

### Advanced IDDQ Instrument with Sense Line Control Supporting Various Measurement Approaches

#### FEATURES

- Wide DUT Supply range:  $V_{DUT} = 0.5V$  to  $7V$
- Wide measurement range:  $IDDQ = 0 - 30mA$
- Typical measurement time:  $100 \mu s$
- High capacitive driving capability: up to  $10 \mu F$
- High single sample resolution:  $20nA_{RMS}$
- 16-bits  $IDDQ$  Value Read Out
- 3-Wire Serial Configuration/Read out Interface
- On-board data processing capabilities
- Supply sense line switching capability

#### APPLICATIONS

- ATE Probe Card Applications
- ATE Interface Board Applications
- Delta  $IDDQ$  Measurements
- Pre & Post Stress Delta  $IDDQ$
- $IDDQ$  Pass/Fail Measurements
- $IDDQ$  Read Out Measurements
- $IDDQ$  Window Comparisons

#### DESCRIPTION

The QD-1040 is a full featured, configurable quiescent supply current ( $IDDQ$ ) instrument, serving both probe and final test, eliminates voltage droops over probe needles and designed for probe card and interface board applications. The instrument has on-board memory and data processing capabilities, supports a wide range of  $IDDQ$  test and measurements applications and provides digital measurement values as well as a pass/fail info.

The QD-1040 embeds automated supply sense line switching, avoiding switching delays when using external sense line switching relays, avoiding influence of sense line leakage on the measurement results and enabling a setup that compensates for voltage droops caused by contact and probe needle resistances when the QD-1040 operates in bypass mode.

The QD-1040 is designed to be inserted between the Automated Test Equipment (ATE) device power supply and the supply pin(s) of the Device Under Test (DUT). There is no need to remove the on-pin decoupling capacitors as the unit can drive high capacitive loads (up to several  $\mu F$ ). Its unique design ensures transparency to both the ATE and DUT, under all conditions.

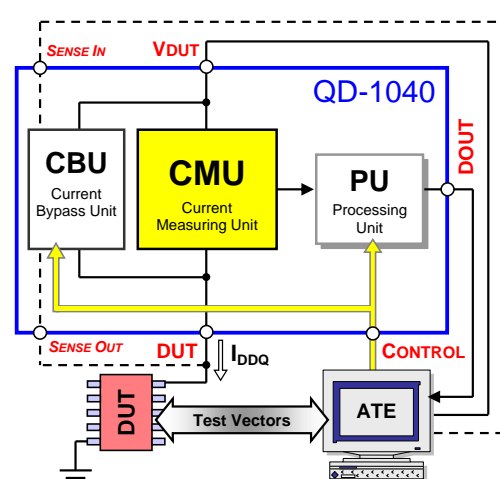
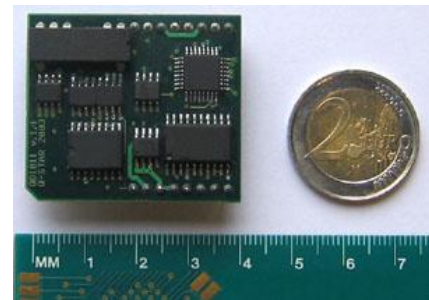


Figure 1. QD-1040 Application

The QD-1040 offers accurate, highly repeatable high speed ( $10kHz$  max)  $IDDQ$  measurement results with  $nA$  resolution/repeatability. The instrument is offered for various measurement ranges. The digital output provides the Pass/Fail flag and/or the measured/processed  $IDDQ$  values with a 16-bit resolution. The QD-1040 requires only a single positive supply, and allows a user programmable ( $0.5$  to  $7V$ ) DUT supply level.

The QD-1040 has a dedicated fast switching on-board compensated bypass switch 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 instrument's measurement range.

By default the QD-1040 is optimised to make an  $IDDQ$  measurement in  $100 \mu s$  for a  $100nF$  to  $10 \mu F$  capacitive load. The processing and read out time is function of the application and takes typically  $20 \mu s$ . The default measurement range of the QD-1040 is set to  $0-1mA$  with a single sample resolution of  $50nA_{RMS}$ . Other possible fixed measurement ranges are  $0-100 \mu A$ ,  $0-10mA$ ,  $0-30mA$  with a single sample resolution of  $20nA_{RMS}$ ,  $360nA_{RMS}$  and  $2.2 \mu A_{RMS}$ . All these parameters can be customised for optimal performance in function of desired measurement speed/resolution and actual loading conditions.

### Operating Modes

The QD-1040 has two main operating modes: **bypass mode** and **measurement mode**. During bypass, the instrument provides a low resistance path between ATE supply and DUT. During measurement, the actual measurement(s) take(s) place. The instrument can be programmed during bypass mode. The programming operation allows selecting the measurement approach and to set the pass/fail level(s). A simple programming protocol is used.

The normal measurement cycle consists of a settling period (typ. 100µs) followed by a capture, processing and read-out period (typ. 20µs). When in measurement mode the instrument is acting as DUT power supply. When during measurement mode the measured current is out of the instrument's measurement range, then the QD-1040 automatically switches back to bypass mode, meanwhile indicating a fail situation. Figures 1 and 2 show a general application diagram as well as a typical measurement cycle.

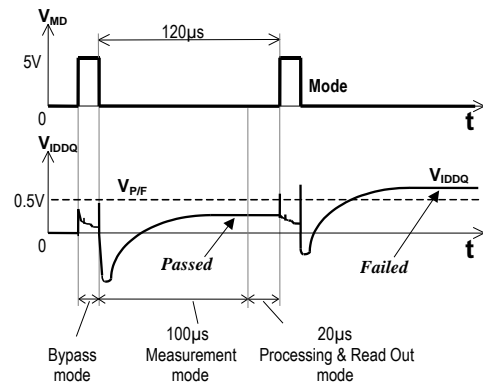


Figure 2. Typical Measurement Cycle

### Typical Applications

The QD-1040 can be applied in various ways, some of them are listed below:

- The unit can be used as a pass/fail (P/F) instrument,
- The instrument can be used as a measurement device to determine the exact value of the measured current. The QD-1040 digitises the measured value with a 16-bit resolution. This value can be read out using the serial interface.
- The QD-1040 can be used as a delta-IDDQ instrument, among the supported delta strategies are:
  - Vector-to-vector delta, providing a 16-bit delta value and/or P/F flag.
  - Vector-to-“reference vector” delta, providing a 16-bit delta value and/or P/F flag per vector referred to the measured value of the reference vector.
  - Vector-to-“external reference” (provided by the ATE and loaded in the module during configuring) delta, providing a 16-bits delta value and/or P/F flag per vector referred to the external reference. The reference value can be changed on a vector-to-vector basis.
  - Pre-to-post stress delta, providing a 16-bit delta value and/or P/F flag per vector referred to the pre stress measured value of the same vector

For all operating modes using a pass/fail flag, the pass/fail flag is generated either as a result of comparing the measurement result (measured value or calculated delta) with a single pass/fail reference value or a pass/fail reference window. The QD-1040 supports a modification of the pass/fail reference level or window on a vector-to-vector basis, as such it supports the use of current signatures.

### ELECTRICAL SPECIFICATIONS

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS
V <sub>CC</sub>	Positive Supply Voltage	+4.5	+5.0	+5.5	V
I <sub>DDQ</sub>	Measurement Range	0.1	1	30	mA
V <sub>DUT</sub>	DUT Supply Voltage	0.5	3 - 5	7	V
	Single Sample Resolution <sup>(1)</sup>	20	50	2200	nA <sub>RMS</sub>
	Measurement Time	<sup>(2)</sup>	100	<sup>(3)</sup>	µs
C <sub>L</sub>	Loading Capacitance	0.01	1	10	µF
V <sub>IDDQ</sub>	V/I Conversion Ratio	0.5	5	50	mV/µA
I <sub>DDT</sub>	Transient Current		30		A
R <sub>ON</sub>	On Resistance		20		mΩ

(1) Configuration dependant, the values listed are for a C<sub>L</sub>=0.5µF optimised unit.

(2) The QD-1040 can be used to perform static measurements

(3) The maximum measurement time is dependent on the number of samples taken. 116µs @ 1 sample, 146µs @ 4 samples, 260µs @ 16 samples.