SUPERVISING DEPT.: E&D - PT&S – Bench Testing

MANAGING DEPT.: E&D - PT&S – Bench Testing

1

APPLICATION CRITERIA

To monitor test item performance when injected with high-frequency transients caused by separation of inductive discharge from supply line and subsequent capacitive migration to signal lines.

Test procedure is for use during test item engineering approval and qualification process.

Change	Date	Description	
-	June 95	Issue 1 –	New, issued in accordance with Technical Memorandum, supersedes para 2 of Std. 7.Z0890.
-	July 97	Issue 2 –	Updated. (SS)
-	Apr. 04	Issue 3 –	Changed Supervisor (was Durando). “Test schedule” para cancelled. (SS)
	Sept. 06	Issue 4 –	Supervisor (was Antonioli) and Manager (was Varallo) changed. Forms 2 – 4 – 6 – 7 – 8 and Helps changed. (SS)

Build Level: A[ ] - B[ ] - C[ ] - D[ ] - E[ ] | Job:
Component Type: | Drawing Number:
Supplier: | Last Change:

2

REFERENCES

7-G0030	Significance of items under test (PGE)
9.90110	Automotive electrical and electronic devices (CEL)
ISO 7637-3	Electrical transient transmission by capacitive and inductive coupling via lines other than supply lines

3

TEST EQUIPMENT

3.1

Test environment

The room size must be sufficient to contain test instrument and setup, free from noises that might affect test results.

Chamber environmental requirements:

Temperature :	23 ± 5 °C
Relative humidity:	45 thru 70%
Atmospheric pressure:	860 thru 1060 mbars

3.2

Pulse generator

To be able to generate pulses defined in Help 3 and 4, with ±2% tolerance as to target for output resistor (Ri), +10% and – 0% for voltages and ±10% for time.

3.3

Capacitive coupler

It must allow coupling of pulses defined in Help 3 and 4, on DUT signal lines over a length of 1 m with a 4 thru 40 mm cable harness.

Moreover, it must be equipped with 50 Ω coaxial connectors on both ends to allow connection to pulse generator and terminal at 50 Ω.

It must comply with electric requirements below:

- Insulation peak voltage >300 V
- Typical capacity between coupler and inside cables ~100 pF
- Characteristic impedance (with no wiring harness) 50 Ω.

Help 2 shows the typical description of capacitive couplet.

3.4

Digital oscilloscope

It must have a pass band greater than 200 MHz, with individual pulse sampling of at least 400 Msamples/s per channel.

Moreover, it must have voltage probes with characteristics below:

- Attenuation: 10 × (R ≥ 10 MΩ, C ≤ 12 pF, max. 500 V, pass band ≥ 200 MHz)
- Attenuation: 100 × (R ≥ 10 MΩ, C ≤ 2.5 pF, max. 1500 V, pass band ≥ 120 MHz).

Build Level: A[ ] - B[ ] - C[ ] - D[ ] - E[ ] Job:
Component Type: Drawing Number:
Supplier: Last Change:

3.5

Ground base

High electrical conductivity sheet metal (e.g. copper, aluminum, brass, galvanized steel), 1 mm min. thickness, 2 x 1 m.

Grounded top shall be connected to ground line of building thru copper braid welded to top.

3.6

Test top

Shall consist of insulating material (e.g. wood), of suitable size to adequately support grounded top.
The non-conductive material support on which EUT (equipment under test) and related wiring is placed, must have relative permeability = 1.4.

3.7

Supply unit

Supply unit to provide voltage and max. current required for correct operation of device under test.

Use supply unit with adjustable voltage 0 to 24V, 40 Amp, with 45 Ah, 225 Amp battery.

Note: *Equivalent equipment may be substituted but must be equal or superior in performance.*

Date:……..

Test Engineer:……..…… Signature……

Build Level: A[ ] - B[ ] - C[ ] - D[ ] - E[ ] | Job:
Component Type: | Drawing Number:
Supplier: | Last Change:

4

DESCRIPTION OF ITEM UNDER TEST

4.1

System

TYPE:	
CODE:	
SUPPLIER:	
DWG. No.	
DESTINATION:	

4.1.1

Electronic Control Unit

CODE:	
SUPPLIER:	
DWG. No.:	
ECU ID:	
BUILD LEVEL	A [ ]
	B [ ]
	C [ ]
	D [ ]
	E [ ]

4.1.2

Wiring harness

SUPPLIER:	
DWG. No.:	
BUILD LEVEL	A [ ]
	B [ ]
	C [ ]
	D [ ]
	E [ ]

Build Level: A[ ] - B[ ] - C[ ] - D[ ] - E[ ] Job:
Component Type: Drawing Number:
Supplier: Last Change:

4.1.3

Sensors / Actuators

TYPE:	
CODE:	
SUPPLIER:	
DWG. No.:	
BUILD LEVEL	A [ ]
	B [ ]
	C [ ]
	D [ ]
	E [ ]

Date:……..

Test Engineer:…….…… Signature……

Build Level: A[ ] - B[ ] - C[ ] - D[ ] - E[ ] Job:
Component Type: Drawing Number:
Supplier: Last Change:

5

SIGNIFICANCE OF COMPONENTS UNDER TEST

COMPONENT WEIGHT AND CHARACTERISTICS FOR EVALUATING TEST SIGNIFICANCE					
Type of component	**% Significance (A)**	**Weight (B)**	**Component affecting test significance**	**Significant characteristics**	**Minimum build level**
Active		0.50	Electronic Control Unit	PCB, box if metallic, software release	B
Active		0.40	Wiring harness	cable length section	C
Active		0.10	Sensors / Actuators	impedances	C

Significance of item under test (%) = Σ (A x B) =

Note: *For each component, evaluate % significance for the three distinct levels indicated in Standard 7-G0030, recording values in column A.*

Date:……..

Test Engineer:……..…… Signature……

6

PRELIMINARY OPERATIONS

6.1

Obtain the technical documents (i.e. drawings, P.S., specifications, etc.) needed for testing, including: [ ]

- Operating conditions of system under test
- Stimulator system (if applicable).
- Monitored parameters and their tolerances
- Definition of malfunction
- Connection diagram of system during test.

6.2

Identify system under test and fill out tables in "Description of item under test" form. [ ]

6.3

From technical documentation available, obtain pulse width and required behavior. Enter information in table of "Data processing" form. [ ]

6.4

Pulse generator calibration

Calibration consists in adjusting width and time characteristics of pulses described in Help 3 and 4 at capacitive couplet output with no load (without system under test wiring harness inside it).

Calibration shall take place as described below according to set-up shown as a diagram in Help 1 fig. 1.

6.4.1

Connect pulse generator at capacitive coupler input. [ ]

6.4.2

Use a 50Ω cable, not longer than 1m, to connect oscilloscope (with high input impedance) to a 50Ω load connected to capacitive coupler output. [ ]

6.4.3

Check for no metallic objects less than 500 mm far from capacitive coupler, except from grounded top. [ ]

6.4.4

Select test pulses and ad just electric characteristics (width and time) of pulses detected by oscilloscope as shown in Help 3 and 4. [ ]

Build Level: A[ ] - B[ ] - C[ ] - D[ ] - E[ ] | Job:
Component Type: | Drawing Number:
Supplier: | Last Change:

6.5

Positioning of test apparatus

6.5.1

Organize test apparatus so as to produce setup as shown in Help 1 fig. 2 (see ISO 7637-3). [ ]

6.5.2

Position system under test and auxiliary instrumentation required for its correct operation (sensors and actuators) at a distance of 50 ± 5 mm on grounded top but maintaining insulation from the latter, at a distance not smaller than 400 ± 50 mm from capacitive couplet, as shown in Help 1. In case system ground connection is explicitly required on system bodyshell or on one of sensors/actuators, this connection shall be as short as possible. The part of cable protruding from capacitive couplet shall be positioned at a distance of 100± 20 mm from grounded top and 90° ± 15 oriented as to coupler longitudinal axis. [ ]

6.5.3

Connect battery and supply unit negative to grounded top and system under test supply lines, sensors/actuators to supply unit, parallel to battery positive. [ ]

6.5.4

Connect pulse generator at capacitive coupler input. [ ]

6.5.5

Connect oscilloscope to 50 Ω load connected to capacitive coupler output. [ ]

Date:…….. Exemption: NO [ ] YES [ ]

Test Engineer:…….…… Signature……

7

TEST PROCEDURE

7.1

Test setup activation

7.1.1

Connect device to sensors and actuators under test, that must possibly be those required for installation on vehicle, as defined by drawing or related P.S. [ ]

Individual DUT signal line: wiring consists of a single conductor.

In case DUT has one or various ports (connectors), the wiring harness type below is defined:

Wiring harness consisting of all signal lines belonging to "an individual connector/Port" of DUT: gather in only one harness all signal lines belonging to an individual connector/Port of DUT (e.g.: if DUT has 3 connectors/Ports, total No. of cables is 3 → one for each connector).

Note: *Wiring harness section must be compatible with the dimension required by capacitive coupler.*

7.1.2

Place wiring harness inside capacitive couplet over a 1000 ± 0.8 mm length. The external sections must be placed on an insulating support 100 ± 20 mm thick and at 90°±15° as to capacitive couplet. [ ]

7.1.3

Leave DUT, sensor and actuator supply lines out of capacitive coupler. In case the standard production wiring harness does not allow indicated configuration, use a purposely built wiring harness. However, used wiring should not be longer than 2 m. [ ]

7.1.4

Set system to static (no change in stimulation signals) or dynamic (sequence of given changes in stimulation signals to deliberately alter system status or behavior) operation specified on drawing or P.S. to test for correct operation. [ ]

7.1.5

Acquire characteristic parameters of signals supplied by actuators to be used as reference during testing. [ ]

Build Level: A[ ] - B[ ] - C[ ] - D[ ] - E[ ] | Job:
Component Type: | Drawing Number:
Supplier: | Last Change:

7.2

Pulse injection

7.2.1

Apply to system under test, through application time defined by P.S. 9.90110 Fiat 3aS pulse as per Help 3 (with electric and time characteristics previously determined during calibration and width level as per P.S.) with procedure below: [ ]

- Apply pulse to each individual DUT signal line.

- Apply pulses to each wiring harness consisting of all signal lines belonging to an individual connector/port of DUT.

7.2.2

For each test type, check for correct operation of test specimen in the condition in question by comparing parameters of signals supplied by sensors to reference signals. [ ]

7.2.3

In case of incorrect device operation, apply pulse again reducing output level after generator no-load adjustment (wiring harness not inserted in capacitive coupler) and repeat test as per para 7.2.2 till reaching voltage level (width) at which system correctly performs its functions. [ ]

Note: *Generator output level decrease must be lower or equal to level of uncertainty admitted as to device under test malfunction knowledge.*

7.2.4

After test, enter voltage level reached, actual test time and possibly the type of malfunction found in table of "Data processing" form. [ ]

7.2.5

Repeat operations from para 7.2.1 to para 7.2.4 applying Fiat 3bS pulse as per Help 4. [ ]

Date:…….. Exemption: NO [ ] YES [ ]

Test Engineer:…….…… Signature……

Build Level: A[ ] - B[ ] - C[ ] - D[ ] - E[ ] Job:
Component Type: Drawing Number:
Supplier: Last Change:

8

DATA PROCESSING

Pulse application on signal line:	
Pulse application on wiring harness:	

PULSE	*TEST CONDITION*	*WIDTH*		*No. of pulses (test time)*		*Perf. target*	*Possible malfunct.*
		Target	**Actual**	**Target**	**Actual**		
FIAT 3aS							
FIAT 3bS							
NOTES							

Date:…….. Exemption: NO [ ] YES [ ]

Test Engineer:…….…… Signature……

Build Level: A[ ] - B[ ] - C[ ] - D[ ] - E[ ] Job:
Component Type: Drawing Number:
Supplier: Last Change:

9

POST-TESTING PROCEDURE

9.1.1

Disconnect instrumentation (sensors, actuators, etc.) not integral to system from system under test. [ ]

9.1.2

Reinstate any connections altered to permit testing. [ ]

9.1.3

Restore test setup to original conditions ready for further testing. [ ]

9.1.4

Archive DUT for at least 10 years so that it can easily be traced. [ ]

Note: *At the end of storage period, component must be demolished.*

Date:…….. Exemption: NO [ ] YES [ ]

Test Engineer:…….…… Signature……

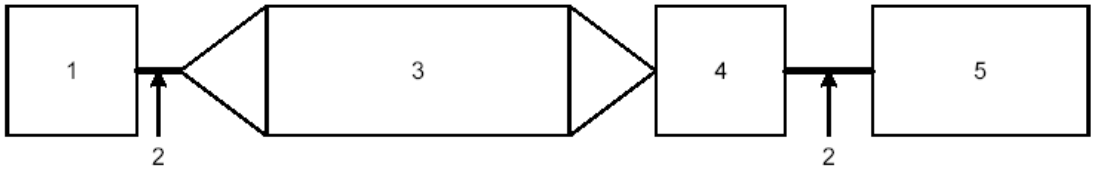
Build Level: A[ ] - B[ ] - C[ ] - D[ ] - E[ ] Job:
Component Type: Drawing Number:
Supplier: Last Change:

10

HELP

Help 1

TEST EQUIPMENT SETUP



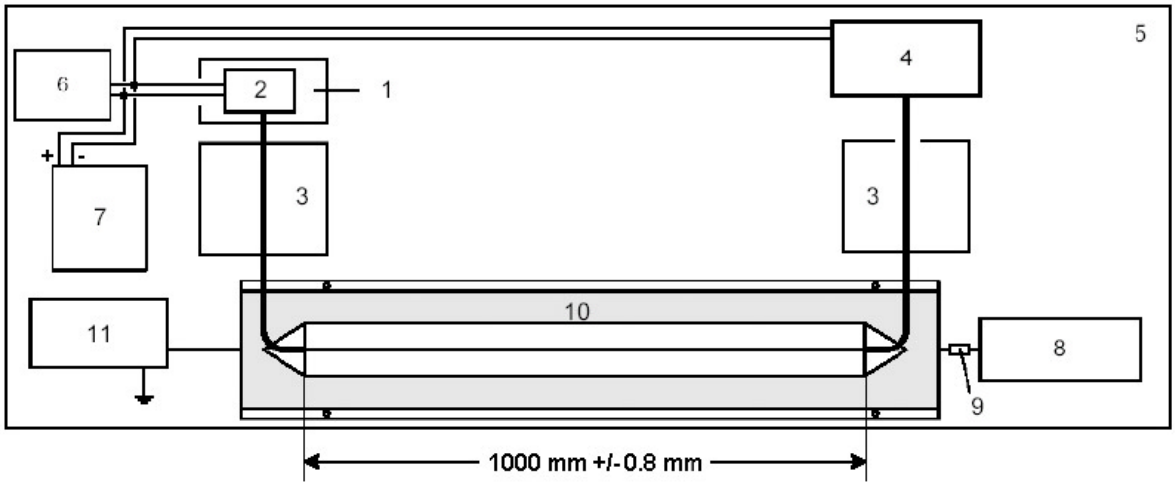
Legend:
1. Pulse generator
2. 50 Ω coaxial cable
3. Capacitive coupler
4. 50 Ω load
5. Oscilloscope

Fig. 1 Calibration set-up

Build Level: A[ ] - B[ ] - C[ ] - D[ ] - E[ ] Job:

Component Type: Drawing Number:

Supplier: Last Change:



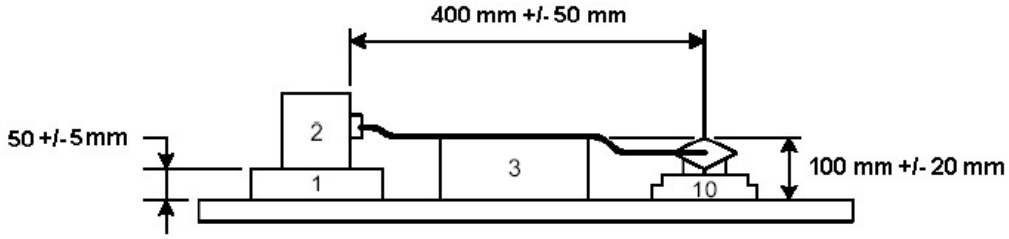


Fig. 2 Test set-up

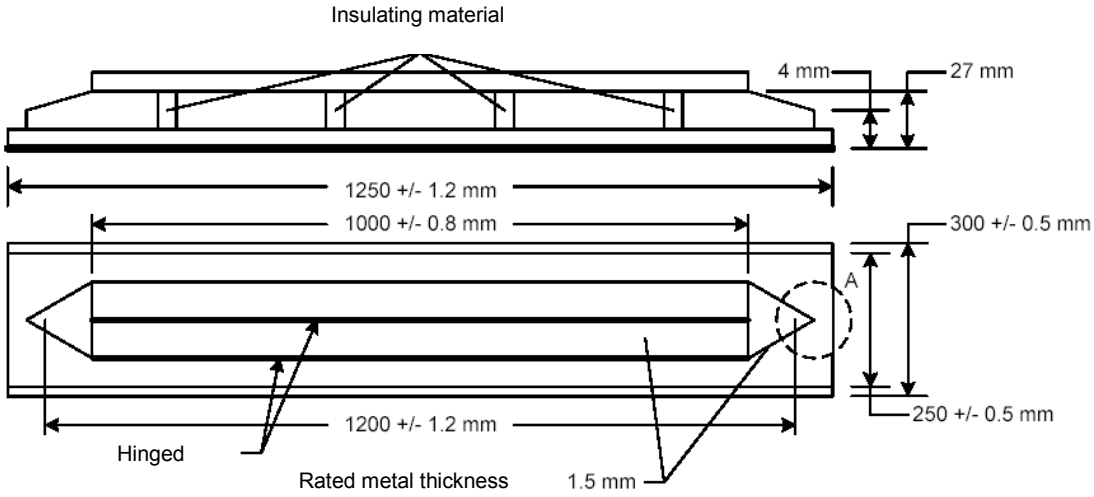
Legend:

1. Insulating support (if DUT is not connected to vehicle shock)
2. DUT
3. Insulating support for wiring
4. Peripherals (sensors, actuators, loads) installed as on vehicle
5. Grounded top
6. Stabilized supply unit
7. Battery
8. Oscilloscope
9. Resistive load
10. Capacitive coupler
11. Pulse generator

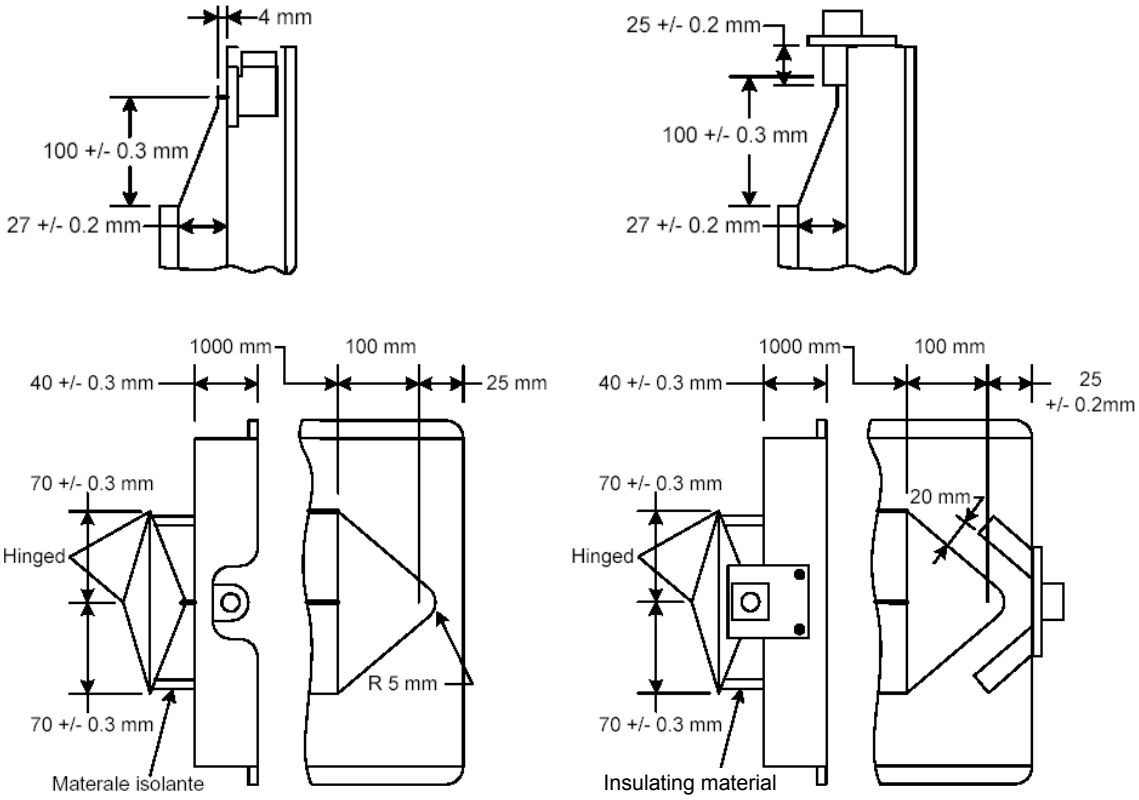
Build Level: A[ ] - B[ ] - C[ ] - D[ ] - E[ ] | Job:
Component Type: | Drawing Number:
Supplier: | Last Change:

Help 2

CAPACITIVE COUPLER



a) General view



b) Alternative 1 in detail A

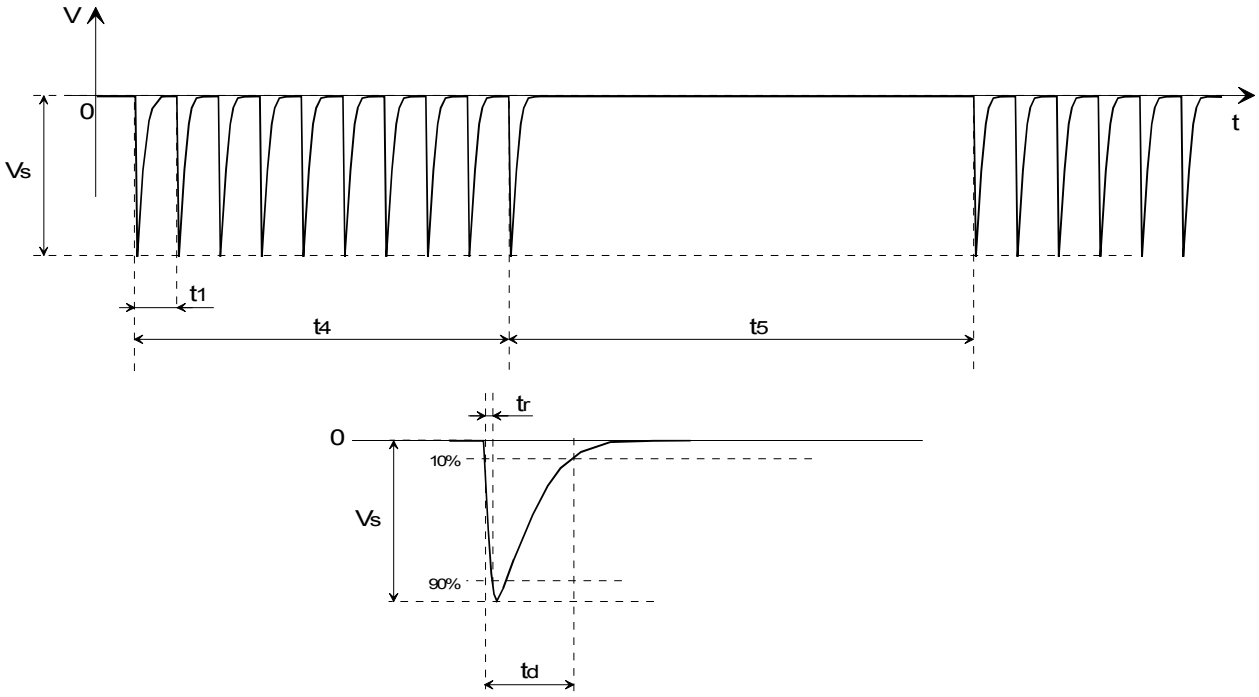
b) Alternative 1 in detail A

Build Level: A[ ] - B[ ] - C[ ] - D[ ] - E[ ] Job:
Component Type: Drawing Number:
Supplier: Last Change:

Help 3

"FIAT 3aS" PULSE

Negative, high-frequency transients caused by disconnection of inductive loads from power supply line.



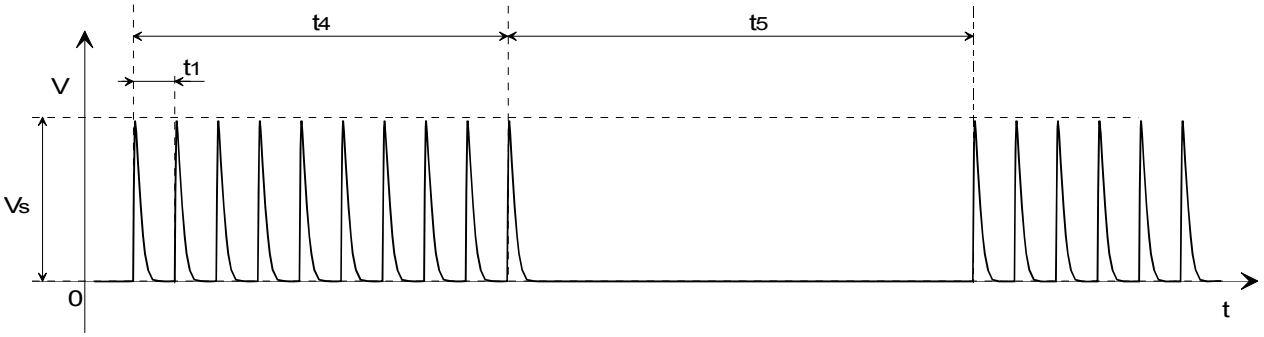
Vs = Width
Ri = 50 Ω (internal generator resistance)
td = 0.1 μs
tr = 5 ns
t1 = 100 μs
t4 = 10 ms
t5 = 90 ms

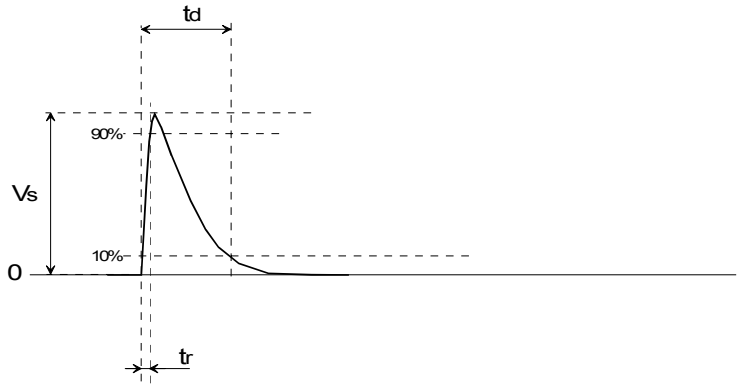
Build Level: A[ ] - B[ ] - C[ ] - D[ ] - E[ ] | Job:
Component Type: | Drawing Number:
Supplier: | Last Change:

Help 4

"FIAT 3bS" PULSE

Positive, high-frequency transients caused by disconnection of inductive loads from power supply line.





Vs = Width
Ri = 50 Ω (internal generator resistance)
td = 0.1 µs
tr = 5 ns
t1 = 100 µs
t4 = 10 ms
t5 = 90 ms