# QT-1411
# Product Highlights

## Advanced Dynamic /Transient (IDDT) Supply Current Measurement Instrument

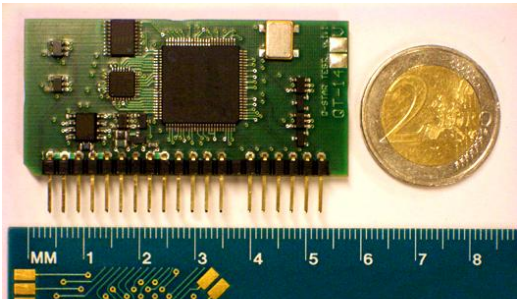
### FEATURES

- VDUT Range: -50V to +50V
- Negligible or no voltage drop
- Measurement range: 5mA up to 100A or more
- IDDT best resolution: 5µA$_{RMS}$
- Measurement bandwidth: up to 10MHz
- Data sampling rate: typ. 50MHz
- High measurement repetition rate: up to 3MHz
- Loading Capacitance: up to 100µF
- 256K sample data storage capability
- 14-bit resolution
- On-board data processing capabilities

### APPLICATIONS

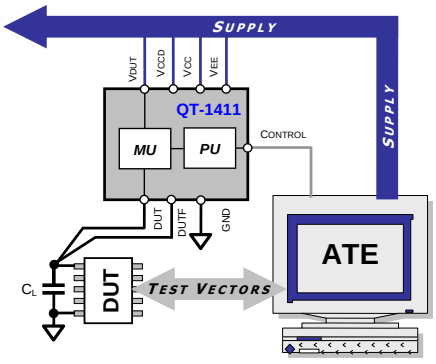
- Transient Supply Current Measurement
- Dynamic (supply) Current Measurements
- Power profiling
- IDDT Peak Measurements
- QDDT Charge Measurements
- Energy Measurement
- Pulse Width Measurement
- IDD(Q) Measurement
- IDD Complete Waveform Capture
- Current signature analysis
- Off-line data analysis (FFT, …)

### DESCRIPTION




The QT-1411 is a fast and sensitive digital dynamic/transient supply current (IDDT) measurement instrument, serving a wide range of test and measurement applications and designed for use on probe cards and interface boards. 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 1A, 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 makes use of the interconnect resistance, an external sense element, or uses 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 instrument itself causes no voltage drop and does not affect the DUT' supply level or its operation.




### MAIN CHARACTERISTICS

The QT-1411 consists of 2 active units, a measurement unit (MU) and a processing and control unit (PU). The *measurement unit* converts the measured current in a corresponding voltage. The *processing unit* combines a fast A/D converter (50Msps) with on-board data storage (256K) & processing capabilities. The minimum measurement window is 20ns. The maximum single vector measurement repetition rate is 3MHz.

The target application of the QT-1411 is to make peak and/or charge measurements of the transient current. The instrument can be configured to capture, store and process a complete transient waveform, to measure the IDD(Q) current, to measure the actual DC value of the DUT' supply voltage, measure pulse width, measure switching energy and other parameters. The on-board 256K 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.



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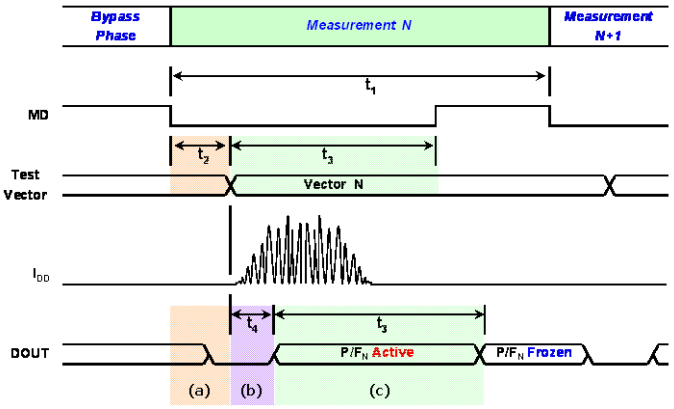
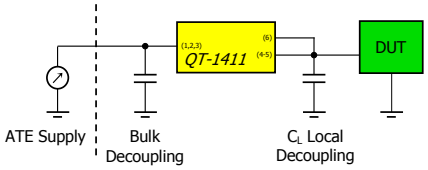
## OPERATING MODES

The QT-1411 has two main operating modes, *bypass mode* and *measurement mode*. During bypass mode the instrument accepts data communications to and from the instrument. Measurement results such as maximum peak value, total charge, IDD value or DUT supply voltage can be read out. A simple 3-wire serial communication protocol is used, hereby limiting the number of ATE resources needed to operate the instrument.




The figure shows a typical QT-1411 measurement cycle. The measurement operation can be divided in an initial measurement setup period ($t_2$, region (a), typically 50 ns) and the measurement window ($t_3$, user controlled: 20ns min.). A data processing setup period ($t_4$, region (b), typically 280 ns) precedes the measurement result window (region (c)), causing the measurement result to lag the actual measurement. Within the measurement result window, the pass/fail flag can be dynamically monitored to identify the exact moment when the set reference is exceeded. As soon as one of the measured values exceeds the reference value set, the pass/fail flag is frozen.

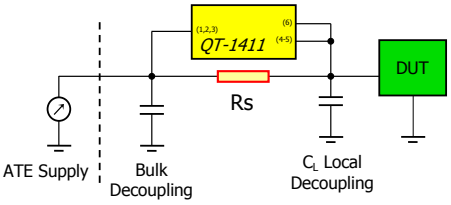



QT-1411 SERIAL APPLICATION

## TYPICAL APPLICATIONS

The QT-1411 can be used either as a serial measurement device or as a parallel measurement device. For serial application, the instrument has to be inserted between the ATE Digital Power Supply (DPS) and the DUT. The serial approach is sensitive, but can negatively affect the operation of the DUT, due to the voltage drop caused by the sense resistor.

For parallel application, the instrument is placed in parallel with the DUT' supply connection. It enables transient current testing of high voltage circuits such as automotive ICs. The resolution of the parallel method is slightly worse than the serial application, but the main advantage is that the operation of the DUT is not affected at all. Therefore, the parallel method is convenient to measure high IDDT currents (> 500mA), even with high decoupling capacitance CL.




QT-1411 PARALLEL APPLICATION

## ELECTRICAL SPECIFICATIONS

| SYMBOL | PARAMETER | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|
| $V_{CCD}$ | Digital Positive Supply Voltage | +4.5 | +5.0 | +5.5 | V |
| $V_{CC}$ | Positive Supply Voltage | +9.5 | +10.0 | +13 | V |
| $V_{EE}$ | Negative Supply Voltage | -13 | -10.0 | -9.5 | V |
| $V_{DUT}$ | DUT Supply Voltage | -50 | | 50 | V |
| $I_{DDT}$ | Transient current detection range | +/- 0.01 | +/- 0.5 | +/- 100 | A |
| $Q_{DDT}$ | Transient charge detection range | +/- 0.05 | +/- 2.5 | +/- 250 | mC |
| $\Delta I_{DDT}$ | Current Resolution @ full range | 0.005 | 0.25 | 50 | $mA_{RMS}$ |
| $\Delta Q_{DDT}$ | Charge Resolution @ full range | 0.1 | 5 | 1000 | $pC_{RMS}$ |
| | Measurement Repetition Rate | | | 3 | MHz |
| $f_S$ | Internal sampling frequency | | | 50 | MHz |
| | Measurement window | 0.02 | | | µs |
| $R_{IN}$ | Input Resistance (1) | 0.1 | 1 | 10 | Ω |

(1) $R_{IN}$ is only applicable for the as a serial measurement application, i.e. when the QT-1411 is inserted in the DUT' supply path. In the parallel application, the QT-1411 is either AC coupled or exploits the DUT' supply interconnect parasitic resistance.