200 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.90 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

Picture 4-13: Highlighting multiple cells in a table.

Filling Cells

If multiple cells are highlighted, they can be filled with the same value using a few different techniques.

- Hit M to set all cells to the same value as the cell in focus. This cell is blue in the picture above. The color may be different depending on the color scheme chosen for Windows.
- Fill cells in one direction. It's possible to fill cells to the right, to the left, upward or downward. Choose direction by right-clicking and selecting "Fill >" from the menu that opens up, or hit Ctrl-R, Ctrl-L, Ctrl-U or Ctrl-D respectively.
- More advanced fill patterns can be set up if you right-click and select "Fill Series..." from the menu that opens up, or hit I on the keyboard. A dialog box appears in which you can choose to interpolate horizontally or vertically, to fill all cells with the same value or to fill the cells with stepwise increasing values in different directions.



Picture 4-14: The Fill Matrix dialog box offers more advanced cell manipulation options.

Modifying the Axis Values

The axis values can be edited directly. Note that the values have to increase monotonously. This means that each value on the x-axis has to be greater than or equal to the previous value as you move to the right. The same rule applies to the y-axis as you move downward.

For safety reasons, a table which doesn't follow these rules can not be uploaded to NIRA I7rp Injector driver and any online connection to NIRA I7rp Injector driver will be disconnected.

If an axis value is changed, all values in the corresponding column (x-axis) or row (y-axis) move to this new value. In other words, the mapping values move to a new axis value.

You can switch quickly between the x-axis cells and the table cells by hitting **X** or between the y-axis cells and the table cells by hitting **Y**. The arrow keys can also be used; if you hit the up key when you're in the top row of table cells, you'll enter the x-axis. The same is true for the y-axis by hitting the left key when you're in the leftmost column of table cells.

Adding Axis Values

Modifying the axes often involves adding more points for greater resolution, rather than moving points around.

| | | | | | | | | | |
|------|------|------|-------|-------|-------|-------|-------|-------|-------|
| 324 | 437 | 549 | 6 000 | 6 000 | 6 500 | 6 900 | 6 999 | 6 999 | 6 999 |
| 0.92 | 0.91 | 0.91 | 0.90 | 0.90 | 0.89 | 0.89 | 1.00 | 0.88 | 0.88 |
| 0.92 | 0.91 | 0.91 | 0.90 | 0.90 | 0.89 | 0.89 | 1.00 | 0.88 | 0.88 |

Picture 4-15: Inserting an x-axis column in order to add rpm values.

To add more points, right-click on an axis value, use "Insert Column..." or "Insert Row..." respectively. You can also hit the **Insert** key on the keyboard. Both methods bring up a dialog box in which the new axis value can be entered. Note that the new value must be between the values to the immediate left and right or up and down.

The new column/row will automatically get interpolated table values, based on the new axis value. This way, the overall mapping doesn't actually change until you change the table values explicitly.

Note: When a new column or row is added, the rightmost column or the bottom row will fall off the edge.

Drag Fill; Filling Axis and Table Cells

There's also a function to fill entire columns or rows, including the axes. This can be done by dragging and dropping a single axis cell value onto a different axis cell value. You can also hold down the **Ctrl** key while using the arrow keys to perform the same function.

The entire column or row will be marked green. Once you let go of the mouse button or the **Ctrl** key, a dialog box will appear in which you can choose among different fill methods.



Picture 4-16: Drag Fill: Filling axis and table cells.

When choosing "Copy", make sure the result of the copy doesn't create an axis with axis values that aren't all equal or increasing looking rightward (x-axis) or downward (y-axis.) Should this happen anyway, NIRA I7rp Injector driver will go offline and you need to fix the axis values before you can go online again.

Undo/Redo

It's always possible to undo any changes you've made to a table. As long as the table is open in a tab, NIRA rk remembers all changes and highlights any changed cells with an orange frame.

You can also undo undo, as long as you haven't made any new changes. This is called redo and is only available if you've undone something at least once.

The standard Windows **Ctrl-Z** och **Ctrl-Shift-Z** shortcuts also work, as well as **U** for undo och **J** for redo.

Copy/Paste

It's possible to copy and paste cells within a table or between tables. You can also copy and paste from other programs, such as Microsoft Excel.

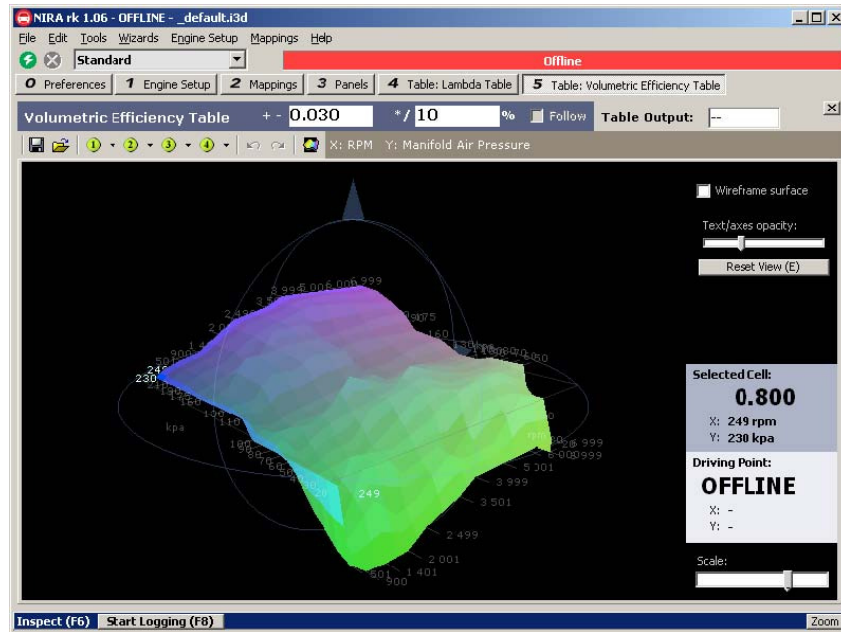
When pasting cells, you have to mark the cells into which you want to paste data. This is different from software such as Excel and offers a level of protection against accidental changes.

Axis cells can also be copied and pasted. Mark the cells with **Shift-Left arrow** or **Shift-Right arrow** or **Shift-click** with the mouse. Unfortunately, it's not possible to drag and drop with the mouse due to the Drag Fill function described above.

Graphical View

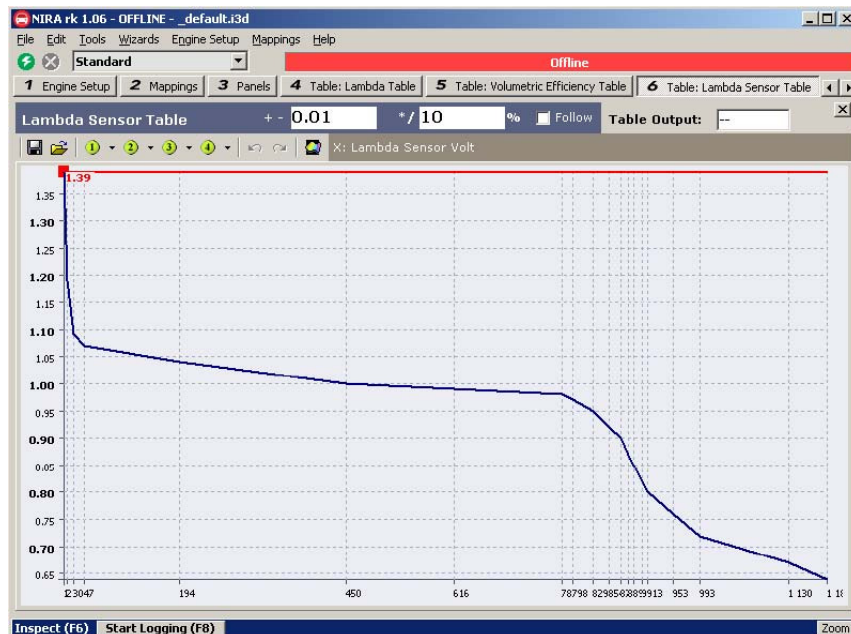
By hitting the **F5** key (NumPad: **Ins**) you can switch to a graphical view of a table.

The graphical presentation is different for one-dimensional tables and multi-dimensional tables. Picture 4-17 below shows an example of the graphical view of a multi-dimensional table where the two axes create a 3-D surface.



Picture 4-17: F5 or the "Toggle Graphics"-button switches to a graphical view of the table.
This is a multi-dimensional table.

One-dimensional tables are shown as graphs. In the graph, the x-axis represents the axis cells and the y-axis represents the table cells.



Picture 4-18: F5 or the "Toggle Graphics"-button switches to a graphical view of the table.
This is a one-dimensional table.

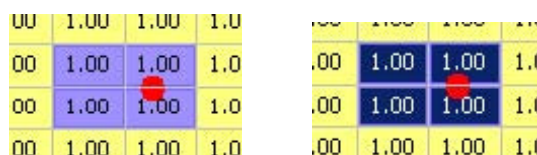
While in the graphical view, it's possible to move among the cells and change their value with the + and – keys, just like in the table view.

Operating Point

When NIRA I7rp Injector driver is online, NIRA rk can show where in a table NIRA I7rp Injector driver is currently operating, the so-called operating point. This is very helpful during the mapping effort.

By checking the "Follow" checkbox or turning this feature on/off with **O**, NIRA rk can move the currently highlighted cell to the operating point.

By hitting **Space** on the keyboard, you can manually move to the operating point. This affects all open tables such that the focus of each table moves to the operating point. If you want to modify multiple tables around the operating point, this can be very useful.



| | | | |
|----|------|------|-----|
| 00 | 1.00 | 1.00 | 1.0 |
| 00 | 1.00 | 1.00 | 1.0 |
| 00 | 1.00 | 1.00 | 1.0 |
| 00 | 1.00 | 1.00 | 1.0 |

| | | | |
|----|------|------|-----|
| 00 | 1.00 | 1.00 | 1.0 |
| 00 | 1.00 | 1.00 | 1.0 |
| 00 | 1.00 | 1.00 | 1.0 |
| 00 | 1.00 | 1.00 | 1.0 |

Picture 4-19: Jumping to the operating point using the Space key.

If "Follow" is enabled (see above), or if you use **Space** to jump to the operating point, four cells around the operating point will be highlighted. The operating point is marked as a red bullet. If you use the **+**, **-**, **/** or ***** keys to modify the cell values, they will be modified in a weighted fashion, with greater weight given to cells closer to the operating point.

Example: In picture 4-19 above, the operating point is farther to the right than the left and thus, when using the **+, **-**, **/** or ***** keys to modify the values, the cells to the right will be adjusted more than those to the left.**

The operating point is visible in the graphical view as well and the same type of adjustments described above can be made in the graphical view.

Saving/Opening Tables

It's possible to save an individual table in a file, an mtx-file. This file can be opened independently of the global i3d-file.

It's also possible to associate a particular mtx-file with a quick-access button. There are four round, green quick-access buttons to the left above the cells in any open table. They are numbered 1-4. You make the association by clicking on the small down-arrow to the right of the corresponding quick-access button. The file can be loaded later by clicking on the quick-access button, or by hitting **Ctrl-1** through **Ctrl-4** on the keyboard.

3.5 Gauges

NIRA rk offers a number of different ways to view input signals, e.g. from sensors.

3.5.1 Sensor Bar

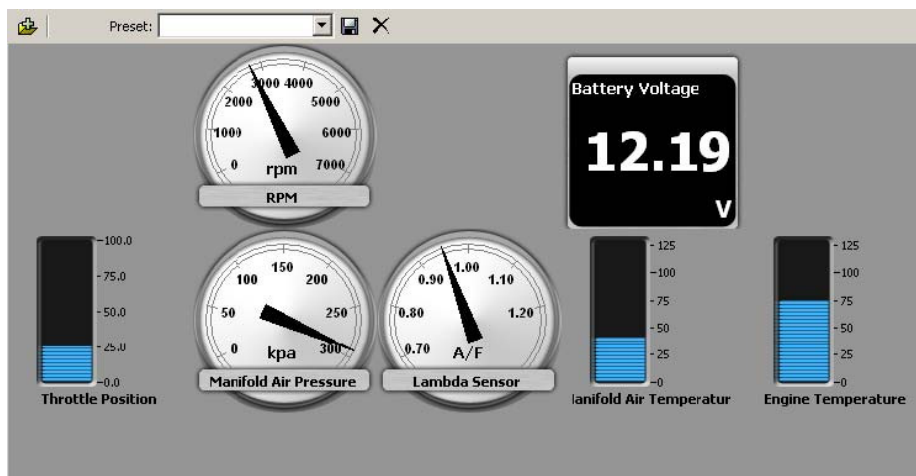
Sensor Bar is the name of the panel at the bottom of the screen. The selection of parameters in the bar is fixed. However, there are a number of different Sensor Bars available, each with a different selection of parameters. Switch among the different types by hitting **T** on the keyboard until you find the appropriate one for your current mapping situation. You can also hide the sensor bar, e.g. if you want the extra space on the screen or if you feel that other parameters on the screen are updated too slowly.




Picture 4-20: Sensor Bar "GENERAL" contains a set of general parameters.

3.5.2 Panels

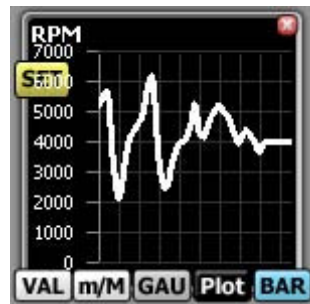
Unlike the Dashboard, the Panel tab is completely flexible. You can add any parameter of interest in the form of a gauge. The selection of gauges can be saved as presets so you can quickly switch among different panel setups.



Picture 4-22: The Panel tab allows you to add any parameter of interest.

To add a gauge to the panel, hit **Ins** on the keyboard or click on  in the top left corner.

By moving the mouse pointer over a gauge, alternative display options will be shown as buttons that can be clicked. You can move a gauge by dragging and dropping the gauge. The panel has an invisible grid to which a gauge will snap when moved. This makes it easy to create panels with a clean, organized look.



Picture 4-23: By moving the mouse pointer over a gauge, display options are shown as buttons that can be clicked.

Referring to picture 4-23 above:

Clicking on the X in the top right corner of the gauge removes the gauge from the panel.

The buttons at the bottom of the gauge change the look of the gauge:

- **VAL** means Value. Selecting this option turns the gauge into a simple value display. The Battery Voltage gauge in picture 4-22 is an example of the Value look.
- **m/M** means min/Max. Selecting this option turns the gauge into a Value display (see above) with additional min/Max displays. A Reset button lets you set the min/Max values to the current value.
- **GAU** means Gauge. Selecting this option turns the gauge into a traditional analog gauge. The RPM gauge in picture 4-22 is an example of the Gauge look.
- **Plot** turns the gauge into a histogram, moving from right to left. The width of the histogram is relatively short, which means it's mostly useful for looking at short-duration events. If you want to capture longer durations and graph them, use the logging feature in NIRA rk. See section 3.6.
- **BAR** turns the gauge into a bar graph. The Engine Temp gauge in picture 4-22 is an example of a bar graph.

In the Gauge, Plot and Bar modes, there's a "Set" button. Double-click on it or hit **Enter** to modify the range of the gauge or to revert to the default range.

As always, **F2** opens a dialog box listing all possible short cut keys.

3.6 Logging

NIRA rk includes a powerful logging feature. Any parameter can be logged and there's no limit to the number of parameters that can be logged. However, as the number of parameters increases, the sampling rate decreases.

The log can be saved to a file and shown graphically after the fact.

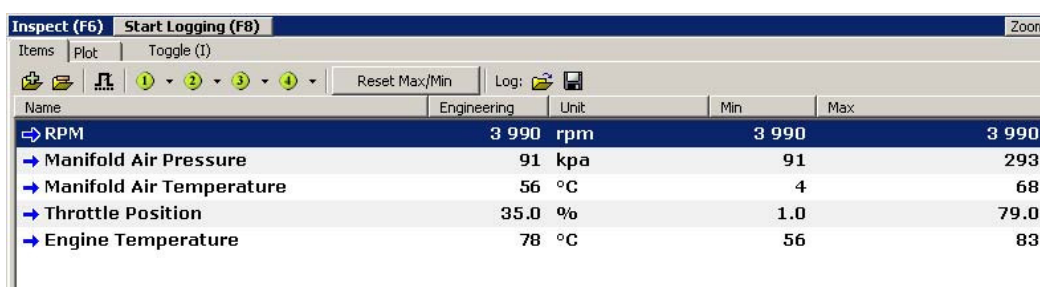
3.6.1 Inspect



At the heart of the logging function is a function called Inspect. Inspect allows you to select a set of parameters at which you want to take a closer look, e.g. by logging them.

Parameters being inspected are shown with min and Max values, even when actual logging isn't active. This can be useful when you map your engine.

Inspect resides in a separate window at the bottom of the screen. The window has three display modes; full view, partial view and minimized view. You can cycle through the modes with **F6**, or by clicking on the Zoom button at the far right of the Inspect window. You can also resize it by clicking and dragging the top of the window up and down.





| Name | Engineering | Unit | Min | Max |
|----------------------------|-------------|------|-------|-------|
| → RPM | 3 990 | rpm | 3 990 | 3 990 |
| → Manifold Air Pressure | 91 | kpa | 91 | 293 |
| → Manifold Air Temperature | 56 | °C | 4 | 68 |
| → Throttle Position | 35.0 | % | 1.0 | 79.0 |
| → Engine Temperature | 78 | °C | 56 | 83 |

Picture 4-24: Inspect. Cycle through the different display modes using F6 or the Zoom button.

Selecting Parameters

To add a parameter to the Inspect window, highlight it in the Mappings tab and click on the "Add to Inspect" button at the top of the window, alternatively hit **I** on the keyboard.

If you would like to add more parameters from within the Inspect window, you can use the  -button. To remove a parameter, use the **Del** key on the keyboard or use the  -button.

Saving/Opening Presets

It's possible to save parameter selections and assign them to the four round, green buttons at the top of the Inspect window. By clicking on the arrow to the immediate right of a button, a menu will open up giving you the option of assigning the parameter selection to the button.

NIRA rk comes with four different parameter selections already assigned to the four buttons.

3.6.2 Basic Logging

To start logging of the parameters in Inspect, hit **F8** on the keyboard. This can be done from anywhere in NIRA rk, whether you're mapping a table, showing gauges or reading help screens.

Note: When logging is active, no parameters are updated in NIRA rk. The reason is that NIRA rk instead tries to sample the logging parameters as fast as possible. The operating point is updated, though, and all alarms are still active.

Parameter values that aren't being updated while logging is active change to dashes, "--", so you can always trust any number that's shown.



| Name | Engineering | Unit | Min | Max |
|----------------------------|-------------|------|-------|-------|
| → RPM | 3 990 | rpm | 3 990 | 3 990 |
| → Manifold Air Pressure | 91 | kpa | 91 | 293 |
| → Manifold Air Temperature | 56 | °C | 4 | 68 |
| → Throttle Position | 35.0 | % | 1.0 | 79.0 |
| → Engine Temperature | 78 | °C | 56 | 83 |


5 item(s) Per item: 16.0 Hz Total: 80.0 Hz [RUNNING] Log size: 1 kB

Picture 4-25: The top of the Inspect window turns red when logging is active.

To stop logging, hit **F8** on the keyboard. This will also open up a dialog box, which gives you the option of saving the log as a file for later analysis.

3.6.3 *Advanced Logging*

Sometimes it is useful to be able to start logging whenever a parameter goes above or below a certain value. Likewise, it may be useful to stop logging whenever a certain event happens. For such situations, there's a trig function in NIRA rk.

Clicking on the -button or hitting **F5** on the keyboard opens up a dialog box in which you can set conditions for starting/stopping the logging and how many seconds before/after the trig point you want to be part of the log.

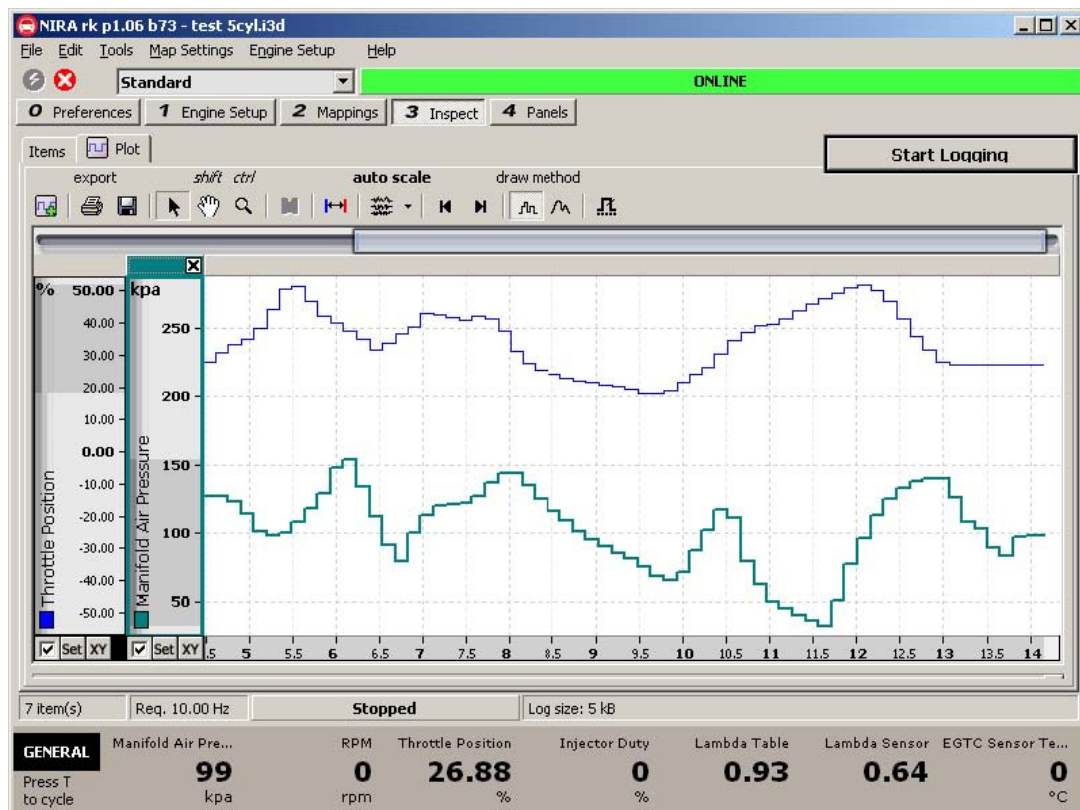
3.6.4 *Opening an Existing Log File*

You can open an existing log file by selecting "Load log file..." under File in the main menu or by hitting **Ctrl-F8** on the keyboard.

| |
|--|
| Note: You can also load NIRA rk log files in MATLAB. |
|--|

3.6.5 *Graphical Presentation*

Select the "Plot" tab to view the logging graphically.



Picture 4-26: Graphical view of logged parameters.

Data from multiple parameters can share the same plot window. Each parameter has its own, adjustable y-axis at the left edge of the window.

Adjusting the View

There are multiple tools available to zoom and pan. Click and drag on an axis to pan. Zoom by moving the mouse perpendicularly against an axis.

It's also possible to adjust the range of an axis by double clicking on the axis or by clicking on the Set-button at the bottom of each axis.

Removing an Axis

Removing an axis can be done by clicking on the X at the top right corner of the axis in question. You can deactivate an axis by un-checking the checkbox to the immediate left of the Set-button at the bottom of the axis.

Adding an Axis

To add an axis, click on .

Starting the Engine

If you've read the previous chapters and followed the installation instructions, NIRA I7rp Injector driver should be installed in your vehicle and you should have got an overview of NIRA rk. This chapter describes how to set the parameters needed to run the engine in a safe manner.

Warning! It is absolutely essential that you set up all parameters correctly under the Engine Setup tab. There are no shortcuts. Failure to do so can easily cause permanent damage to the engine.

4.1 *Setting Up Parameters Offline*

Before you turn on the ignition in the car you must set up all parameters under the Engine Setup tab. Make sure you complete all steps before you upload the settings to NIRA I7rp Injector driver by going online.

4.1.1 *Injector Setup*

NIRA I7rp Injector driver has 8 separate outputs for controlling fuel injectors. NOTE that with the direct triggering system 6 drivers are available.

The actual cylinder firing order is determined by the wiring to the injectors. Most injectors for common automotive engines can be handled

The system has ten different charge and discharge tables either one has a constant that states the number of sites to use in the arrays describing the charge or discharge curves.

The charge and discharge tables states the on dutycycle of the stated period. The period is normally set to 4us and should not be less than 3us since the internal losses in the ecu increases.

Piezo-electric injector interface

These are the parameters that needs to be mapped

| Name | Unit | Description |
|------------------------------|------|---|
| Inj Angle Start Max | Csd | Earliest permitted injection start for any injection |
| Injector Conv Table | μs | Injector map converting a required fuel amount at a given fuel pressure to an injection time |
| Injector Enable Dc Dc | | Enabling of internal high voltage DC/DC |
| Injector Idle Time Min Table | μs | Minimum requested idle time between two consecutive injections |
| Injector Load Cylinder Angle | Csd | Sets start angle for load of next cylinder relative TDC |
| Injector Max Time | μs | Max permitted injection time for any individual injection |
| Injector Min Hysteresis | μs | Hysteresis for minimum injection time. An injection is always turned of if calculated time is less then FIC ILT Min. Injection is turnrd on again if injection time is greater than FIC ILT Min plus hyst |

4.1.2 Injection Timing

Injection timing is an area of great interest and where a proper mapping can yield significant power improvements.

It's very, very important, however, to make sure the injection timing is correct since too much advance can cause significant damage at high loads.

It's very useful to have in cylinder pressure readings to assist during the mapping procedure.

Advancing the timing increases the efficiency of the engine and lowers the fuel consumption and yields more engine power, NOTE! This yields up to a certain point. You have to understand how boost pressure, compression, IAT, rpm, air/fuel mixture, load conditions etc. all effect the max injection advance before you start modifying the timing.

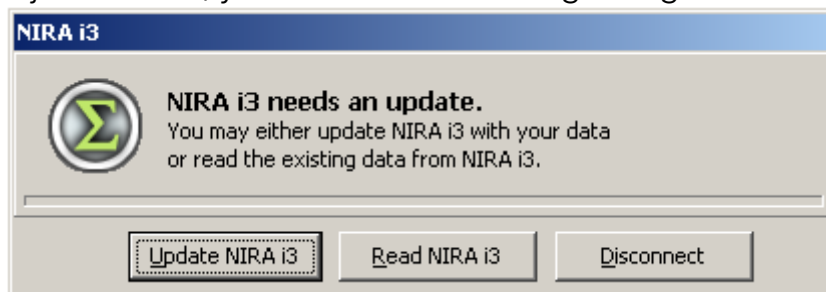
You can check things by entering the same value in the entire table. Choose a value around 4 degrees of advance. Then hook up a timing light to cylinder 1 to verify that you see the correct advance at the crank pulley. Naturally, this requires that the pulley has the appropriate markings.

It's beyond the scope of this manual to give any further advice on how to map injection timing.

4.2 Going Online

When you have entered values for all parameters in Engine Setup you can connect your PC to NIRA I7rp Injector driver. Follow the steps below before you attempt to start the engine.

1. Turn on the ignition
2. At the top of the main window in NIRA rk is the online/offline status bar. In order to go online, click on the little green flash icon in the top left corner of the main window in NIRA rk. If the parameters in NIRA rk are different from the parameters previously uploaded to NIRA I7rp Injector driver, you will see the following dialogbox:



3. Select Update NIRA I7rp Injector driver in order to upload all the data to NIRA I7rp Injector driver. This may take as long as two minutes.

Later you can select Read NIRA I7rp Injector driver if you want to download all the settings from NIRA I7rp Injector driver into NIRA rk so you can save them as an i3d file. (This is very handy if, for some reason, your PC were to hang while you're in the middle of mapping the engine since you can always go back and download the most recently uploaded mapping.)

4. Once you have uploaded the data to NIRA I7rp Injector driver, the system goes online, the status bar changes colors to green and the text changes to Online.

When the system is in the Online mode, it's important to first go to the Mappings tab and select the Monitor Output folder in the tree to the left and then select Alarm. Open the table "Dg Fault Stack" here is all the system errors listed. See **Error! Reference source not found.** for more information.

You can now start the engine.

