

## Product Configuration Selection Guide

This document serves as a guide to help to select the proper Q-Star Test module configuration in function of meeting customer requirements and following an initial product selection on base of the Product Selection guide.

To support the module configuration selection process, this document lists the related product features and configuration options for each of the Q-Star Test products.

In combination with the module specific Product Checklist a customer specific module configuration can be determined, whereby the completed checklist then further serves as module configuration specification sheet supporting the module ordering process.

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## QA-1000

The QA-1000 is a configurable analog supply current monitor, designed for load board applications. Its unique design ensures its transparency (only a negligible voltage drop occurs during measurement) to both the test system and the device under test (DUT). The unit provides a well-regulated DUT supply in the 0-8V range under control of the VDUT input voltage.

The QA-1000 is designed to accurately measure analog (supply) currents of maximum 50mA, thereby providing a high repeatability. The module has two user selectable measurement ranges: 0-5mA and 0-50mA. The monitor has a maximum bandwidth of 1.5MHz, offers a best resolution of 30nARMS, and is capable of driving reasonable capacitive loads (up to several 100nF) without loss of performance. The actual performance of the monitor is a function of the desired accuracy, the bandwidth and the value of the loading capacitance CL (the DUT local on-pin supply decoupling capacitance). As such, the accuracy and measurement resolution of the QA-1000 is function of the desired measurement range (MR), the measurement speed (MS) and the on-pin capacitive loading condition CL. Alternatively in function of the actual loading condition and the desired resolution the measurement speed and measurement range can be selected.

The processing unit of the QA-1000 is configurable by making the proper pin (jumper) connections. A first jumper determines the amplification factor (1 or 10) and the related current to voltage conversion factor (100μV/μA or 1mV/μA). Selecting a higher ratio decreases the measurement range from 0-50mA to 0-5mA, but does not influence the driving capability of the DUT pin (50mA max). A second set of jumpers determines the filter characteristics by allowing the user to select the actual bandwidth (1.5MHz, 300kHz or 30kHz) in function of desired speed and accuracy.

The QA-1000 has no digital control pins. It measures continuously and relies for further signal processing and decision making on the capabilities of the (mixed-signal) test system (ATE). The QA-1000 provides an analog output voltage, corresponding to the measured current. The QA-1000 has a broad application range. Examples are the application for analog supply current monitoring, dynamic current monitoring, power consumption monitoring of low-power/low-voltage ICs, voltage stress test applications and many more.

<b>QA-1000 Features &amp; Options</b>	
<b>FEATURES</b>	
<input checked="" type="checkbox"/>	VDD/VCC monitor
<input checked="" type="checkbox"/>	Loading Capacitance: 20 – 500 nF
<input checked="" type="checkbox"/>	VDUT range: 0V – +8V
<input checked="" type="checkbox"/>	Dual +/- 15V supply
<input checked="" type="checkbox"/>	Buffered analog output
<b>USER CONFIGURATION OPTIONS<sup>(1)</sup></b>	
<input type="checkbox"/>	IDDX Measurement Range <sup>(2)</sup>
<input type="checkbox"/>	IDDX Measurement Bandwidth <sup>(3)</sup>
<b>Notes:</b>	
(1) User programmable via jumpers.	
(2) 5mA or 50mA.	
(3) 30kHz, 300kHz, 1.5MHz.	

		C <sub>L</sub> [nF] ⇄	20	50	100	200	500
MR ↓	MS ↓	Resolution I <sub>RMS</sub> [μA]					
0-50 mA	1.5 MHz	4.0	3.0	2.0	1.5	1.2	
	300 kHz	0.1	0.2	0.4	0.6	0.7	
	30 kHz	0.1	0.1	0.2	0.3	0.3	
0-5 mA	1.5 MHz	3.00	2.50	2.00	1.50	1.20	
	300 kHz	0.07	0.15	0.30	0.50	0.60	
	30 kHz	0.03	0.05	0.10	0.15	0.20	

## QA-1000HC

The QA-1000HC is a configurable analog supply current (IDD) monitor designed for high current and load board applications. Its low internal resistance ensures its transparency (causing only a negligible voltage drop when inserted into the supply or ground path of the device under test). The module is designed to be inserted between the DUT supply provided by the ATE and the supply pin of the DUT or between ground and DUT ground. The VDUT supply can be positive or negative (VDD/VCC or VSS/VEE).

The resolution and performance of the monitor is a function of the selected bandwidth and the value of the loading capacitance CL (the DUT local on-pin supply decoupling capacitance). The processing unit of the QA-1000HC is configurable by making the proper pin (jumper) connections, This allows to select the actual bandwidth (5MHz, 500kHz or 50kHz) in function of desired speed and accuracy. **These configurations can be changed upon request.**

The QA-1000HC has no digital control pins. It measures continuously and relies for further signal processing and decision making on the capabilities of the mixed-signal ATE. The QA-1000HC provides an analog output voltage, corresponding to the measured current.

The QA-1000HC is designed to accurately measure analog (supply) currents up to 2A (upon demand the range can be adapted to 100mA, 200mA, 500mA, 1A or 5A), thereby providing a high measurement repeatability. The monitor has a bandwidth of 5MHz, offers a resolution of 300µA @2A, and is capable to drive high capacitive loads up to 100uF.

Similar to the QA-1000, the QA-1000HC has a broad application range. Examples are the application to high-power ICs and during voltage stress test applications. By using two QA-1000-HC monitors, supply currents of analog DUTs with (symmetrical) +/- supply can also be measured simultaneously.

<b>QA-1000HC Features &amp; Options</b>	
<b>FEATURES</b>	
<input checked="" type="checkbox"/>	can be used as VDD/VCC or as VEE/VSS monitor
<input checked="" type="checkbox"/>	High Loading Capacitance: 0 – 100 µF
<input checked="" type="checkbox"/>	High IDDX resolution: 300 µARMS
<input checked="" type="checkbox"/>	VDUT range: -7V – +7V
<input checked="" type="checkbox"/>	Low internal resistance: 25mΩ
<input checked="" type="checkbox"/>	Dual +/- 15V supply
<input checked="" type="checkbox"/>	Buffered analog output
<b>HARDWARE CONFIGURATION OPTIONS<sup>(1)</sup></b>	
<input type="checkbox"/>	IDDX Measurement Range <sup>(2)</sup>
<b>USER CONFIGURATION OPTIONS<sup>(3)</sup></b>	
<input type="checkbox"/>	IDDX Measurement Bandwidth <sup>(4)</sup>
<b>Notes:</b>	
(1)	Fixed upon assembly.
(2)	100mA, 250mA, 500mA, 1A, 2A, 5A.
(3)	User programmable via jumpers.
(4)	50kHz, 500kHz, 5MHz.

## QD-1000

The QD-1000 is a full featured, single chip, programmable quiescent supply current (IDDQ) monitor, designed for load board applications. The QD-1000 is designed for insertion between the Automated Test Equipment (ATE) device power supply and the supply pin(s) of the Device Under Test (DUT), without the need to remove the decoupling capacitors. Its unique design ensures its transparency to both the ATE and DUT. It can drive high capacitive loads (up to several  $\mu\text{F}$ ) and causes no additional voltage drop during the measurement.

The QD-1000 offers the capability to perform accurate (up to 1.5nARMS) and repeatable high-speed (up to 30kHz) quiescent supply current measurements. It has a fixed wide measurement range (0-1mA). The QD-1000 requires a single positive supply, and provides, under all conditions, a stable, guaranteed and user programmable supply level to the DUT (0.5V to 7V).

The QD-1000 has an on-board compensated bypass switch, which minimizes charge transfers. Its switch is capable of transferring large transient currents. To assure DUT supply stability, the bypass switch is automatically activated when the measured current is out of the monitor's measurement range. The QD-1000 can be configured for optimal performance in function of desired measurement speed/resolution and actual loading condition using a simple programming scheme. The monitor can be used in various application configurations.

The space-saving 16-pin CSOIC package provides the smallest IDDQ measurement solution available. It requires a small amount of external components for device configuration and for proper operation.

***The QD-1011Lite or QD-1011 are better alternatives, given their additional functionality and ease of application.***

## QD-10xx(HC)

### **GENERAL DESCRIPTION & SELECTION TREE**

The QD-10xx(HC) product line represents a family of basic and advanced full featured configurable quiescent supply current (IDDQ/ISSQ) measurement modules, designed for load board applications. Their unique design ensures transparency to both the test system (ATE) and the device under test (DUT). The QD-1011 and QD-1011HC are now the base members of the family and are the basis of the other more application specific products of this product family. The QD-1011 and QD-1011HC products (and other derivatives) offer improved performance (compared to the initial QD-1010 and QD-1010HC products), more memory and more (data processing) capabilities. The QD-1011Lite and QD-1011HCLite are the low cost members of the family and support only basic IDDQ measurement functionality and pass/fail operation.

Except for the *Lite* products, all other family members support standard IDDQ or ISSQ, as well as advanced IDDQ/ISSQ schemes like Delta-IDDQ, Relative IDDQ, Current ratios, etc., and hence offer an answer to the deep-submicron and Nanotechnology IDDQ/ISSQ test challenges and needs. They serve as well for high performance low current (leakage) measurements. A dedicated application of ultra-low current measurements is the test of MEMS that are based on capacitive principles. The QD-10xx(HC) products have on-board memory and data processing capabilities, and combine a hardware measurement platform with a software configurable data processing platform. The modules provide in general analog and digital measurement values as well as a pass/fail output signal.

The QD-10xx modules are available with SIL (single pin row) or DIL (dual pin row) packages, according to the table below.

The standard versions can measure currents up to 30mA. The "HC" versions are designed for measurement ranges ranging from 50mA to 2A and can have measurement ranges beyond 2A when used in combination with an external sensing element.

The QD-1011 can store up to 500 measurement results and can have a measurement range in the range from 100nA up to 30mA.

The QD-1012 is a QD-1011 based module for low (DUT) voltage applications and the QD-1013 is a QD-1011 based module adapted for high (DUT) voltage applications. The QD-1020 is also based on the QD-1011 and is optimized for multi-site testing, enabling sharing of monitor control and communication resources. The QD-1022 and QD-1023 are QD-1020 modules adapted for low and high voltage applications respectively.

The QD-1011HC is a High Current QD-1011 based module and the QD-1020HC is a High Current QD-1020 based module. HC versions for high voltage applications also exist. The QD-1013HC and QD-1023HC are QD-1011HC and QD-1020HC modules adapted for high voltage applications respectively.

The QD-1030 and QD-1030HC are based on the QD-1011 and QD-1011HC but are optimized for ISSQ or ground current measurement applications instead. The QD-1030(HC) application is DUT supply voltage level independent and hence the module can be used for high voltage as well as low voltage applications.

The table below lists the different QD-10xx(HC) features as well as the possible hardware and firmware configuration options. It should be noted that not all modules support all possible configuration options as such. The actual configurable options of a particular module are related to its particular firmware.

QD-10xx(HC) Features & Configuration Options	QD-1011Lite	QD-1011HC Lite	QD-1011	QD-1012	QD-1013	QD-1020	QD-1022	QD-1023	QD-1030	QD-1011HC	QD-1013HC	QD-1020HC	QD-1023HC	QD-1030HC
<b>FEATURES</b>														
<input checked="" type="checkbox"/> Single +5V supply	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<input checked="" type="checkbox"/> Standard ATE compliant	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<input checked="" type="checkbox"/> Compensated bypass switch	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<input checked="" type="checkbox"/> Digital reference setting	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<input checked="" type="checkbox"/> Module Output														
• Analog output voltage	•	•	•	•	—	•	•	—	•	•	—	•	—	•
• Digital pass/fail output	•	•	•	•	•	•	•	•	•	•	•	•	•	•
• Digital measurement/data processing result	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<input checked="" type="checkbox"/> Data processing														
• Data comparison	•	•	•	•	•	•	•	•	•	•	•	•	•	•
• Advanced data processing capabilities	—	—	•	•	•	•	•	•	•	•	•	•	•	•
• Advanced IDD/ISSX optimized	—	—	•	•	•	•	•	•	•	•	•	•	•	•
<input checked="" type="checkbox"/> Module BIST	—	—	•	•	•	•	•	•	•	•	•	•	•	•
<input checked="" type="checkbox"/> Mounting														
• Horizontal	•	•	•	•	•	—	—	—	•	•	•	—	—	•
• Vertical	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<input checked="" type="checkbox"/> Multi-site application optimized	—	—	—	—	—	•	•	•	—	—	—	•	•	—
<input checked="" type="checkbox"/> Measurement type														
• Quiescent IDD (IDDQ) or standby IDD measurements	•	•	•	•	•	•	•	•	—	•	•	•	•	—
• Quiescent ISS (ISSQ) or standby ISS measurements	—	—	—	—	—	—	—	—	•	—	—	—	—	•
<input checked="" type="checkbox"/> Voltage range														
• $V_{DUT} \leq 0.5V$	—	—	—	•	—	—	•	—	—	—	—	—	—	—
• $0.5V \leq V_{DUT} \leq 7V$	•	•	•	—	—	•	—	—	—	•	—	•	—	—
• $V_{DUT} \geq 7V$	—	—	—	—	•	—	—	•	—	—	•	—	•	—
<input checked="" type="checkbox"/> Measurement range														
• $IDD \leq 30mA$	•	—	•	•	•	•	•	•	•	—	—	—	—	—
• $IDD \geq 30mA$	—	•	—	—	—	—	—	—	—	•	•	•	•	•
<b>HARDWARE CONFIGURATION OPTIONS</b>														
<input type="checkbox"/> Selectable Measurement range (see below)														
• $IDD \leq 10mA$	•	—	•	•	•	•	•	•	•	—	—	—	—	—
• $10mA \leq IDD \leq 30mA$	•	—	•	•	•	•	•	•	•	—	—	—	—	—
• $30mA \leq IDD \leq 1A$	—	•	—	—	—	—	—	—	—	•	•	•	•	•
• $1A \leq IDD \leq 100A$	—	—	—	—	—	—	—	—	—	•	•	•	•	•
<input type="checkbox"/> Selectable Capacitive Loading Range (CL) (see below)	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<b>FIRMWARE CONFIGURATION OPTIONS</b>														
<input type="checkbox"/> Selectable Pass/Fail comparison	—	—	•	•	•	•	•	•	•	•	•	•	•	•
<input type="checkbox"/> Selectable # samples per measurements	—	—	•	•	•	•	•	•	•	•	•	•	•	•
<input type="checkbox"/> Selectable advanced measurement strategies (max. 2)	—	—	•	•	•	•	•	•	•	•	•	•	•	•
<input type="checkbox"/> Offset measurement & correction option	—	—	•	•	•	•	•	•	•	•	•	•	•	•
<input type="checkbox"/> Measurement storage & burst readout option	—	—	•	•	•	•	•	•	•	•	•	•	•	•
<input type="checkbox"/> Multi-site optimized	—	—	—	—	—	•	•	•	—	—	—	•	•	—
<input type="checkbox"/> Selectable Teseda, Inovys compliance	—	—	•	•*	•*	—	—	—	•*	—	—	—	—	—
<b>Legend:</b> • : Available      — : Unavailable      □ : Not applicable •* : module will be recognized as being a QD-1011														

## HARDWARE OPTIONS

### QD-1011Lite

The table below lists the QD-1011Lite hardware configuration options in function of measurement range and loading. Configurations that are not listed are unavailable. When the assembly of the module is done the measurement range and capacitive loading range (CL) are fixed.

I - RANGE \ CL <sup>(1)</sup>	100nF	500nF	1µF	5µF	10µF
100µA	•	•	•	•	•
1mA	–	–	•	•	•
10mA	–	–	–	–	•

**Legend:** • : Available – : Unavailable

**Notes:**  
(1) Maximum loading without loss of performance.

### QD-10xx

The QD-10xx family members (QD-1011, QD-1012, QD-1020, ...) support µA measurement ranges and loading optimizations below 100nF and as such are offering solutions with sub-nanoAmp resolution. The table below lists the QD-10xx hardware configuration options in function of measurement range and loading.

The standard configurations that are also listed in the product data sheet are highlighted. Configurations that are not listed (e.g. 500µA-1µF, ...) are available upon request. When the assembly of the module is done, the measurement range and capacitive loading range (CL) are fixed.

I - RANGE \ CL <sup>(2)</sup>	1nF	10nF	100nF	500nF	1µF	2µF	5µF	10µF
1µA	•	•	•	–	–	–	–	–
10µA	–	•	•	•	•	–	–	–
100µA	–	–	•	•	•	•	•	•
1mA	–	–	–	–	•	•	•	•
10mA	–	–	–	–	–	–	–	•
30mA	–	–	–	–	–	–	–	•

**Legend:** • : Available – : Unavailable

**Notes:**  
(1) For the grey patterned configurations, resolution figures are available in the related product data sheet. Resolution figures not listed in the data sheet are available upon request  
(2) Maximum loading without loss of performance.

### QD-1011HCLite

The QD-1011HCLite modules are designed for measurement ranges up to 1A. The user can select a measurement range, in the range from 100mA to 1A. The hardware configuration options in function of measurement range are listed below. Configurations that are not listed are unavailable. When the assembly of the module is done the measurement range is fixed. Given a standard measurement settling time of 100µs, the maximum capacitive loading (CL) that can be driven is determined by the measurement range selected.

Measurement range	CL <sub>MAX</sub>
<input type="checkbox"/> 100mA	10µF
<input type="checkbox"/> 250mA	25µF
<input type="checkbox"/> 500mA	50µF
<input type="checkbox"/> 1A	100µF

## QD-10xxHC

The QD-10xxHC modules are designed for measurement ranges up to 2A, however when used in combination with an external sensing element they can be used for higher measurement range applications as well. The user can select a measurement range, in the range from 50mA to 2A, when using one of the standard measurement ranges and can select a measurement ranges beyond 2A when using the unit in combination with an external sensing element. The hardware configuration options in function of measurement range are listed below. Configurations that are not listed are available upon request. When the assembly of the module is done the measurement range is fixed. Given a standard measurement settling time of 100µs, the maximum capacitive loading (CL) that can be driven is determined by the measurement range selected and the base measurement time. Allowing more settling time, the CL range can be increased.

Standard Measurement range	CLMAX
<input type="checkbox"/> 50mA	5µF
<input type="checkbox"/> 100mA	10µF
<input type="checkbox"/> 250mA	25µF
<input type="checkbox"/> 500mA	50µF
<input type="checkbox"/> 1A	100µF
<input type="checkbox"/> 2A	100µF

Measurement ranges, when used in combination with external sensing element
<input type="checkbox"/> 50mA
<input type="checkbox"/> 100mA
<input type="checkbox"/> 250mA
<input type="checkbox"/> Other

## STANDARD FIRMWARE OPTIONS

The standard firmware supports “Standard IDDQ” – “Standard Delta IDDQ” – “Sample setting” and “BIST”. The firmware is fixed upon module assembly. Changing the firmware is possible but requires the module to be returned to Q-Star Test for reprogramming.

The QD-1011 modules are fully supported by the Teseda V500 & V520 and Inovys (Personal) Ocelot platforms. The standard Teseda firmware supports Standard IDDQ, Standard Delta-IDDQ (vector to vector delta), programmable sample setting and the BIST function. The Inovys platform supports the basic measurement function and relies on system software based data post processing.

## QD-10xx

QD-10xx Standard Firmware & Options	
<b>OPERATING MODES</b>	
<input checked="" type="checkbox"/>	Mode 1: Standard IDDQ <sup>(1)</sup>
<input checked="" type="checkbox"/>	Mode 2: Standard Vector-to-vector Delta IDDQ <sup>(2)</sup>
<input checked="" type="checkbox"/>	Mode 3: User Programmable sample setting <sup>(3)</sup>
<input checked="" type="checkbox"/>	Mode 4: BIST
<b>FIRMWARE OPTIONS<sup>(4)</sup></b>	
<input type="checkbox"/>	Default # samples / measurement
<input type="checkbox"/>	Teseda compliant <sup>(5)(6)</sup>
<input type="checkbox"/>	Inovys compliant <sup>(5)(6)</sup>
<b>Notes:</b>	
(1)	Supporting both value and pass/fail measurements as well as global or vector related single level pass/fail reference setting.
(2)	Vector-to-vector delta IDDQ combined with a delta and an absolute pass/fail level.
(3)	1, 4 or 16 samples per measurement
(4)	Fixed upon assembly. Changing the firmware is possible but requires the module to be returned.
(5)	Available only for QD-1011 modules.
(6)	Exclusive option. The module can be either Teseda or Inovys compliant.

**QD-10xxHC**

<b>QD-10xxHC Standard Firmware &amp; Options</b>	
<b>OPERATING MODES</b>	
<input checked="" type="checkbox"/>	Mode 1: Standard IDDQ <sup>(1)</sup>
<input checked="" type="checkbox"/>	Mode 2: Standard Vector-to-vector Delta IDDQ <sup>(2)</sup>
<input checked="" type="checkbox"/>	Mode 3: User Programmable sample setting <sup>(3)</sup>
<input checked="" type="checkbox"/>	Mode 4: BIST
<b>FIRMWARE OPTIONS<sup>(4)</sup></b>	
<input type="checkbox"/>	Default # samples / measurement
<b>Notes:</b>	
(1)	Supporting both value and pass/fail measurements as well as global or vector related single level pass/fail reference setting.
(2)	Vector-to-vector delta IDDQ combined with a delta and an absolute pass/fail level.
(3)	1, 4, 16 or 256 samples per measurement
(4)	Fixed upon assembly. Changing the firmware is possible but requires the module to be returned.

**CUSTOM FIRMWARE OPTIONS**

Custom firmware versions and options can be provided and can be supplied upon request. Custom firmware versions and options can be supplied for both the standard and the HC module versions. Both measurement modes 1 and 2 can be adapted as well as the sample setting mode (see list below). In addition, special functions are also available. The custom firmware backbone as well as the available function blocks are listed below.

**QD-10xx(HC)**

<b>QD-10xx(HC) Custom Firmware &amp; Options</b>	
<b>CUSTOM OPERATING MODES<sup>(1)</sup></b>	
<input type="checkbox"/>	Mode 1: Custom IDDQ mode 1
<input type="checkbox"/>	Mode 2: Custom IDDQ mode 2
<input type="checkbox"/>	Mode 3: User Programmable sample setting schemes
<b>FIXED OPERATING MODES</b>	
<input checked="" type="checkbox"/>	Mode 4: BIST
<b>FIRMWARE OPTIONS<sup>(1)</sup></b>	
<input type="checkbox"/>	Default # samples / measurement
<input type="checkbox"/>	Up to 4 special functions
<b>Notes:</b>	
(1)	Fixed upon assembly. Changing the firmware is possible but requires the module to be returned.



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<b>QD-10xx(HC) Custom Function blocks</b>	
<b>MEASUREMENT MODES</b>	
<input type="checkbox"/>	Standard IDDQ
<input type="checkbox"/>	Vector-to-vector delta IDDQ
<input type="checkbox"/>	Vector-to-“reference vector” delta IDDQ
<input type="checkbox"/>	Vector-to-“external reference” delta IDDQ
<input type="checkbox"/>	Pre-to-post stress delta IDDQ
<input type="checkbox"/>	Relative Delta IDDQ
<input type="checkbox"/>	Current Ratios IDDQ
<input type="checkbox"/>	Others <sup>(1)</sup>
<b>REFERENCE OPTIONS</b>	
<input type="checkbox"/>	Level comparison
<input type="checkbox"/>	Window comparison
<input type="checkbox"/>	Set of vector related pass/fail references, stored in a circular buffer and changeable at any moment
<input type="checkbox"/>	Pre-defined and fixed set of pass/fail references (to be supplied by customer)
<input type="checkbox"/>	Others <sup>(1)</sup>
<b>SAMPLE SELECTION OPTIONS</b>	
<input type="checkbox"/>	User selectable 1-4-16-256 samples per measurement <sup>(2)</sup>
<input type="checkbox"/>	User selectable 1-4-16-64-256 samples per measurement
<input type="checkbox"/>	User selectable 1-4-16-64-256-1024 <sup>(3)</sup> samples per measurement
<input type="checkbox"/>	User selectable 1-4-16-256-1024 <sup>(3)</sup> samples per measurement
<input type="checkbox"/>	User selectable 1-4-16-1024 <sup>(3)</sup> samples per measurement
<input type="checkbox"/>	Others <sup>(1)</sup>
<b>SPECIAL FUNCTIONS</b>	
<input type="checkbox"/>	Offset measurement & correction option + SRAM offset storage
<input type="checkbox"/>	Offset measurement & correction option + EEPROM offset storage
<input type="checkbox"/>	Measurement storage & burst readout <sup>(4)</sup>
<input type="checkbox"/>	Others <sup>(1)</sup>
<b>VARIOUS FIRMWARE OPTIONS</b>	
<input type="checkbox"/>	Default # samples / measurement
<b>Notes:</b>	
(1)	Customer specific function blocks can be developed upon request.
(2)	Option for QD-10xx modules, standard for QD-10xxHC modules.
(3)	50/60Hz power supply ripple reduction mode.
(4)	Maximum <b>500</b> values.

## QT-1411

The QT-1411 is a fast and sensitive digital transient (IDD<sub>T</sub>) and dynamic supply current monitor designed for load board applications. The module samples the current waveform at 50MHz. Depending on application constraints, the QT-1411 is configured to be used either as a serial or as a parallel measurement device. The serial application allows high-speed high-resolution measurements and is suited for measurement ranges up to 500mA, reduced capacitive loading and DUT supply voltages in the -5 to 5V range. The parallel application targets measurement ranges above 500mA and DUT supply voltages up to 50V. A QT-1411 configured for parallel application either exploits the parasitic resistance of the supply interconnect or makes use of an AC coupling.

The QT-1411's unique design ensures transparency to both the ATE and DUT, under all conditions. When inserted in the DUT supply path (serial application), the QT-1411 causes only a negligible voltage drop. When used as a parallel device the module itself causes no voltage drop and does not affect the DUT' supply level or its operation.

The QT-1411 is designed to accurately quantify and compare transient and dynamic (supply) currents of up to 100A (500mA for the serial configuration), thereby providing a high repeatability. The module can be configured for different measurement ranges. The serial application offers the best resolution for transient currents with peak values in the 0 to 500mA range, whereas for switching currents with peak values above 500mA the parallel application is suited.

A QT-1411 configured for serial application has a typical 5MHz bandwidth, supports a measurement repetition rate of 3MHz, offers a best resolution of 5 $\mu$ A, and is capable of driving high capacitive loads.

The target application of the QT-1411 is to make peak and/or charge measurements of the transient current. The monitor can be configured to capture, store and process a whole transient waveform, it can also be used to measure the IDD(Q) current drawn by the DUT, to measure the actual DC value of the DUT' supply voltage, measure pulse width, measure switching energy and other parameters. The 256K on-board memory enables storing a partial or complete transient waveform that can be read for advanced off-line data analysis such as FFT, neural network analysis, ... These advanced data analysis techniques are reported to bring additional test coverage. The QT-1411 provides its measured values in a digital way – as a serial digital data bit stream. The QT-1411 functionality includes automated offset correction to assure accurate peak readings.

The QT-1411 has a simple to control serial interface. The module also provides an analogue output voltage on its VIDD pin corresponding to the IDD current.

As the actual IDD can have positive as well as negative values, due to parasitics, the VIDD analog output is positively biased, to provide an always positive output voltage. The bias point is set at 1.00V for IDD=0 and no output load. If the 1.00V positive shift is not desired, an AC coupled connection can be used. Since the IDD signal can have high frequency components (the IDD<sub>T</sub> portion of the signal), the VIDD output is 50  $\Omega$  terminated. If a 'no load' termination is used (e.g. traditional oscilloscope probe), the VIDD load should be preferably  $\geq 1M\Omega$  and  $\leq 20pF$  not to affect the output value.

<b>QT-1411 Features &amp; Options</b>	
<b>FEATURES</b>	
<input checked="" type="checkbox"/>	Single +5V supply
<input checked="" type="checkbox"/>	Buffered analog 50Ω output
<input checked="" type="checkbox"/>	Digital Reference setting
<input checked="" type="checkbox"/>	Pass/Fail and digital value output
<b>HARDWARE CONFIGURATION OPTIONS</b>	
<input type="checkbox"/>	Application <ul style="list-style-type: none"> <li>○ Serial or parallel (exclusive)</li> </ul>
<input type="checkbox"/>	Default Measurement Ranges <ul style="list-style-type: none"> <li>○ Serial: 0–10mA, 0–50mA, 0–100mA, 0–500mA, others<sup>(1)</sup>.</li> <li>○ Parallel: 0–500mA, 0–1A, 0–10A, 0–100A, others<sup>(1)</sup></li> </ul>
<input type="checkbox"/>	VDUT voltage range <ul style="list-style-type: none"> <li>○ Serial: 0–5V, -5–0V</li> <li>○ Parallel: 0–50V, -50–0V</li> </ul>
<b>MEMORY OPTION</b>	
<input type="checkbox"/>	1K samples
<input type="checkbox"/>	256K samples
<b>MOUNTING</b> <sup>(2)</sup>	
<input type="checkbox"/>	Horizontal
<input type="checkbox"/>	Vertical
<b>FIRMWARE CONFIGURATION OPTIONS</b>	
<input type="checkbox"/>	Fixed 50MHz sampling
<input type="checkbox"/>	User controlled sampling
<input type="checkbox"/>	Other <sup>(1)</sup>
<b>Notes:</b>	
(1)	Other ranges & customer specific firmware can be provided upon request.
(2)	Exclusive option. The module is either built for horizontal or vertical mounting.