

GATE & DRAIN Probe heads specifications

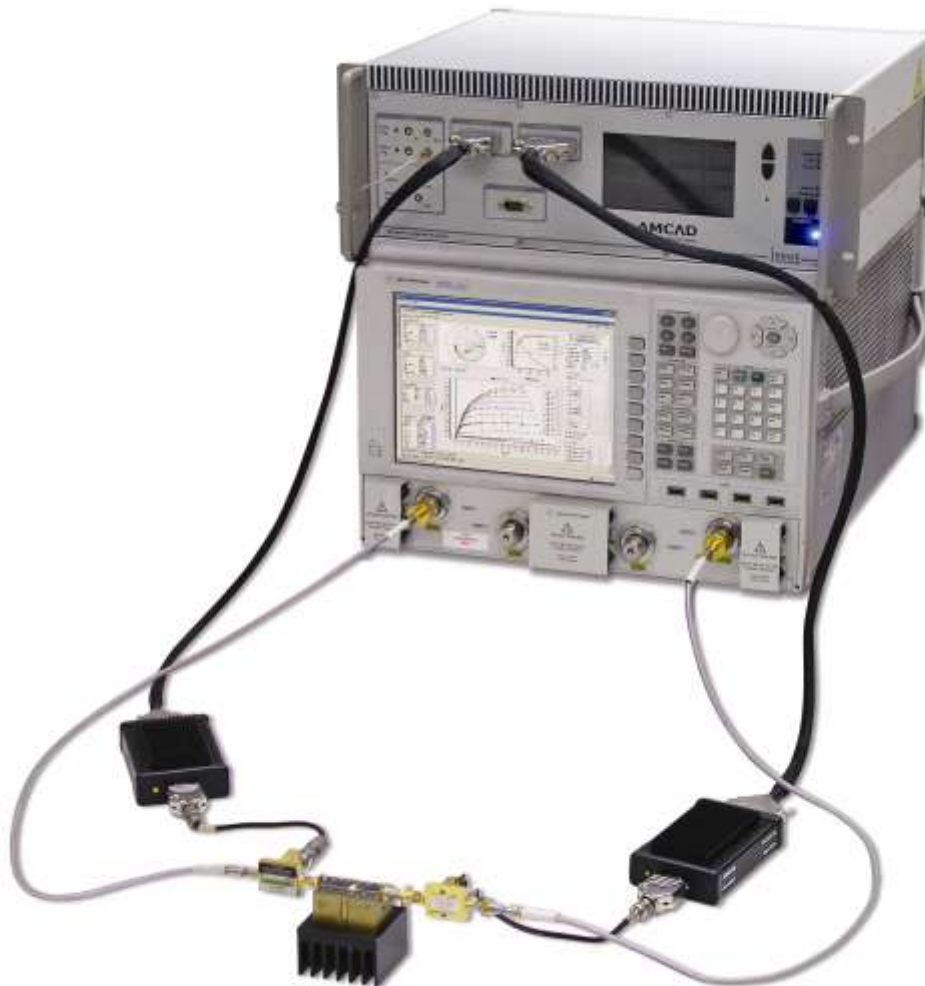


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1 Main Characteristic of the Pulse IV System

This product has been designed for RF and microwave semiconductor characterization in pulsed mode. This product has been powered by from the BILT product line of Innovative Test system.



1.1 General Description

The system consists of two independently operating power mode; Pulsed or DC (continuous mode). The maximum average power delivered by the sensors output is 50Watts in pulsed mode, or 80W in DC mode. This specification is linked to the external power probes used. The voltage measurements on the two channels are carried out from the internal resistance of each channel. The current measurements are made using differential measurements at the terminals of the same internal resistance.

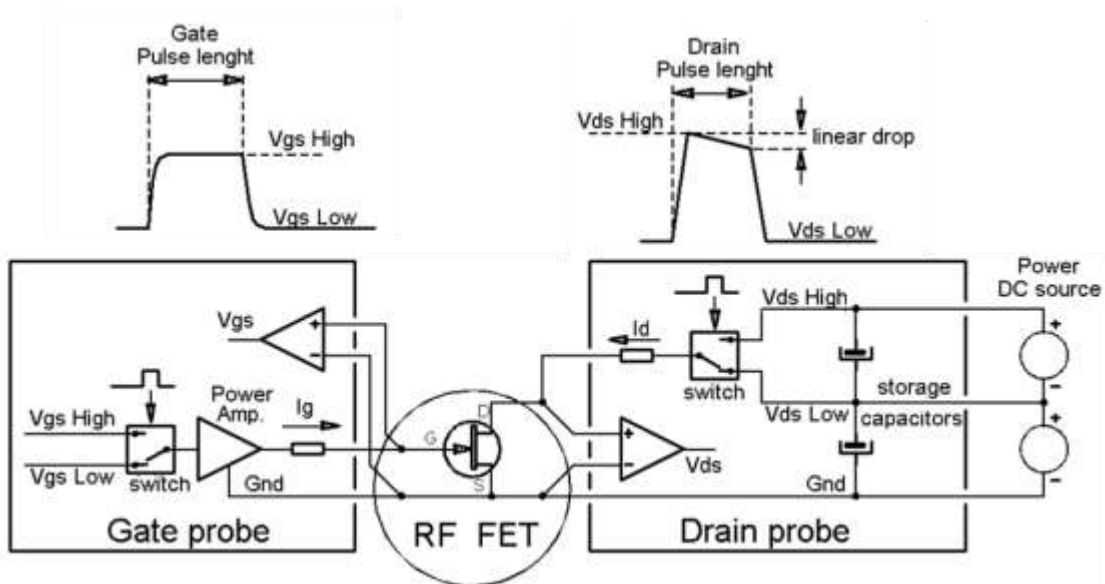


Fig.1. Pulse IV system Synoptic

When measuring Field Effect Transistors (FET), the internal series resistance of 10 Ohm of the gate probe head allows highly accurate differential measurement of this gate current. For the drain, the internal series resistance of the drain probe can be as low as 0.5/0.15 Ohms as a function of the model used. This facilitates the feedback control voltage (low voltage drop across the series resistance) and therefore achieves a high voltage sweep. The accuracy of current measurement is given as a function of the probe model used.



Fig.2. Pulse IV system picture

The main unit is composed of:

- 19" rack mountable mainframe control unit with five embedded power supplies
- Output (drain/collector) and Input (gate/base) remote pulser heads
- Range of multiple interchangeable output pulser heads to fulfill PIV and Load-Pull requirements
- Integrated measurement unit in each pulse head

1.2 Main features

The system's main features are:

- Pulse width down to 200ns
- Embedded measurement units providing wide bandwidth & high accuracy simultaneous current and voltage measurements:
 - Equivalent to 50Msamples/s & 10MHz bandwidth scope for pulse shape monitoring
 - Fast averaging function providing 16 bit resolution and 0,1% typical measurement accuracy
 - Fast acquisition of complete power sweep for load pulls measurements
- Synchronized pulsed S parameter and IV measurements
- Embedded fast short-circuit current breaker, performing the protection of both pulser heads (drain and gate) as well external component such as Bias Tees
- Automatic pulser head calibration procedure
- Pulse and measurement clocks are both available in stand alone or external triggered mode
- Remote control GPIB or LAN
- Set of resistive networks

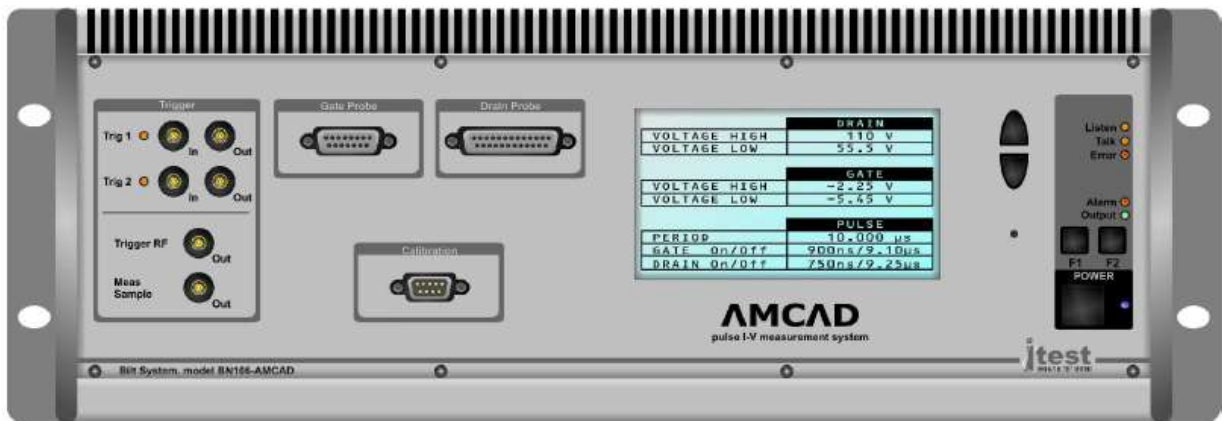


Fig.3. Pulse IV main unit

The system consists of a main unit, two probes, and two cables for connecting the sensors with the main unit as well as two adapters SUB-D/BNC. The two probes and the main unit are equipped with specific plugs and jacks to avoid a wrong connection. At the end of each probe, an adapter must be added to connect SUB-D/BNC then to characterize the device. These adapters also make the connection between the power line and the IV measurement units.

Caution

It is mandatory to make the connections and disconnections between the main unit and the power cords and sensors only when the system turned off. Failure to observe this precaution could result in the destruction of electronic circuits within the main unit and inside of the probes.

This system can be used to bias transistors in pulsed conditions for both PIV and Load Pull measurements.

For pulsed IV application, the target is to provide small pulse widths in order to avoid self heating, while load pull measurements are made in "R.A.D.A.R" like operating conditions with larger pulse width. In this latest case, the aim is to avoid voltage drop during the current consumption caused by the RF power level of the test signal.

Dedicated performances for PIV and Load Pull applications:

	PIV	Load Pull
Drain Voltage	Switching between Vds High and Vds Low	Switching between 0V and Vds High, or Fixed Vds with pulsed current
Timing	Fastest settling time for power pulse down to 200ns	Smallest voltage drop for power pulse > 100 μ s
Pulser head size	Small dimensions, easy to connect	Large storage capacitor inside the probe
Measurement	Accurate level monitoring and pulse shape monitoring	External synchronisation available

1.3 Pulse Timing

The switching working point is defined according to 4 programmable signals: Gate Switch, Drain Switch, RF switch and sample clock.

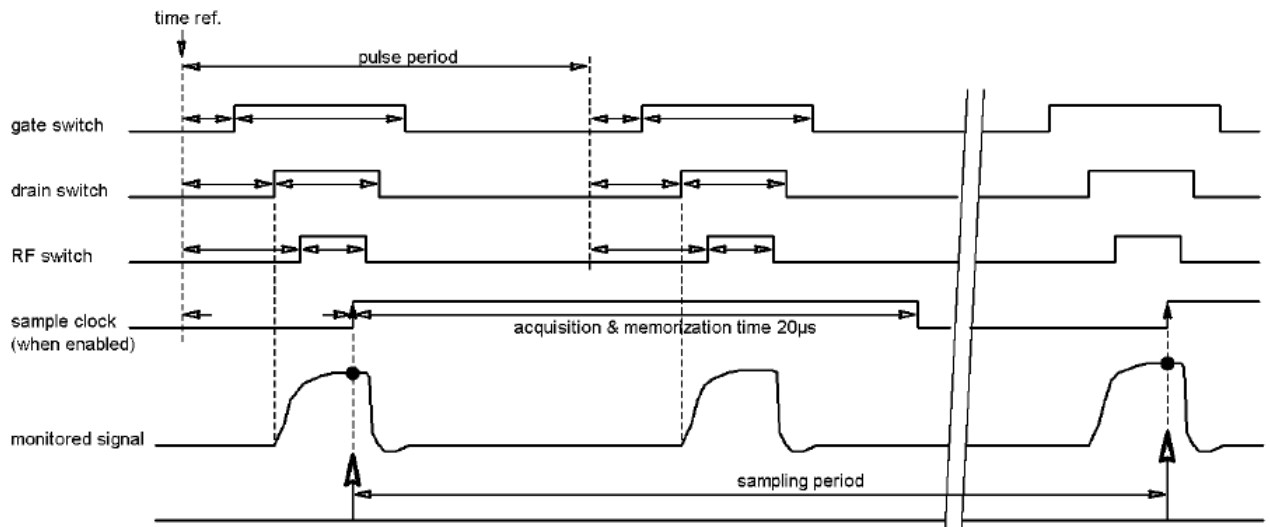


Fig.4. Synchronization between RF and IV signals

Parameter	conditions	spec.	min	max
Time resolution	any outputs, sampler, duration and delays	20ns		
Time jitter	using external synchronization input			±2ns
Pulse frequency	according to power and analog limits		50Hz	500kHz
Pulse width	according to power and analog limits		200ns	1ms
Sample frequency				50kHz

Additional specifications:

- time reference is both available using internal master clock or external signal
- measurement sampler clock is available using internal sequencer or external signal
- the complemented level is available independently for each output.

Continuous signals capability:

Although the system is first designed for pulsed test, it is able to operate on continuous mode:

- Larger pulses are available using on/off continuous mode with a time resolution of 1 ms.
- pulsed or continuous operation are available independently for each output

2 Gate and Drain Probe heads specifications

2.1 Gate Probe Head AM211

2.1.1 General description

The purpose of the gate probe is to drive the transistor's input access with high voltage accuracy as well as to provide current high resolution for current measurement.

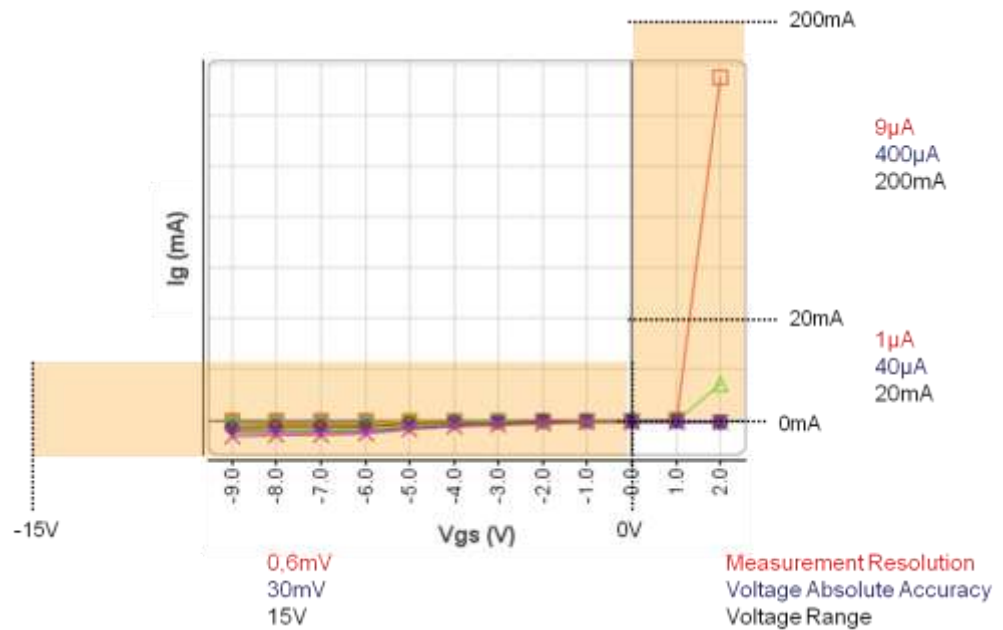


Fig.5. Gate Probe AM211 Operating Range / Accuracy

The signal is delivered by a fast amplifier which is referenced to the component under test. It enables to improve the quality of the pulse shape even in presence of strong drain current variation. This gate probe head is equipped with an electronic fuse which is triggered by +/-250mA maximum gate current. In case of short circuit between transistor's gate and drain accesses, the gate probe is protected against input current that can be re-injected into the amplifier, up to 4A.

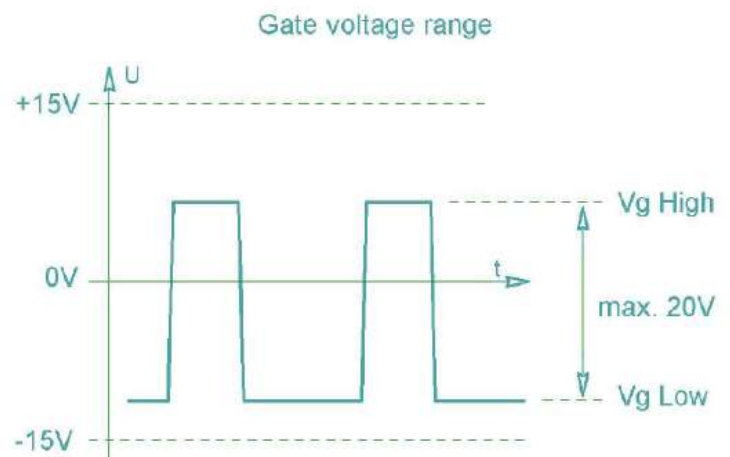
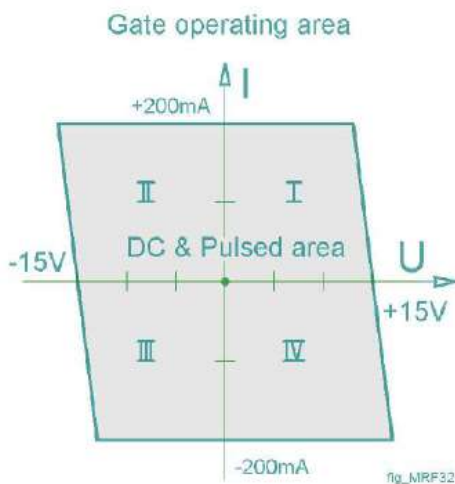


Fig.6. Gate Probe AM211

2.1.2 Specifications

Programmable pulsed source:

Parameter	conditions	min	max
Operating voltage range	no load	-15V	+15V
Max. differential voltage = (Vg HIGH - Vg LOW)		0	20V
Output impedance		10Ω	
Voltage derating @ i max			-2V
Switched current	source or sink, whatever the polarity	-200mA	+200mA
Voltage setup resolution		15 bit + sign	



Pulse timing specifications:

	Parameter	conditions	min	max
	Duty cycle	including DC	0%	100%
	Frequency	Maximum switched voltage		500kHz
tG	Pulse width		200ns	
dGo	Dead time before switching	without software offset compensation	15ns	25ns

Measurement specifications:

Parameter	conditions	Voltage full range	current full range	current one tenth range
Measurement settling time	level monitoring (1)	200ns	200ns	200ns
Measurement bandwidth	-3dB	12MHz	12MHz	11MHz

2.2 200mA PIV Drain Probe Head AM223

2.2.1 General description

The purpose of the PIV AM223 drain probe head is to provide short pulses (down to 200ns) for Pulse IV network measurements which the highest measurement accuracy. The aim is to decrease the self heating phenomena during pulse IV transistor characterization for transistor electro thermal modeling activities or reliability testing.

Two different measurement units are embedded into this probe, one for current lower than 20mA, one for current between 20mA and 200mA. Such features enable both fast and accurate measurements.

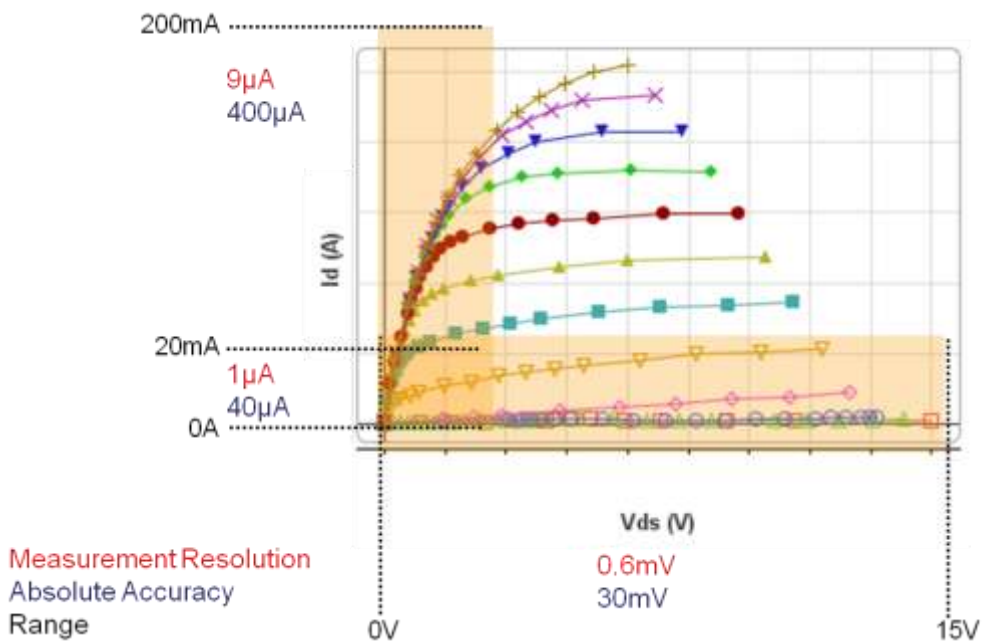


Fig.7. 200mA PIV Drain Probe AM223 Operating Range / Accuracy

2.2.2 Specifications

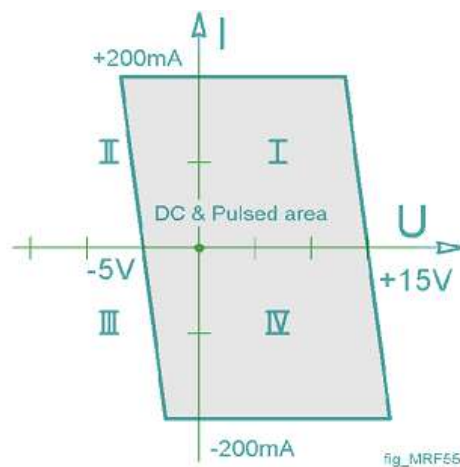


Fig.8. 200mA PIV Drain Probe AM223 Operating area

Programmable pulse source

Parameter	conditions	min	max
Operating voltage range	no load	-5V	+15V
Output impedance		10 Ω	
Voltage derating @ i max			-2V
Switched current	source or sink, whatever the polarity	-200mA	+200mA
Voltage setup resolution		15 bit + sign	
Voltage setup absolute accuracy	no current, VOLT=5, 2years	0,20%	
Max. sinking power	inside operating area (II and IV)		2W

Protection circuitry specification

	Parameter	conditions	
	Absolute over voltage clamping	latch OFF, 500ns pulse, +/-1A	Vg HIGH max +3,7V
	Latch delay	short circuit or over voltage	<150ns
Igmax	Over current latch threshold	40 Ω Load +/-12,5V pulse	+/-250mA
Vgmax	Over voltage latch threshold	connected to drain probe pulse	Vg HIGH max +3V
	Output level when latch ON	no current	0V
	Max positive clamping voltage	latch ON, at +4A max.	+1V
	Max negative clamping voltage	latch ON, at -250mA max.	-2,5V

2.3 10A PIV Drain Probe Head AM221

2.3.1 General description

The purpose of the PIV AM221 drain probe head is to provide short pulses (down to 200ns) for Pulse IV network measurements. The aim is to decrease the self heating phenomena during pulse IV transistor characterization for transistor electro thermal modeling activities or reliability testing.

Two different measurement units are embedded into this probe, one for current lower than 1A, one for current higher than 1A. Such features enable both fast and accurate measurements.

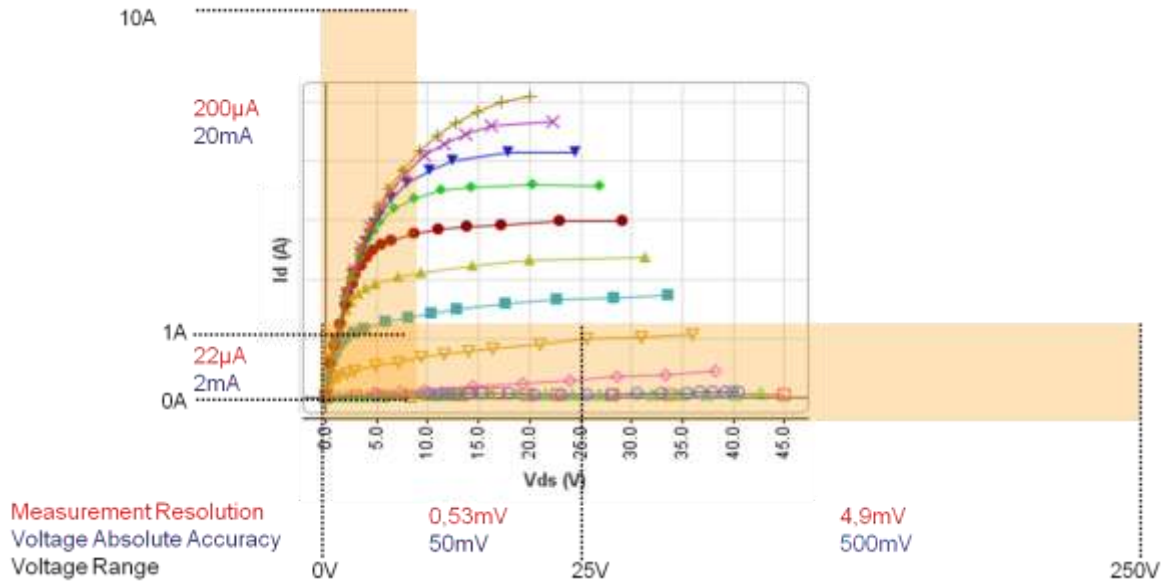


Fig.9. 10A PIV Drain Probe AM221 Operating Range / Accuracy

The signal is delivered by fast MOSFET switch (10KV/µs). It enables to improve the quality of the pulse shape even in presence of strong drain current variation. This drain probe head is also equipped with an electronic fuse. This trigger level can be adjusted to a required current value, as a function of the size to the device under test. The detection speed is about 500ns. In case of failure, it enables to turn off the system immediately after the device under test destruction. Both quiescent and pulsed bias levels can be tuned to desired values.



Fig.10. 10A PIV Drain Probe AM221

2.3.2 Specifications

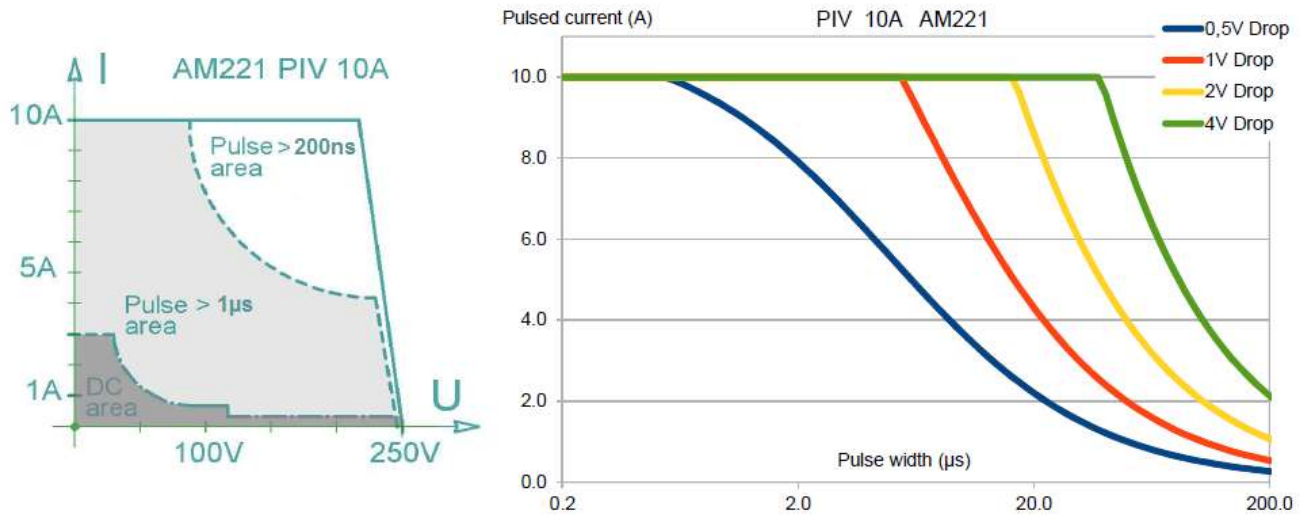


Fig.11. 10A PIV Drain Probe AM221 Operating area / Maximum Current versus Pulse Width

Programmable pulse source

Parameter	conditions	min	max
Switched voltage HIGH level	no load	0V	+250V
Switched voltage LOW level	no load	0V	+120V
Output impedance	DC	0,5Ω	
Switched current	High or Low level		10A
Max. pulse width @ -1V drop	10A pulsed		5µs
On board storage capacitor		110µF	
Peak power			2kW
Average output power	pulsed mode		50W
	static mode		80W
RMS or DC current	pulsed or static mode		3A

Protection circuitry specification

Parameter	conditions	min	max
over current latch threshold		1A	11A
over current latch resolution	8 bits	100mA	
over current latch accuracy		100mA	
over current latch delay	short circuit / +100V setup		70ns
output level / latch ON		High Impedance	
internal temperature alarm threshold		70°C	

2.4 30A PIV Drain Probe Head AM222

2.4.1 General Description

The purpose of the PIV AM222 drain probe head is to provide high current pulses with short pulse widths (down to 400ns) for Pulse IV network measurements. The aim is to decrease the self heating phenomena during pulse IV transistor characterization for transistor electro thermal modeling activities or reliability testing.

Two different measurement units are embedded into this probe, one for current lower than 3A, one for current higher than 3A. Such features enable both fast and accurate measurements.

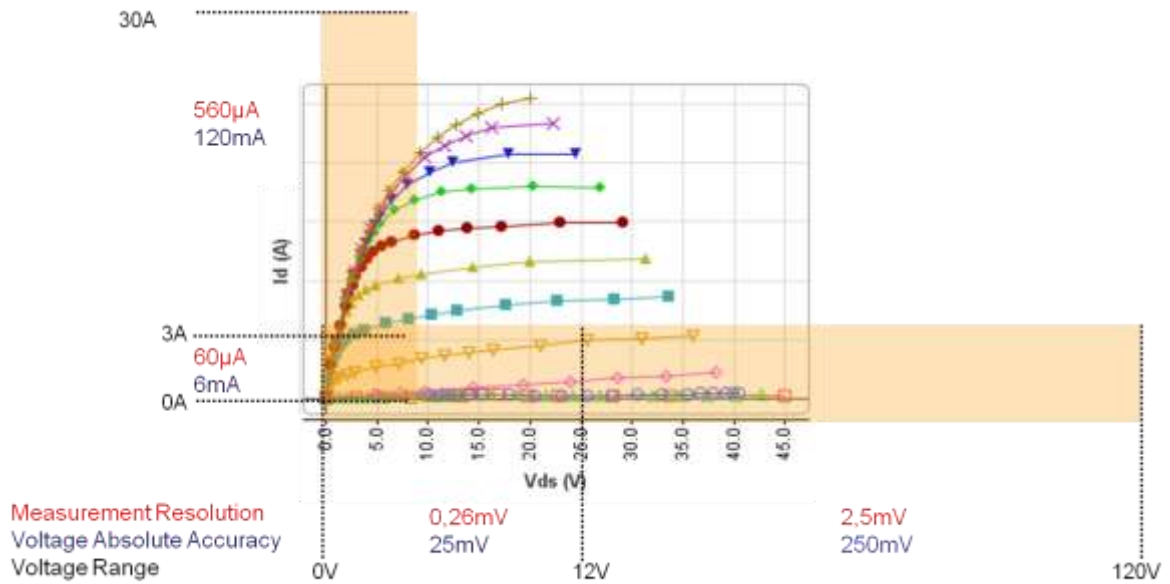


Fig.12. 30A PIV Drain Probe AM222 Operating Range / Accuracy

As for 10A PIV drain probe head, this 30A solution is equipped with electronic fuse.

2.4.2 Specifications

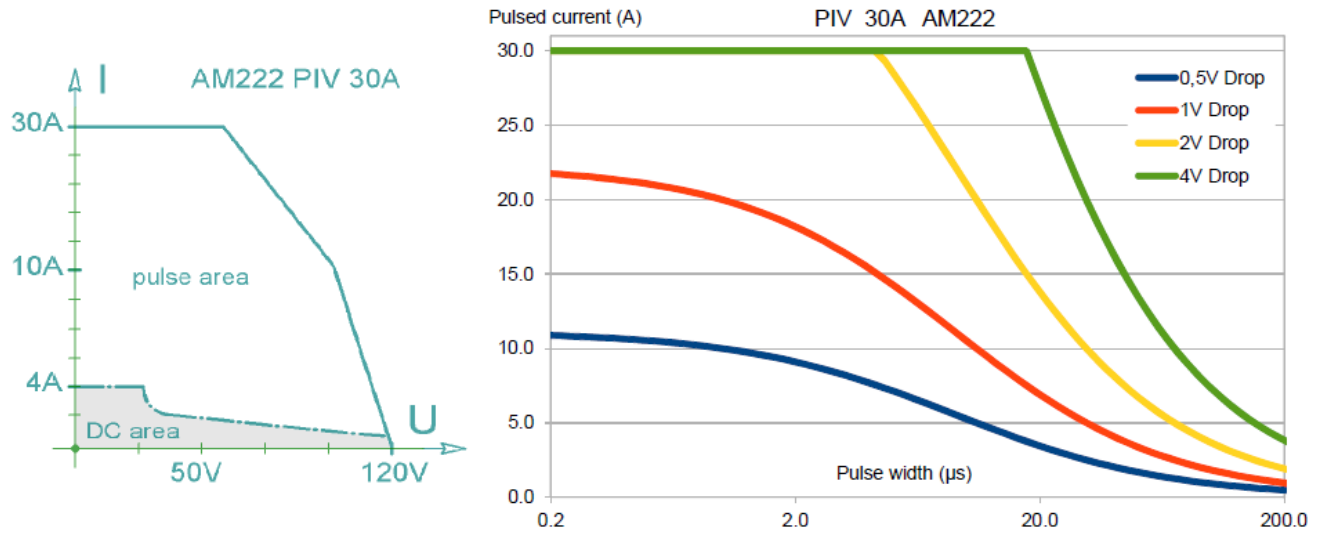


Fig.13. 30A PIV Drain Probe AM222 Operating area / Maximum Current versus Pulse Width

Programmable pulse source

Parameter	conditions	min	max
Switched voltage HIGH level	no load	0V	+120V
Switched voltage LOW level	no load	0V	+100V
Output impedance	DC	0,15Ω	
Switched current	High or Low level		30A
Max. pulse width @ -2V drop	30A pulsed		4µs
On board storage capacitor		200µF	
Peak power			2kW
Average output power	pulsed mode		50W
	static mode		80W
RMS or DC current	pulsed or static mode		4A

Protection circuitry specification

Parameter	conditions	min	max
over current latch threshold		3A	33A
over current latch resolution	8 bits	150mA	
over current latch accuracy		150mA	
over current latch delay	short circuit / +100V setup		35ns
output level / latch ON		High Impedance	
internal temperature alarm threshold		70°C	

2.5 10A Load Pull Drain Probe Head AM231

2.5.1 General Description

Even if the PIV drain probe can be used for pulse load pull measurements, a specific LP drain probe has been designed to provide long pulses (up to 1ms). This LP drain probe avoids voltages drop when delivering significant current level during long pulse (radar like pulse widths).

The internal capacitance size is larger while the output resistance of this LP head has been reduced. The LP drain probe provides a pulse from a fixed bias 0V voltage. As for PIV drain probe, the DC mode is also permitted.

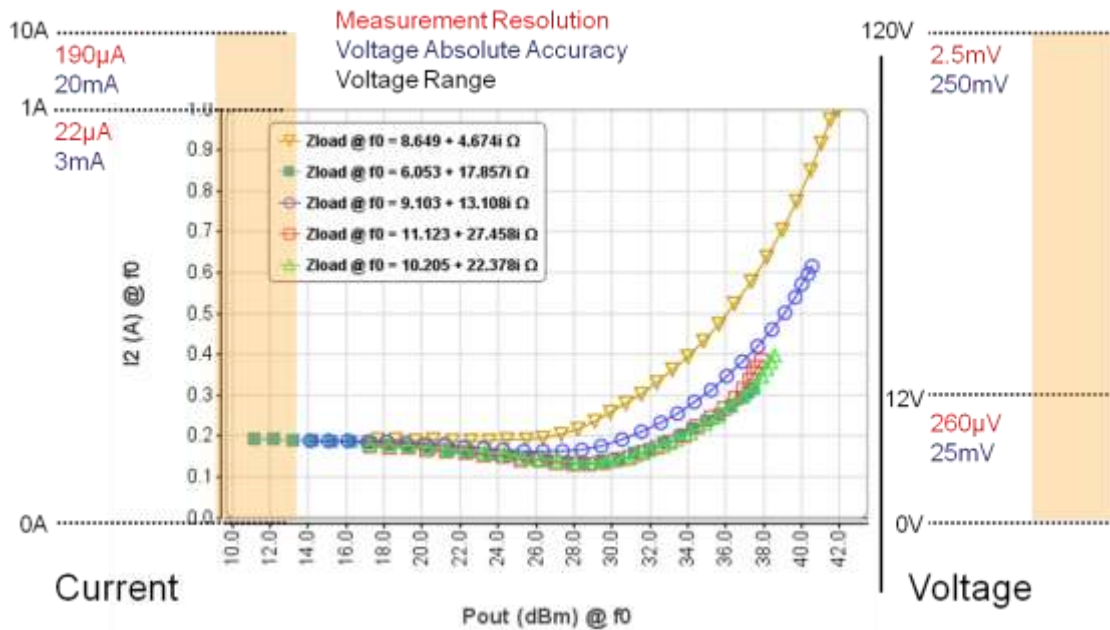


Fig.14. 10A LP Drain Probe AM231 Operating Range / Accuracy

As for PIV probe heads, this load pull probe head is also equipped with electronic fuse.



Fig.15. 10A LP Drain Probe AM231

2.5.2 Specifications

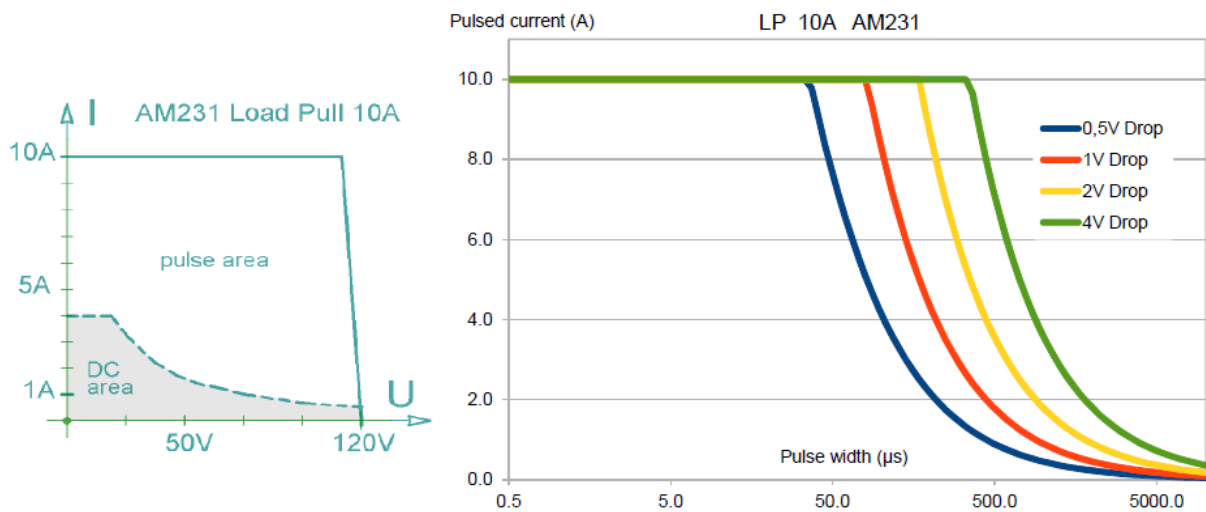


Fig.16. 10A LP Drain Probe AM231 Operating area / Maximum Current versus Pulse Width

Programmable pulse source

Parameter	conditions	min	max
High level Switched voltage (Low level connected to GND)	no load	0V	+120V
Output impedance	DC	0,08Ω	
Voltage derating @ i max			-0,8V
Switched current			10A
Max. pulse width @ -1V drop	10A pulsed		60μs
On board storage capacitor		900μF	
Peak power			1,2kW
Average output power	pulsed mode		50W
	static mode		80W
RMS or DC current	pulsed or static mode		4A

Protection circuitry specification

Parameter	conditions	min	max
over current latch threshold		1A	11A
over current latch resolution	8 bits	60mA	
over current latch accuracy		60mA	
over current latch delay	short circuit / +100V setup		35ns
output level / latch ON		High Impedance	
internal temperature alarm threshold		70°C	

2.6 30A Load Pull Drain Probe Head AM232

2.6.1 General Description

The concept of the 30A load pull drain probe head is the same as the 10A drain probe head, but dedicated to high power transistor with large DC consumption.

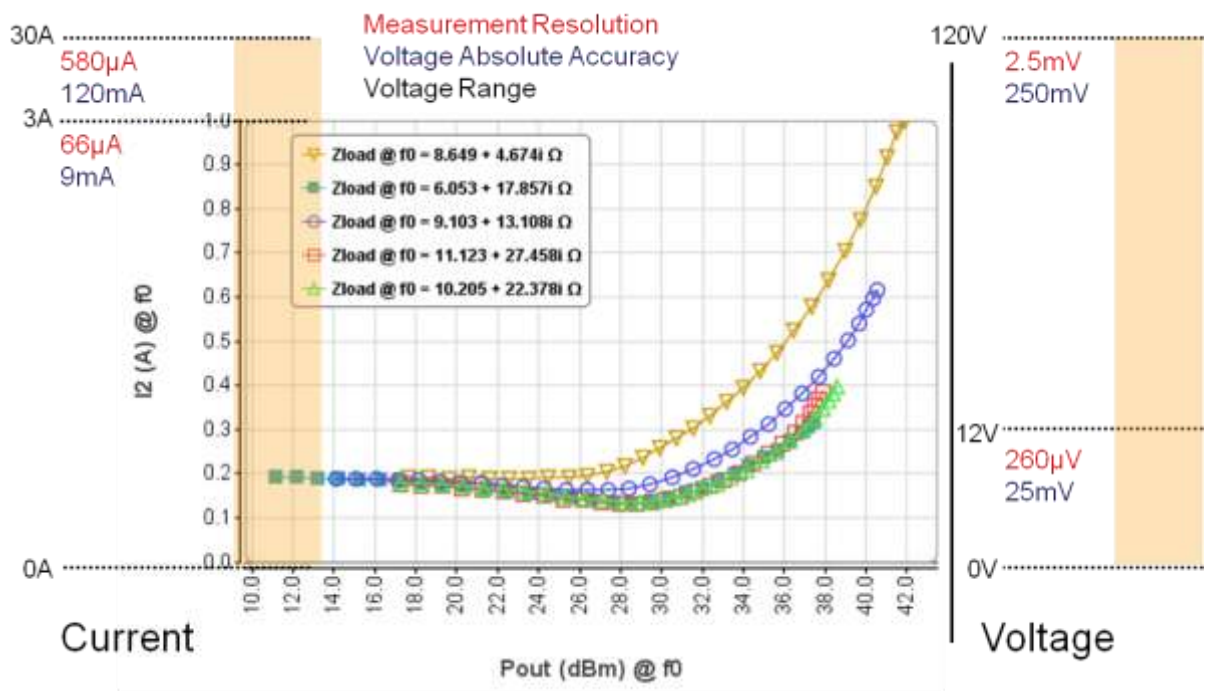


Fig.17. 30A LP Drain Probe AM232 Operating Range / Accuracy

As for LP probe heads, this load pull probe head is also equipped with electronic fuse.

2.6.2 Specifications

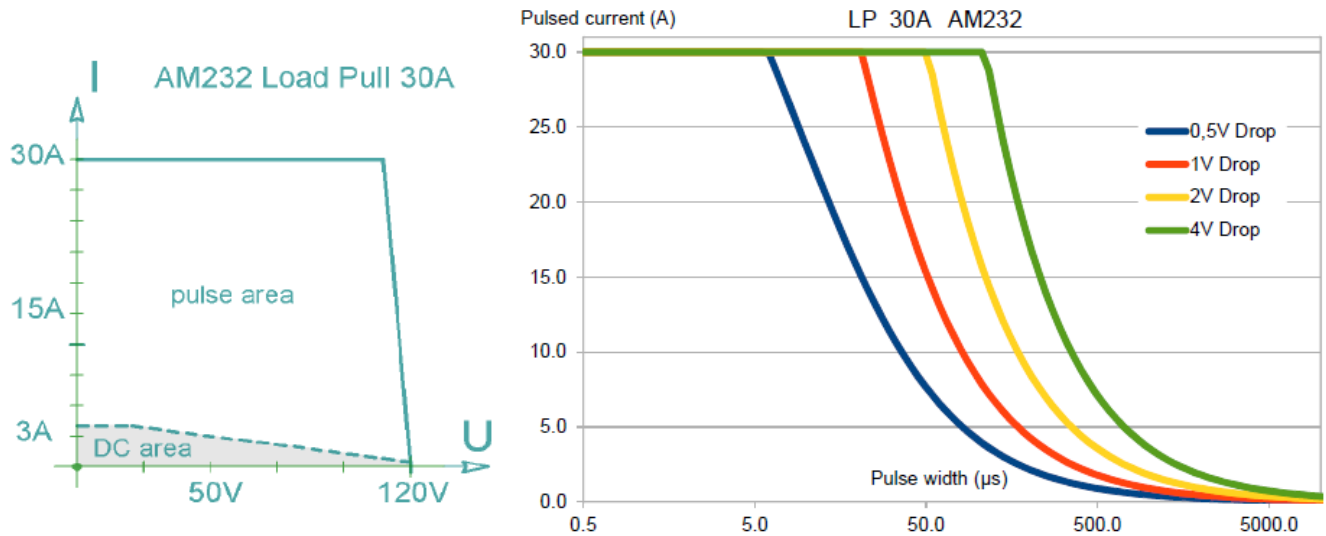


Fig.18. 30A LP Drain Probe AM232 Operating area / Maximum Current versus Pulse Width

Programmable pulse source

Parameter	conditions	min	max
High level Switched voltage (Low level connected to GND)	no load	0V	+120V
Output impedance	DC	0,08Ω	
Voltage derating @ i max			-0,8V
Switched current			10A
Max. pulse width @ -1V drop	10A pulsed		60μs
On board storage capacitor		900μF	
Peak power			1,2kW
Average output power	pulsed mode		50W
	static mode		80W
RMS or DC current	pulsed or static mode		4A

Protection circuitry specification

Parameter	conditions	min	max
over current latch threshold		1A	11A
over current latch resolution	8 bits	60mA	
over current latch accuracy		60mA	
over current latch delay	short circuit / +100V setup		35ns
output level / latch ON		High Impedance	
internal temperature alarm threshold		70°C	