M2 combined HV 3kV / LV 200A test generator

The M2 HV3kV / LV200A test generator is one of the Mostrak-2 (M2) family of test generators from ipTEST. It performs high voltage off-state tests and low voltage on-state and active region tests on power semiconductor devices such as MOS, IGBT and fast GaN and SiC.

The generator has a unipolar 3kV source which may be switched to the appropriate device terminals for HV tests with a floating ±25V Vx generator and a bipolar ±50V 200A output to the Drain/Collector terminal with a ±50V 20A Gate/Base output for LV tests. Thermal die attach tests to 50V/20A for up to 25ms are also included.

Programmable digital servos loops allow fast settling for each test and user control over the device under test stability.

FEATURES

3kV, 200A high speed static test generator for packaged devices, bare die or wafer test

High throughput with fast settling

0.1% voltage and current measure accuracy with force condition datalogging

Digital control loops for fast test settling

Waveform capture for rapid test-plan development and debugging

Low board count for high reliability and low spares inventory

Modular, expandable architecture for higher LV currents

Compact dimensions allow the generator to be mounted on a handler or prober table

HV generator specifications

Voltage measure

The voltage measurement uses a 16bit ADC sampled at up to 1µs with a 125% over-range measurement capability.

Load (Drain/Collector) & Drive (Gate/Base) Voltage measure specification				
Range	**Unit**	**Resolution**	**Unit**	**Accuracy[1]**
3	kV	114.4	mV	0.1%
1	kV	38.15	mV	0.1%
300	V	11.44	mV	0.1%
100	V	3.815	mV	0.1%
30	V	1.144	mV	0.1%
10	V	381.5	µV	0.1%
3	V	114.4	µV	0.1%
1	V	38.15	µV	0.1%
300	mV	11.44	µV	0.1%
100	mV	3.815	µV	0.1%
30	mV	1.144	µV	0.1%

Note 1: Voltage measure accuracy as ±% of value from 10% to 120% of range subject to ±0.01% of range, ±100µV and ±0.005% of common mode voltage (CMV), using averaging.

Current measure

The current measurement uses a 16bit ADC sampled at up to 1µs with a 125% over-range measurement capability.

Current measure specification				
Range	**Unit**	**Resolution**	**Unit**	**Accuracy[2]**
100	mA	3.815	µA	0.1%
10	mA	381.5	nA	0.1%
1	mA	11.44	nA	0.1%
100	µA	3.815	nA	0.1%

10	µA	1.144	nA	0.5%
1	µA	381.5	pA	0.1%
100	nA	3.815	pA	1.0%

Note 2: Current measure accuracy as ±% of value from 10% to 120% of range subject to ±0.01% of range, ±1nA, using averaging.

Vx Voltage measure

The Vx voltage measure has 20V compliance and a 25V range and uses 16 bit forcing DACs and 12 bit serial ADCs sampling up to 18µs.

Vx Voltage measure specification				
Range	**Unit**	**Resolution**	**Unit**	**Accuracy[3]**
25*	V	12.21	mV	0.25%

Note 3: Voltage measure accuracy measured into a high impedance load as ±% of range from 10% to 120% of range, ±1nA, using averaging.

Vx Current measure

The Vx current measurement uses a 12bit serial ADC sampled at up to 18µs with a 125% over-range measurement capability.

Vx current measure specification				
Range	**Unit**	**Resolution**	**Unit**	**Accuracy[4]**
1	mA	610.4	nA	0.3%
100	µA	61.04	nA	0.3%
10	µA	6.104	nA	0.3%
1	µA	610.4	pA	0.3%
100	nA	61.04	pA	1.0%

Note 4: Current measure accuracy as ±% of range from 10% to 120% of range, ±1nA, using averaging.

LV generator specifications

Voltage measure

The voltage measurement uses a 16bit ADC sampled at up to 1µs with a 125% over-range measurement capability.

Load (Drain/Collector) & Drive (Gate/Base)				
Range	**Unit**	**Resolution**	**Unit**	**Accuracy [Note 1]**
3	kV	114.4	mV	0.1%
1	kV	38.15	mV	0.1%
300	V	11.44	mV	0.1%
100	V	3.815	mV	0.1%
30	V	1.144	mV	0.1%
10	V	381.5	µV	0.1%
3	V	114.4	µV	0.1%
1	V	38.15	µV	0.1%
300	mV	11.44	µV	0.1%
100	mV	3.815	µV	0.1%
30	mV	1.144	µV	0.1%

Note 1: voltage measure accuracy 0.1% of value from 10% to 120% of range subject to ±100µV and ±0.005% of common mode voltage (CMV), using averaging.

Current measure

The current measurement uses a 16 bit ADC sampled at up to 1µs with a 125% over-range measurement capability.

Load (Drain/Collector) current measure specification				
Range	**Unit**	**Resolution**	**Unit**	**Accuracy [Note 2]**
1000	A	38.15	mA	0.1%
300	A	11.44	mA	0.1%
100	A	3.815	mA	0.1%
10	A	381.5	µA	0.1%
1	A	38.15	µA	0.1%

100	mA	3.815	µA	0.1%
10	mA	381.5	nA	0.1%
1	mA	38.15	nA	0.1%
100	µA	3.815	nA	0.1%
10	µA	381.5	pA	0.1%
1	µA	38.15	pA	0.1%
100	nA	3.815	pA	1.0%

Drive (Gate/Base) current measure specification				
Range	**Unit**	**Resolution**	**Unit**	**Accuracy** [Note 2]
10	A	381.5	µA	0.1%
1	A	38.15	µA	0.1%
100	mA	3.815	µA	0.1%
10	mA	381.5	nA	0.1%
1	mA	38.15	nA	0.1%
100	µA	3.815	nA	0.1%
10	µA	381.5	pA	0.1%
1	µA	38.15	pA	0.1%
100	nA	3.815	pA	1.0%

Note 2: current measure accuracy 0.1% of value from 10% to 120% of range subject to ±0.01% of range, ±1nA, using averaging.

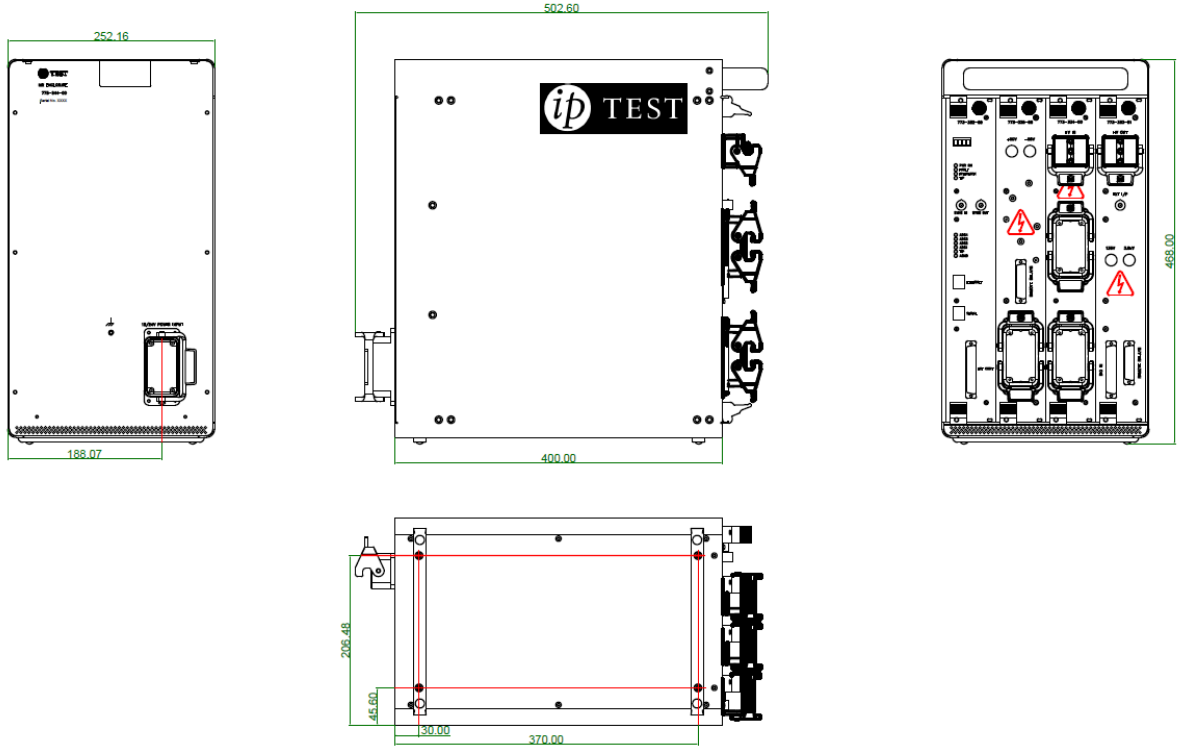
Kelvin resistance measure

The Kelvin test forces 20mA and measures the series voltage to determine the Kelvin resistance between power and sense contacts. Any internal tester resistance may be nulled using an external calibration process. The Kelvin test includes a built-in self-check.

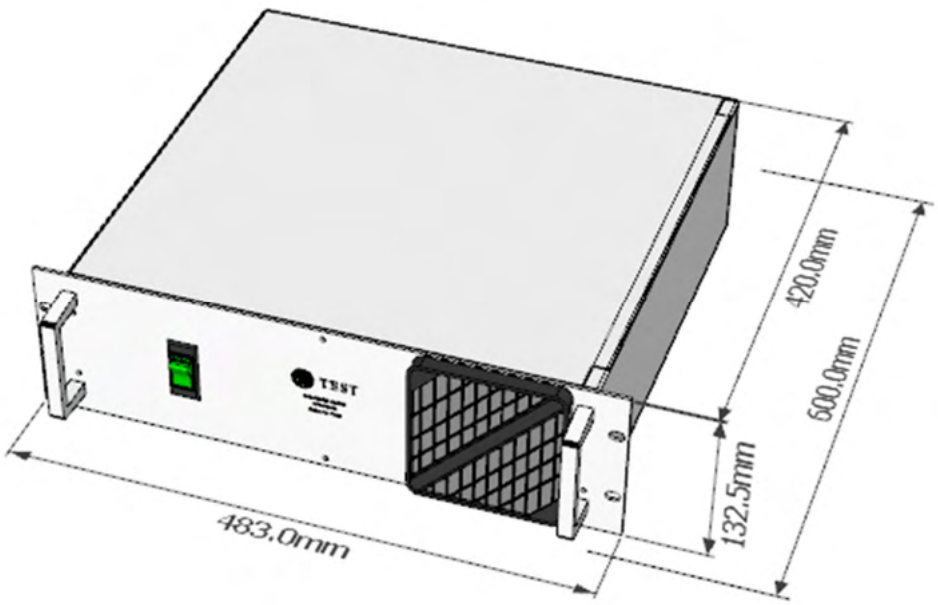
Current force	**Unit**	**Resolution**	**Unit**	**Accuracy**[5]
20 (fixed value)	mA	-	-	1%
Resistance measure range	**Unit**	**Resolution**	**Unit**	**Accuracy**
30	Ohms	7.32	mV	1%

Note 5: Excluding internal resistance.

Generator dimensions



PSU dimensions



The power supply cable from the Mostrak system cabinet to the M2 test head is 5m.

M2 HV test generator test modes

Setup and Kelvin tests	
KELVIN	Executable Kelvin PASS/FAIL test mode
RKELVN	Recalls the Kelvin resistance per pin
MCHECK	Compensates for internal and cable resistance.
MATRIX	Sets the matrix connections
RRELAY	Sets remote relays
CALCULATE	Calculation.
DELAY	Adds the specified delay before the next tests - a setup test mode.
WAIT	Adds the specified delay between tests - an executable test mode
SET_B	Set buffer - set up mode for setting a high impedance measurement buffer for the next test maximum 25V compliance including common mode voltage.
SET_T1	Set timer states 1 - set up mode for setting the state timers 0-7 for the next test.
SET_T2	Set timer states 2 - set up mode for setting the state timers 8-15 for the next test.
DataIO	Reads from or writes to the 8 bit external data and address bus (control card front panel).
MOSFET device tests	
BVDSO	**BV_{DSO}** or **$V_{(BR)DSO}$** - Drain-Source breakdown voltage, Gate open-circuit.
BVDSS	**BV_{DSS}** or **$V_{(BR)DSS}$** - Drain-Source breakdown voltage, Gate-Source short-circuit.
BVDSX	**BV_{DSX}** or **$V_{(BR)DSX}$** - Drain-Source breakdown voltage, with a floating reverse biased voltage applied between Gate and Source.
BVDGO	**BV_{DGO}** or **$V_{(BR)DGO}$** - Drain-gate breakdown voltage, with the Source open-circuit.
BVGSO	**BV_{GSO}** or **$V_{(BR)GSO}$** - Gate-Source breakdown voltage, Gate open-circuit.
BVGSS	**BV_{GSS}** or **$V_{(BR)GSS}$** - Gate-Source breakdown voltage, Gate short-circuit.
IDSO	**I_{DSO}** - Zero Gate voltage Drain current, Gate open-circuit.
IDSS	**I_{DSS}** - Zero Gate voltage Drain current, Gate short-circuit.
IDSX	**I_{DSX}** - Zero Gate voltage Drain current, floating reverse biased voltage applied between Gate and Source.
IDSG	**I_{DSG}** - Drain-Source leakage current, floating reverse biased voltage applied between Gate and Source Gate current measure range programmable.
IDGO	**I_{DGO}** - Drain-Gate leakage current, Source open-circuit.
IGSO	**I_{GSO}** - Gate-source leakage current, Drain open-circuit.
IGSS	**I_{GSS}** - Gate-source leakage current, Drain-Source short-circuit.
VGS ON	**V_{GSON}** - Gate on-state voltage.

Bi-polar transistor device tests	
BVCBO	**BV_{CBO}** or **$V_{(BR)CBO}$** - Collector-Base breakdown voltage, Emitter open-circuit.
BVEBO	**BV_{EBO}** or **$V_{(BR)EBO}$** - Emitter-Base breakdown voltage, Collector open-circuit.
BVCEO	**BV_{CEO}** or **$V_{(BR)CEO}$** - Collector-Emitter breakdown voltage, Base open-circuit.
BVCES	**BV_{CES}** or **$V_{(BR)CES}$** - Collector-Emitter breakdown voltage, Base-Emitter short-circuit.
BVCEX	**BV_{CEX}** or **$V_{(BR)CEX}$** - Collector-Emitter breakdown voltage, floating reverse biased voltage applied between Base-Emitter.
ICBO	**I_{CBO}** - Collector-Base leakage current, Emitter open-circuit.
IEBO	**I_{EBO}** - Emitter-Base leakage current, Collector open-circuit.
ICEO	**I_{CEO}** - Collector-Emitter leakage current, Base open-circuit.
ICES	**I_{CES}** - Collector-Emitter leakage current, Base-Emitter Short-circuit.
IGBT device tests	
BVCEO	**BV_{CEO}** or **$V_{(BR)CEO}$** - Collector-Emitter breakdown voltage, Gate open-circuit.
BVCES	**BV_{CES}** or **$V_{(BR)CES}$** - Collector-Emitter breakdown voltage, Gate-Emitter short-circuit.
BVCEX	**BV_{CEX}** or **$V_{(BR)CEX}$** - Collector-Emitter breakdown voltage, floating reverse biased voltage applied between Gate-Emitter.
IGES	**I_{GES}** - Gate-Emitter leakage current, Collector-Emitter short-circuit.
Diode device tests	
BVR	**BV_R** - Reverse breakdown voltage.
IR	**I_R** - Reverse leakage current.
Recall tests	
DRIVEI	Recall the Vx current measurement stored for the preceding test mode.
DRIVEV	Recall the Vx voltage measurement stored for the preceding test mode.
LOADI	Recall the load current measurement stored for the preceding test mode.
LOADV	Recall the load voltage measurement stored for the preceding test mode.
R_TIME	Recall the state times for the preceding test mode.
CODE_r	Returns the number representing the non-numeric result of the previous test.
Miscellaneous test modes	
SERVOD	Controls the digital servo compensation for the next test.

M2 LV test generator test modes

Setup and Kelvin tests	
KELVIN	Executable Kelvin PASS/FAIL test mode
RKELVN	Recalls the Kelvin resistance per pin
MCHECK	Compensates for internal and cable resistance.
MATRIX	Sets the matrix connections
RRELAY	Sets remote relays
CALCULATE	Calculation.
DELAY	Adds the specified delay before the next tests - a setup test mode.
WAIT	Adds the specified delay between tests - an executable test mode
SET_B	Set buffer - set up mode for setting a high impedance measurement buffer for the next test maximum 25V compliance including common mode voltage.
SET_T1	Set timer states 1 - set up mode for setting the state timers 0-7 for the next test.
SET_T2	Set timer states 2 - set up mode for setting the state timers 8-15 for the next test.
DataIO	Reads from or writes to the 8 bit external data and address bus (control card front panel).
MOSFET device tests	
dVSD	Measures the difference in VDS before and after a power pulse.
GFS	g_{fs} - forward transconductance.
ID ON	$I_{D(on)}$ - On-state Drain-Source current.
RDS ON	$R_{DS(on)}$ - On-state Drain-Source resistance.
VDS ON	$V_{DS(on)}$ - On-state Drain saturation voltage.
VGS ON	$V_{GS(on)}$ - On-state Gate saturation voltage.
VTH	$V_{(GS)th}$ - Gate threshold voltage.
VSD	V_{SD} - Source-Drain voltage (on-state of body Drain diode).
Bi-polar transistor device tests	
dVBE	Measures the difference in V_{BE} before and after a power pulse.
hfe	h_{fe} - DC current gain.
ICon	I_{Con} - On-state collector current.
VBE	V_{BE} - Base-emitter voltage - collector open.
VBEON	$V_{BE(on)}$ - Base-emitter on-state voltage.
VBESAT	$V_{BE(sat)}$ - Base-emitter saturation voltage.
VCESAT	$V_{CE(sat)}$ - Collector-emitter saturation voltage.

IGBT device tests	
dVCE	Measures the difference in $V_{CE(sat)}$ before and after a power pulse.
GFS	g_{fs} - forward transconductance.
ICon	$I_{C(on)}$ - On-state Collector current.
VCES	$V_{CE(sat)}$ - On-state Collector-Emitter saturation voltage.
VGS ON	$V_{GE(on)}$ - On-state Gate voltage.
VGETH	$V_{(GE)th}$ - Gate threshold voltage.
VFT	V_{FT} - Emitter-Collector voltage (of anti-parallel diode).
Diode device tests	
dVF	Measures the difference in V_F before and after a power pulse.
VF	V_F - Diode forward voltage.
IR	I_R - Reverse leakage current.
Recall tests	
DRIVEI	Recall the Drive current measurement stored for the preceding test mode.
DRIVEV	Recall the Drive voltage measurement stored for the preceding test mode.
LOADI	Recall the load current measurement stored for the preceding test mode.
LOADV	Recall the load voltage measurement stored for the preceding test mode.
R_TIME	Recall the state times for the preceding test mode.
CODE_r	Returns the number representing the non-numeric result of the previous test.
Miscellaneous test modes	
SERVOD	Controls the digital servo compensation for the next test.
MODTST	Modify test - affects the low level operation of the preceding test. Mainly used for de-bug Warning: There is a risk of damaging the tester if used inappropriately, only to be used by trained ipTEST engineers.
VMREAD	Diagnostic mode which is used to verify the accuracy of the M2 voltage measure circuit by measuring an external voltage.

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