QA-1000HC

Full Featured Programmable Analog Supply Current Monitor

FEATURES

- Wide I_{DDX} Measurement BW: 0 – 5 MHz
- High I_{DDX} resolution: 300 μA_{RMS}
- High I_{DDX} Measurement Range: 0 – 2 A
- High Loading Capacitance: 0 – 100 µF
- Low internal resistance: 25mΩ

APPLICATIONS

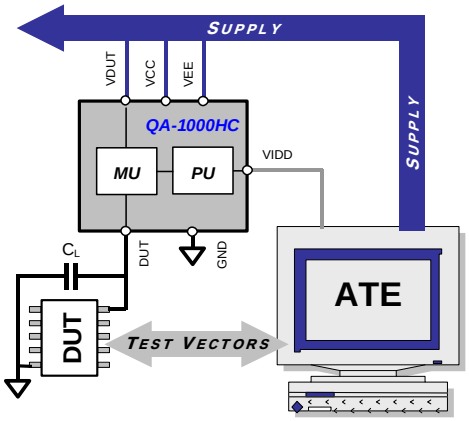
- Continuous Analog Supply Current Measurement
- Static and transient Analog Supply Current Measurements
- Positive and negative supply and ground current measurement
- Analog Current Measurements

DESCRIPTION

The QA-1000HC is a configurable analog supply current monitor, designed for loadboard 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 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. The resolution and performance of the monitor is a function of the selected bandwidth and the value of the loading capacitance C_L (the DUT local on-pin supply decoupling capacitance).

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 figure shows a block diagram of the QA-1000HC as well as a typical application diagram. The output has a 50Ω impedance for optimum RF performance. The low resistive output can be customised when AF performance is preferred.



The QA-1000HC consists of 2 active units, a measurement unit (MU) and a processing unit (PU). The measurement unit is a fast and sensitive current measurement device that converts the measured analog current in a corresponding voltage. The processing unit is configurable and provides amplification and filtering functionality. The QA-1000HC has a low internal resistance between its VDUT and DUT terminals, therefore the voltage at the DUT terminal closely follows the supply voltage applied at its VDUT terminal within a -7V to +7V range. 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.

L.Bauwensstraat 20, B-8200 Brugge, Belgium, Tel.: +32 50 319273, Fax: +32 50 312350, http://www.Qstar.be

ELECTRICAL SPECIFICATIONS

Measured at V_{DUT}=+5.00V, V_{CC}= +12.0V, V_{EE}= -12.0V, T=20°C

SYMBOL	PARAMETER	CONDITION	MIN	TYP	MAX	UNITS
Power Supply						
V_{CC}	Positive Supply Voltage		+11.5	+12	+16	V
V_{EE}	Negative Supply Voltage		-11.5	-12	-16	V
I_{CCQ}	Quiescent Supply Current	@ I_{DUT}=0mA		+12	+40	mA
I_{EEQ}	Quiescent Supply Current	@ I_{DUT}=0mA		-12	-40	mA
Input Range						
I_{DUT}	DUT Supply Current		0		2	A
V_{DUT}	DUT Supply Voltage (1)		-7.0		+7.0	V
I_{VDUT}	Input Bias Current				2	µA
DC Accuracy						
ΔI_{DUT}	Resolution (2)	@ C_L=100nF, f_{-3dB}=50kHz		0.3		mA_{RMS}
		@ C_L=100nF, f_{-3dB}=500kHz		1		mA_{RMS}
		@ C_L=100nF, f_{-3dB}=5MHz		2		mA_{RMS}
	Measurement Offset			2	5	mA
	Gain error			0.1	0.5	%
I/V	I/V Conversion Ratio			2.5		mV/mA
AC Characteristics						
	I_{DUT} –3dB bandwidth	@ C_L=100nF, JP2,3=OFF		5000		kHz
		@ C_L=100nF, JP2=ON, JP3=OFF		500		kHz
		@ C_L=100nF, JP2=OFF, JP3=ON		50		kHz
SR	Slew Rate	@ C_L=100nF, JP2,3=OFF		TBD		V/µs
THD	Total Harmonic Distortion	@ C_L=100nF		TBD		dB
DUT Output						
I_{DUT}	DUT current		-2		2	A
C_L	Loading Capacitance C_L		0		100	uF
Internal Resistance						
	Between DUT & V_{DUT}			25		mΩ
	DUT – V_{DUT} voltage drop	@ I_{DUT}=2A		50		mV

(1) The VDUT pin must be permanently connected to a voltage source and must notbe left floating.

(2) Considering clean supplies and no external noise pick up at VDUT/DUT terminals such as switching noise from ATE power supply.

ABSOLUTE MAXIMUM RATINGS

Parameter	*With Respect To*	*Min*	*Max*	*Units*
V_{CC}	GND	-0.3	+18	V
V_{EE}	GND	-18	+0.3	V
V_{DUT}	GND	-0.3	10	V
I_{DUT}	GND	-3	3	A
Operating Temperature Range		0	+70	°C
Storage Temperature		-40	+80	°C
Lead Temperature (10sec) (1)			+220	°C

(1) Manual soldering is recommended using standard eutectic Sn63Pb solder.

NOTE: Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum ratings for extended periods may affect device reliability.

CONFIGURING THE QA-1000HC

The processing unit of the QA-1000HC is configurable by making the proper pin (jumper) connections. A set of jumpers (JP2&3) determines the filter characteristics, allowing to select the actual bandwidth (5MHz, 500kHz or 50kHz) in function of desired speed and accuracy. These configurations can be changed upon request. More information on how to configure the QA-1000HC can be found in application note AN0024.

State / JP	ON	OFF
JP2 (1) (2)	500 kHz	5 MHz
JP3 (1) (2)	50 kHz	

(1) Setting of bandwidth

(2) JP2 and JP3 must be closed exclusively, only one of them might be closed for a given configuration.

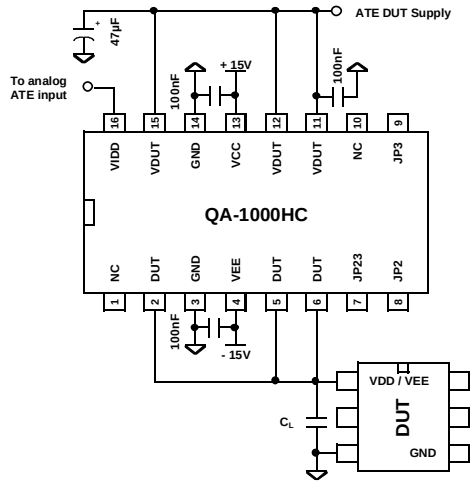
CALIBRATION

Due to component tolerances and potential leakage currents caused by the test set-up (e.g. PMU channel connected to DUT terminal), the current-to-voltage ratio (I/V) of the QA-1000HC can differ from module to module and/or test set-up to test set-up. Therefore, to perform accurate measurements, a calibration of each module in relation to the test set-up used is recommended. Once the module has been calibrated, there is no need to repeat this procedure for every application provided the measurement conditions remain. The calibration of the QA-1000HC can be easily performed as the module has a linear transfer characteristic. More information on how to calibrate the QA-1000HC module can be found in application note AN0025.

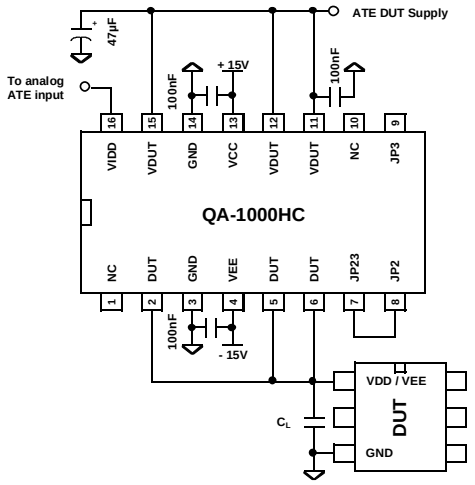
APPLICATION

The QA-1000HC should be placed as close as possible to the DUT. All connections to the QA-1000HC should be well designed not to degrade the monitor's accuracy. The QA-1000HC's power-on delay time is about 1 second. The VDUT pin must be permanently connected to a voltage source (0V-7V) and not left floating. Although the monitor has a very high ripple rejection ratio even at RF, the ATE should deliver a good quality V_{DUT} reference signal (DUT supply voltage reference) for the DUT. The value of the on-pin decoupling capacitance (C_L) is preferable in the 100pF – 1uF range, higher values can be handled but decrease the monitor's measurement bandwidth. Global decoupling capacitors should be placed at the VDUT side of the monitor if RF operation of VDUT is not needed. All possible application diagrams are shown below.

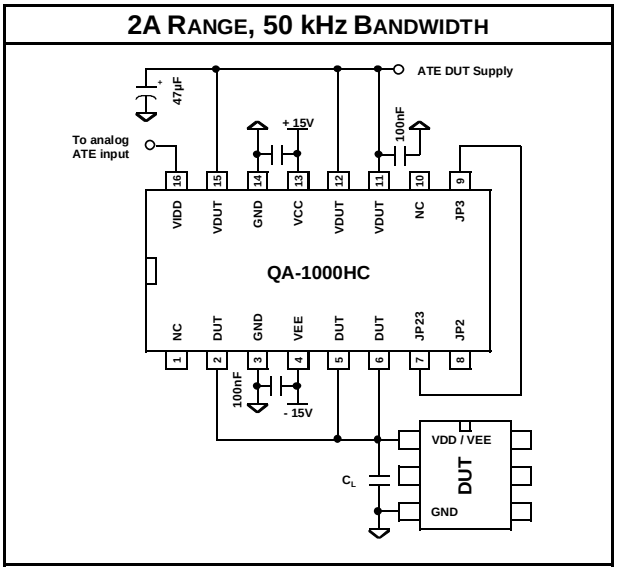
2A RANGE, 5 MHZ BANDWIDTH



2A RANGE, 500 KHZ BANDWIDTH



2A RANGE, 50 kHz BANDWIDTH



PIN DESCRIPTION

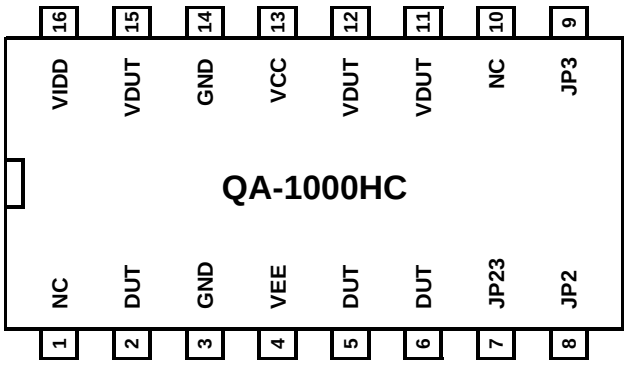
The QA-1000HC has a standard 16 pins wide DIL footprint.

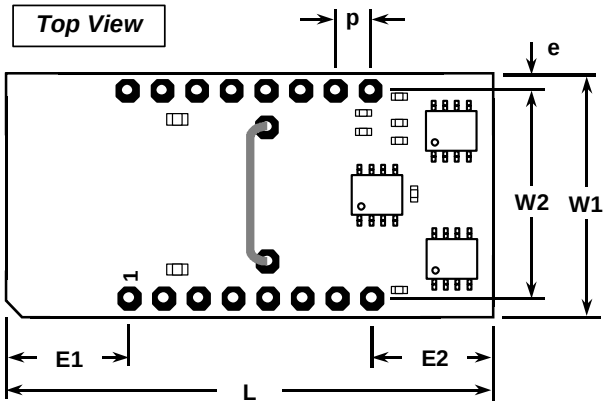
Pin #	Name	Type	Function
1	NC		Not Connected
2	DUT	O	DUT supply pin
3	GND	S	Monitor ground
4	VEE	S	Monitor negative supply pin (-12V)
5	DUT	O	DUT supply pin
6	DUT	O	DUT supply pin
7	JP23	C	Monitor configuration pin – common pin for JP2 and JP3
8	JP2 (1)(2)	C	Monitor configuration pin – JP2 JP2 and JP3 allow selecting the bandwidth of the module. If both JP2 and JP3 are open (NOT connected) then the monitor operates with maximum bandwidth (5MHz). If JP2 is closed (JP2 shortened to JP23) then the bandwidth is limited to about 500kHz
9	JP3 (1)(2)	C	Monitor configuration pin – JP3 JP2 and JP3 allow setting the bandwidth of the module. If both JP2 and JP3 are open (NOT connected) then the monitor operates with maximum bandwidth (5MHz). If JP3 is closed (JP3 shortened to JP23) then the bandwidth is limited to about 50kHz
10	NC		Not Connected
11	VDUT (3)	I	DUT supply reference input
12	VDUT (3)	I	DUT supply reference input
13	VCC	S	Monitor positive supply pin (+12V)
14	GND	S	Monitor ground
15	VDUT (3)	I	DUT supply reference input
16	VIDD	O	Analog IDD output voltage

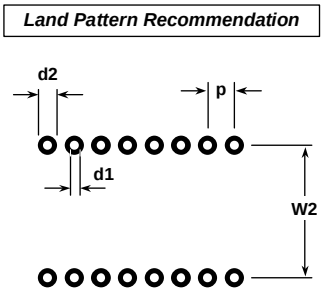
(1) JP2 and JP3 should be closed exclusively, only one of them might be closed for a given configuration, they must not be closed at the same time (if not, cut off frequency will be 45kHz instead of 50kHz).

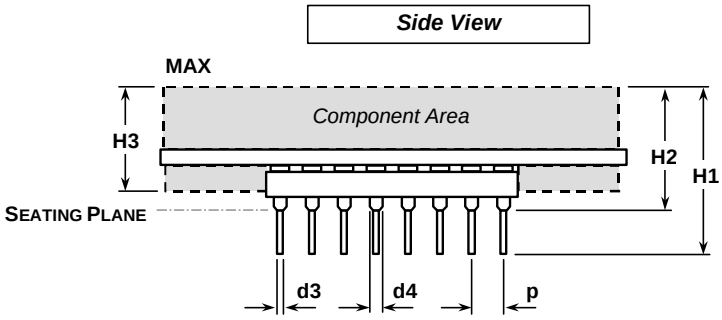
(2) For optimum performance, the connection between JP2-JP23 or JP3-JP23 must be as short as possible.

(3) The VDUT pin must be permanently connected to a voltage source and must not be left floating.









Unit	W1	W2	L	P	d1	d2	d3	d4
inches	0.700	0.600	1.525	0.10	0.035	0.067	0.020	0.039
mm	17.80	15.24	38.735	2.54	0.90	1.70	0.50	1.00

Unit	H1	H2	H3	E1	E2	e
inches	0.591	0.453	0.335	0.375	0.450	0.050
mm	15.00	11.50	8.50	9.525	11.43	1.27

LIST OF APPLICATION NOTES

A series of applications notes concerning the QA-1000HC is listed below:

AN0024	Performing measurements with the QA-1000HC
AN0025	Calibrating the QA-1000HC