

TECHNICAL SPECIFICATION

The AET7000 Automotive Immunity Test System is suitable for the immunity test of on-board electronic equipment. It conforms to the international standards ISO7637-2, ISO7637-3, ISO16750-2, JASOD001, SAEJ1113 and EMC test standards of many car companies. The system integrates APV4030 Automotive Voltage Variation Simulation Generator, AET7620 Automotive Transient Pulse Generator, AET7650 Automobile Load Dump Simulation Generator, SMG-200 Automotive Power Supply System Arbitrary Waveform Analog Recorder, which can cover many standards and automotive manufacturers. The interference waveform. The system has a high degree of integration, convenient operation, and standardized output waveforms, which provide a standardized test method for measuring the anti-interference ability of vehicle electronic equipment.

Main features of this system:

- (1) Fully conform to the latest standard test requirements of ISO7637-2, ISO7637-3, ISO16750-2, JASOD001, SAEJ1113;
- (2) It has rich programming function and with the arbitrary waveform editing function, it can meet various test requirements;
- (3) It has a waveform recording function, which can record on-site waveforms and achieve perfect reproduction through the power simulator;
- (4) The integrated test port is designed, and all test steps are completed with "one key", simple operation and high test efficiency;
- (5) Adopt replaceable module design method, pulse module can be flexibly replaced, and various special test waveforms can be customized;
- (6) The built-in CDN supports a capacity up to 60V/100A;
- (7) Abnormal monitoring and protection of overvoltage, overcurrent, overload, etc.;
- (8) Touch screen display.

1. AET7620 Automotive Transient Pulse Generator 1PC

Host characteristics			
Signal test	DUT voltage/current	Trigger mode	Auto/manual/external trigger
Failure detection mode	External signal/safety circuit	CRO trigger	Oscilloscope 5V trigger signal
Communication port	RJ45	Power input	AC100-240VAC(50Hz/60Hz)
CDN			
voltage	60V	frequency	DC
current	100A		
Output waveform characteristics			
ISO7637-2-2011/ISO7637-3-2016 standard waveform			
Micro pulse module P1/P2a			
Voltage range	8-600V±10%	Rise Time Tr	1us/3us+0%/-50% (10%-90%)
Source impedance	2Ω (Only 50us pulse width) 4Ω, 10Ω, 30Ω, 50Ω, 90Ω±10%	Pulse duration Td	50us, 200us, 300us, 500us, 1ms, 2ms±20% (10%-10%)
polarity	Positive/negative	Pulse repetition time	0.2-9999s (According to voltage level)
Coupling method	DUT/DCC/ICC	Battery off time	0-9999ms
testing time	1-9999s		

Electrical fast transient pulse group module P3a/3b			
voltage range	20-800V±10%	Rise time Tr	5ns±30% (10%-90%)
Source impedance	50Ω	Pulse duration Td	150ns±30% (10%-10%)
Pulse frequency	0.1-250kHz	Pulse group duration T4	0.1ms-999ms
testing time	1-9999s	Pulse group repetition time T5	10-9999ms
polarity	positive/负	Calibration load	50Ω/1000Ω
Coupling method	DUT/DCC/CCC		

Micro pulse module P6			
voltage range	20-300V±10%	Rise time Tr	60us+0%/-50% (10%-90%)
Source impedance	30Ω±10%	Pulse duration Td	300us±20% (10%-10%)
polarity	负	Pulse repetition time	0.5-9999s (According to voltage level)
		testing time	1-9999s

Standard Waveform of Car Manufacturers			
JASO D-001pulse A2		JASO D-001pulse B2	
Test voltage	110V	Test voltage	260V
Capacitance C	4.7uF	Capacitance C	33uF
Pulse duration	2.5us±30% time constant (36.8%)	Pulse duration	2.0ms±30% time constant (36.8%)
Internal resistance R2	0.6 Ω	Internal resistance R2	60 Ω
Internal resistance R3	0.4 Ω	Internal resistance R3	80 Ω
polarity	positive	polarity	negative
JASO D-001pulse D2		NISSAN 28400 NDS 03 pulse B2	
Test voltage	170V	Test voltage	300V
Capacitance C	2.2uF	Capacitance C	33uF
Pulse duration	2.5us±30%time constant (36.8%)	Pulse duration	100 Ω
Internal resistance R2	1.2 Ω	Internal resistance R2	75 Ω
Internal resistance R3	0.9 Ω	polarity	negative
polarity	positive		
NISSAN 28400 NDS 07pulseC8		NISSAN 28400 NDS 07pulse C50	
Test voltage	±300V	Test voltage	±300V
Capacitance C	1uF	Capacitance C	33uF

Internal resistance R1	500 Ω	Internal resistance R1	30 Ω
Internal resistance R2	450 Ω	Internal resistance R2	200 Ω
polarity	Positive/negative	polarity	Positive/negative
NISSAN 28400 NDS 07pulse C300		JASO D-001pulse A1	
Test voltage	300V	Test voltage	70V
Capacitance C	33uF	Capacitance C	110000uF
Internal resistance R1	75 Ω	Pulse duration	200ms \pm 30% time constant (36.8%)
Internal resistance R2	75 Ω	Internal resistance R2	2 Ω
polarity	negative	Internal resistance R3	0.8 Ω

JASO D-001 pulse A1		polarity	positive
Test voltage	70V	JASO D-001 pulse B1	
Capacitance C	110000uF	Test voltage	80V
Pulse duration	200ms±30%time constant (36.8%)	Capacitance C	3000uF
Internal resistance R2	2 Ω	Pulse duration	60ms±30% time constant (36.8%)
Internal resistance R3	0.8 Ω	Internal resistance R2	20 Ω
polarity	positive	Internal resistance R3	8 Ω
polarity	positive	polarity	negative
JASO D-001pulse D1		JASO D-001pulse E	
Test voltage	120V	Test voltage	320V
Capacitance C	73000uF	Capacitance C	2000uF

Pulse duration	400ms±30%time constant (36.8%)	Pulse duration	26ms±30%time constant (36.8%)
Internal resistance R2	5.5 Ω	Internal resistance R2	13 Ω
Internal resistance R3	1.5 Ω	Internal resistance R3	210 Ω
polarity	positive	polarity	negative
NISSAN 28400 NDS3 pulse A1		NISSAN 28400 NDS3 pulse A2	
Test voltage	60V	Test voltage	60V
Capacitance C	15000uF	Capacitance C	15000uF
Internal resistance R2	18 Ω	Internal resistance R2	11 Ω
Internal resistance R3	0.66 Ω	Internal resistance R3	0.8 Ω
Polarity	positive	Polarity	positive
NISSAN 28400 NDS3 pulse B1			
Test voltage	80V		
Capacitance C	1000uF		
Internal resistance R2	20 Ω		
Internal resistance R3	20 Ω		
polarity	positive		

The standard waveform rise time of special automobile manufacturers, unless otherwise specified, the indicators are $\cong 1\mu s$

2) AET 7650 Load Dump simulation generator :

Technical Specifications			
Host characteristics			
Signal measurement	DUT voltage/current	Trigger mode	Auto/manual/external trigger
Failure detection mode	External signal/safety circuit	CRO trigger	Oscilloscope 5V trigger signal
Communication port	RJ45	Power input	AC100-240VAC(50Hz/60Hz)
CDN			
Voltage	60V	Frequency	DC
Current	100A		
Load dump waveform parameters P5a/P5b/P5c			
voltage range	20-210V±10% 0.1Vstep	Rise time Tr	1ms-10ms ±20% (10%-90%) 1msstep
Source impedance	P5a/5b:0.5-40Ω P5c:0.4-40Ω step0.1Ω	Pulse duration Td	40-1200ms ±20% (10%-10%) 1ms step
Clamp voltage	10-100V±10% 0.1Vstep	Number of pulses	1-9999 次
polarity	positive	Pulse repetition time	10-999s (According to voltage level)
Load dump waveform parameters P5b_S (P5b dedicated waveform)			
Clamp voltage	10-100V±10% 0.1Vstep	Rise time Tr	1ms-10ms ±20% (10%-90%) 1msstep
Source impedance	0.5-40Ω step0.1Ω	Clamping time Ts	20-800ms ±20% (10%-10%) 1ms step
Number of pulses	1-9999times	Fall time Tf	10-200ms ±20% (10%-10%) 1ms step
polarity	positive	Pulse repetition time	10-999s(According to voltage level)

3) SMG 200 Automotive Power Supply System Arbitrary Waveform Analog Recorder 1 PC
(NON COMPRIS DANS LA VERSION DE BASE)

3.1 Output index

project	specification
Output signal channel	4 channels
The output voltage	10V, unipolar or bipolar
Output resolution	16Bit
Output frequency range	DC-100kHz
Output range	±10V
Output differential linearity error	±8 LSB (DAC)
Output integral linearity error	±4 LSB (DAC)
Output accuracy	±(0.5% + 5mV)
Output impedance	50Ω
Output current	10mA with short circuit protection
Wave segment type	DC
	Sine
	Sine sweep (log, linear)
	Damp Sine
	Sine Ramp
	Square
	Profile
	Triangle
	Sawtooth
	Ramp
	Step
	Exponent
	Switching
	Noise
	Sine Damp
Calculated based on mathematical formula	
Wave segment time	unlimited

The number of waveform segments contained in each waveform	Depend on the complexity of the waveform (up to 50)
--	---

3.2 Input index

project	specification
Input signal channel	2 channels
Voltage measurement range	5V, 10V, 20V, 50V, 100V unipolar or bipolar
Measurement channel resolution	16Bit
Measurement accuracy	$\pm(0.1\% \text{ reading} + 0.1\% \text{ range})$ (for measurement conditions see remarks)
Measuring frequency range	DC-100kHz
Sampling rate	5S/s...1MS/s
data storage	1GB max (single file)

Note:

Test Conditions	Signal amplitude	Accuracy
Input waveform: sine wave Common mode voltage: 0V Use the highest sampling rate that satisfies the sampling period ≥ 100 signal periods.	500Hz: 10%-100 range Other frequencies: 80% range	$\pm(0.1\% \text{ reading} + 0.1\% \text{ range})$

3.3 Triggering and monitoring

project	specification
trigger	2 outputs, 2 inputs
DUT monitoring	2 inputs

3.4 Display

project	specification
monitor	10.1 inch color LCD display with touch function
Total pixels	1280 (horizontal) \times 800 (vertical)

3.5 Interface

project	specification
---------	---------------

Communication Interface	Standard configuration: USB, LAN, RS-232; optional configuration: GP-IB, CAN option
-------------------------	---

3.6 Conventional technical requirements

Project	Specification
working environment	Temperature: 5°C~40°C Humidity: 20%R.H.~80%R.H. (no condensation)
Rated power supply voltage	90VAC~250VAC, 47Hz~63Hz, or 12VDC~32VDC
lithium battery	8V, 10000mAh; this function will be optional in the future, and conventional products will supply power to the grid, which will be restructured according to customer needs.

4. APV6015 Automotive Voltage Variation Simulation Generator 1PC

4.1 General technical indicators

Transient response time: <math><100\mu\text{s}</math>;

Voltage ripple: <math><0.2\text{V}</math>;

Load regulation rate: <math><1\%</math>;

Source impedance: $\leq 10\text{m}\Omega$;

Maximum compensation voltage: 4V.

Maximum output rated current: $\pm 15\text{A}$, $\pm 60\text{A}$, $\pm 100\text{A}$

Maximum impulse current: $\pm 30\text{A}$, $\pm 120\text{A}$, $\pm 200\text{A}$, lasting 500ms.

Maximum output voltage: $\pm 60\text{V}$

4.2 DC supply voltage

Table 1: 12V system power supply voltage

Level	12V system power supply voltage			
	U_{Smin}	U_{Smax}	Error	Injection time
A	6V	16V	$\pm 0.2\text{V}$	1~9999s/continued
B	8V	16V	$\pm 0.2\text{V}$	
C	9V	16V	$\pm 0.2\text{V}$	
D	10.5V	16V	$\pm 0.2\text{V}$	
USER	0V	24V	$\pm 0.2\text{V}$	

Table 2: 24V system power supply voltage

Level	24V system power supply voltage			
	U_{\min}	U_{\max}	Error	Injection time
E	10V	32V	$\pm 0.2V$	1~9999s/continued
F	16V	32V	$\pm 0.2V$	
G	22V	32V	$\pm 0.2V$	
H	18V	32V	$\pm 0.2V$	
USER	0V	60V	$\pm 0.2V$	

Table 3: 42V system power supply voltage

Level	42V system power supply voltage			
	U_{\min}	U_{\max}	Error	Injection time
L	32V	48V	$\pm 0.2V$	1~9999s/continued
USER	0V	60V	$\pm 0.2V$	

4.3 Overvoltage

Table 4: Overvoltage test level

Nominal voltage U_N (V)	Output voltage U_A (V)		Duration	Standard time requirements
12	18		1~9999s	60min
	24			60s $\pm 10\%$
	USER	U upper limit U lower limit 12~24V		/
24	36			60min
	USER	U upper limit U lower limit 24~60V		/
42V	48V		/	
	USER	U upper limit U lower limit 30~60V	/	

Note: Change from 16V to 18V at a rate of 1V per minute. (Required by GE)

4.4 Superimposed AC voltage

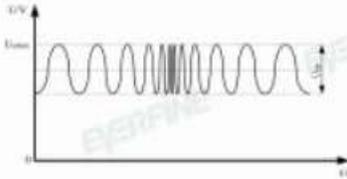


Figure 1 Superimposed AC voltage waveform

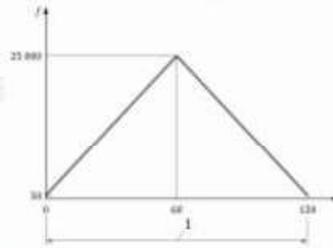


Figure 2 Frequency sweep

sweep

Table 5: Test level and waveform parameters

Test level and waveform parameters	$U_{li} = 12V$	$U_{li} = 24V$	$U_{li} = 42V$
Test voltage U_{Smax}	/	/	/
Grade I U_{pp}	1 V	1 V	4V
Grade II U_{pp}	4 V	4 V	1V
Grade III U_{pp}	/	10 V	4V
Level IV U_{pp}	2V	/	1V
USER U_{pp}	1V~6V (0.5V/step)	1V~10V (0.5V/step)	1V~10V (0.5V/step)
USER U_N	10V~16V (0.1V/step)	20V~32V (0.1V/step)	32V~48V (0.1V/step)
Frequency lower limit	15Hz~300kHz Continuously adjustable		
Upper frequency limit	15Hz~300kHz Continuously adjustable		
Sweep type	Triangle, logarithm		
Sweep duration	120s		
Voltage error	±0.2V		
Time/frequency error	±5%		

4.5 Voltage rises slowly

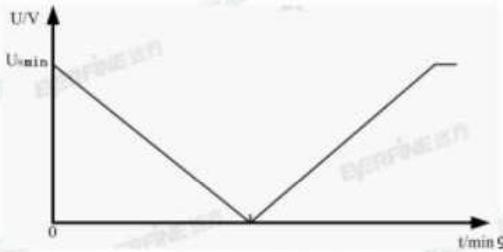


Figure 3 Slow rise and fall of voltage

System	Test Level	Test Level Description	Repeat Interval	Repeat Times
12V system	A	$U=6V$ (0.5V/min)	1000~99000ms	(6→0→6)
	B	$U=8V$ (0.5V/min)		(8→0→8)
	C	$U=9V$ (0.5V/min)		(9→0→9)
	D	$U=10.5V$ (0.5V/min)		(10.5→0→10.5)
	USER	$U = (6V\sim24V)$ Voltage change rate: (0.1~3.0±0.1)V/min		(U→0→U)
24V system	E	$U=10V$ (0.5V/min)	1~99	(10→0→10)
	F	$U=16V$ (0.5V/min)		(16→0→16)
	G	$U=22V$ (0.5V/min)		(22→0→22)
	H	$U=18V$ (0.5V/min)		(18→0→18)
	USER	$U = (10V\sim40V)$ Voltage change rate: (0.1~3.0±0.1)V/min		(U→0→U)
42V system	L	$U=48V$ (3V/min)		(48→0→48)
	USER	$U = (24V\sim60V)$ (0.1~5V) /min		(U→0→U)

4.6 Supply voltage interruption

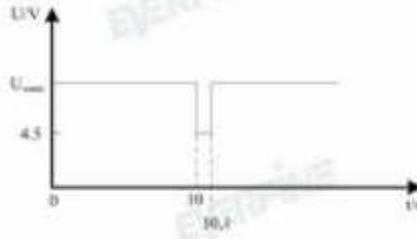


Figure 4a Voltage interruption (12V system)

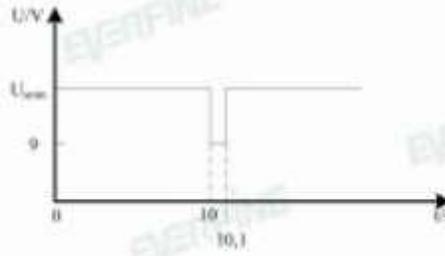


Figure 4b Voltage interruption (24V system)

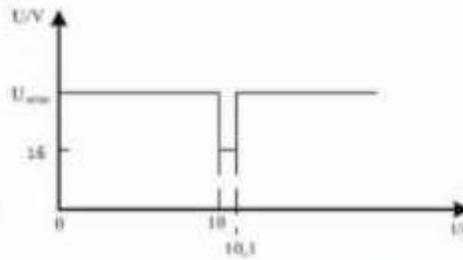


Figure 4c Voltage interruption (42V system)

12V system	A	6V→4.5V	Repeat interval: 1~9999s
	B	8V→4.5V	
	C	9V→4.5V	
	D	10.5V→4.5V	
	USER	X (6.0~12V) →Udrop (0~4.5V)	
24V system	E	10V→9V	Repeat times: 1~99 Pulse duration: 100~9999ms
	F	16V→9V	
	G	22V→9V	
	H	18V→9V	
	USER	X (10.0~24.0V) →Udrop (0~9.0V)	
42V system	L	30V→16V	
	USER	X (24.0~60.0V) →Udrop (0~20V)	

4.7 Voltage dip

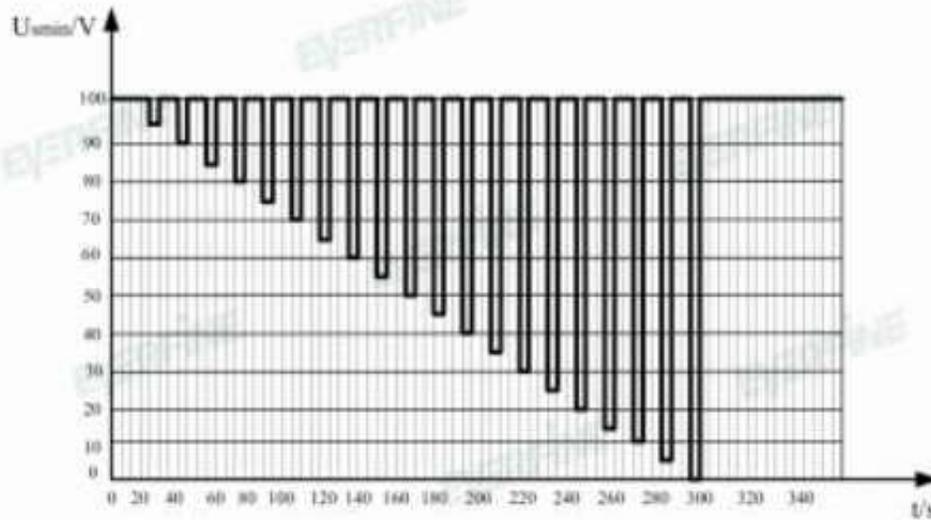


Figure 5 Voltage sag waveform

System type	Test level	voltage range	Low voltage hold time	High voltage hold time	
12V system	A	6V--0V	5s	10s	Repeat interval: 1000~9900ms Repeat times: 1~99
	B	8V--0V			
	C	9V--0V			
	D	10.5V--0V			
	USER	X (6.0~12V) --0V			
24V system	E	10V--0V	5s	10s	
	F	16V--0V			
	G	22V--0V			
	H	18V--0V			
	USER	X (10.0~24.0V) --0V			
42V system	L	30V--0V	5s	10s	
	USER	X (24.0~60.0V) --0V	1~9999s	1~9999s	

4.8 Voltage start waveform

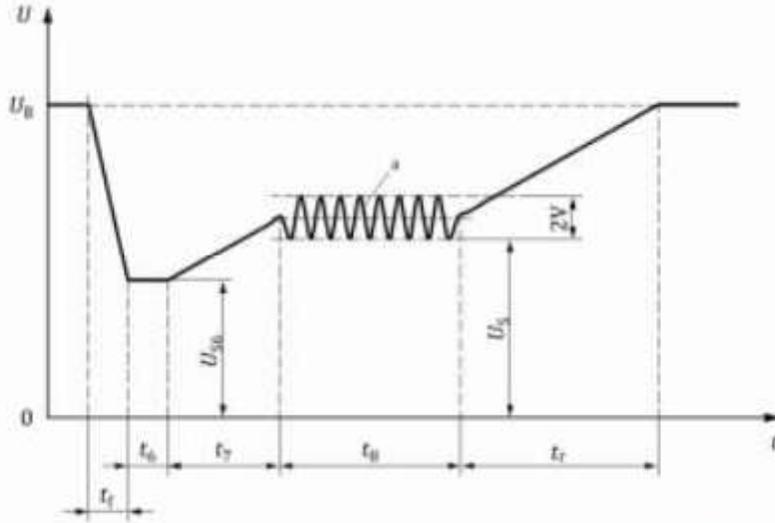


Figure 6 Voltage start waveform

Table 6: Waveform parameters when UN=12V

Grade/Voltage/Duration (12V system)					
I	II	III	IV	USER	tolerance
$U_{30}=8V$	$U_{30}=4.5V$	$U_{30}=3V$	$U_{30}=6V$	$U_{30}=(1.5\sim 7V)$	-0.2V
$U_5=9.5V$	$U_5=6.5V$	$U_5=5V$	$U_5=6.5V$	$U_5=(4\sim 9.5)$ $(U_{30}\leq U_5)$	
$t_r=5ms$					±10%
$t_d=15ms$				10~45ms (1ms/step)	
$t_f=50ms$				1~50ms (1ms/step)	
$t_0=1s$	$t_0=10s$	$t_0=1s$	$t_0=10s$	$t_0=0.5\sim 20s$ (0.1/step)	
$t_r=40ms$	$t_r=100ms$	$t_r=100ms$	$t_r=100ms$	$t_r=40\sim 9999ms$	
/	/	/	/	$f=1\sim 5Hz$	
/	/	/	/	UPP=1V~3V	
/	/	/	/	Phase 0°180°	

Table 7: Function status when UN=12V

Code	Function status (12V system)			
	I	II	III	IV
A ¹	a ²	b ²	b ²	a ²
B ¹	a ²	b ²	c ²	b ²
C ¹	b ²	c ²	c ²	c ²
D ¹	b ²	c ²	c ²	c ²

Note 1: A, B, C, D represent various power supply voltages of 12V system, see Table 6 for details;

Note 2: a, b, and c correspond to the functional status levels Class A, Class B, and Class C respectively. For the specific meaning of each functional status level, please refer to ISO 16750-1.

Table 8: Waveform parameters when UN=24V

Grade/Voltage/Duration (24V system)				
I	II	III	USER	tolerance
$U_{S6}=10V$	$U_{S6}=8V$	$U_{S6}=6V$	$U_{S6}=(5\sim 12V)$	-0.2V
$U_S=20V$	$U_S=15V$	$U_S=10V$	$U_S=(12\sim 16)$ ($U_{S6}\leq U_S$)	
$t_6=10ms$			$10\sim 45ms$ (1ms/step)	±10%
$t_6=50ms$				
$t_7=50ms$			$1\sim 50ms$ (1ms/step)	
$t_8=1s$	$t_8=10s$	$t_8=1s$	$t_8=0.5\sim 20s$ (0.1/step)	
$t_r=40ms$	$t_r=100ms$	$t_r=40ms$	$t_r=40\sim 9999ms$	
/	/	/	$f=1\sim 5Hz$	
/	/	/	UPP=1V~3V	
/	/	/	$\theta: 0^\circ\sim 180^\circ$	

Table 9: UN=24V function status

Code	Function status (24V system)		
	I	II	III
E ¹	a ²	b ²	b ²

F ¹	b ²	c ²	c ²
G ¹	b ²	c ²	c ²

Note 1: E, F, G represent various power supply voltages of 24V system, see Table 7 for details;

Note 2: a, b, and c correspond to the functional status levels Class A, Class B, and Class C respectively. For the specific meaning of each functional status level, please refer to ISO 16750-1.

Table 10: Waveform parameters when UN=42V

Grade/Voltage/Duration (42V system)		
L	USER	tolerance
U _{SS} =18V	U _{SS} =(5~30V)	-0.2V
U _S =21V	U _S =(12~30) (U _{SS} ≤U _S)	
t _r =100ms	5~9999ms	±10%
t _e =15ms	10~45ms (1ms/step)	
t _v =50ms	1~50ms (1ms/step)	
t _s =10s	t _B =0.5~20s (0.1/step)	
t _r =5ms		
/	f=1~5Hz	
UPP=0V	UPP=1V~3V	
/	Phase 0°180°	

4.9 Reverse voltage

Table 11: Reverse voltage test level

Nominal voltage UN (V)	Output voltage UA (V)	duration	Standard time requirements
12	-4	0.1~9999s	(60±6) s
	-14		
	USER -4~-18V		
28			
24	USER -10~-36V		
	42V	100ms	

	USER	-12~-60V		/
--	------	----------	--	---

4.10 Open circuit

Table 12: Open circuit and short circuit test parameters

Types	The output voltage			Open circuit impedance (MΩ)	Off time	Standard required time
	12V system	24V system	42V system			
Single wire disconnection	12V	24V	42V	≥10	1~9999s	(10±1) s
Multi-wire disconnection						

4.11 Pulse 2b

parameter	12V system	24V system	42V system
Stable voltage UA	13.5V±0.5V	27V±1V	42V±1V
Pulse voltage US	10V	20V	USER:20V~42V
Pulse duration td	0.2s~2s (0.1s/step)		
Voltage drop time t12	0.5ms~1.5ms (0.1ms/step)		
Pulse rise time tr	0.5ms~1.5ms (0.1ms/step)		
Voltage delay time t6	0.5ms~1.5ms (0.1ms/step)		
Pulse interval time	0.5s~5s (0.1s/step)		
Allow repetitions	1~9999次 (1/step)		
Maximum load current I _{max}	15A		

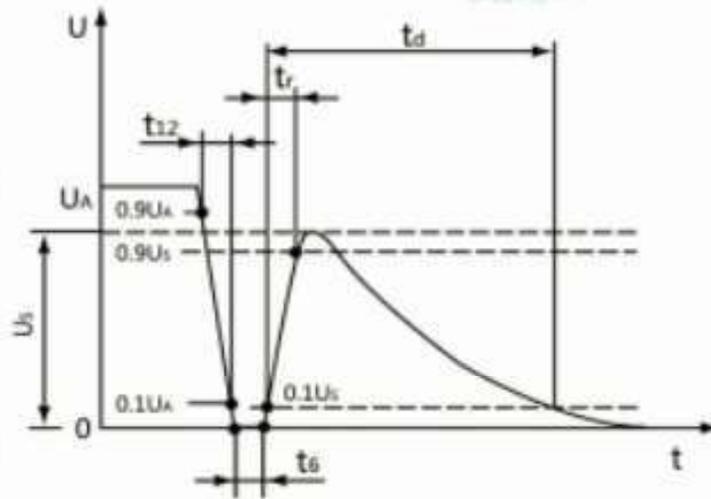


Figure 7 Test pulse P2b

4.12 Pulse 4

parameter	12V system	24V system	42V system
Stable voltage U_B	12V±0.2V	24V±0.4V	42V±0.4V
The first voltage drop amplitude U_S	6.0V~7.0V (0.1V/step)	12.0V~16.0V (0.1 V/step)	12.0V~30.0V (0.1 V/step)
The second voltage drop amplitude U_A	2.5V~6.0V (0.1V/step)	5.0V~12.0V (0.1V /step)	5.0V~30.0V (0.1V /step)
The first voltage drop stabilization time t_7	10ms~45ms (1ms/step)	5ms~100ms (1ms /step)	5ms~100ms (1ms /step)
Rise time of the first voltage drop t_8	1ms~50ms (1ms/step)		
Second voltage drop stabilization time t_9	0.5s~20.0s (0.5s/step)		
The first voltage drop down time t_{10}	5 ms	10 ms	5ms
Second voltage drop rise time t_{11}	5ms~100ms (1ms/step)		
Pulse interval time	1s~9999s (1min/step)		
Allow repetitions	1~9999times (1/step)		

Maximum load current I_{max}	15A
--------------------------------	-----

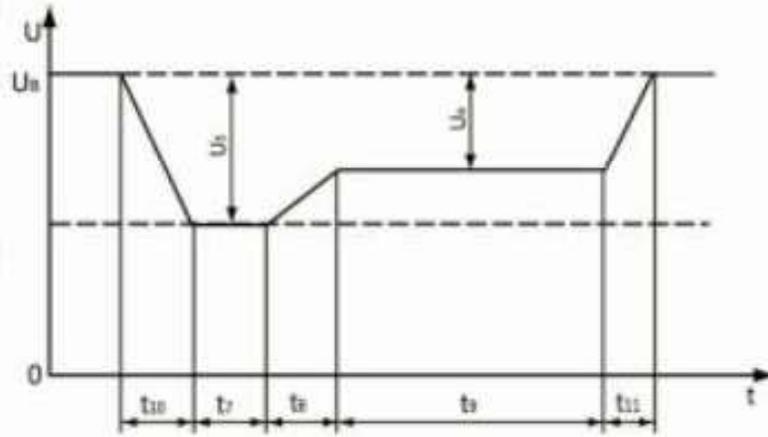


Figure 8 Test pulse P4

4. EFTC-3 EFT Capacitive Coupling Clamp 1PC



Main Features:

- Fully meets the latest requirements of ISO7637-3, output waveform stable and formal;
- The structure design is neat, convenient for cable clamping;
- Good looking appearance.

Main technical specification:

Coupling capacitance	<200pF
Insulation resistance	DC 5000V
Dimension (W×D×H)	1250mm×300mm×70mm
Weight	About 8kg

5. AET7000 Automobile Immunity Test System Control Platform 1PC

Main Features:

- ✓ High bright LCD screen display, friendly man-machine interface, convenient operation with touchable screen;
- ✓ Low power consumption, have standby mode for energy-saving;
- ✓ Integrated with software platform for automotive electronic immunity test system, rich in function, fulfill the various testing requirements;
- ✓ 19 inch standard cabinet, reasonable design and neat appearance.

