PURPOSE

To provide indications regarding the operation of the M2.10.4 Motronic Bosch multiple injection/ignition system.

To define the methodology for identifying faulty components.

COMPOSITION OF THE STANDARD

- **point 1** : composition of the system.
- **point 2** : operation of the system.
- **point 3** : functional checks and identification of faulty components.
- **Annex 1** : system diagnosis characteristics.

This standard consists of 10 pages and 1 annex (see page 2) .

Change	Date	Description			
=	Jan. '96	Edition 1		– New	(RG)
A	June '96	"	"	– Annex 1 updated with the insertion of the prescriptions for Alfa Romeo and FIAT Coupè Turbo versions. § A of this text corrected.	(RG)
B	July '96	"	"	– § 3.2.1 changed (Customisation memory module)	(RG)
C	Dec. '96	"	"	– Annex updated with the insertion of the prescriptions for Alfa Romeo 145/146 versions with 1400cc. 16–Valve TS engine; Alfa Romeo 932 (Nuova Giulietta) version with 1600cc. 16–Valve TS engine updated. § A and point 3.2.1 of this text corrected.	(RG)

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§ " A " – ANNEXES

ANNEX No.	MODEL OF VEHICLE	ADDRESS	IDENTIFICATION CODE	DRAWING No.	SUPPLIER SPARE PART CODE
1	Bravo/Brava 2000cc. 5 cyl. 20–Valve	address 10th, on line K	55 32 86 02 94 23	46424711	0.261.204.381
	Marea 2000cc. 5 cyl. 20–Valve				
	Coupé Fiat 2000cc. 5 cyl. 20–Valve			46476757	0.261.204.482
	Coupé Fiat Turbo 2000cc. 5 cyl. 20–Valve		55 32 86 83 15 25	46476758	0.261.204.483
	Alfa 145/146 4 cyl. 1.4cc. 16–Valve TS		55 32 86 85 15 A7	46454805	0.261.204.481
	Alfa 145/146 4 cyl. 1.6cc. 16–Valve TS		55 32 86 04 15 26	46454804	0.261.204.480
	Alfa 145/146 4 cyl. 1.8cc. 16–Valve TS			46447506	0.261.204.479
	Alfa 145/146 4 cyl. 2.0cc. 16–Valve TS			46474071	0.261.204.478
	Alfa 155 4 cyl. 1.6cc. 16–Valve TS			46453455	0.261.204.421
	Alfa 155 4 cyl. 1.8cc. 16–Valve TS			46468485	0.261.204.168
	Alfa 155 4 cyl. 2.0cc. 16–Valve TS			46462485	0.261.204.422
	GTV / Spider Alfa 4 cyl. 2.0cc. 16–Valve TS			46421639	0.261.204.484
	Alfa 932 (Nuova Giulietta) 1600cc. 16–Valve TS		– – – – – – – –		

1

COMPOSITION OF SYSTEM

The system is composed of the following components the characteristics of which are described in the relative procurement specifications listed below:

1)	M2.10.4 Motronic Bosch multiple electronic injection/ignition control unit	P.S.	●	(CEL)
2)	Electric fuel pump	P.S.	9.93227/01	(CEL)
3)	Timing variator control solenoid valve	P.S.		(CEL)
4)	Throttle valve potentiometer	P.S.	9.93228/02	(CEL)
5)	Diagnosis socket	P.S.		(CEL)
6)	Relay group	P.S.	9.92210	(CEL)
7)	Electric fuel pump relay	P.S.	9.91815	(CEL)
8)	Idle adjustment actuator	P.S.	9.93239	(CEL)
9)	Fuel pressure regulator	P.S.	9.02240/01	(CME)
10)	Electroinjectors (Quantity : 5)	P.S.	9.93231	(CEL)
11)	Engine coolant temperature sensor	P.S.	9.93225	(CEL)
12)	Resonator	P.S.		
13)	Intake air temperature sensor	P.S.	9.93225	(CEL)
14)	Air−flow meter	P.S.	9.93232	(CEL)
15)	Air cleaner	P.S.	9.02255/01	(CME)
16)	Ignition coil (Quantity : 5)	P.S.	9.93207	(CEL)
17)	RPM and TDC sensor	P.S.	9.93206	(CEL)
18)	Knock sensor (Quantity : 2)	P.S.	9.93205	(CEL)
19)	Timing sensor (cam angle)	P.S.	9.96222	(CEL)
20)	Lambda sensor	P.S.	9.93233/50	(CEL)
21)	Catalytic converter	P.S.	9.02165/02	(CMD)
22)	Canister washing solenoid valve	P.S.	9.92605	(CEL)
23)	Fuel filter	P.S.	9.02235/01	(CME)
24)	Sheet metal or plastic fuel tank	P.S.	9.02159	(CME)
		P.S.	9.02159/01	(CME)
25)	Pneumatic actuator (if the VIS is present)	P.S.		
26)	Three−way pneumatic actuator control solenoid valve (if the VIS is present)	P.S.	9.04138	(CEL)
27)	Vacuum accumulator	P.S.		
28)	Speedometer sensor	P.S.	9.96222	(CEL)
29)	Electronic injection system malfunction warning light	P.S.		(CEL)
30)	Alarm system control unit communication socket	P.S.		(CEL)
31)	Radiator cooling electric fan control	P.S.		(CEL)

● While awaiting drafting of the specific Procurement Specification refer to P.S. 9.90110 (CEL)

2
OPERATION OF THE SYSTEM

The M2.10.4 Motronic Bosch system belongs to the category of integrated digital electronic ignition systems with induction discharge and static distribution and electronic injection of the timed phased type (1 – 2 – 4 – 5 – 3).

In addition to electronically control the moment of ignition and the idle speed air flow, the control unit controls and manages injection so that the stoichiometric ratio (air/fuel) is always at the optimal value in order to ensure regularity of operation of the engine as the environmental parameters and applied loads vary.

The system functions are mainly the following :

– injection time adjustment;
– ignition advance adjustment;
– cold starting control;
– enrichment control during acceleration;
– fuel cut–off during deceleration;
– idle speed control and management;
– max. rpm limitation;
– lambda sensor combustion control;
– fuel vapour recovery;
– connection with climate control system (where applicable);
– connection with the automatic gearbox control unit (where applicable);
– connection with the ELECTRONIC KEY control unit (Immobiliser);
– system self–adaptation;
– self–diagnosis;
– two speed cooling electronic fan control (where applicable)

2.1
General description of the injection system

There are basically two main conditions which must always be fulfilled during the preparation of the air–fuel mixture to ensure that a controlled ignition engine runs well:

1) Metering (air/fuel ratio) which must be maintained as close to the stoichiometric value as possible in order to ensure rapidity of combustion avoiding wasting fuel;

2) The mixture must be composed of fuel vapours diffused in the air as finely and uniformly as possible.

The nozzles of the injectors in the M2.10.4 Motronic Bosch system ensure that the fuel is atomised in tiny drops. As the air may be under various conditions of absolute pressure, the quantity of fuel to be injected must be adapted in order to avoid altering the air–fuel weight ratio.

The constancy of the ratio is obtained by varying the value of the fuel delivery pressure value using a regulator on the basis of the air vacuum in the intake manifold so that the difference between the two pressures is constant regardless of the conditions of engine operation.

The optimal metering is calculated after the following measurements have been made:
– exact quantity of intake air measured by the airflow meter;
– speed of engine rotation (rpm) using the rpm sensor;
– requested acceleration with the throttle valve angular position sensor;
– engine coolant temperature by the sensor located on the thermostat support;
– oxygen content in the exhaust gas with the lambda sensor.

This information is processed by a microprocessor contained in the injection–ignition control unit which determines the injection basic time by values obtained experimentally, which are mapped in a specific memory in the control unit.

2.2

General description of the ignition system

The ignition system is of the static inductive discharge type (i.e. without high voltage distributor) with power modules located inside the electronic control unit

The system has a single coil for each spark plug (SINGLE COIL); the advantages of this solution are :
- lower electrical overloading;
- constant discharge on each spark plug guarantee.

A map containing all optimal advance values that the engine may use during its operation on the basis of engine rpm and loading is stored in the electronic control unit.

These values are obtained experimentally by using a long series of practical tests carried out on prototypes on the engine test bench, to identify the advances with which the most satisfactory arrangement between the contradictory requirements of full power, lower fuel consumption and toxic exhaust emissions can be obtained.

The optimal advances are then memorised in the system's control unit. During operation of the engine, the electronic control unit is constantly informed as to the engine rpm and loading and on the basis of these, "chooses" the most suitable advance value from those stored in its memory, so that a spark strikes on the spark plug of the cylinder during the knocking phase with the optimal advance value.

Corrections to the advance value are made mainly on the basis of:
- engine coolant temperature;
- intake air temperature;
- throttle valve position and knocking.

The information required by the control unit to pilot the single coils, is transmitted with electrical signals emitted by the following sensors:

a) A **rpm sensor** which generates an alternating single–phase signal, the frequency of which indicates the engine rpm.

b) An **air flow meter** which, on the basis of the quantity of air taken in by the engine, transforms this value in an electrical signal which is sent to the electronic control unit.

c) An **air temperature sensor** which transforms the intake air temperature value into an electric signal which is then sent to the electronic control unit.

d) Two **knocking sensors** located on the upper part of the engine block, one between cylinders 1 and 2 and the other between cylinders 4 and 5. These sensors enable the control unit to recognise the knocking cylinder (or that with initial knocking) and to correct the ignition advance only on the spark plug of the relative cylinder.

e) A throttle **valve position sensor** which transforms the angular value of the throttle valve into an electric signal enabling the control unit to recognise the minimum, partial and full load conditions.

2.3

Adjustment of injection timing

The electronic control unit establishes the “time” lapse to the electroinjectors to open with a relatively simple rule which can be summarised as follows.

Taking the physical characteristics of the fuel (viscosity and density), the difference in fuel pressure and the vacuum in the inlet manifolds as constant, the quantity of fuel injected depends only on the “opening time” of the electroinjectors.

Digital technology has made it possible to optimise consumption and performance by programmed maps memorised inside the electronic control unit on the basis of the engine rpm and loading.

The control unit controls the electroinjectors with extreme rapidity and precision, calculating the opening time on the basis of engine loading (rpm and air flow) taking the battery voltage and engine coolant temperature into account at the same time.

Injection is sequential and timed for each cylinder and occurs at the optimal injection point.

2.4

Ignition advance adjustment

The control unit with a mapping memorised inside it, is able to calculate the ignition advance on the basis of engine loading (minimum, partialised, full on the basis of the rpm and air flow) of the intake air and of the engine coolant liquid temperatures.

It is possible to delay in a selective way the ignition on the cylinder where necessary. This is recognised by the combination of values recorded by the knocking and cam angle sensors.

2.5

Cold starting control

Under these conditions a natural lean–out of the mixture occurs due to the bad turbulence of the fuel particles at low temperature, reduced evaporation and condensation on the inner walls of the intake manifold, all of which is compounded by the greater viscosity of the lubricating oil.

The electronic control unit recognises this conditions and corrects the injection time on the basis of the engine coolant temperature, intake air temperature, battery voltage and engine rpm.

The ignition advance only depends on to the engine rpm and engine coolant temperature.

During start–up the control unit controls a first, simultaneous injection of all injectors (full–group injection) and after the reference on the pulse generator has been recognised, switches to normal timing sequential operation.

Whilst the engine is warmed up, the electronic control unit pilots the idle actuator which determines the quantity of air necessary to ensure the self–supporting rpm of the engine. The speed of rotation is decreased proportionally as the temperature increases until the nominal value is obtained for the engine at normal running temperature.

2.6

Enrichment control during acceleration

Following a request for acceleration, if the variation in the signal from the air–flow meter exceeds a pre–set increase, the control unit updates injection to the new situation and also increases it further, so that the requested rpm is reached more quickly.

As the set rpm value draws nearer, the injection increase is progressively eliminated.

NOTE : *The request for acceleration is also measured by the potentiometer located on the throttle valve; this makes it possible to ensure optimal running in the event of a malfunction affecting the air–flow meter until a Service Centre can be reached.*

2.7

Fuel cut–off during deceleration

Fuel cut–off during deceleration is of the adapted type.

When the throttle valve is recognised as being closed and the rpm exceeds a set level, fuel injection is deactivated (for engine speeds below this threshold the cut–off function is not operative).

When there is no fuel supply, the rpm will begin to fall more or less rapidly on the basis of the vehicle speed conditions.

Before reaching the idle state, the dynamics of the engine rpm drop is verified.

If this is above a certain value, fuel delivery is partially re–activated on the basis of a logic which includes "soft accompanying" of the engine to idle rpm.

Once this state has been reached, the normal idle function and cut–off during deceleration will only be reactivated when the fuel cut–off threshold has been exceeded to prevent jerking of the engine.

The insertion thresholds for fuel supply and fuel cut–off vary on the basis of engine temperature.

Another fuel cut–off logic has been developed in the control unit which occurs during partial deceleration that is when a lower engine loading is required.

This function is only active if the new state lasts for a pre–set time and after adapting the ignition advance angle to the new situation.

2.8

Engine idle control and management

Idle speed adjustment is piloted under all operating conditions by the constant idle speed actuator which acts on the throttle by–pass.

In addition to the idle rpm control it also acts as an additional air box and as a regulator for the engagement of various devices (i.e. air conditioner compressor); when the throttle is closed the actuator adjusts the gap of the by–pass compensating for the power requested by the devices in order to ensure an idle speed which is a constant as possible around the set value.

The actuator used in this version guarantees a quick regulation response as the opening and closing of the by–pass are both controlled by magnetic windings.

Idle speed correction besides to the constant idle speed actuator is also carried out by the ignition angle adjustment (advance) as this has a faster response time.

NOTE : *The self–adaptation function makes it possible to eliminate any regulation of the idle speed when the position of the throttle is recognised by the throttle body sensor as being in the closed position thus correcting for any wear occurring on the closed position of the throttle.*

2.9

Maximum rpm limitation (over–revving protection)

When the electronic control unit recognises that the set engine rpm limit value has been exceeded it interrupts the piloting of the electroinjectors, thus preventing the overloading of the engine and protecting it from over–revving.

When the rpm returns to a non–critical value, fuel injection is restored.

2.10

Combustion control–lambda sensor

The lambda sensor is in contact with the exhaust gas and informs the control unit as to the conditions of combustion of the AIR–FUEL mixture (lean and rich mixtures) by reading the concentration of oxygen present in the gas itself.

The optimal mixture is obtained with the coefficient $\lambda = 1$ (optimum stoichiometric mixture).

The electric signal which the sensor sends to the control unit undergoes a rapid variation when the composition of the mixture departs from the value $\lambda = 1$.

When the mixture is lean ($\lambda > 1$) the control unit increases the quantity of fuel injected; when the mixture is rich ($\lambda < 1$) it decreases it, and in this way, the engine runs as close as possible to the ideal lambda value.

The signal from the lambda sensor is processed inside the control unit by a special integrator which prevents sudden variations of the injection time to correct the the mixture ratio.

The sensor is heated by an electrical resistance so that the operating temperature can be reached rapidly (approximately 300 °C) moreover making it possible, to comply with the regulations regarding polluting emissions.

2.11

Fuel vapour recovery

The (polluting) fuel vapours are collected in a vapour–liquid separator (canister) where they are condensed and return in the form of a liquid to the fuel tank through the appropriate hoses.

The remaining vapours leaving the separator are sent to the engine where they are burnt; this takes place by the intervention of a solenoid valve which is controlled by the control unit only when the engine is under load conditions which permit correct combustion without disturbing the operation of the engine; the control unit in fact, compensates for this extra quantity of fuel by reducing delivery to the injectors.

2.12

Knocking control

This function detects the presence of the knocking phenomenon (pinging) by processing the signal coming from the relative sensors.

The control unit continually compares the signals coming from the sensors to a set value, which is in turn, continually updated to take into account the basic noise and the ageing of the engine.

The control unit is thus able to detect the presence of the knocking phenomenon (or knocking start) and take steps to reduce the ignition advance until the phenomenon disappears. Following this, the advance is gradually restored up to the basic value.

During acceleration a higher threshold is used to take the increase in engine noise into account under this condition.

The knocking control strategy is also equipped with a self–adaptation function which memorises any reduction in the advance that might occur repeatedly, in order to adequately map the various conditions under which the engine is running.

2.13

Radiator cooling electric fan control (where present)

The speed of the electric fan may be set at two levels:
– Low speed level;
– High speed level.

Depending on the temperature of the engine coolant, the control unit activates and deactivates the low speed and high speed of the radiator cooling electric fan with hysteresis.

A further control (trinary signal) is also used, which activates the electric fan at the higher speed when the air conditioning system is switched on.

2.14

Connection to the air conditioning system

When the air conditioner is switched on the compressor absorbs power from the engine, which at idle has a tendency to cut–out.

To avoid this problem, the control unit adapts the air flow to the new power request controlling the relative actuator (the adaptation is also made during use to maintain optimal driveability).

Another function of the system is to temporarly interrupt the power supply to the compressor when high engine power is requested (high acceleration).

2.15

Connection to the automatic transmission system

The control unit regulates the engine idle speed on the basis of the load which overtakes when the gear lever is moved to select a gear.

In the versions with automatic transmission the throttle valve position sensor consists of two potentiometers each one with its own connector.

2.16

System self–adaptation

The control unit is equipped with a self–adaptation function which recognises the changes which occur in the engine due to settling over a period of time and ageing both of the components and of the engine itself.

These changes are memorised under the form of modifications to the basic mapping and have the purpose to adapt the operation of the system to the progressive alterations of the engine and of the components in relation to the characteristics when new.

This adaptation function also makes it possible to compensate for the inevitable diversity (due to production tolerances) of any replaced components.

This makes it possible to obtain the maximum results for all vehicles without requiring particular regulation and control interventions.

The self–adaptation parameters are lost if the control unit is disconnected.

NOTE : *The above description shows how important is to pay close attention when control units are exchanged between vehicles, as this procedure should be avoided*.

2.17

Connection to the ELECTRONIC KEY control unit (Immobiliser)

The engine control units **must** be connected to an Electronic Key control unit

The function of the electronic key system is to prevent the engine from being started unless one of the keys (fitted with a Transponder) memorised by the electronic key control unit when the vehicle is customised is used.

As soon as the ignition key has been turned to the MAR position, an exchange of information is made between the engine control unit and the electronic key control unit; if the procedure has a positive outcome the engine control unit allows the engine to be started, if not prevents it.

The communication occurs by a dedicated bi−directional diagnosis serial line which connects the two control units.

2.18

Self−diagnosis

The diagnosis of the inputs/outputs and of the electronic unit can be made by cyclically verifying the characteristic signals and, in the case of malfunctions, memorising the relative codes (passive self−diagnosis) in the EEPROM.

The single actuators can be activated by the diagnosis instrument to check their efficiency.

Any anomalous operation of a sensor/actuator is signalled to the user via the illumination of a malfunction warning light as soon as this is validated by the control unit (depending on the type of anomaly); the warning light will go out when the relative repairs have been made, or if the failure is not of the permanent type.

The EEPROM memory is totally erased by the diagnosis instrument.

When a failure is present, the control unit manages the alternative functions in order to maintain the engine operatiing if possible and to allow the vehicle to be driven to a service station (**recovery**).

3

FUNCTIONAL CHECKS AND IDENTIFICATION OF FAULTY COMPONENTS

3.1

With the testing procedure given below the correctness of the electrical/pneumatic connections and the presence of any system malfunctions can be checked.

A total check is only carried out when the engine is running at idle as specified in Production Standard 3.00093.

3.2

Engine testing−diagnosis procedure (to be fully completed)

This operation must be carried out with the aid of the on−line testing equipment for the electronic control units of the FIATxxx.(M2.10.4 yyyy) design, or with the aid of the FIAT−LANCIA Tester where the above testing equipment does not exist or has not yet been suitably modified.

3.2.1

If the testing equipment has a FIAT JFT2 hardware interface board, the application programs as per system diagnostic features in the Annex 1 can be requested from Dept.

D.T.−F.V.−S.I.E.E.−Sperimentazione−Autodiagnosi e Simulazione.

If this equipment has not the aforesaid board, the D.T. could supply only the application program for the F.L.T.

1

SYSTEM DIAGNOSIS CHARACTERISTICS

1.1

DIAGNOSIS TABLE (1.3 version)

SYSTEM SUB–GROUP	ASSISTANCE PERFORMANCE OBTAINED CONNECTING THE TESTING INSTRUMENT TO THE DIAGNOSIS SOCKET, WITH CONTROL UNIT POWERED AND OPERATING	PO	CK	ER	VR	NOTES
CONTROL UNIT (cont.d)	**Signalling of** : – plausibility error on the control unit due to failure reading/writing internal RAM memory or erroneous checksum of the ROM/EPROM memory). As recovery function, normal operation is maintained as far as possible.	*	*	*	*	**Communication protocol with FLT** : This is the standard BOSCH communication protocol already used on the MOTRONIC control units. The initialisation of the diagnostic dialogue occurs by the transmission of the address 10h at 5 baud on line K, from the tester towards the control unit. This procedure must occur under key–on conditions or with the engine running with a speed of < 2000 RPM. The operations which can be carried out with a diagnosis instrument are those included in the protocol i.e. RAM cell reading, error memory reading, error memory deletion, active diagnosis on actuators.
	Verification of : – diagnosis connection to control unit	*	*	*	*	**Failure detection** : This is carried out during execution of the basic function with which the sensor/actuator is managed.
	– correct ISO reading	*				
	– identification code reading	*	*	*	*	**Memorisation of the error and structure of the error memory** : The errors are memorised in the control unit in the order in which they occur, in EEPROM. For each of them are memorised the location and the type of error, 2 environmental conditions (specific for each type of failure) measured at the moment the fault was detected and a frequency counter.
	Visualisation of : – advance angle – transfer function : 78 – DATUM x 0.75 [°]					
	Activation : – Air conditioner upon command sent by Testing Instrument with piloting frequency of 0.5 Hz	*				**Classification of the defect** : If a defect is recognised for the first time and the error condition persists for a time of t > 0.5s, the defect is memorised as ”permanent”. If this defect then disappears, it is memorised as ”intermittent” and ”not present”. If it then reappears, it remains memorised as ”intermittent” but becomes ”present”. The classification of a failure as ”permanent” activates the recovery function; when the failure disappears normal reading or actuation is restored.

KEY: PO = POWER ON – CK = STARTING – ER = ENGINE RUNNING – VR = VEHICLE RUNNING

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DIAGNOSIS TABLE continued

SYSTEM SUB−GROUP	ASSISTANCE PERFORMANCE OBTAINED CONNECTING THE TESTING INSTRUMENT TO THE DIAGNOSIS SOCKET, WITH CONTROL UNIT POWERED AND OPERATING	PO	CK	ER	VR	NOTES
CONTROL UNIT						Some types of failure are classified as ”important” i.e. important in accordance with the CARB anti−pollution standards. The presence of these failures is signalled to the user via the malfunction warning light. **Frequency counter** : An error counter is assigned to each error, which is used to determine the moment in which a failure that is no longer present is memorised. When the failure is first memorised, the counter is set to 40. If the failure disappears, the counter remains at the actual value. If it occurs again, it is increased by 1 (up to a maximum of 50). The counter is decreased each time a start−up occurs without the failure reappears again. If the counter reaches zero the failure is automatically deleted from the memory. If, after the counter has decreased, the failure reappears, the counter is returned to 40 (if it was already greater than 40, it remains unchanged). **Malfunction warning light** : The malfunction warning light comes on when there is a defect stored as ”present” and “important”. The delay time between detection of the failure and illumination of the warning light is 0.1 second; the delay time between the failure disappearing and the warning light going out is 4 seconds. The warning light comes on at each ”key−on”. If there are no ”important” failures already present, the warning light goes out 4 seconds after the ”key−on”. **Deletion of the error** : When the frequency counter reaches 0, the failure is deleted along with the parameters associated with it. The immediate deletion of the entire error memory occurs in the following cases: −via a “delete error memory” command send by the tester.

KEY: PO = POWER ON – CK = STARTING – ER = ENGINE RUNNING – VR = VEHICLE RUNNING

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DIAGNOSIS TABLE continued

SYSTEM SUB–GROUP	ASSISTANCE PERFORMANCE OBTAINED CONNECTING THE TESTING INSTRUMENT TO THE DIAGNOSIS SOCKET, WITH CONTROL UNIT POWERED AND OPERATING	PO	CK	ER	VR	NOTES
LAMBDA SENSOR (zirconium sensor)	**Visualisation of** :					**The sensor is "theoretically ready" to operate if the following conditions occur simultaneously:** –engine T $>$69.6 °C for at least 174 s; –engine loading $>$3.5 ms; –engine loading $>$2.8 ms only for Alfa Romeo 1.4TS engines; –the following conditions occur for at least 5 s; –there is no error on the air flow meter. **Detection and recovery conditions for each type of failure**: –short circuit battery V : sensor voltage $>$1.099 V for more than 2.55 s. –recovery : open loop; –open circuit : sensor voltage between 0.400 V and 0.518 V for more than 2.55 s and sensor theoretically ready; –recovery : open loop; –probable short circuit to GND (failure not recognised by FLT) : sensor voltage $<$ 0.0879 V for more than 2.55 s ; –recovery : block of self–adaptation of the mixture ratio, canister control as in open loop, max. FR= 1.4; –short circuit to GND : sensor voltage $<$ 0.0879 V and simultaneously sensor integrator FR = 1.4 for more than 1 s; –recovery : open loop, max. FR = 1.25; –lambda integrator (FR) : –FR $>$ 1.25 for at least 15 s; –FR $<$ 0.75 for at least 15 s; –recovery : FR blocked at limit value reached; –self–adaptation parameters : –DTV, FRA, TRA out of upper limit –DTV, FRA, TRA out of lower limit **Environmental parameters** : –engine rpm and engine loading for lambda sensor and sensor integrator. –engine rpm and engine temperature for the self–adaptation parameters. **Malfunction warning light** : OFF
	–FR lambda integrator value			⋆	⋆	
	–multiplication correction self–adapting factor FRA			⋆	⋆	
	–addition correction self–adapting factor DTV			⋆	⋆	
	–addition correction self–adapting factor TRA			⋆	⋆	
	–lambda adjustment state			⋆	⋆	
	–sensor voltage on ADC channel			⋆	⋆	
	– transfer function : DATUM x 5/255 [V]					
	Signalling of :					
	–short circuit to battery V on the sensor			⋆	⋆	
	–open circuit on the sensor			⋆	⋆	
	–short circuit to GND on the sensor			⋆	⋆	
	–attainment of limit values for lambda integrator			⋆	⋆	
	–exceeding of limit values of self–adaptation parameters DTV, FRA and TRA			⋆	⋆	

KEY: PO = POWER ON – CK = STARTING – ER = ENGINE RUNNING – VR = VEHICLE RUNNING

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DIAGNOSIS TABLE continued

SYSTEM SUB−GROUP	ASSISTANCE PERFORMANCE OBTAINED CONNECTING THE TESTING INSTRUMENT TO THE DIAGNOSIS SOCKET, WITH CONTROL UNIT POWERED AND OPERATING	PO	CK	ER	VR	NOTES
AIR FLOW METER (Hot wire sensor)	**Visualisation of** :					**Error detection conditions** : −short circuit to GND or open circuit: if, with engine running and not during starting, the air flow measured is 5 kg/h; −short circuit Battery V: if, with engine running and not during starting, the air flow measured is greater than the rpm 26.56 [g] / 2.
	−intake air flow −transfer function : 0.2 m^3/h for flow rates up to 51 m^3/h; −transfer function : −1.519 m^3/h for flow rates > 51 m^3/h; −voltage value via an ADC channel; −transfer function : DATUM x 5/255 [V]. −adaptation of air at idle −transfer function : DATUM x 0.4 m^3/h with 80h = 0 m^3/h.			*	*	**Environmental parameters** : engine rpm and relative throttle angle **Malfunction warning light** : ON **Recovery** : −With no simultaneous error on throttle potentiometer : −at idle: engine loading is calculated on the basis of rpm; −out of idle and under full load conditions: value is assigned to the engine loading, calibrated in a mapping configuration according to the rpm and the throttle angle.
	Signalling of :					−When a simultaneous error on the throttle potentiometer is present : −the engine loading and advance values are assigned by a table based on the rpm.
	−short circuit to Battery V			*	*	
	−short circuit to GND or open circuit			*	*	**Additional steps** : −Self−adaptation of the mixture ratio and idle blocked at present values.

KEY: PO = POWER ON – CK = STARTING – ER = ENGINE RUNNING – VR = VEHICLE RUNNING

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DIAGNOSIS TABLE continued

SYSTEM SUB−GROUP	ASSISTANCE PERFORMANCE OBTAINED CONNECTING THE TESTING INSTRUMENT TO THE DIAGNOSIS SOCKET, WITH CONTROL UNIT POWERED AND OPERATING	PO	CK	ER	VR	NOTES
ENGINE COOLANT TEMPERATURE SENSOR (NTC sensor)	**Visualisation of** :					**Error detection conditions** : −short circuit to GND : ENGINE T >130.3°C. −short circuit to Battery V or open circuit: if ENGINE T < −35.4°C and AIR T > −20°C; −value not plausible : if ENGINE T < estimated value.
	−engine temperature value	⋆	⋆	⋆	⋆	**Environmental parameters** : −engine rpm and engine loading. **Malfunction warning light** : ON
	−value from ADC channel of the engine temperature					
	Signalling of :					**Recovery** :
	−short circuit to GND.	⋆	⋆	⋆	⋆	
	−short circuit to Battery V or open circuit	⋆	⋆	⋆	⋆	−if air T > 19.9°C then engine T= 80°C
	−signal not plausible (different from that estimated on the basis of engine conditions)	⋆	⋆	⋆	⋆	−if air T ≤ 19.9°C then engine T= air T for t<3 mins. and engine T = 80°C for t>3 mins. −Fan second speed cutsin 6/8 s after failure detected (for version in which it is implemented). **Additional steps** : −Self−adaptation of the mixture ratio and idle blocked at present values.
AIR TEMPERATURE SENSOR (NTC sensor)	**Visualisation of** :					**Error detection conditions** : −s.c. battery V or o.c.: if after 3 minutes have passed since starting with engine at idle, an air T < −35°C (read on ADC channel) for 30 s is detected.
	−air temperature value	⋆	⋆	⋆	⋆	
	−value from ADC channel of the air temperature					−s.c. GND if air T > 130°C (read on ADC channel)
	Signalling of :					**Environmental parameters** : −engine rpm and engine temperature.
	−short circuit to GND.			⋆	⋆	**Malfunction warning light** : ON
	−short circuit to Battery V or open circuit			⋆	⋆	**Recovery** : −air T= 20, 40°C and mixture ratio blocked at last values.

KEY: PO = POWER ON – CK = STARTING – ER = ENGINE RUNNING – VR = VEHICLE RUNNING

DIAGNOSIS TABLE continued

SYSTEM SUB−GROUP	ASSISTANCE PERFORMANCE OBTAINED CONNECTING THE TESTING INSTRUMENT TO THE DIAGNOSIS SOCKET, WITH CONTROL UNIT POWERED AND OPERATING	PO	CK	ER	VR	NOTES
ENGINE TIMING SENSOR	**Signalling of** : −s.c. to GND −s.c. to battery V or open circuit		⋆ ⋆			**Error detection conditions** : −The timing information is controlled at each revolution of the engine. The timing signal must be present every 2 revolutions of the engine. If the sequence 0−1, 0−1 is not correct, i.e. if the signal appears for two consecutive revolutions or if it is absent for two consecutive revolutions, then, the error is detected. This diagnosis is carried out when the vehicle is being started, if the anomaly occurs when the vehicle is running (after crank) the failure is not detected and to recognise it, the next starting procedure must be waited.
THROTTLE ANGLE SENSOR	**Visualisation of** : −absolute angle. − transfer function : DATUM x 96/230 [˚] −relative angle (absolute − minimum threshold) − transfer function : DATUM x 96/230 [˚] −idle position recognised −transfer function : DATUM x 96/230 [˚] −voltage on potentiometer from ADC channel − transfer function : DATUM x 5/255 [V] **Signalling of** : −short circuit to Battery V −short circuit to GND	⋆	⋆	⋆ ⋆ ⋆ ⋆ ⋆ ⋆	⋆ ⋆ ⋆ ⋆ ⋆ ⋆	**Error detection conditions** : −short circuit to Battery V : if the throttle_angle > 253 (byte error top threshold value) −short circuit to GND : if throttle_angle < 5 (byte error bottom threshold value) **Environmental parameters** : −engine loading, engine temperature. **Malfunction warning light** : ON **Recovery** : −butterfly angle = 10° −idle state : air flow < 12.8 m^3/h; −exit from idle state : air flow > 17.6 m^3/h; −full load conditions : engine loading > 4.5 ms and simultaneously speed > 2000 RPM; −exit from full load state : engine loading ≤ 4.5 ms or speed ≤ 2000 RPM. **Additional steps** : −the dashpot and idle integrator strategies are blocked.

KEY: PO = POWER ON − CK = STARTING − ER = ENGINE RUNNING − VR = VEHICLE RUNNING

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DIAGNOSIS TABLE continued

SYSTEM SUB–GROUP	ASSISTANCE PERFORMANCE OBTAINED CONNECTING THE TESTING INSTRUMENT TO THE DIAGNOSIS SOCKET, WITH CONTROL UNIT POWERED AND OPERATING	PO	CK	ER	VR	NOTES
PRESSURE SENSOR	**Visualisation of** : –atmospheric pressure –transfer function : DATUMx5 [mbar]	*	*	*	*	**Error detection conditions** : –s.c. to battery V: if value is > 0.949 (byte error top threshold value) –s.c. to GND: if value is < 0.05 (byte error bottom threshold value) **Environmental parameters** : –engine rpm and engine loading **Malfunction warning light** : ON **Recovery** : –Pressure value: 1000 mbar **Additional steps** : –None.
	Signalling of : –s.c. to battery V		*	*	*	
	–s.c. to GND		*	*	*	
ENGINE RPM SENSOR (Variable reluctance sensor)	**Visualisation of** : –engine rpm – transfer function : DATUMx40 [RPM]		*	*	*	**Error detection conditions** : –signal lacking : if injection has already begun and the rpm read is < 22.85, no correct synchronisation during cranking will be recognised; –signal not plausible : if cranking has already been carried out with correct synchronisation and the rpm is greater than 2000 RPM, an error is signalled if the reference notch is outside the measurement frame; **Error deletion** : The error is cancelled as soon as at least one program cycle has been completed with correct recognition of two successive reference notches. **Environmental parameters** : –engine loading and engine temperature **Malfunction warning light** : ON **Recovery** : Not applicable. **Additional steps** : –None.
	–engine rpm – transfer function : DATUMx10 [RPM]		*	*	*	
	Signalling of : –signal not plausible (Fiat Coupè Turbo only)		*	*	*	
	–signal lacking		*			

KEY: PO = POWER ON – CK = STARTING – ER = ENGINE RUNNING – VR = VEHICLE RUNNING

DIAGNOSIS TABLE continued

SYSTEM SUB−GROUP	ASSISTANCE PERFORMANCE OBTAINED CONNECTING THE TESTING INSTRUMENT TO THE DIAGNOSIS SOCKET, WITH CONTROL UNIT POWERED AND OPERATING	PO	CK	ER	VR	NOTES
KNOCKING AND INTERFACE SENSORS	**Visualisation of** :					<u>**Error detection conditions on sensor**</u> : −Recognition of the knocking is obtained by opening subsequent ”measurement frames”, each of them corresponds to one of the cylinders. In these frames, the signal from the sensor is integrated; then, this voltage is amplified or reduced to restore the signals corresponding to the various cylinder to a single comparable range. This operation is carried out automatically by the software calibrating an amplifier inside the control unit. If the gain applied to the integrator of one of the cylinders exceeds a specified threshold (i.e. if the signal coming from the sensor is so low that it needs to be amplified to the maximum level), it is supposed that the sensor in the corresponding row is disconnected and therefore it declares itself failure. This failure is memorised if it occurs for 3 seconds continuously. −eng T > 39.8; speed > 2000 rpm −engine loading > 3 ms
	−voltage of knock sensor on ADC channel			*	*	−for Alfa Romeo 1.4 TS engines the engine loading is > 2.3 ms.
	−transfer function : DATUM x 5/255 [V]					<u>**Environmental parameters**</u> :
	Signalling of :					−engine rpm and engine temperature.
	−plausibility error on sensor			*	*	<u>**Error detection conditions on sensor interface circuit**</u>:
	−plausibility error on sensor interface circuit.			*	*	−An interface circuit which automatically generates a sequence of test pulses inserting them at the input reserved on the sensor and measuring the trend of the integrator in presence of this fictitious signal. If the return signal is below the minimum threshold or above a maximum threshold, a non plausibility error of the circuit inside the control unit is respectively declared. This failure is memorised if it occurs for 5 seconds continuously with an engT>39.8. <u>**Environmental parameters**</u> : −engine rpm and engine loading. <u>**Malfunction warning light**</u> : OFF; ON for Alfa Romeo Twin Spark engines <u>**Recovery**</u> : −Advance decrease according to the rpm −Knocking control deactivated −Knocking self−adaptation deactivated

KEY: PO = POWER ON – CK = STARTING – ER = ENGINE RUNNING – VR = VEHICLE RUNNING

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DIAGNOSIS TABLE continued

SYSTEM SUB–GROUP	ASSISTANCE PERFORMANCE OBTAINED CONNECTING THE TESTING INSTRUMENT TO THE DIAGNOSIS SOCKET. WITH CONTROL UNIT POWERED AND OPERATING	PO	CK	ER	VR	NOTES
VEHICLE SPEED SENSOR	**Visualisation of** :					**Error detection conditions** :
	–vehicle speed –transfer function : DATUM [km/h]			⋆	⋆	–signal not plausible : the failure is memorised if, with a speed of > 4000 RPM and engine loading > 5.5 ms, no signal is detected (speed < 2 km/h) for at least 5.120 s.
	Signalling of : –signal not plausible			⋆	⋆	**Environmental parameters** : –engine rpm and engine loading. **Malfunction warning light** : OFF **Recovery** : Not applicable.
BATTERY VOLTAGE	**Visualisation of** :					**Error detection conditions** :
	–voltage value in RAM –transfer function : DATUM x 0.0705 [V]			⋆	⋆	–short circuit to Battery V : voltage > 16.01 V;
	–battery voltage value read on ADC channel –transfer function : DATUM / 14.68 [V]	⋆	⋆	⋆	⋆	–short circuit to GND or open circuit : voltage < 10 V, if at least 180 seconds have passed since starting.
	–key–operated battery voltage value read on ADC channel –transfer function : DATUM / 14.68 [V]					**Environmental parameters** : –engine rpm and engine temperature. **Malfunction warning light** : OFF **Recovery** :
	Signalling of : –battery voltage out of range			⋆	⋆	–self–adaptation of mixture ratio blocked at current values.

KEY: PO = POWER ON – CK = STARTING – ER = ENGINE RUNNING – VR = VEHICLE RUNNING

DIAGNOSIS TABLE continued

SYSTEM SUB−GROUP	ASSISTANCE PERFORMANCE OBTAINED CONNECTING THE TESTING INSTRUMENT TO THE DIAGNOSIS SOCKET, WITH CONTROL UNIT POWERED AND OPERATING	PO	CK	ER	VR	NOTES
INJECTORS (POWER TER- MINALS)	**Visualisation of** : −injection time −transfer function (**MSB**) : DATUMx0.384 [ms] −transfer function (**LSB**) : DATUM/255 [ms]			⋆	⋆	**Environmental parameters** : −engine rpm and engine temperature. **Malfunction warning light** : ON **Recovery** : −self−adaptation of mixture ratio blocked at current values. −idle adjustment self−adaptation blocked.
	Signalling of : −short to Battery V. −short circuit to GND. −open circuit	⋆	⋆			
	Activation : −upon command sent by Diagnosis Instrument, for each single jector, with a frequency of 1 Hz and activation time of 1 ms.			⋆	⋆	
PURGE CANISTER EVAPORATION VALVE (POWER TERMINALS)	**Visualisation of** : −piloting duty−cycle. −transfer function : DATUM x 0.39 [%]			⋆	⋆	**Environmental parameters** : −engine rpm and engine temperature. **Malfunction warning light** : OFF **Recovery** : −self−adaptation of the mixture ratio and self−adaptation of the evaporation system blocked. −final stage is deactivated.
	Signalling of : −short circuit to GND. −short circuit to Battery V. −open circuit.	⋆				
	Activation : −upon command sent by Dignosis Instrument. with piloting frequency of 0.5 Hz.			⋆	⋆	

KEY: PO = POWER ON – CK = STARTING – ER = ENGINE RUNNING – VR = VEHICLE RUNNING

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DIAGNOSIS TABLE continued

SYSTEM SUB−GROUP	ASSISTANCE PERFORMANCE OBTAINED CONNECTING THE TESTING INSTRUMENT TO THE DIAGNOSIS SOCKET, WITH CONTROL UNIT POWERED AND OPERATING	PO	CK	ER	VR	NOTES
IDLE ACTUATOR (POWER TERMINALS)	**Visualisation of** : −actuator offset −transfer function : DATUM.			⋆	⋆	**<u>Environmental parameters memorised in any case</u>** : −engine rpm and engine temperature. **<u>Malfunction warning light</u>** : OFF **<u>Recovery 1</u>** : valve in recovery position near to the idle air flow for: −short circuit to Battery V on opening winding. −open circuit on opening winding. −short circuit to Battery V on closing winding. −open circuit on closing winding. −short circuit to Battery V on opening and closing windings. −short circuit to Battery V on opening winding and open circuit on closing winding. −short circuit to Battery V on closing winding and open circuit on opening winding. −open circuit on opening winding and closing windings. **<u>Recovery 2</u>** : valve open to 0% for : −short circuit to Battery V on opening winding and short circuit to GND on closing winding. −open circuit on opening winding and short circuit to GND on closing winding. **<u>Recovery 3</u>** : valve open to 50% for : −short circuit to GND on opening winding. −short circuit to GND on closing winding. −short circuit to GND on opening and closing windings. **<u>Recovery 4</u>** : open valve to 100% for : −short circuit to Battery V on closing winding and short circuit to GND on opening winding. −open circuit on closing winding and short circuit to GND on opening winding. **<u>Additional steps</u>** : −self−adaptation of idle blocked at current values. −idle control blocked and integrator set at 0.
	Signalling of : −opening winding in short circuit to GND, short circuit to Battery V and open circuit	⋆		⋆	⋆	
	−closing winding in short circuit to GND, short circuit to Battery V and open circuit			⋆	⋆	
	Activation : −upon command sent by Diagnosis Instrument, with opening of 1 second (piloting duty cycle = 90%) and closing of 1 second (piloting duty cycle = 10 %) alternately.					

KEY: PO = POWER ON − CK = STARTING − ER = ENGINE RUNNING − VR = VEHICLE RUNNING

DIAGNOSIS TABLE continued

SYSTEM SUB–GROUP	ASSISTANCE PERFORMANCE OBTAINED CONNECTING THE TESTING INSTRUMENT TO THE DIAGNOSIS SOCKET, WITH CONTROL UNIT POWERED AND OPERATING	PO	CK	ER	VR	NOTES
FUEL PUMP RELAY (POWER TERMINALS)	**Signalling of** : –short circuit to Battery V.			⋆	⋆	**Environmental parameters** : –engine rpm, engine temperature. **Malfunction warning light** : ON **Recovery** : –None.
MODULAR MANIFOLD (POWER TERMINALS) (Deactivated on Fiat Coupè Turbo)	**Signalling of** : –short circuit to Battery V. –short circuit to GND. –open circuit. **Activation** : –upon command sent by Diagnosis Instrument, with piloting frequency of 0.5 Hz.	⋆		⋆ ⋆ ⋆	⋆ ⋆ ⋆	**Environmental parameters** : –engine rpm, engine temperature. **Malfunction warning light** : OFF **Recovery** : –The final stage is deactivated.
E.G.R. VALVE (Deactivated on Alfa/Fiat versions)	**Signalling of** : –short circuit to Battery V. –short circuit to GND. –open circuit. **Activation** : –upon command sent by Diagnosis Instrument, with piloting frequency of 0.5 Hz.(not present)	⋆		⋆ ⋆ ⋆	⋆ ⋆ ⋆	**Environmental parameters** : –engine rpm, engine temperature. **Malfunction warning light** : OFF **Recovery** : –The final stage is deactivated. **Additional steps** : –self–adaptation of idle blocked at current values. –idle control blocked.
TIMING VARIATOR	**Signalling of** : –short circuit to Battery V. –short circuit to GND. –open circuit. **Activation** : –upon command sent by Diagnosis Instrument, with piloting frequency of 0.5 Hz.	⋆		⋆ ⋆ ⋆	⋆ ⋆ ⋆	**Environmental parameters** : –engine rpm, engine temperature. **Malfunction warning light** : OFF **Recovery** : The final stage is deactivated.

KEY: PO = POWER ON – CK = STARTING – ER = ENGINE RUNNING – VR = VEHICLE RUNNING

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DIAGNOSIS TABLE continued

SYSTEM SUB–GROUP	ASSISTANCE PERFORMANCE OBTAINED CONNECTING THE TESTING INSTRUMENT TO THE DIAGNOSIS SOCKET, WITH CONTROL UNIT POWERED AND OPERATING	PO	CK	ER	VR	NOTES
COOLING FANS	**Signalling of** : –signal not plausible **Activation:** –upon command sent by Diagnosis Instrument with piloting frequency of 0.5/ Hz.	⋆		⋆	⋆	**Error detection conditions** : –signal not plausible The failure is memorised if the engine temperature at start–up is >116.9 °C and the engine temperature continues to be > 116.9 °C 3 min. after start–up. **Environmental parameters** : –engine rpm and engine loading. **Malfunction warning light** : ON **Recovery** : The final stage is deactivated.
AUTOMATIC TRANSMISSION INPUT	**Signalling of** : –short circuit to GND			⋆	⋆	**Error detection conditions** : –short circuit to GND : when a gear change lasts more than 2.5 seconds **Environmental parameters** : –engine rpm, engine loading. **Malfunction warning light** : OFF **Recovery** : None.
WASTE–GATE VALVE (POWER TERMINALS) (On Fiat Coupè Turbo only)	**Signalling of** : –s.c. to battery V –s.c. to GND –open circuit **Activation:** –upon command sent by Diagnosis Instrument with piloting frequency of 0.5 Hz.	⋆	⋆ ⋆ ⋆	⋆ ⋆ ⋆	⋆ ⋆ ⋆	**Environmental parameters** : –engine rpm and engine loading. **Malfunction warning light** : ON **Recovery** : –the final stage is deactivated.

KEY: PO = POWER ON – CK = STARTING – ER = ENGINE RUNNING – VR = VEHICLE RUNNING

DIAGNOSIS TABLE continued

SYSTEM SUB−GROUP	ASSISTANCE PERFORMANCE OBTAINED CONNECTING THE TESTING INSTRUMENT TO THE DIAGNOSIS SOCKET, WITH CONTROL UNIT POWERED AND OPERATING	PO	CK	ER	VR	NOTES
ELECTRONIC KEY	**Visualisation of** : −electronic key status byte value	*	*	*	*	**Error detection conditions** : −no code received or interrupted link : this can occur in the presence of an open circuit or a short circuit to Battery V or a short circuit to GND or where the electronic key does not respond to any code (in case of breakage of the electronic key itself or if both the electronic key and the engine control unit are not initialised and an error is present on the electronic key). −code unknown or not recognised : when the electronic key transmits a code which is different from that the control unit expects to receive. −erroneous key code transmitted by the electronic key: when the antenna is disconnected or if a key which is not memorised or a mechanical key is inserted. **Malfunction warning light** : ON **Recovery** : −The control unit is in ” prohibit engine management ” i.e. it is blocked. **Environmental parameters** : −State of electronic key and battery voltage.
	Signalling of :					
	−no code received or interrupted link.	*				
	−code unknown or not recognised.	*				
	−erroneous key code transmitted by the electronic key.	*				
	N.B. : The communication line between electronic key and engine control unit is dedicated and has a permanent EEPROM memory.					

KEY: PO = POWER ON − CK = STARTING − ER = ENGINE RUNNING − VR = VEHICLE RUNNING

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1.2

Configuration of the lines and initialisation

1.2.1

Used lines

Configuration with bi–directional line ”K” .

1.2.2

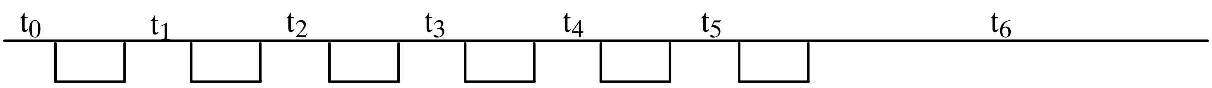
Initialisation

Initialisation by address (address 10H) on line ”K” at 5 baud ±5%.

The dialogue does not start and should be initiated again if:
a) The start bit is not considered valid by E.C.U.;
b) The stop bit is not considered valid by E.C.U.;
c) The address code is wrong;
d) The parity bit is not valid;
e) engine rpm exceeds a fixed threshold in the E.C.U.(2000 RPM)

1.2.3

ISO code



For the description of the ISO Code relative to the models see § A.

1.2.4

Time schedule

Time lapse between initialisation and preamble:	**200 ms $< t_0 <$ 400 ms**
Time lapse between the bytes of the preamble:	**0 ms$< t_1 <$ 200 ms**
	0 ms$< t_2 <$ 200 ms
	0 ms$< t_3 <$ 200 ms
	0 ms$< t_4 <$ 200 ms
	0 ms$< t_5 <$ 200 ms

After reception of the preamble there is a recognition of the test instrument by the ECU corresponding to the complement of the third byte of the preamble (key2). This recognition (acknowledge) must reach the control unit in a time of: **5 mS $< t_6 <$ 1200 mS**.

If the control unit receives an acknowledge which is incorrect or does not receive anything at all, it send the tester the complete preamble another two times.

1.3

Communication

1.3.1

Communication parameters

The transmission logic is in positive logic.
The coding of the datum occurs in **NRZ**, and the baud rate is **4.8 KBaud** (208 μs/bit) with a permitted tolerance of: **± 5 %.**

- **Start bit (”0”)** :1
- **Datum bits** :8
- **Stop bit (”1”)** :1

1.3.2

Communication protocol

Bi–directional communication (master–slave) on line ”K”.
Following complemented key 2 the ECU sends to the tester the identification code on a number of blocks in accordance with the following chart:

E.C.U.			TESTER
		<–––	Complemented Key 2
Identification block 1	–––>		
		<–––	Acknowledge frame
Identification block 2	–––>		
		<–––	Acknowledge frame
....	–––>		
		<–––	....
Last identification block	–––>		
		<–––	Acknowledge frame
Acknowledge frame	–––>		

From here the dialogue can continue with a request by the Testing Instrument until the request for end of diagnosis is reached:

E.C.U.			TESTER
		<–––	Request frame 1
Response frame 1	–––>		
		<–––	Acknowledge frame
Acknowledge frame	–––>		
		<–––	Request frame 2
Response frame 2	–––>		
		<–––	Request frame 3
Response frame 3	–––>		
		<–––	End of diagnosis frame

Communication must be maintained active by the exchange of request/response frame or, more simply, by exchanging acknowledge frames.
The slave must respond with a complemented echo byte to each byte sent by the master apart from the ETX byte which must be simply send again without carrying out out the complement; if the master does not receive this echo in the set time correctly, the master itself will begin to transmit again the current frame from the start until the communication is not taken up again by the slave.
The slave has a ”no–acknowledge” frame available with which it can request transmission of the preceding frame or indicate recognition of the request block (discrimination occurs with the value assigned to the parameter).
The delay time between the two frames is 1 second at maximum.

1.3.2.1

Structure of the frames

The exchange of information occurs via groups of bytes called frames, structured as follows:

Length of the frame (1 byte): **Following number of bytes** (max. **15**)

Frame counter (1 byte): Increased each transmission from the master, has value 1 for the first identification blocks. The values equal to the frame counter correspond to the Testing Instrument.

Title of frame (1byte): Identifies the type of operation requested or carried out

Information: n byte **(0 <= n <= 12)**.

End of frame (1 byte): End of transmission character, **ETX=03H.**

Delay time between subsequent bytes in the tester frame : **1 ms < t < 40 ms**

Delay time between subsequent bytes in the ECU frame : **0 ms < t < 40 ms**

Time between request and acknowledge bytes : **1 ms < t < 40 ms**

Acknowledge after each request byte (by ECU) (Excluding ETX) : complemented echo

Time within which the ECU must send a response to the tester after receiving a request from it : **1 ms < t <1 s**

Time within which the ECU must send a response to the tester after receiving a request from it : **0 ms < t <1 s**

No. of bytes present in a block (excluding: title, length, counter and end of block) : **12**

1.3.2.1.1

Frame titles

Description of frame	FLT TITLE (HEX)	E.C.U. TITLE (HEX)
REQUEST FOR READING OF ERROR MEMORY	07H	FCH
REQUEST FOR DELETION OF ERROR MEMORY	05H	09H (ACK)
REQUEST FOR READING OF RAM CELLS	01H	FEH
REQUEST FOR READING AD CHANNELS	08H	FBH
REQUEST FOR ACTUATOR COMMAND	04H	09 H (ACK)
REQUEST FOR END OF DIAGNOSIS	06H	− − −(*)
ACKNOWLEDGE	09H	− − −(**)
NO ACKNOWLEDGE	0AH	− − −(**)
TRANSMISSION OF SECURITY CODE	24H	EAH

(*) No response is managed
(**) Variable response.

1.3.2.2

End of diagnostic dialogue

Time out.

1.3.2.3

Identification block

FRAME:

As the identification code of the control unit is composed by a long series of bytes (ASCII), these will be sent to FLT on a number of blocks.

BYTE No.	MEANING	CODE
1	Length of block	N−1 H
2	Block counter	xx H
3	Title	F6 H
4	ASCII code	
N−1	ASCII code	
N	End of frame byte (**ETX**)	03 H

The identification code is subdivided as follows:
from the 30th ASCII caracter to the 21st FIAT drawing no
from the 20th to the 11th Bosch SW identification code
from the 10th to the 1st Bosch HW identification code.

1.3.3

List of parameters requested from E.C.U.

1.3.3.1

Reading of RAM cells

READING

BYTE No.	MEANING	CODE
1	Length of block	06 H
2	Block counter	xx H
3	Title	(See point 1.3.2.1.1)
4	No. of RAM cells requested	(See point 1.3.3.2)
5	Requested cell address (**H**)	
6	Requested cell address (**L**)	
7	End of frame byte (**ETX**)	03 H

RESPONSE

BYTE No.	MEANING	CODE
1	Length of block	N−1 H
2	Block counter	xx H
3	Title	(See point 1.3.2.1.1)
4	RAM cell(s) emitted	(See point 1.3.3.2)
	RAM cell(s) emitted	
N	End of frame byte (**ETX**)	03 H

1.3.3.2

RAM addresses

Number	SIZE	CONVERSION FORMULA	RAM ADDRESS (hex)	
			Bravo/Brava	Present
1	Engine rpm [**MSB**]	DATUM x 40 [RPM]	2000	Yes
2	Engine rpm (up to 2500 RPM) [**LSB**]	DATUM x 10 [RPM]	2001	Yes
3	Engine water temperature	See point 1.3.4.4.2	2002	Yes
4	Air temperature		2003	Yes
5	Absolute throttle angle position	DATUM x 96/230.4 [˚]	2004	Yes
6	Air flow	DATUM x 1.60 [m^3/h]	2005	Yes
7	Air flow up to 51 m^3/h	DATUM x 0.20 [m^3/h]	2006	Yes
8	Advance angle	78 – DATUM x 0.75 [˚]	2007	Yes
9	Injection time [**MSB**]	DATUM x 0.384 [ms]	2008	Yes
10	Injection time [**LSB**]	DATUM/255 [ms]	2009	Yes
11	Relative throttle angle position	DATUM x 96/230.4 [˚]	200A	Yes
12	Engine loading	DATUM x 0.05 [ms]	200B	Yes
13	Air pressure in the intake manifold	–	200C	No
14	Barometric pressure	DATUM x 5 [mbar]	200D	Yes
15	Theoretical air flow **QSOLL**	DATUM x 0.20 [m^3/h]	200E	Yes
16	Voltage of air flow meter	DATUM x 5/255 [V]	200F	Yes
17	Voltage of battery	DATUM x 0.0705 [V]	2010	Yes
18	Vehicle speed	DATUM x 1.0 [Km/h]	2011	Yes
19	Temperature of λ sensor	–	2012	No
20		–	2013	No
21	Voltage of λ sensor1	DATUM x 1.25/255 [V]	2014	Yes
22	Voltage of λ sensor2	–	2015	No
23	Integrator of λ sensor MSB1 (**FR1**)	±0.8 % / byte with: 00h = –102% 80h = 0% FFh = +102%	2016	Yes
24	Integrator of λ sensor LSB1 (**FR1**)	–	2017	No
25	Integrator of λ sensor MSB2 (**FR2**)	–	2018	No
26	Integrator of λ sensor LSB2 (**FR2**)	–	2019	No

continued

RAM addresses continued

Number	SIZE	CONVERSION FORMULA	RAM ADDRESS (hex)	
			Bravo/Brava	Present
27	FRA1 factor	±0.8 % / byte with: 00h = −102% 80h = 0% FFh = +102%	201A	Yes
28	FRA2 factor		201B	No
29	TRA1 factor	±2 μs / byte with: 00h = −256 μs 80h = 0 μs FFh = +256 μs	201C	Yes
30	TRA2 factor		201D	No
31	Byte flag Open/closed loop		201E	No
32	Status byte	See point 1.3.4.3	201F	Yes
33	Status byte sensor λ	See point 1.3.4.1	2020	Yes
34	Immobiliser status byte	See point 1.3.4.2	2021	Yes
35	Target rpm	–	2022	Yes
36	Target rpm at idle	DATUM x 10 [RPM]	2023	Yes
37	Position of idle actuator	–	2024	No
38	Estimated position of idle actuator	–	2025	No
39	Idle actuator offset	–	2026	No
40	Idle actuator gain	–	2027	No
41	CO trimmer	–	2028	No
42	Duty cycle overboost driver	–	2029	No
43	Duty cycle EGR driver	–	202A	No
44	Duty cycle canister driver	DATUM x 0.39 [%]	202B	Yes
45	Odometer [1]	DATUM x 0.1 [km]	202C	Yes
46	Odometer [1]		202D	Yes
47	Odometer [1]		202E	Yes
48	Flag checksum	00h = Ok 01−FEh=Nok FFh = Experimental Eprom	202F	Yes
49	Max. speed reached	DATUM x 40 [RPM]	2030	Yes

[1] The information given concerning the odometer is not considered to be valid.

1.3.4

Decoding status bytes

1.3.4.1

State of λ sensor (2020h)

BIT	BINARY	MEANING
01	0000.0001	Short circuit to earth / sensor at lower limit
02	0000.0010	Lean
03	0000.0011	Sensor cold or open circuit
04	0000.0100	Rich
05	0000.0101	Short circuit to Battery V / sensor at upper limit

1.3.4.2

Immobiliser status byte (2021h)

BIT	MEANING
0	No code received or interrupted link.
1	Code unknown or not recognised.
2	Erroneous key code (10.10.10.10.10) transmitted by Immobiliser.
3	Virgin ECU.
4	ECU in ”prohibit engine management”.
5	Universal code received.
6	Immobiliser communication on dedicated line (0 on line ’K’)
7	N.U.

1.3.4.3

Status byte (201Fh)

BIT	MEANING
0	Full power position
1	Idle position
2	Automatic transmission: gear change (S_GE)
3	
4	Automatic transmission: position D (S_FS)
5	
6	Air conditioner selection (S_AC)
7	Activation of compressor (S_KO)

1.3.4.4

AD/C channels

READING

BYTE No.	MEANING	CODE
1	Length of block	04 H
2	Block counter	xx H
3	Title	(See point 1.3.2.1.1)
4	Channel No.	(See point 1.3.4.4.1)
5	End of frame byte (**ETX**)	03 H

RESPONSE

BYTE No.	MEANING	CODE
1	Length of block	05 H
2	Block counter	xx H
3	Title	(See point 1.3.2.1.1)
4	Emitted value (**MSB**)	00 H
5	Emitted value (**LSB**)	(See point 1.3.4.4.1)
6	End of frame byte (**ETX**)	03 H

1.3.4.4.1

Conversion of AD/C channels

SIZE	CHANNEL (HEX.)	CONVERSION FORMULA
Throttle angle	00 H	(DATUMx96)/230.4 [°]
Battery voltage	01 H	DATUM/14.68 [V]
Position of automatic transmission	02 H	DATUMx5/255 [V] 1
Water temperature	03 H	See table at point 1.3.4.4.3
Air flow meter signal	04 H	DATUMx255 [mV]
Air temperature	05 H	See table at point 1.3.4.4.3
Knock sensor	06 H	DATUMx5000/255 [mV]
λ sensor	07 H	DATUMx1250/255 [mV]
Air conditioner input	09 H	DATUMx5/255 [V] 2
Automatic transmission input	0A H	DATUMx5/255 [V] 3
Power supply with key	0B H	DATUM / 14.68 [V] 4

1 If the voltage measured is < 3.5V ⇒ S_FS=1

2 If the voltage measured is < 0.974V ⇒ S_AC=0, S_KO=0
If the voltage measured is > 0.974V and < 2.840V⇒ S_AC=1, S_KO=0
If the voltage measured is > 2.840V and < 4.360V⇒ S_AC=0, S_KO=1
If the voltage measured is > 4.360V⇒ S_AC=1, S_KO=1

3 If the voltage measured is < 3.5V ⇒ S_GE=1

4 If the voltage measured is > 2.5V ⇒ S_KL15=1 (key ON)

The variables S_XX shown above are present in the status byte (see point 1.3.4.3).

1.3.4.4.2

Air/water table (RAM)

Interpolation for values read in RAM cells

	00	01	02	03	04	05	06	07	08	09
00	−33.0	−32.5	−31.9	−31.4	−30.8	−30.1	−29.5	−28.9	−28.5	−27.9
10			−22.3	−21.6	−20.9	−20.3	−19.6	−18.9	−18.3	−17.7
20	−12.8	−11.8	−11.3	−10.8	−10.4	−9.9	−9.0	−8.1	−7.6	−7.2
30	−2.5	−1.8	−1.0	−0.3	0.4	−1.0	−1.7	2.4	3.0	3.7
40	8.5	9.0	9.6	10.2	10.7	11.3	11.8	12.3	13.4	13.9
50	18.5	19.4	19.9	20.4	21.3	21.8	22.3	23.2	23.7	24.6
60	28.7	29.2	30.0	30.5	30.9	31.8	32.3	33.2	33.6	34.5
70	38.9	39.3	39.8	40.7	41.1	42.0	42.5	43.4	43.8	44.7
80	49.3	49.8	50.2	51.2	51.6	52.6	53.1	53.6	54.5	55.0
90	59.6	60.6	61.2	61.7	62.8	63.3	63.9	65.0	65.5	66.1
A0	71.1	71.4	72.1	72.7	73.3	74.0	74.6	74.0	75.3	76.0
B0	80.2	80.9	81.7	82.1	82.4	83.2	84.0	84.8	85.6	86.4
C0	90.7	91.2	91.6	92.5	93.0	93.5	94.0	94.5	95.5	96.0
D0	100.8	101.4	101.9	102.5	103.1	104.3	104.9	105.5	106.8	107.4
E0	–	–	112.3	–	–	113.8	114.5	115.3	–	–
F0	–	–	–	–	125.0	–	–	–	–	–

	0A	0B	0C	0D	0E	0F
00	−27.5	−27.0	−26.2	−25.4	−24.6	−23.8
10	−17.1	−16.0	−15.5	−14.9	−13.8	−13.3
20	−6.4	−6.0	−5.6	−4.8	−4.0	−3.2
30	4.3	5.5	6.1	6.7	7.3	7.9
40	14.4	15.5	16.0	16.5	17.5	18.0
50	25.1	25.5	26.4	26.9	27.4	28.3
60	34.9	35.4	36.2	36.7	37.6	38.0
70	45.2	45.6	46.5	47.0	47.9	48.4
80	55.5	56.5	57.0	57.5	58.5	59.1
90	67.2	67.8	68.4	69.6	70.2	70.8
A0	76.7	77.3	78.0	78.4	78.7	79.5
B0	86.8	87.2	88.1	88.9	89.4	89.8
C0	96.5	97.0	97.5	98.6	99.1	99.6
D0	108.1	108.5	109.1	109.5	110.2	110.9
E0	116.9	124.0	–	–	–	–
F0	–	–	–	–	–	–

1.3.4.4.3

Air/water table (AD/C)

Interpolation for values read on ADC channel

	00	01	02	03	04	05	06	07	08	09
00	400.0						193.7	185.3	178.1	172.0
10	143.2	140.3	137.5	135.0	132.6	130.3	128.1	126.0	124.0	122.2
20	110.9	109.5	108.1	106.8	105.5	104.3	103.1	101.9	100.8	99.6
30	92.5	91.6	90.7	89.8	88.9	88.1	87.2	86.4	85.6	84.8
40	79.5	78.7	78.0	77.3	76.7	76.0	75.3	74.6	74.0	73.3
50	69.0	68.4	67.8	67.2	66.7	66.1	65.5	65.0	64.4	63.9
60	60.1	59.6	59.1	58.5	58.0	57.5	57.0	56.5	56.0	55.5
70	52.1	51.6	51.2	50.7	50.2	49.8	49.3	48.8	48.4	47.9
80	44.7	44.3	43.8	43.4	42.9	42.5	42.0	41.6	41.1	40.7
90	37.6	37.1	36.7	36.2	35.8	35.4	34.9	34.5	34.0	33.6
A0	30.5	30.0	29.6	29.2	28.7	28.3	27.8	27.4	26.9	26.4
B0	23.2	22.8	22.3	21.8	21.3	20.9	20.4	19.9	19.4	18.9
C0	15.5	15.0	14.4	13.9	13.4	12.9	12.3	11.8	11.3	10.7
D0	6.7	6.1	5.5	4.9	4.3	3.7	3.0	2.4	1.7	1.0
E0	−4.0	−4.8	−5.6	−6.4	−7.2	−8.1	−9.0	−9.9	−10.8	−11.8
F0	−19.6	−20.9	−22.3	−23.8	−25.4	−27.0	−28.9	−30.8	−33.0	−35.4

	0A	0B	0C	0D	0E	0F
00	166.5	161.7	157.3	153.3	149.7	146.3
10	120.3	118.6	116.9	115.3	113.8	112.3
20	98.6	97.5	96.5	95.5	94.5	93.5
30	84.0	83.2	82.4	81.7	80.9	80.2
40	72.7	72.1	71.4	70.8	70.2	69.6
50	63.3	62.8	62.2	61.7	61.2	60.6
60	55.0	54.5	54.1	53.6	53.1	52.6
70	47.4	47.0	46.5	46.1	45.6	45.2
80	40.2	39.8	39.3	38.9	38.5	38.0
90	33.2	32.7	32.3	31.8	31.4	30.9
A0	26.0	25.5	25.1	24.6	24.2	23.7
B0	18.5	18.0	17.5	17.0	16.5	16.0
C0	10.2	9.6	9.0	8.5	7.9	7.3
D0	0.4	−0.3	−1.0	−1.8	−2.5	−3.2
E0	−12.8	−13.8	−14.9	−16.0	−17.1	−18.3
F0	−38.1	−41.2	−44.9	−49.4	−55.6	−65.3

1.3.4.5

Acknowledge

BYTE No.	MEANING	CODE
1	Length of block	03 H
2	Block counter	xx H
3	Title	(See point 1.3.2.1.1)
4	End of frame byte (**ETX**)	03 H

1.3.4.5.1

No Acknowledge

BYTE No.	MEANING	CODE
1	Length of block	04 H
2	Block counter	xx H
3	Title	(See point 1.3.2.1.1)
4	Preceding block counter	yy H
5	End of frame byte (**ETX**)	03 H

1.3.4.6

Error memory

READING

BYTE No.	MEANING	CODE
1	Length of block	03 H
2	Block counter	xx H
3	Title	(See point 1.3.2.1.1)
4	End of frame byte (**ETX**)	03 H

RESPONSE

BYTE No.	MEANING	CODE
1	Length of block	N−1 H
2	Block counter	xx H
3	Title	(See point 1.3.2.1.1)
4	Error 1	(See point 1.3.4.7.2)
....	....	”
N	End of frame byte (**ETX**)	03 H

1.3.4.7

Error decoding

1.3.4.7.1

Structure of error memory

The error memory is structured in blocks of 5 bytes for a total of 25 bytes and each of these blocks is associated with an error (a maximum of 5 error can be stored at the same time).
Where more than 2 errors are present at the same time the bytes are divided into a number of blocks.

The 5 byte measured at each error have the following meaning:

1st ERROR CODE byte : defines the component subject to malfunction
(See point 1.3.4.7.2).

2nd ERROR TYPE byte : describes the type of failure, e.g. short circuit to GND
(See point 1.3.4.7.2).

3rd and 4th ENVIRONMENTAL CONDITIONS bytes : these are the values of two parameters measured at the moment in which the failure was detected (See point 1.3.4.7.2).

5th FAILURE FREQUENCY COUNTER byte: this is a counter which is initialised at value 10 the moment the failure is detected for the first time.
The counter is decreased by 1 every subsequent power on which is concluded without the failure being detected again.
If on the other hand the failure–appears, the counter is increased by 1 (if it was already lower than the initial value it is returned to 10).
When the frequency counter reaches 0, the error is erased from the memory.

1.3.4.7.2

Error memory table

ERROR	ERROR CODE	TYPE	CODE TYPE	PARAMETER 1	PARAMETER 2
ECU	01 H	Internal RAM error	X8	–	–
	06 H	ROM/EPROM error	X8		
λ sensor	1C H	s.c. to Battery V	X1	Engine rpm (n)	Engine loading (t_L)
		short circuit to GND	X2		
		open circuit	X4		
Sensor integrator (FR)	0A H	FR at upper limit	X1	Engine rpm (n)	Engine loading (t_L)
		FR at lower limit	X2		
Air flow meter	07 H	short circuit to Battery V	X1	Engine rpm (n)	Relative throttle angle.(Wdkbl)
		short circuit to GND / open circuit	X2		
Water/engine temperature sensor	2D H	short circuit to Batt.V/ open circuit	X1	Engine rpm (n)	Engine loading (t_L)
		short circuit to GND	X2		
		signal not plausible	X8		
Air temperature sensor	2C H	short circuit to Battery V/ open circuit	X1	Engine rpm (n)	Engine temp. (ENG T)
		short circuit to GND	X2		
Engine rpm sensor	05 H	open circuit	X4	Engine loading (t_L)	Engine temp. (ENG T)
	37 H	signal not plausible (Fiat Coupè Turbo only)	X8		
Engine timing sensor	08 H	short circuit to Battery V/open circuit	X1	Engine rpm (n)	Engine loading (t_L)
		short circuit to GND	X2		
Vehicle speed sensor	09 H	signal not plausible	X8	Engine rpm (n)	Engine loading (t_L)
Throttle potentiometer	0C H	max.> angle (253)	X1	Engine loading (t_L)	Engine temp. (ENG T)
		max.< angle (5)	X2		
Pressure sensor	89 H	value> s_max (0.949 V) voltage < s_min (0.050 V)	X1 X2	Engine rpm (n)	Engine loading (t_L)
Supercharging pressure over limit	85 H	at top limit	X1	Engine rpm (n)	Air temp. (TANS)
Supercharging adjustment with throttle closed	8A H	at top limit	X1	Engine rpm (n)	Engine temp. (ENG T)
		at bottom limit	X2		
Battery voltage	25 H	voltage > 5 max (1.6.01 V)	X1	Engine rpm (n)	Engine temp. (ENG T)
		voltage < s min (10.01 V)	X2		
Injector 1	E1 H	s.c. to Battery V	X1	Engine rpm (n)	Engine temp. (ENG T)
		short circuit to GND	X2		
		open circuit	X4		
Injector 2	E2 H	s.c. to Battery V	X1	Engine rpm (n)	Engine temp. (ENG T)
		short circuit to GND	X2		
		open circuit	X4		

continued

Error memory table continued

ERROR	ERROR CODE	TYPE	CODE TYPE	PARAMETER 1	PARAMETER 2
Injector 3	E3 H	s.c. to Battery V	X1	Engine rpm (n)	Engine temp. (ENG T)
		short circuit to GND	X2		
		open circuit	X4		
Injector 4	E4 H	s.c. to Battery V	X1	Engine rpm (n)	Engine temp. (ENG T)
		short circuit to GND	X2		
		open circuit	X4		
Injector 5	E5 H	s.c. to Battery V	X1	Engine rpm (n)	Engine temp. (ENG T)
		short circuit to GND	X2		
		open circuit	X4		
Waste Date	16 H	s.c. to Battery V	X1	Engine rpm (n)	Engine temp. (ENG T)
		s.c. to GND	X2		
		open circuit	X4		
Automatic transmission input	0DH	s.c. to GND	X2	Engine rpm (n)	Engine loading (t_L)
Idle actuator (opening winding)	04 H	s.c. to Battery V	X1	Engine rpm (n)	Engine temp. (ENG T)
		short circuit to GND	X2		
		open circuit	X4		
Idle actuator (closing winding)	02 H	s.c. to Battery V	X1	Engine rpm (n)	Engine temp. (ENG T)
		short circuit to GND	X2		
		open circuit	X4		
Purge Canister	22 H	s.c. to Battery V	X1	Engine rpm (n)	Engine temp. (ENG T)
		short circuit to GND	X2		
		open circuit	X4		
Knock sensor 1	80 H	Signal not plausible	X8	Engine rpm (n)	Engine temp. (ENG T)
Knock sensor 2	81 H	Signal not plausible	X8	Engine rpm (n)	Engine temp. (ENG T)
Knock evaluation circuit	8F H	Signal not plausible	X2	Engine rpm (n)	Engine loading (t_L)
DTV Self−adaptation parameters	67 H	Beyond the plausible upper limit	X1	Engine rpm (n)	Engine temp. (ENG T)
		Beyond the plausible lower limit	X2		
FRA Self−adaptation parameters	66 H	Beyond the plausible upper limit	X1	Engine rpm (n)	Engine temp. (ENG T)
		Beyond the plausible lower limit	X2		
TRA Self−adaptation parameters	68 H	Beyond the plausible upper limit	X1	Engine rpm (n)	Engine temp. (ENG T)
		Beyond the plausible lower limit	X2		
Fuel pump relay	03 H	s.c. to Battery V	X1	Engine rpm (n)	Engine temp. (ENG T)
Modular manifold command	10 H	s.c. to Battery V	X1	Engine rpm (n)	Engine temp. (ENG T)
		short circuit to GND	X2		
		open circuit	X4		
EGR (not activated)	FF H	s.c. to Battery V	X1	Engine rpm (n)	Engine temp. (ENG T)
		short circuit to GND	X2		
		open circuit	X4		

Error memory table continued

ERROR	ERROR CODE	TYPE	CODE TYPE	PARAMETER 1	PARAMETER 2
Electronic key (Immobiliser)	C8 H	Error between Immobiliser and E.C.U.	X8	Immobiliser Byte	Battery voltage
Timing variator	16 H	s.c. to Battery V	X1	Engine rpm (n)	Engine temp. (ENG T)
		short circuit to GND	X2		
		open circuit	X4		
Cooling Fan	18 H	Signal not plausible	X8	Engine rpm (n)	Engine temp. (ENG T)

Error type coding

xxxx 0001	Short circuit to battV or value > max
xxxx 0010	Short circuit to GND or value < min
xxxx 0100	Open circuit
xxxx 1000	Signal not plausible
xxx1 xxxx	Important error for CARB (light on)
xx1x xxxx	Failure memorised after a period of time
x1xx xxxx	Failure momentarily present
1xxx xxxx	Sporadic error (=0, static error)

1.3.4.8

Transmission of secret code

Code transmission from Tester

BYTE No.	MEANING	CODE
1	Length of block	09 H
2	Block counter	xx H
3	Title	(See point 1.3.2.1.1)
4	(fixed code)	01 H
5	First digit	0x H
6	Second digit	0x H
7	Third digit	0x H
8	Fourth digit	0x H
9	Fifth digit	0x H
10	End of frame byte (**ETX**)	03 H

The code is known to the owner of each vehicle and is written on the ”Security Card” given to the customer together with the keys.
To start the recovery procedure with the Testing Instrument, the code must be entered on the tester’s key pad starting from the fist digit on the left.

E.C.U. response

BYTE No.	MEANING	CODE
1	Length of block	09 H
2	Block counter	xx H
3	Title	(See point 1.3.2.1.1)
4	(fixed code)	01 H
5	First digit	0x H
6	Second digit	0x H
7	Third digit	0x H
8	Fourth digit	0x H
9	Fifth digit	0x H
10	End of frame byte (**ETX**)	03 H

For safety reasons the E.C.U. does not confirm the correctness of the code received:
the only way of checking is to observe the warning light which should go out at the end of each procedure.

1.4

Active diagnosis

1.4.1

List of active diagnoses available after request by Testing Instrument − E.C.U.

Error erasure
Injector 1
Injector 2
Injector 3
Injector 4 (**Not used on Alfa Romeo engines**)
Injector 5
Idle actuator
Canister purge relay
EGR (**not used**)
Timing variator relay
Modular manifold (**Not used**) / Waste Gate (**used on Coupè Fiat Turbo only**)
Air conditioning compressor
Fan speed 1 (**used on Alfa Romeo engines only**)
Fan speed 2 (**used on Alfa Romeo engines only**)
End of diagnosis
Transmission of Security Code (01 + 5 five digits of code)

1.4.2

Active diagnosis mode

1.4.2.1

Error memory reset

No authorisation is necessary.

Error deletion frame from FLT

BYTE No.	MEANING	CODE
1	Length of block	03 H
2	Block counter	xx H
3	Title	(See point 1.3.2.1.1)
4	End of frame byte (**ETX**)	03 H

The response to the request to delete the error memory is composed by an acknowledge block where the command is carried out correctly in addition to the action itself; otherwise the ECU sends a no acknowledge block.

1.4.2.2

Actuator activation block

Vehicle conditions : Key ON and engine not running.

Active diagnosis input mode : actuator activation frame.

Behaviour of the control unit during active diagnosis : exchange of acknowledge with the Testing Instrument

Mode of interrupting activation of the device :
– with a data/error request;
– starting the engine.

Exit from active diagnosis :
– exceeding **time out** between exchange of blocks
– with a data/error request;
– starting the engine.

BYTE No.	MEANING	CODE
1	Length of block	H
2	Block counter	xx H
3	Title	(See point 1.3.2.1.1)
4	Actuator pin number	(See point 1.4.2.2.1)
5	End of frame byte (**ETX**)	03 H

1.4.2.2.1

Actuator table

Pin No.	Description	Mode of activation
17	Injector 1	Activation for 1 ms with f = 1 Hz
16	Injector 2	
35	Injector 3	
34	Injector 4	
15	Injector 5 [3]	
4	Idle actuator	Activation with duty cycle = 90% for 1 sec. and duty cycle = 10% for 1 sec.
5	Canister purge relay	Activation with f = 0.5 Hz
52	Timing variator relay	
23	Modular manifold (⋆) [1] Waste gate [4]	
32	Air conditioner compressor	
25	Fan 2 [2]	
26	Fan 1 [2]	

[1] Not used.

[2] Used on Alfa Romeo engines only.

[3] Not used on Alfa Romeo engines.

[4] Used on Fiat Coupè Turbo ony.

1.4.2.3

End of diagnostic dialogue

The diagnostic dialogue is ended by the transmission of the following frames:

DIAGNOSTIC DIALOGUE END REQUEST

BYTE No.	MEANING	CODE
1	Length of block	03 H
2	Block counter	xx H
3	Title	(See point 1.3.2.1.1)
4	End of frame byte (**ETX**)	03 H

The dialogue is also ended by disconnecting the control unit or by time out, after 1 second.

1.5

DIFFERENCE VERSION TABLE

This table snows the differences between the various versions of vehicles equipped with the M2.10.4 control unit.

Application	Timing variator	Knock sensor	Odometer	Sensor value	Fans	T/C
Bravo/Brava 2.0 5cyl.	x	x	x	–	–	–
Marea 2.0 5cyl.	x	x	x	–	–	–
N.Dedra 2.0 5cyl.	x	x	x	–	–	–
COUPÈ Fiat 2.0 5cyl.	x	x	x	–	x	–
COUPÈ Fiat Turbo 2.0 5cyl.	x	x	x	x	x	x
Alfa 145/6 1.4/1.6/1.8/2.0 TS	x	x	x	–	x	–
Alfa 155 1.6/1.8/2.0 TS	x	x	x	–	x	–
Alfa 932 (Nuova Giulietta) 1.6 TS	x	x	x	–	x	–

N.B. All Alfa 145/6/155 engines have 4 cylinders