

**Diagnosis – Oscilloscope****General information**

Sample digital oscilloscope patterns are shown on the following pages. The Bear and Sun engine analyzers feature a memory with a manual display freeze. The sample oscilloscope display patterns should be compared to those of the test and adjustment equipment. However, the same test depth is not available since analog instruments can not store data.

The **ignition oscilloscope** can perform the following functions:

- Parade display,
- Raster display,
- Single display,
- Switching from time and voltage ranges.

The displays listed can be stored, stopped and printed out individually. In addition to the high voltage displays in the kV range, it is also possible to record signal displays in the low voltage range, for example, signals from sensors with 100 % or millisecond time basis.

Refer to page 50/1 for additional signal checks.

Diagnosis – Oscilloscope

Oscilloscope

Good scope pattern, single and dual ignition system (CFI/LH-SFI)

Secondary side.

Time range ..... 100 %  
 Measurement range ..... 10 kV

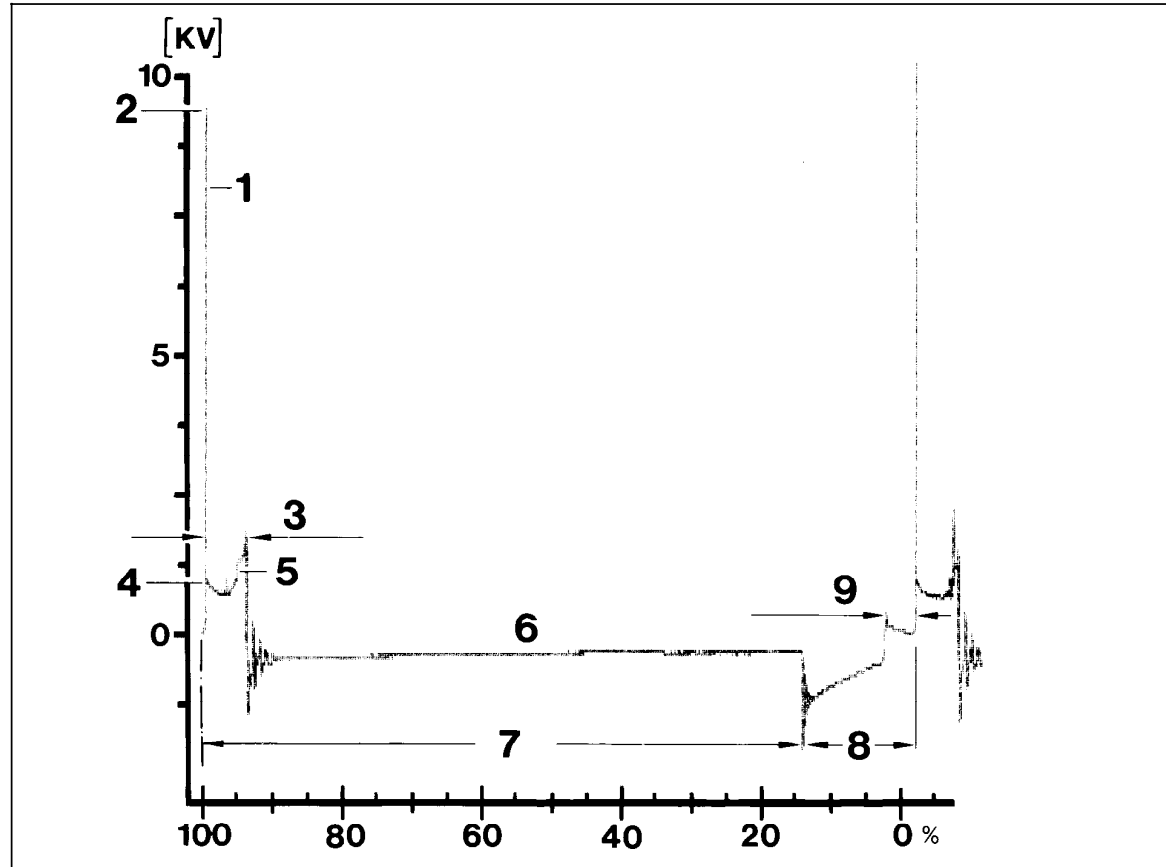


Figure 1

- 1 Ignition voltage line
- 2 Ignition voltage height
- 3 Burn time
- 4 Burn voltage height
- 5 Burn voltage line
- 6 Decay process
- 7 Opening section
- 8 Closing section
- 9 Primary current limiting (active only up to 2000 rpm)

P15-5068-57A

Diagnosis – Oscilloscope

Oscilloscope

Good scope pattern, single and dual ignition system (CFI/LH-SFI)

Secondary side (parade).

Engine at idle.

Example: 4 cylinder engine 102.

Display follows firing order 1 3 4 2.

Measurement range ..... 20 kV

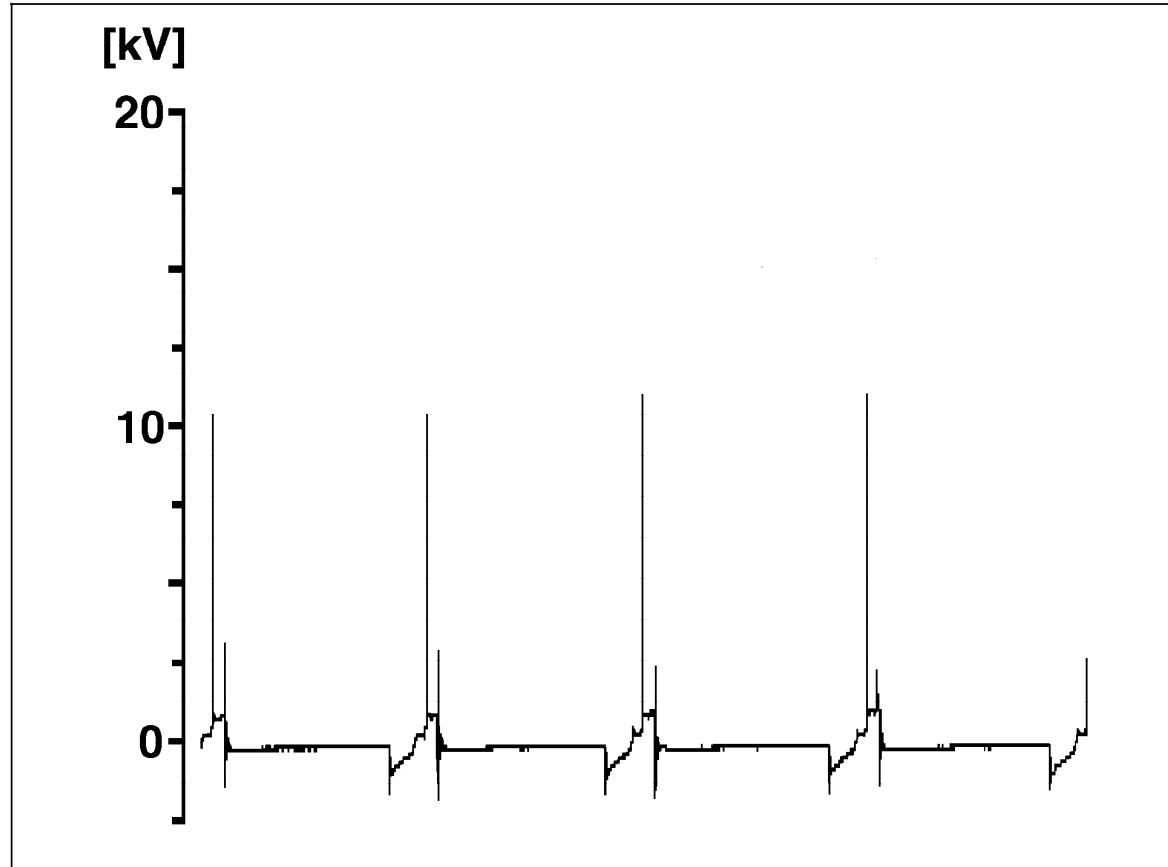


Figure 2

P15-0005-57

Diagnosis – Oscilloscope

Oscilloscope

Good scope pattern, single and dual ignition system (CFI/LH-SFI)

Secondary side (Raster).

Engine at idle.

Example: 4-cylinder engine.

Measurement range ..... 20 kV  
Time range ..... 100 %

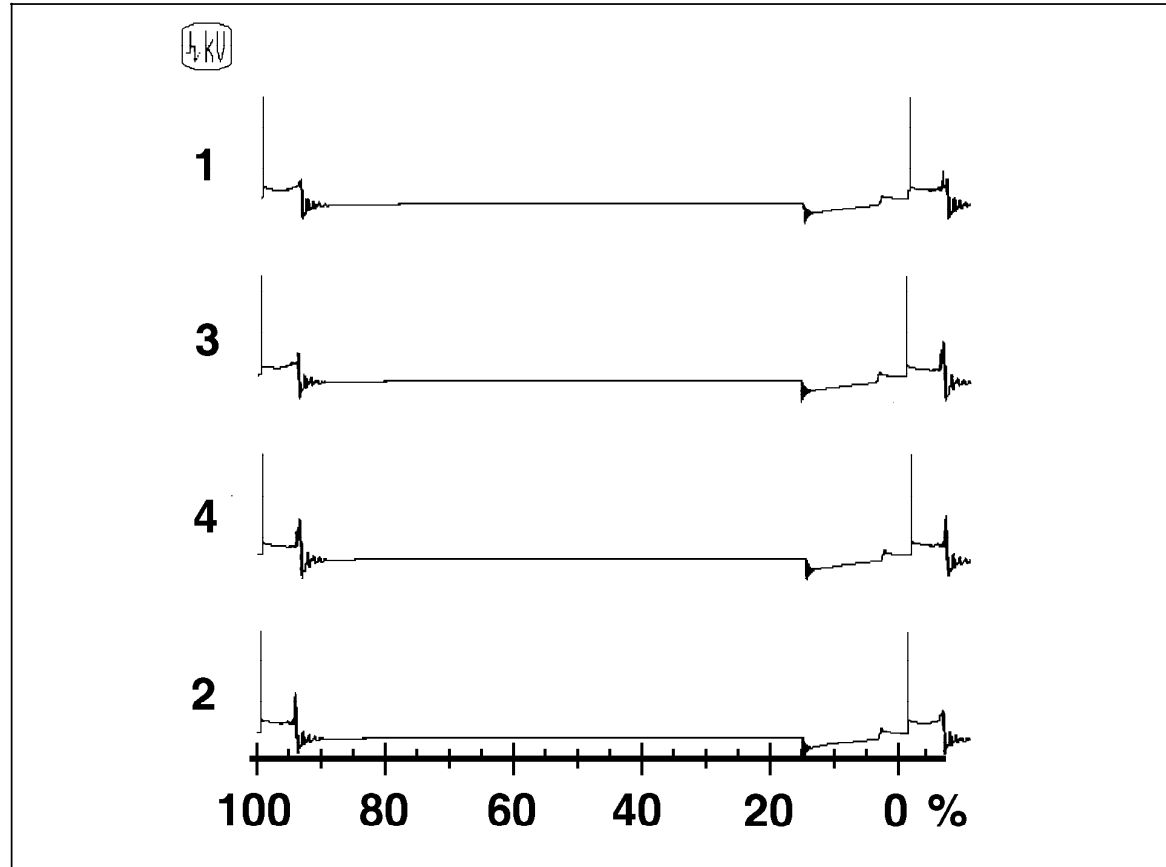


Figure 3

P15-0006-57

Diagnosis – Oscilloscope

Oscilloscope

Good scope pattern, single and dual ignition system (CFI/LH-SFI)

Secondary side (single display).

Engine at idle.

Measurement range ..... 10 kV

Time range ..... 100 %

Note:

The next cylinder is displayed according to firing order.

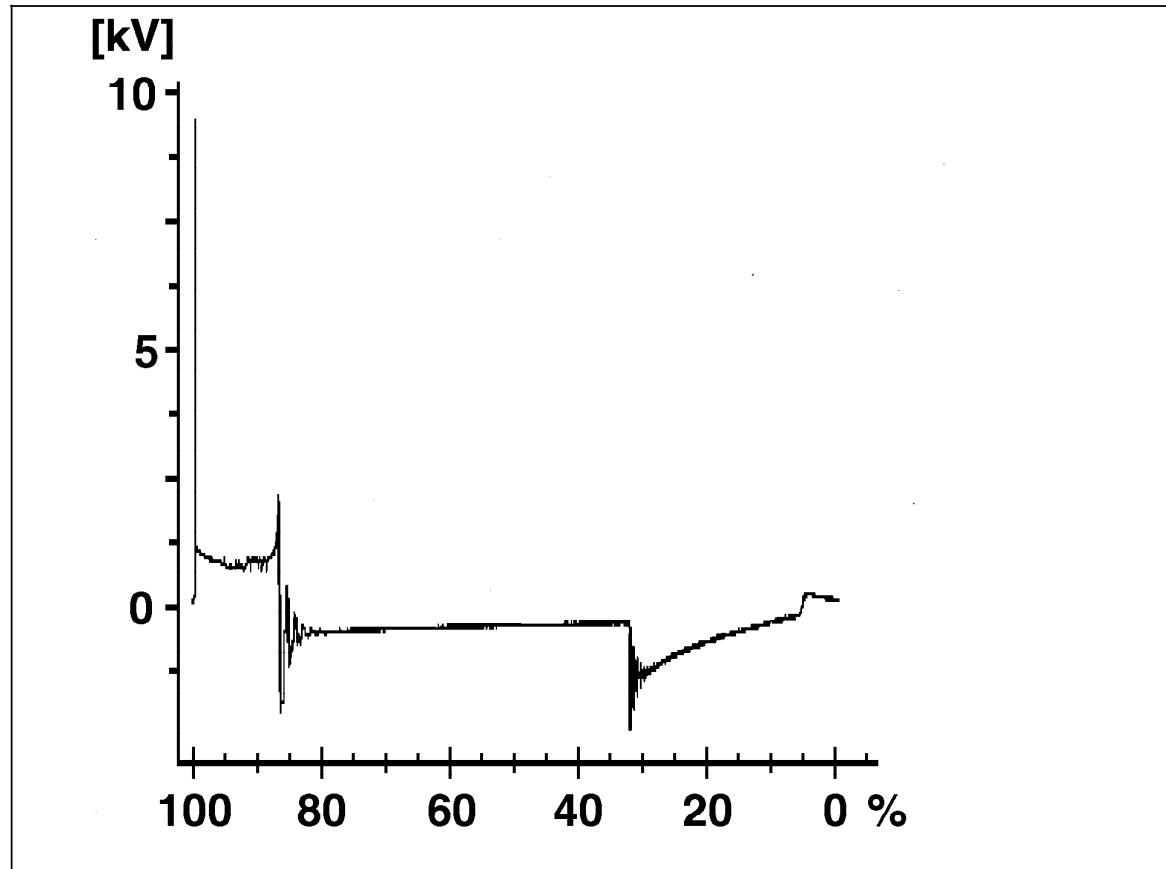


Figure 4

P15-0007-57

Diagnosis – Oscilloscope

Oscilloscope

Good scope pattern, single and dual ignition system (CFI/LH-SFI)

Secondary side (single display).

Engine at idle.

Measurement range ..... 20 kV

Time range ..... 5 ms

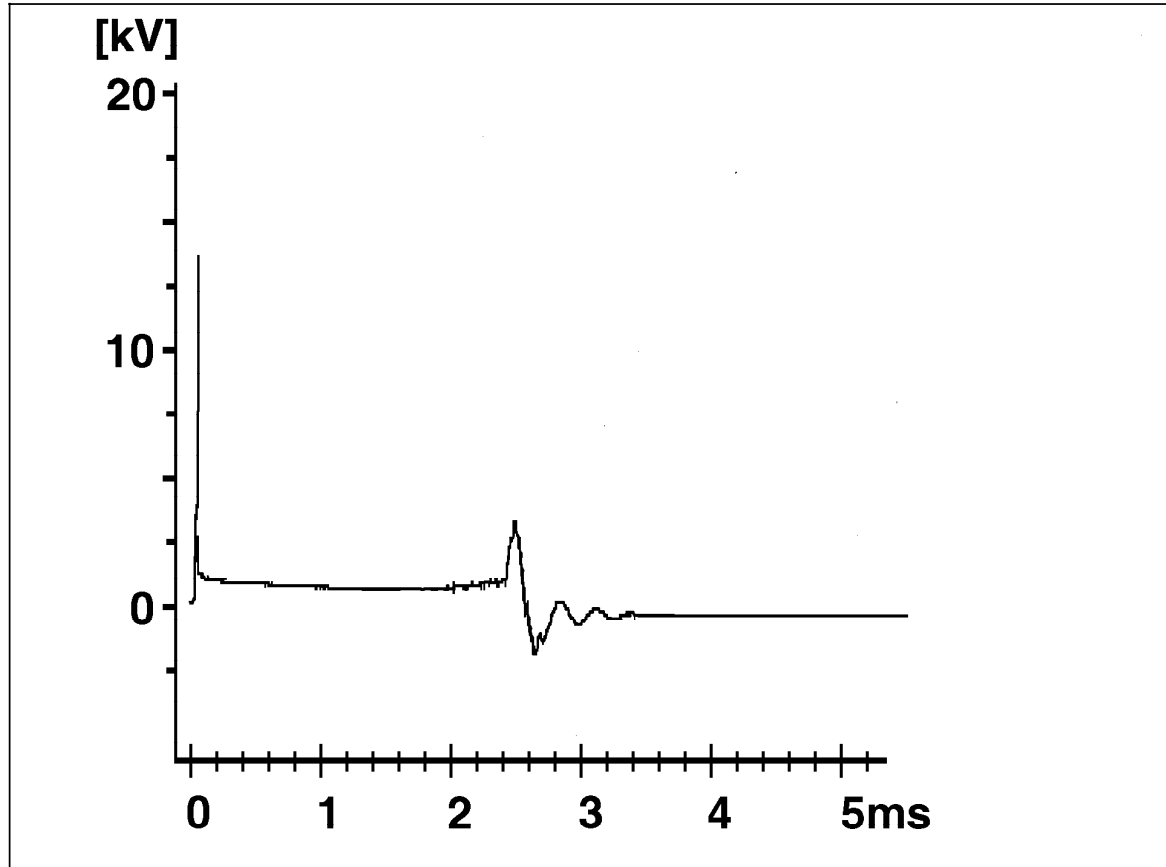


Figure 5

P15-0008-57

Diagnosis – Oscilloscope

Oscilloscope

Good scope pattern, single and dual ignition system (CFI/LH-SFI)

Secondary side (single display).

Engine at idle.

Measurement range ..... 20 kV

Time range ..... 5 ms

Note:

Bosch ignition coil 11 A.

Identification:

Green sticker at least 5 oscillations.

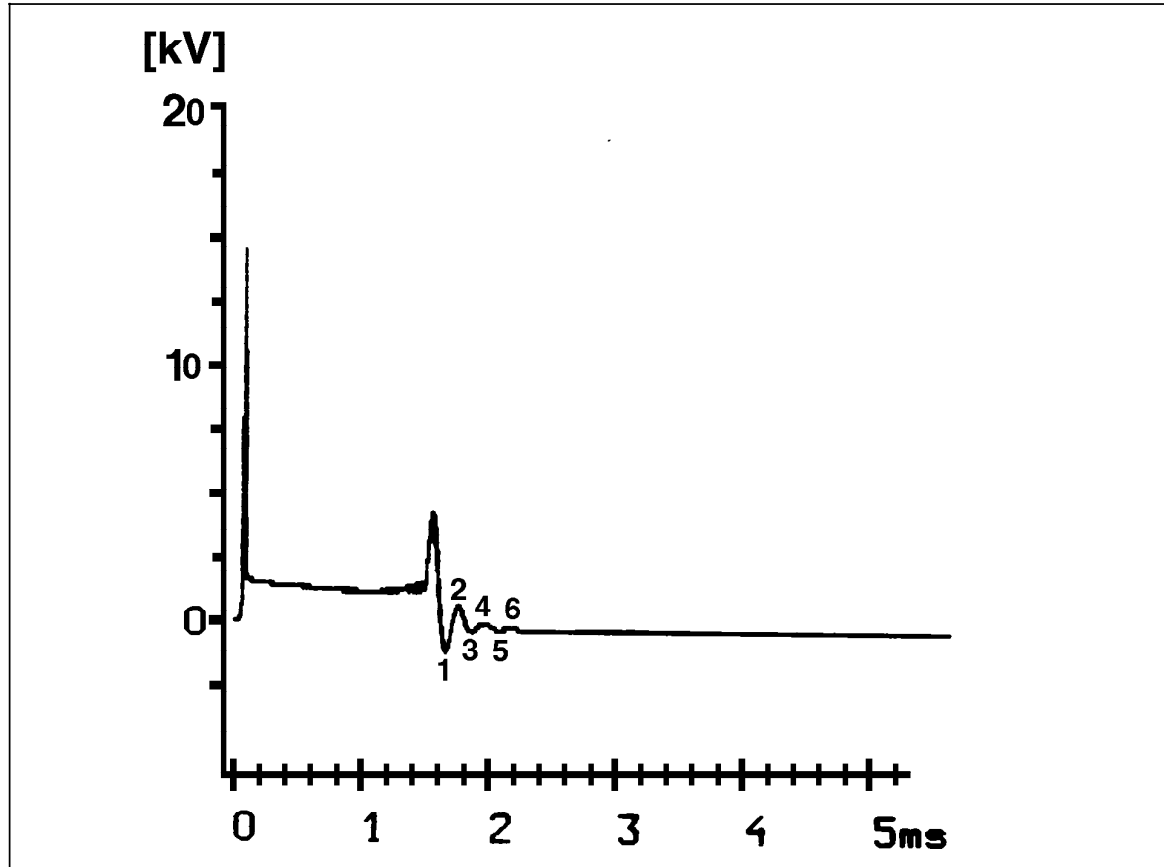


Figure 6

- 1 Oscillation
- 2 Oscillation
- 3 Oscillation
- 4 Oscillation
- 5 Oscillation

P15-0384-57

Diagnosis – Oscilloscope

Oscilloscope

Good scope pattern, single and dual ignition system (CFI/LH-SFI)

Secondary side (single display).

Engine at idle.

Measurement range ..... 20 kV  
 Time range ..... 5 ms

**Note:**

May Christi ignition coil 8 and 11 A.

Bosch ignition coil 8A.

**Coil Identification:**

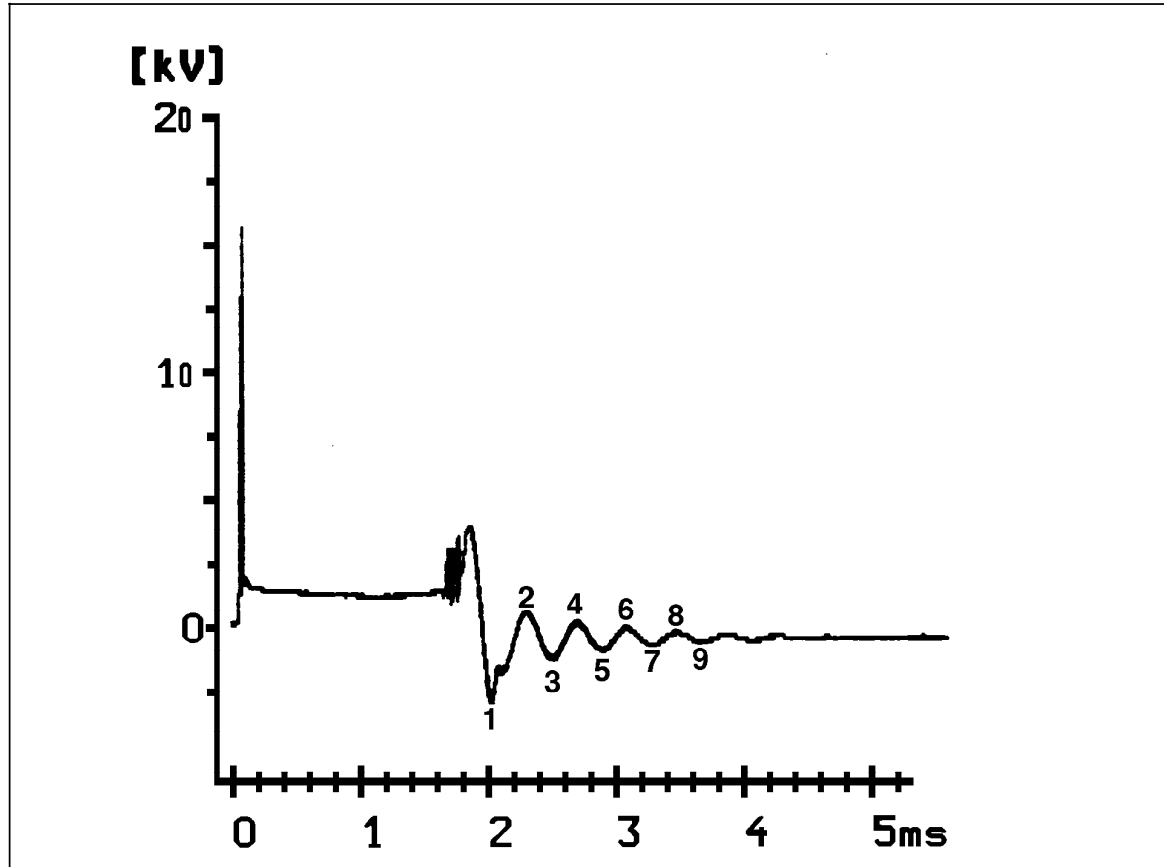
8 A yellow sticker.

11 A green sticker.

at least 8 oscillations.

Figure 7

- 1 Oscillation
- 2 Oscillation
- 3 Oscillation
- 4 Oscillation
- 5 Oscillation
- 6 Oscillation
- 7 Oscillation
- 8 Oscillation
- 9 Oscillation



P15-0385-57



Diagnosis – Oscilloscope

Oscilloscope

Good scope pattern, single and dual ignition system (CFI/LH-SFI)

Secondary side (parade).

Measurement range ..... 20 kV  
 Acceleration to ..... 3000 rpm

Test condition: accelerate engine repeatedly to 3000 rpm.

Note

- As a result of the acceleration process, several cylinders are displayed in succession according to firing order, see display example (1–3–4–2–1–3–4–2 etc.).
- The ignition voltage shows a uniform increase at all cylinders during the acceleration phase. The ignition voltage increase must not exceed 6 kV.

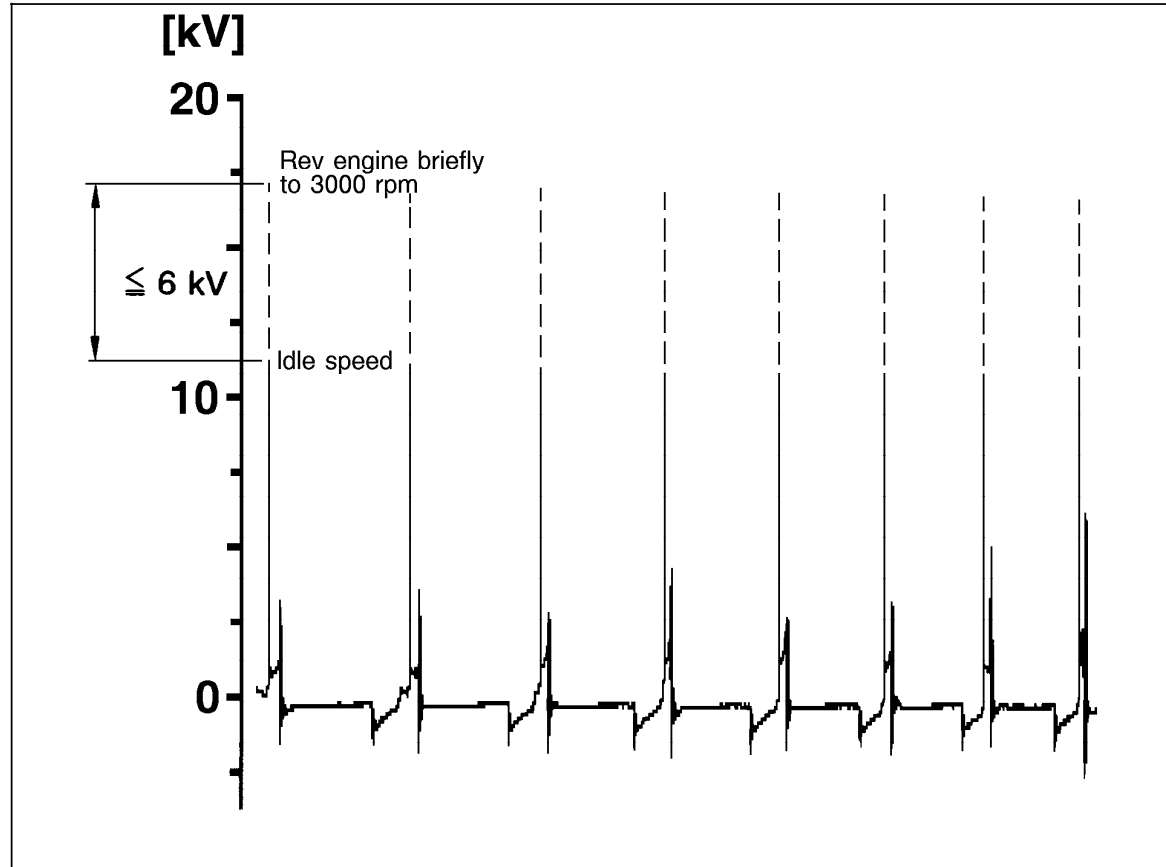


Figure 8

P15-0011-57

Diagnosis – Oscilloscope

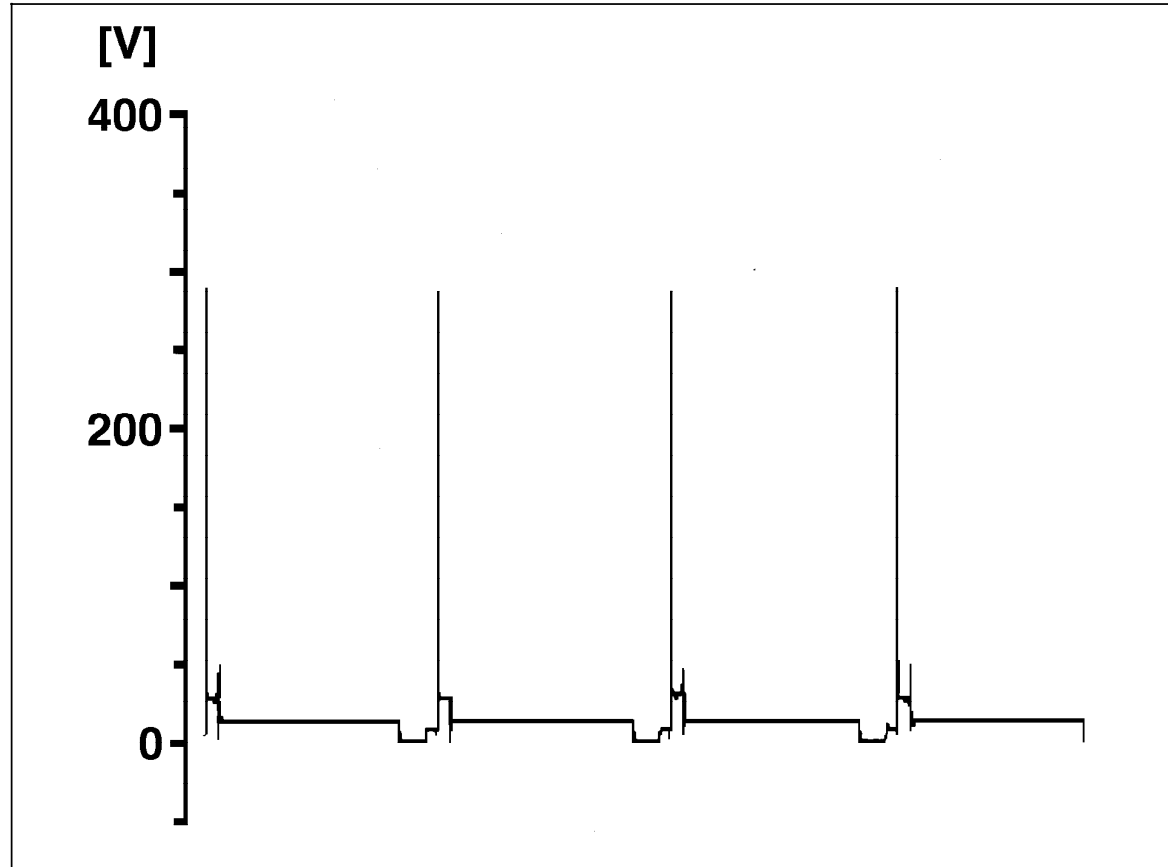
Oscilloscope

Good scope pattern, single and dual ignition system (CFI/LH-SFI)

Primary side (parade).

Engine at idle.

Measurement range ..... 400 V



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Figure 9

Diagnosis – Oscilloscope

Oscilloscope

Good scope pattern, single and dual ignition system (CFI/LH-SFI)

Primary side (single display).

Engine at idle.

Measurement range ..... 400 V  
Time range ..... 100 %

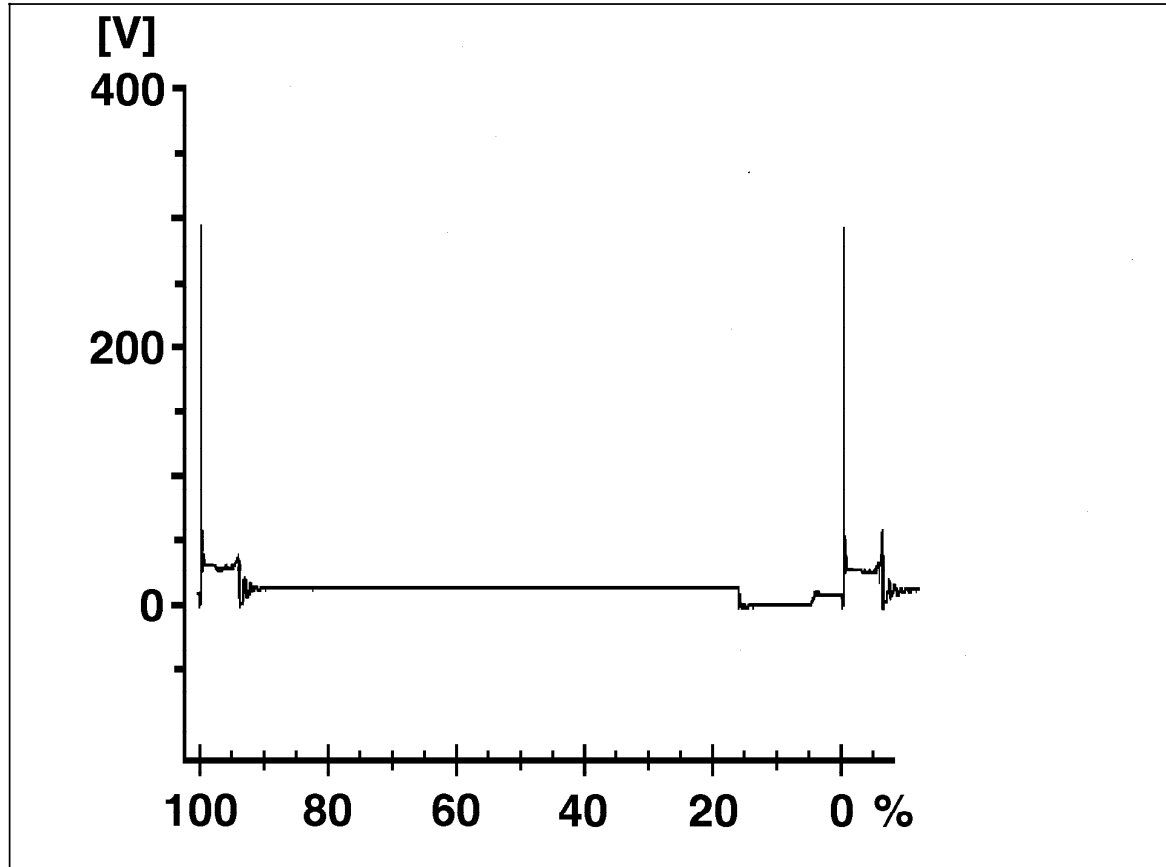


Figure 10

P15-0010-57

Diagnosis – Oscilloscope

Oscilloscope

Good scope pattern, single and dual ignition system (CFI/LH-SFI)

Primary side (Primary current limit).

Measurement range ..... 20 kV

Acceleration to ..... 3000 rpm

Note:

Limiting of the primary current can occur intermittently, at one or all cylinders, at engine speeds above 2000 rpm with and without load (arrows).

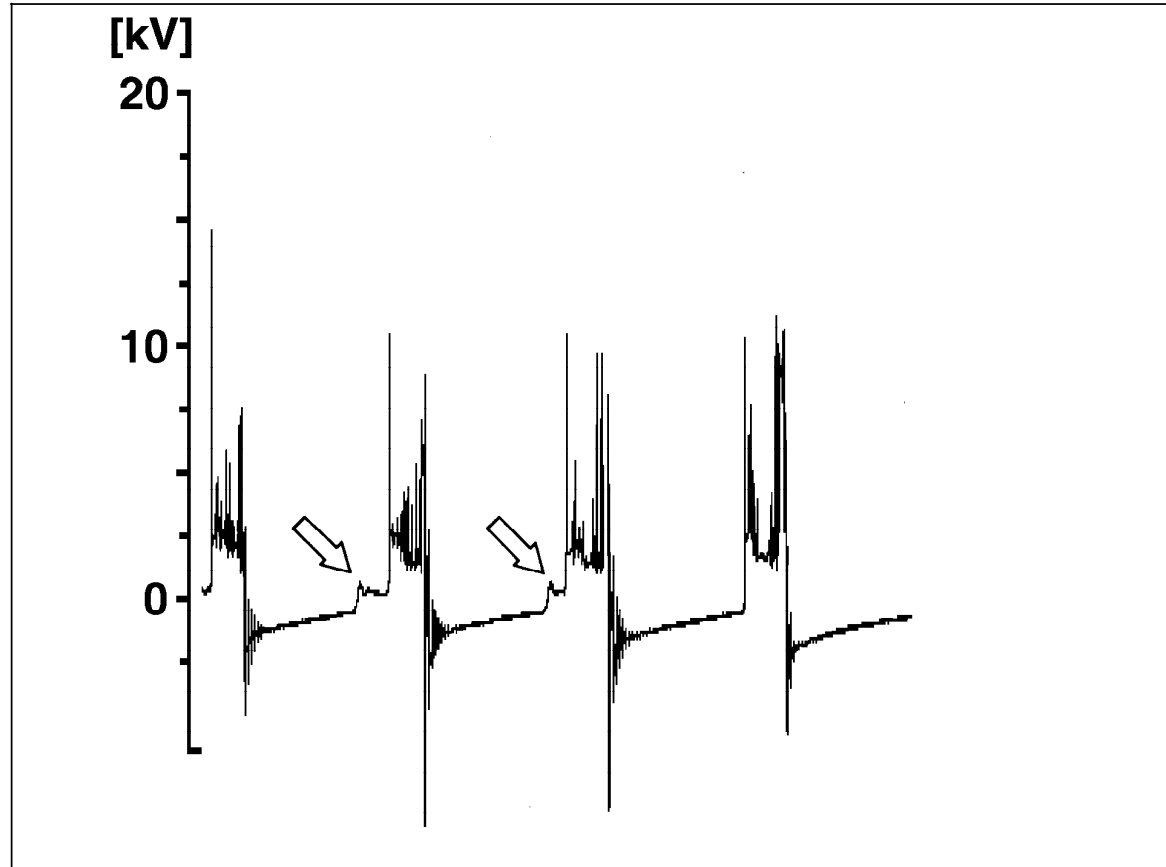


Figure 11

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Diagnosis – Oscilloscope

Oscilloscope

Bad scope pattern, single and dual ignition system (CFI/LH-SFI)

Secondary side (parade).

Measurement range ..... 20 kV

Ignition voltage too high/burn time shorter (arrows).

Test condition: can occur at **any engine RPM with or without load.**

Cause

- Spark plug electrode gap too large,
- Additional spark paths on secondary side,
- Fuel/air mixture too lean.

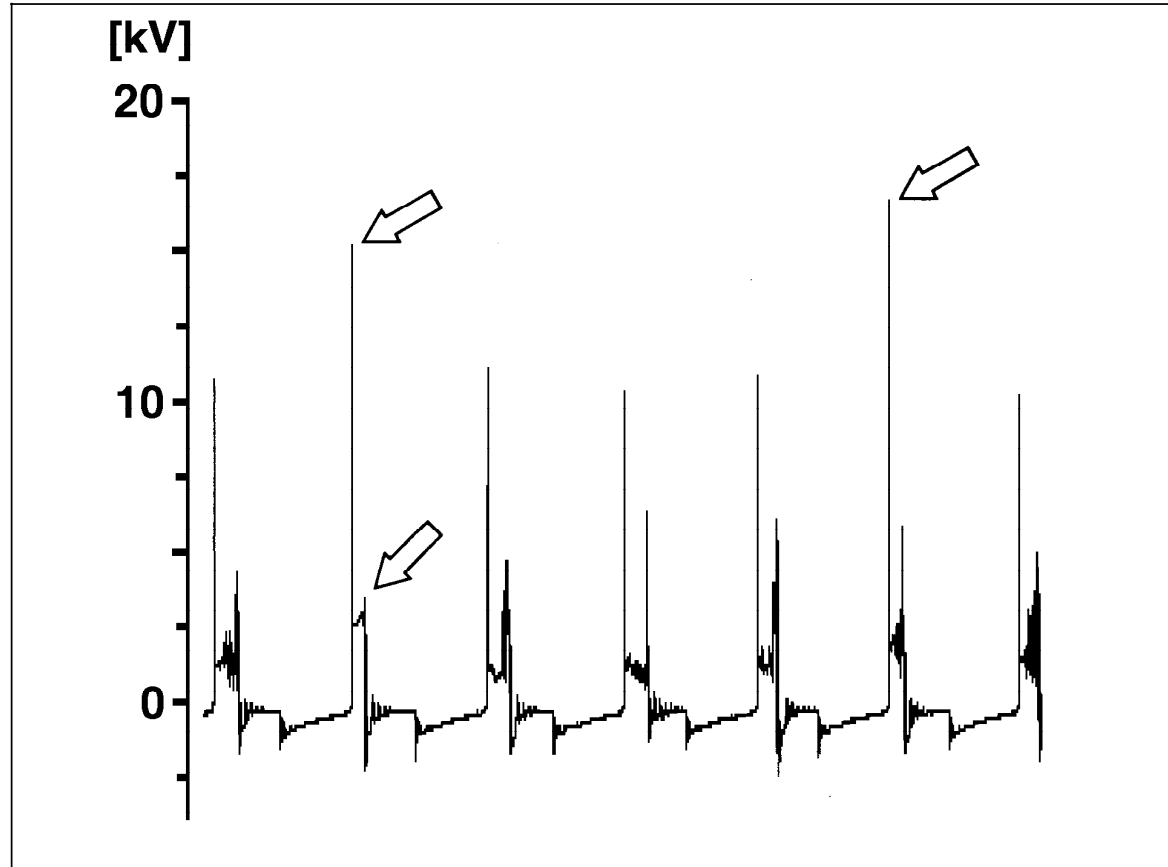


Figure 12

P15-0013-57

Diagnosis – Oscilloscope

Oscilloscope

**Bad scope pattern, single and dual ignition system (CFI/LH-SFI)**

Secondary side (parade).

Measurement range ..... 20 kV

Ignition voltage too low/combustion time longer.

Test condition: can occur at **any engine RPM with or without load.**

**Cause:**

- Spark plug gap too small,
- Fuel/air mixture too rich,
- Loss of compression.

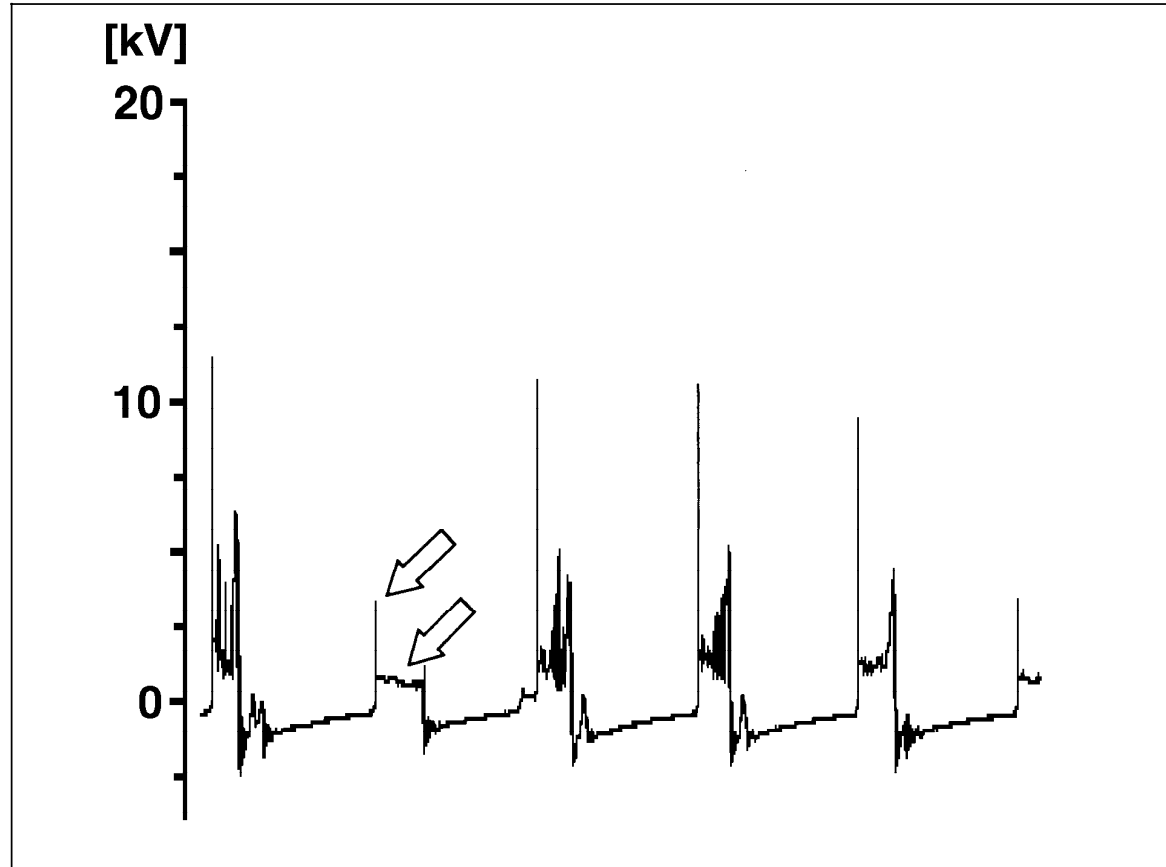


Figure 13

P15-0014-57

Diagnosis – Oscilloscope

Oscilloscope

**Bad scope pattern, single and dual ignition system (CFI/LH-SFI)**

Secondary side (parade).

Measurement range ..... 20 kV

Decay process too high.

Test condition: **Accelerate engine repeatedly up to approx. 3000 rpm or operate engine under load on dynamometer.**

**Cause**

Fuel/air mixture too lean at one cylinder (arrows).

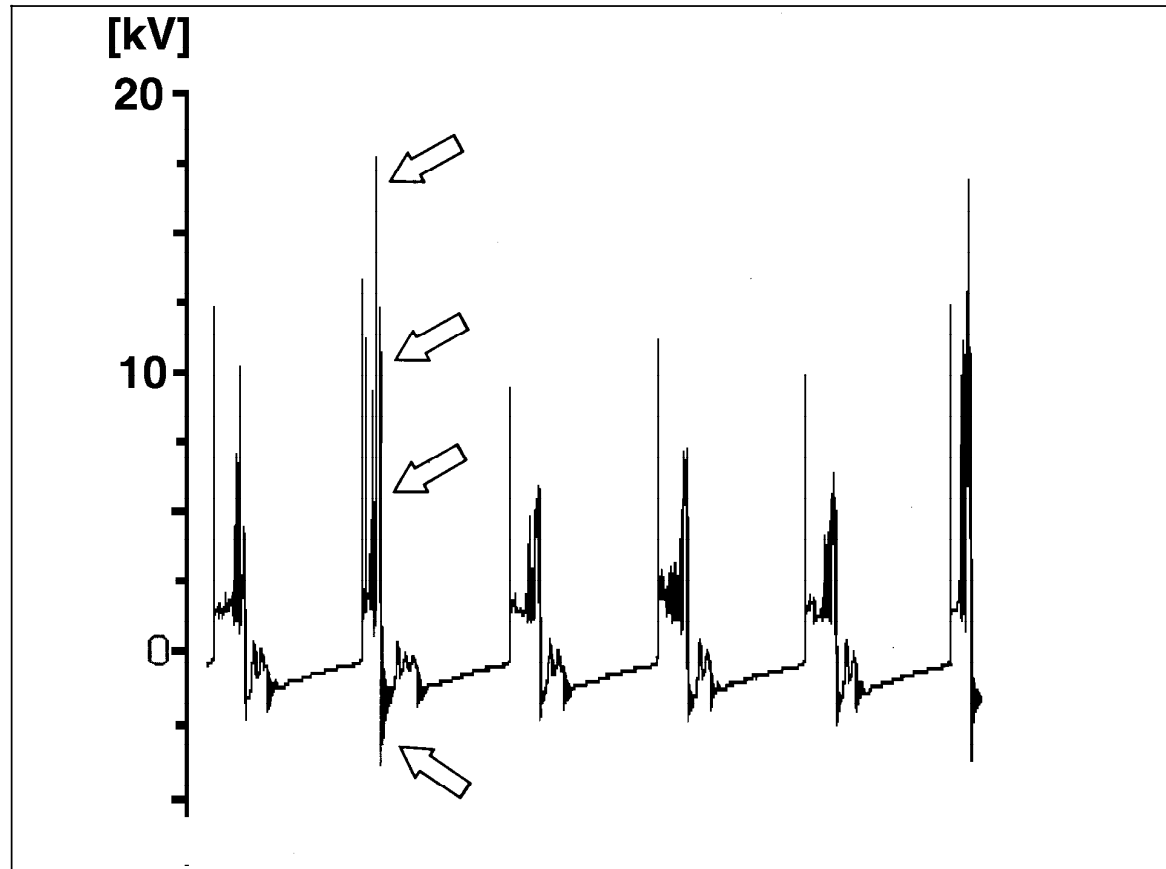
**Note**

If engine is not running smoothly (not running on all cylinders) after start up, the engine should be turned off at normal operating temperature and started again after a cool off period (approx. 15 min.) to allow a better diagnosis.

When re-starting, note test condition.



Malfunction may only occur momentarily.



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Figure 14

Diagnosis – Oscilloscope

Oscilloscope

**Bad scope pattern, single and dual ignition system (CFI/LH-SFI)**

Secondary side (parade).

Measurement range ..... 20 kV

Higher voltage >1.5 kV at single cylinder

Test condition: can occur at **any engine RPM with or without load.**

**Cause:**

Spark plug fouled by carbon, oil, (arrow).

Excessive resistance at secondary side.

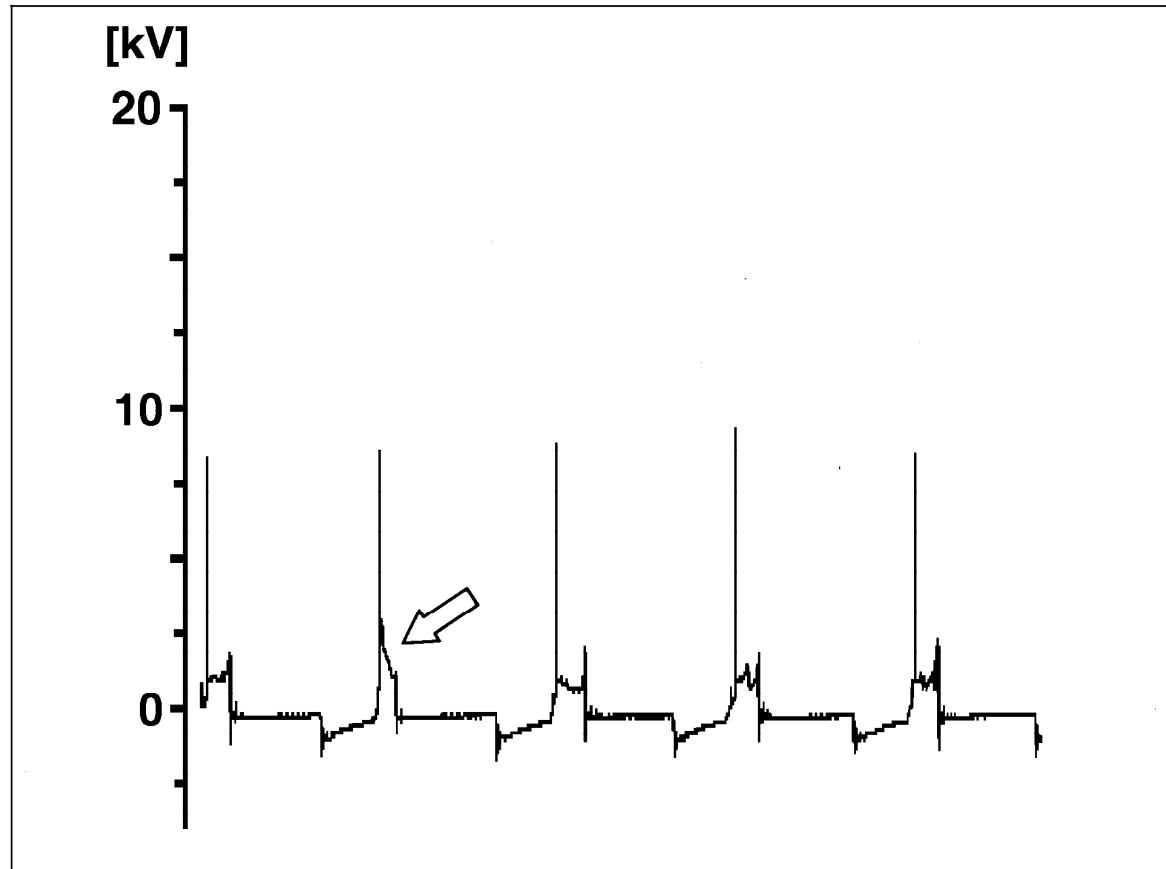


Figure 15

P15-0017-57



Diagnosis – Oscilloscope

Oscilloscope

**Bad scope pattern, single and dual ignition system (CFI/LH-SFI)**

Secondary side (parade).

Measurement range ..... 20 kV

Voltage too high >1.5 kV at one cylinder (arrow).

Test condition: can occur at **any engine RPM with or without load.**

**Cause:**

Excessive resistance at secondary side (ignition cable 4, distributor rotor, ignition coil, or high voltage output).

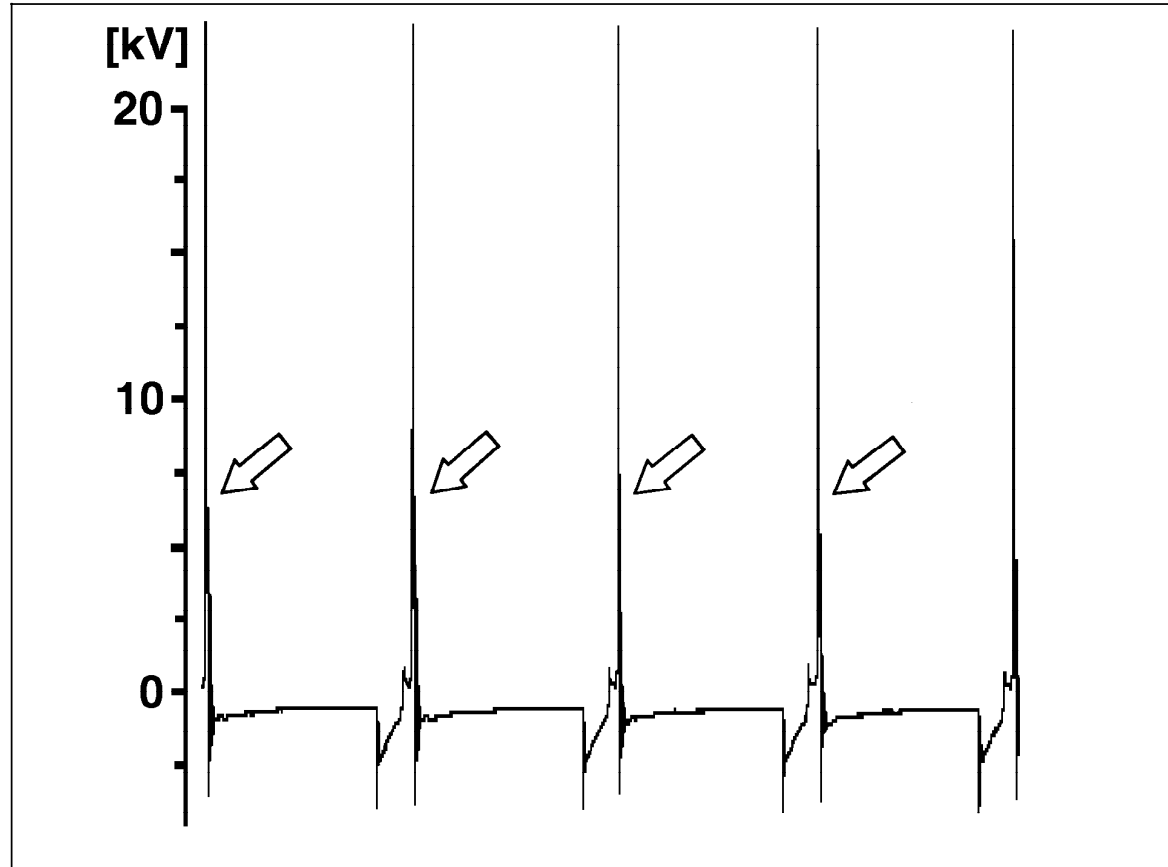


Figure 16

P15-0018-57

Diagnosis – Oscilloscope

Oscilloscope

Bad scope pattern, single and dual ignition system (CFI/LH-SFI)

Secondary side (single display).

Measurement range ..... 10 kV

Time range ..... 100 %

Ignition voltage ..... <8 kV at terminal 4

Test condition: **Starting RPM.**

**Cause:**

Ignition coil, voltage terminal 15, terminal 1.

**Note**

Engine does not start (engine not running).

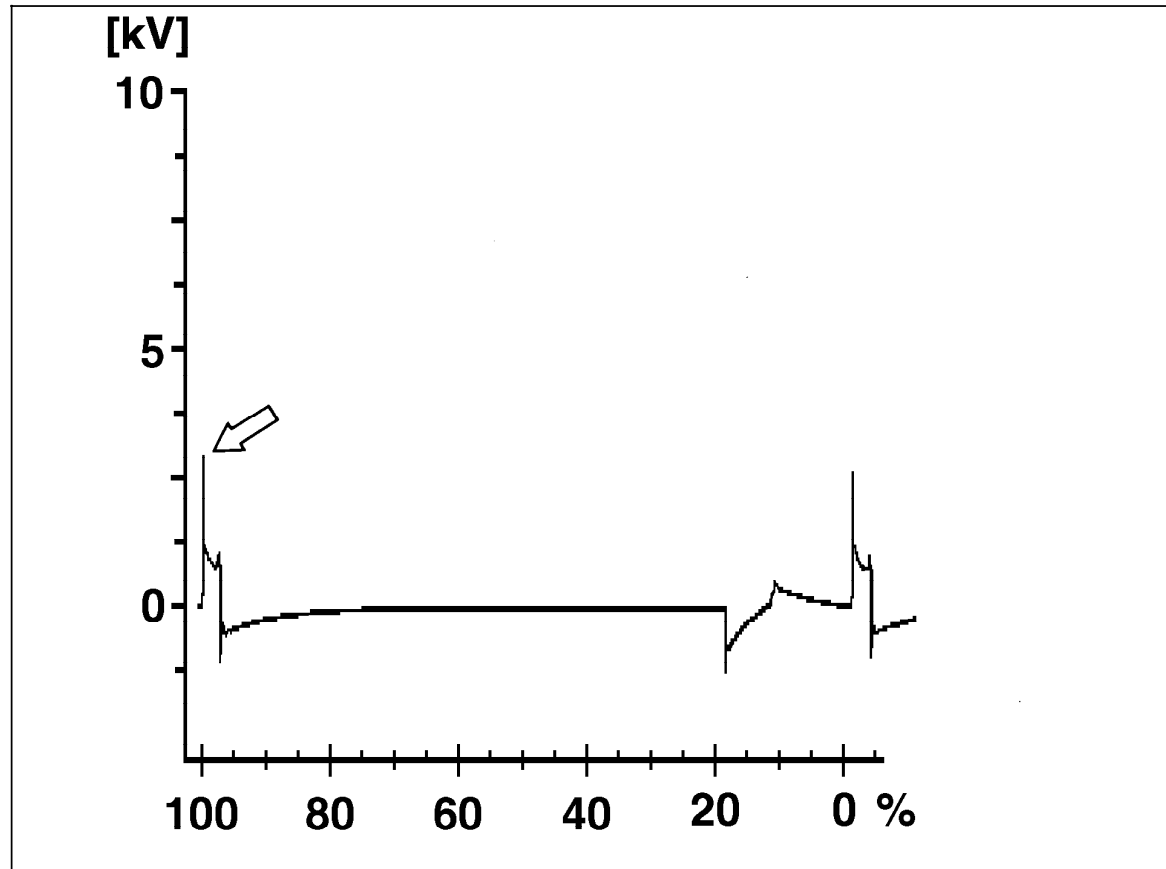


Figure 17

P15-0019-57

Diagnosis – Oscilloscope

Oscilloscope

**Bad scope pattern, single and dual ignition system (CFI/LH-SFI)**

Secondary side (single display).

Measurement range ..... 20 kV  
Time range ..... 100 %

No decay process.

Test condition: **cranking rpm.**

**Cause:**  
Ignition coil or DI control module.

**Note:**  
Engine does not start (engine not running).

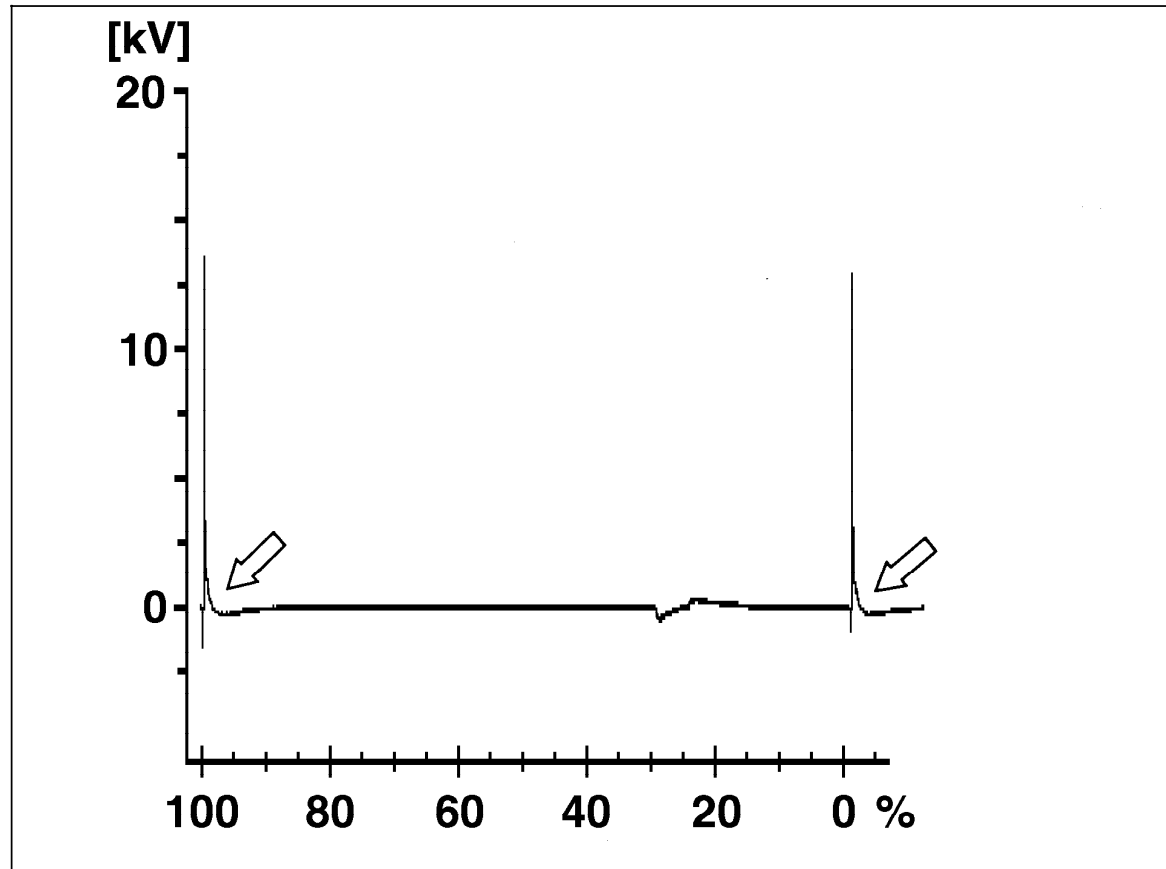


Figure 18

P15-0021-57

Diagnosis – Oscilloscope

Oscilloscope

**Bad scope pattern, single and dual ignition system (CFI/LH-SFI)**

Secondary side (single display).

Measurement range ..... 20 kV  
Time range ..... 100 %  
too few oscillations

Test condition: can occur at **any engine rpm with or without load.**

**Engine running**

**Cause:**  
Ignition coil or DI control module.

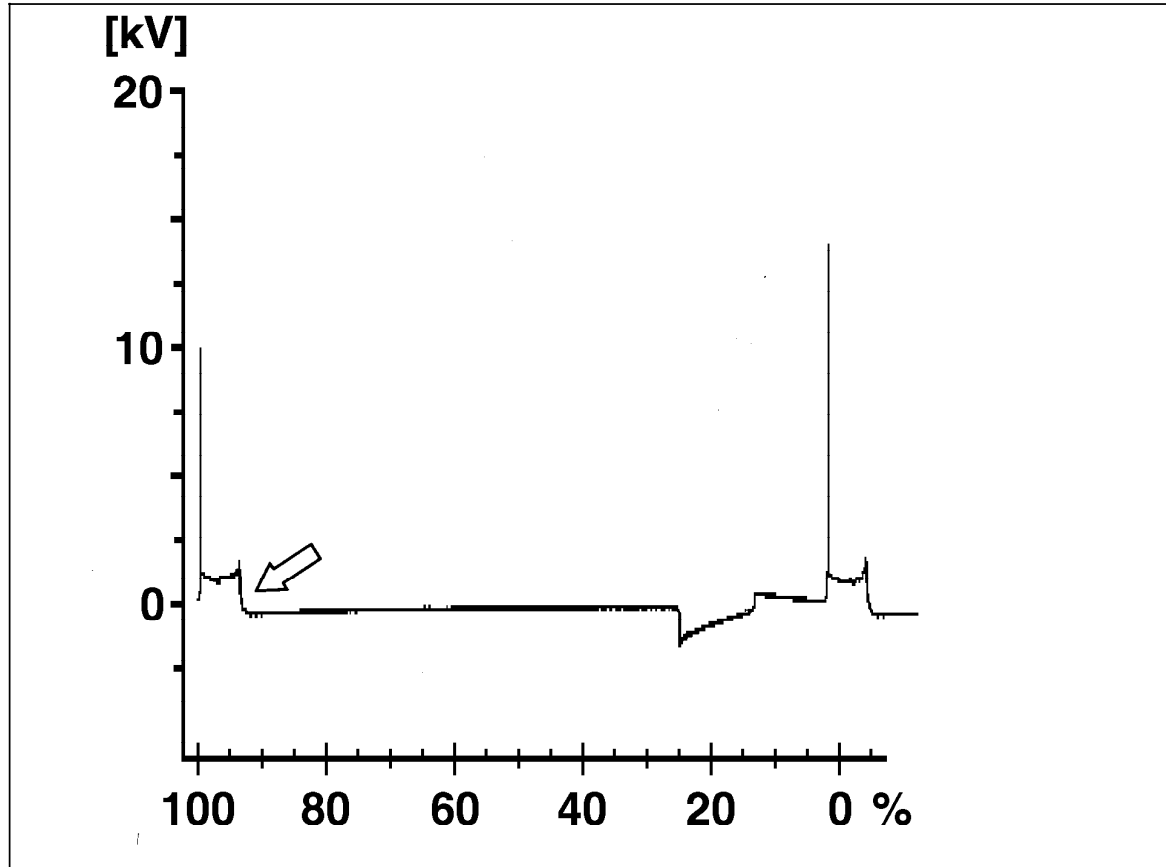


Figure 19

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Diagnosis – Oscilloscope

Oscilloscope

Bad scope pattern, single and dual ignition system (CFI/LH-SFI)

Secondary side (parade).

Measurement range ..... 20 kV

Too few oscillations.

Test condition: can occur at **any engine rpm with or without load.**

Cause:

Ignition coil or DI control module.

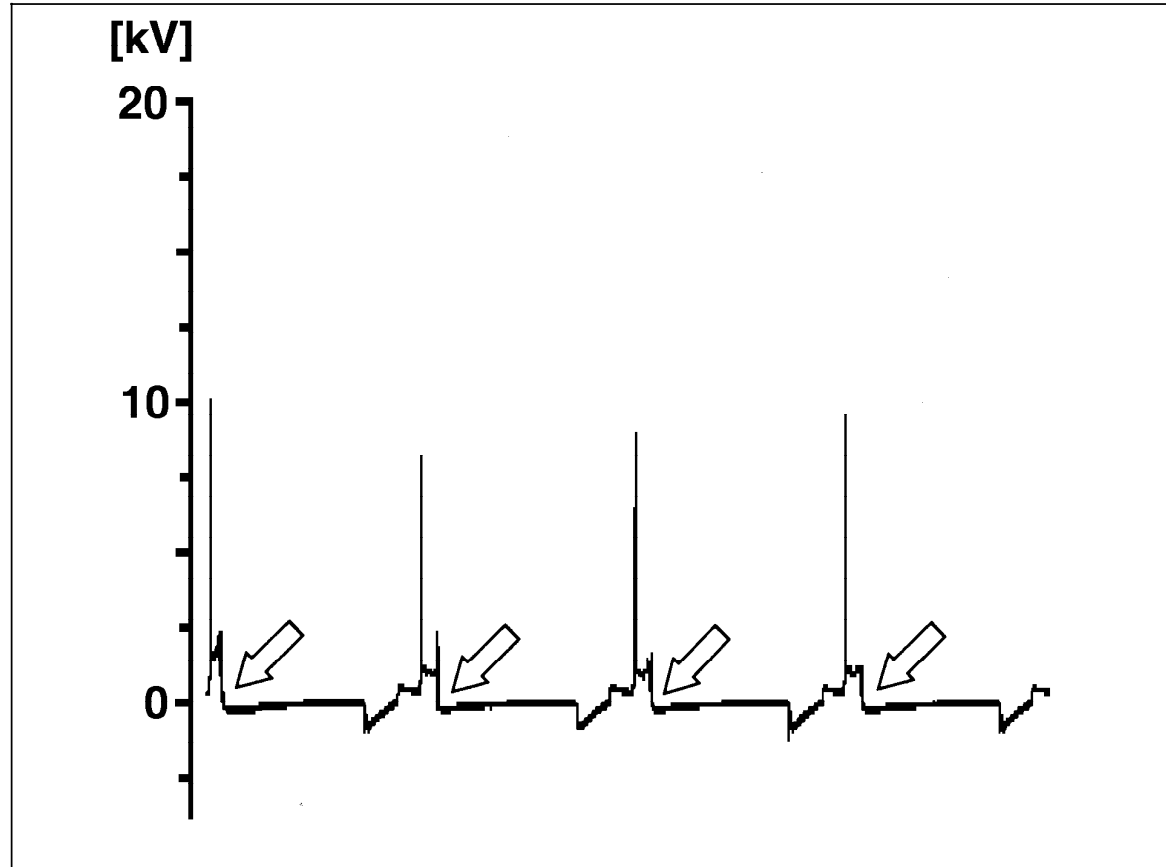


Figure 20

P15-0022-57

Diagnosis – Oscilloscope

Oscilloscope

Bad scope pattern, single and dual ignition system (CFI/LH-SFI)

Secondary side (parade).

Measurement range ..... 10 kV

Ignition voltage ..... <6 kV at one cylinder

Test condition: cranking rpm.

Cause:

Ignition coil.

Note:

Engine does not start (engine not running).

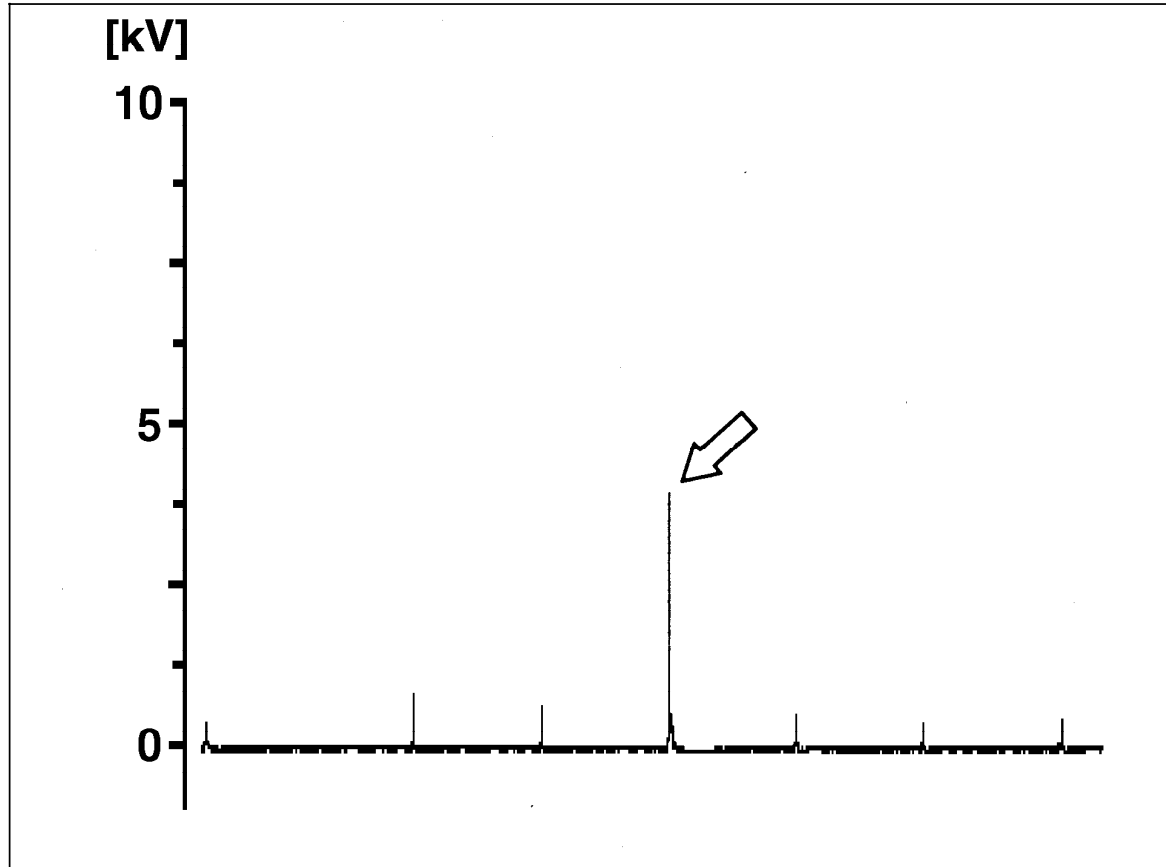


Figure 21

P15-0020-57

Diagnosis – Oscilloscope

Oscilloscope

Bad scope pattern, single and dual ignition system (CFI/LH-SFI)

Secondary side (parade).

Measurement range ..... 20 kV

Decay processes too high.

Test condition: **Accelerate engine repeatedly up to approx. 3000 rpm or operate engine under load on dynamometer.**

**Cause:**

Fuel/air mixture too lean at all cylinders.

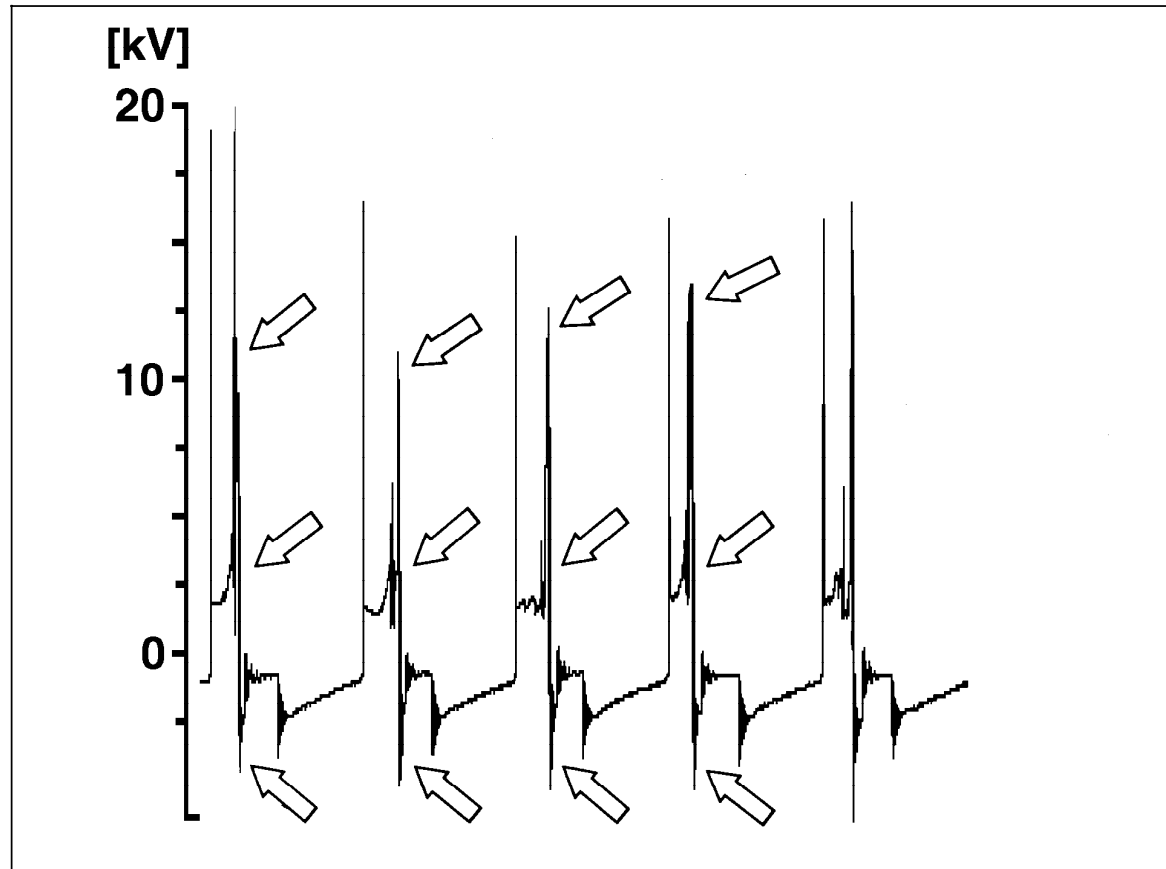


Figure 22

P15-0016-57

Diagnosis – Oscilloscope

Oscilloscope

**Bad scope pattern, dual ignition system (LH-SFI)**  
Secondary side (parade) 12-cylinder engine 120.

Measurement range ..... 20 kV  
Ignition voltage ..... > 20 kV

Test condition: can occur at **any engine rpm.**

**Cause:**  
Spark plug connector, ignition wire defective.

**Note:**  
Engine does not run smoothly.

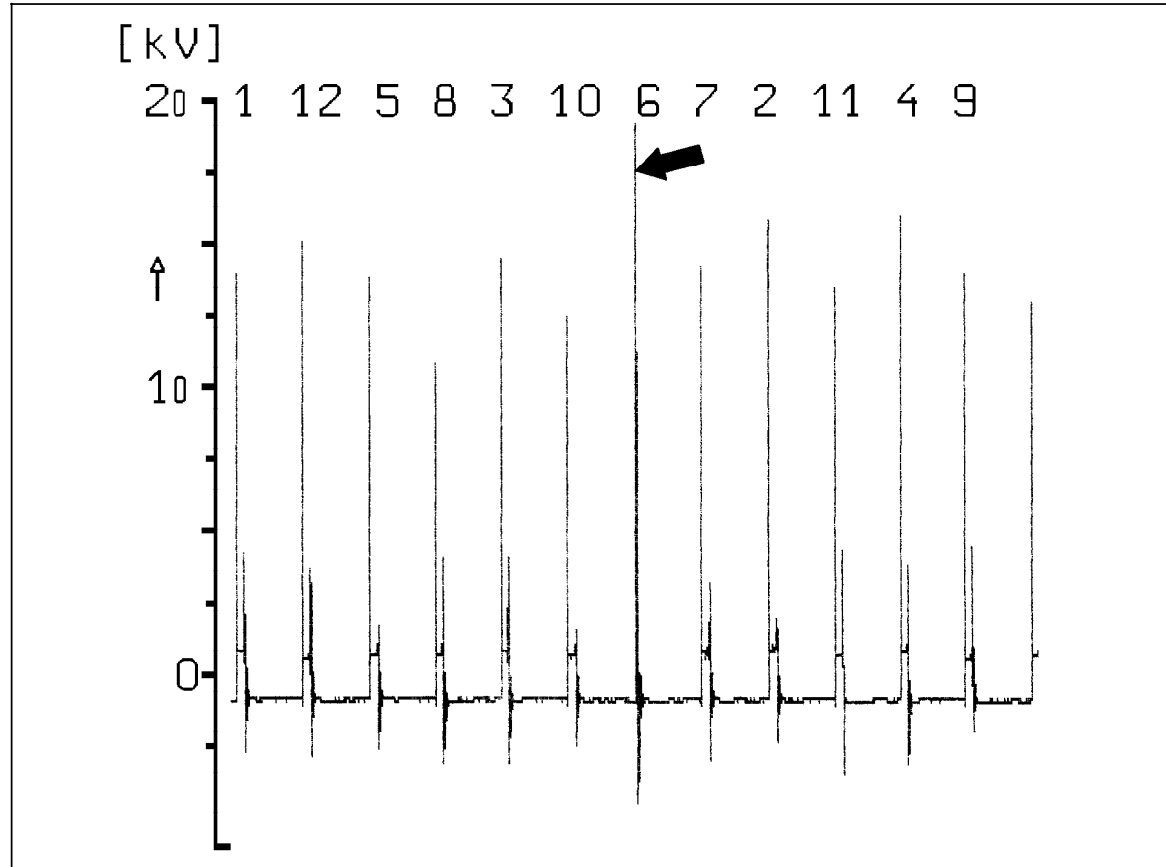


Figure 23

P07-5125-57



Diagnosis – Oscilloscope

Oscilloscope

**Bad scope pattern, dual ignition system (LH-SFI)**  
 Secondary side (parade) 12-cylinder engine 120.

Measurement range ..... 20 kV

Retarded ignition angle of cylinders 1–6.

Test condition: can occur at **any engine RPM**.

**Cause:**

Vacuum line on DI control module for cylinders 1–6 defective or not connected.  
 DI control module defective.

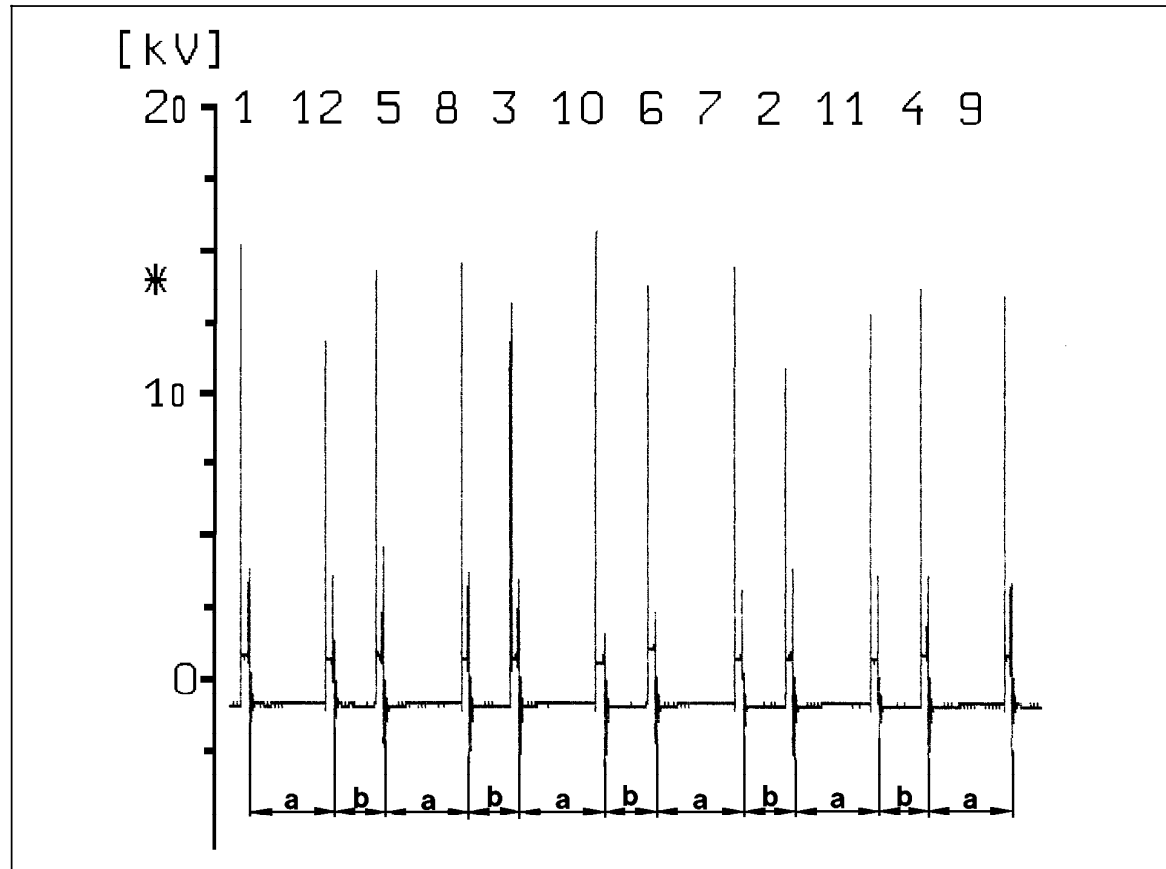


Figure 24

- a Retarded ignition timing, cylinder bank 1–6
- b Cylinder bank 7–12

P07-5126-57

Diagnosis – Oscilloscope

Oscilloscope

**Bad scope pattern, dual ignition system (LH-SFI)**

Secondary side (single display) 12-cylinder engine 120.

Measurement range ..... 20 kV  
Time range ..... 5 ms

Test condition: can occur at **any engine RPM.**

**Engine runs rough at idle.**

**Cause:**

Spark plug connector, ignition wire defective.

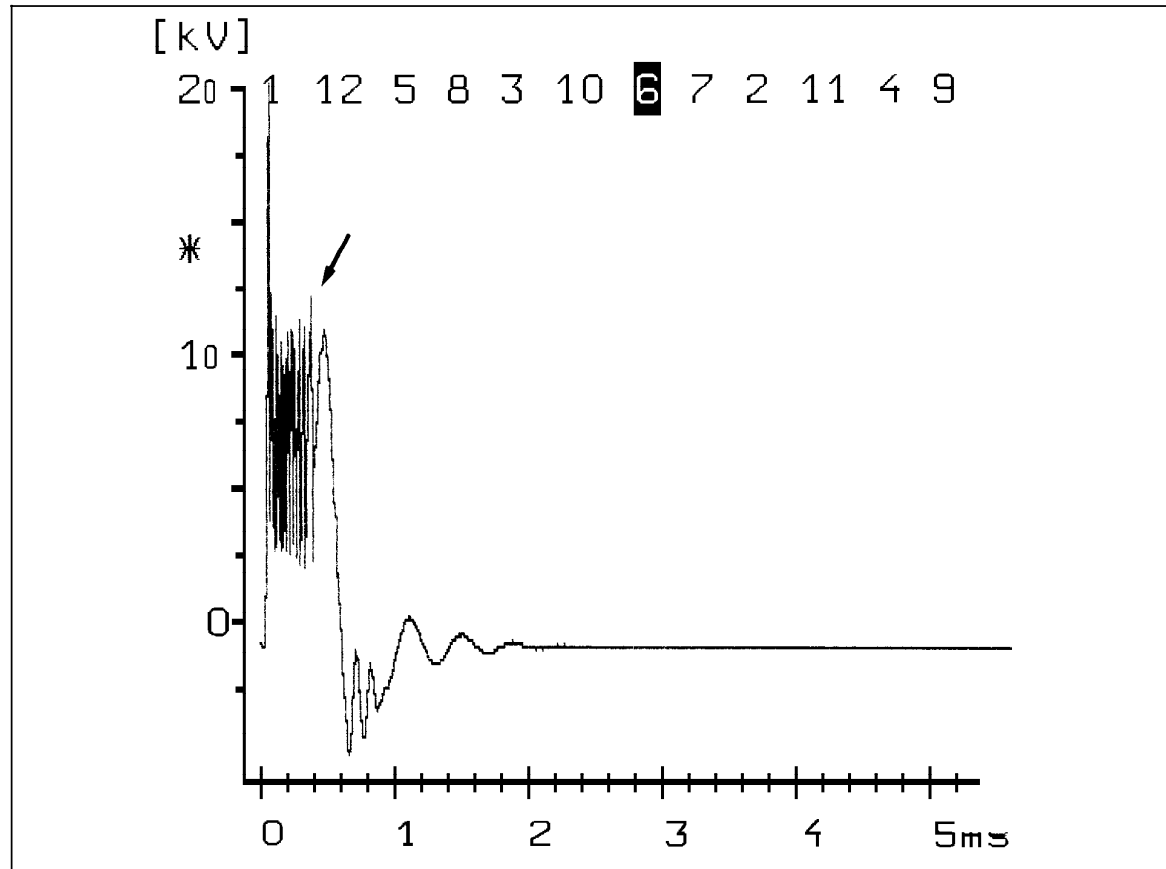


Figure 25

P07-5127-57

Diagnosis – Oscilloscope

Oscilloscope

Good scope pattern, Electronic Ignition (EI)  
System (distributor-less) (ME-SFI)

Secondary side (single display)

Engine: Idle

e.g. 8-cylinder, engine 119

No.1 cylinder displayed

Measurement range ..... 40 kV  
Time range ..... 5 ms

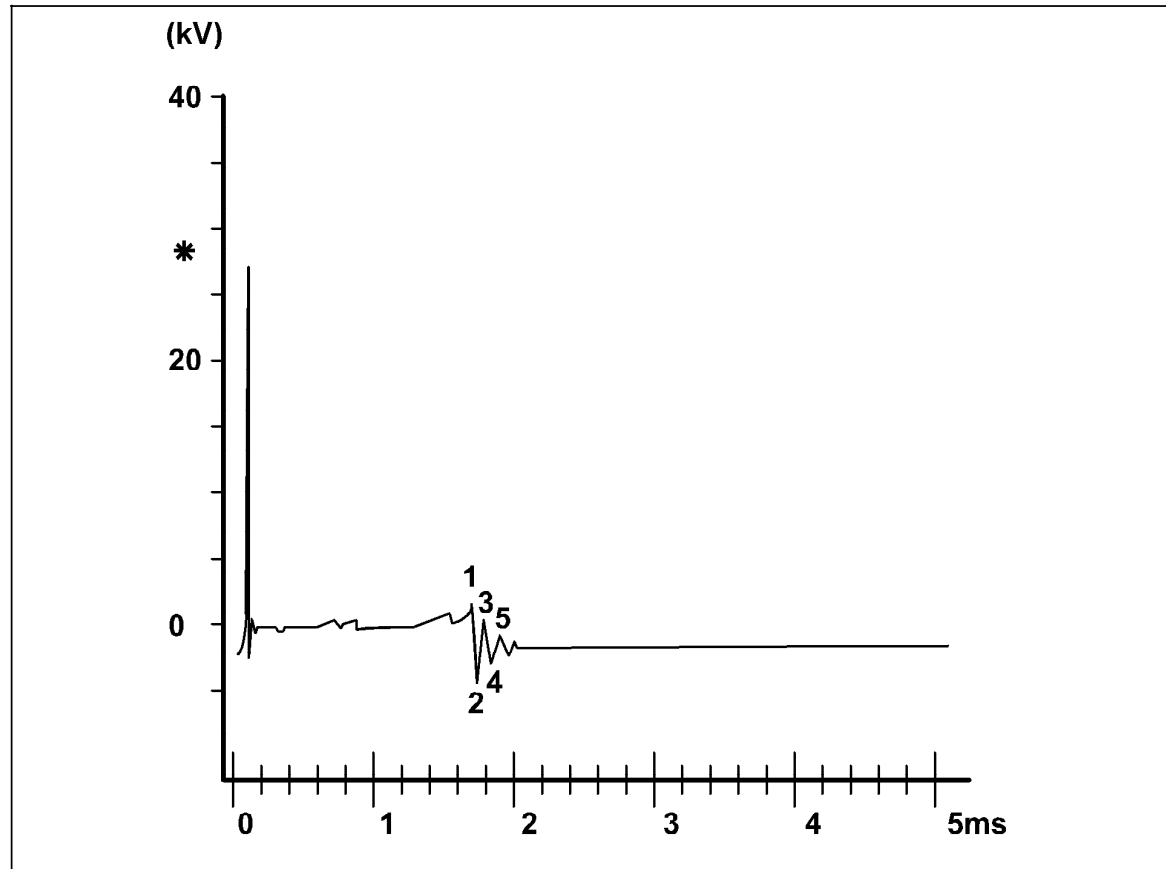


Figure 26  
Bosch ignition coil

- 1 Oscillation
- 2 Oscillation
- 3 Oscillation
- 4 Oscillation
- 5 Oscillation

P07.61-0434-57

Diagnosis – Oscilloscope

Oscilloscope

Good scope pattern, Electronic Ignition (EI)  
System (distributor-less) ME-SFI

Primary side (single display)

Engine: Idle

e.g. 8-cylinder, engine 119

No.1 cylinder displayed

Measurement range ..... 40 kV

Time range ..... 5 ms

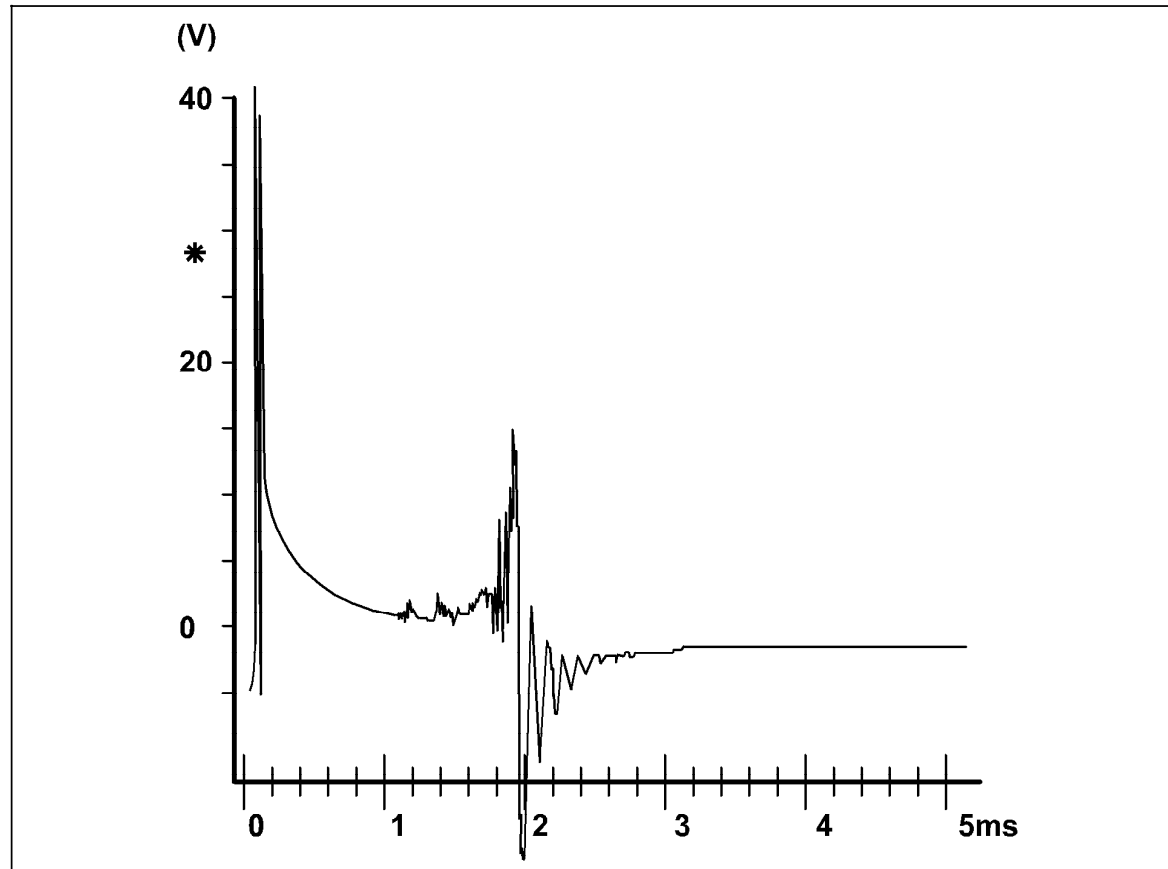


Figure 27

P07.61-0435-57