The Current Test Company

QD-1011 Data Sheet

Advanced (Delta) IDDQ Measurement Instrument Supporting Various Test Applications

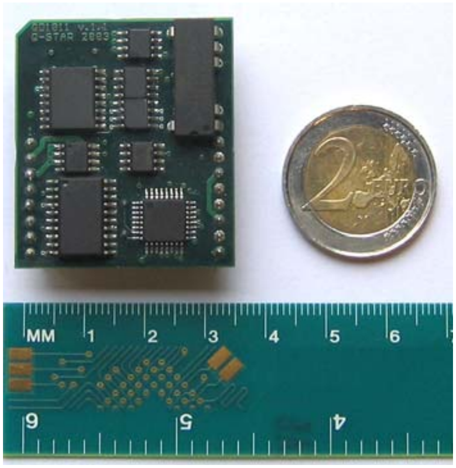
FEATURES

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

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-1011 is a full featured, advanced configurable quiescent supply current (IDDQ) measurement instrument, supporting both probe and final test and designed for probe card and interface board applications. The instrument supports a wide range of IDDQ test and measurements applications and provides digital measurement values as well as a pass/fail output signal. On-board memory and data processing capabilities allow implementing various advanced current based test strategies including but not limited to a wide range of Delta-IDDQ approaches

The QD-1011 operates according to the Stabilised Voltage Drop principle and 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 local decoupling capacitors. Its unique design ensures transparency to both the ATE and DUT, under all conditions. The unit can drive high capacitive loads (up to several µF).

The QD-1011 offers the capability to perform accurate (better than 50nA @ 10kHz) and highly repeatable high speed (up to 10kHz) quiescent supply current measurements. On-board data processing allows improving the accuracy further at the cost of a small speed penalty.

The instrument has a wide measurement range (0-30mA). The serial output provides the Pass/Fail flag and/or the measured/processed IDDQ values with a 16-bit resolution. The QD-1011 requires only a single positive supply, and allows a user programmable (0.5 to 7V) DUT supply level.

The QD-1011 has an on-board compensated bypass switch, which minimises charge transfers and 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 instrument's measurement range.

By default the QD1011's Current Measurement Unit (CMU) is optimised to perform an IDDQ measurement in 100µs for a 100nF to 10µF capacitive load. The processing and read out time is function of the application and takes typically 20µs. The default measurement range of the QD1011 is set to 0-1mA with a single sample resolution of $90nA_{RMS}$. Other possible fixed measurement ranges are 0-100µA and 0-10mA with a single sample resolution of $50nA_{RMS}$ and $400nA_{RMS}$ respectively. All these parameters can be customised for optimal performance in function of desired measurement speed/resolution and actual loading conditions. In addition to the digital readout capabilities, the QD-1011 also provides an analogue output *VIDDQ* that can be measured by the ATE.

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ELECTRICAL SPECIFICATIONS

V_{CC} = +5.0V ±500mV, V_{DUT} = +5.000V ±1mV, T = +25°C

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS
Power Supply					
V_{CC}	Positive Supply Voltage	+4.5	+5.0	+5.5	V
I_{CC}	Supply Current		+200	+500 (1)	mA
Measurement Characteristics					
CMR	Current Measurement Range	0.1	1	30 (4)	mA
V_{DUT}	DUT Supply Voltage	0.5	3 - 5	7	V
$t_{MEASURE}$	Measurement Time	(2)	100	(3)	µs
f_{-3dB}	Analog bandwith in measurement mode		20		kHz
C_L	External loading capacitance	0	1	10	µF
	Internal QD-1011 decoupling capacitance		10		nF
VI_{VIDDQ}	V/I Conversion Ratio	0.5	5	50	mV/µA
GE_{VIDDQ}	DC gain error @ I_{DDQ} = 50%FS		±0.1		%FS
OE_{VIDDQ}	DC offset error @ I_{DDQ} = 0	0	+0.05		%FS
Bypass Characteristics					
I_{DDT}	Transient Current			30	A
R_{ON}	On Resistance between VDUT pin 2 and DUT pin 3 in bypass mode		20		mΩ
t_{on}	Bypass Switch On Time		4	6	µs
t_{off}	Bypass Switch Off Time			15	µs
Analogue Input/Output					
C_{IN}	Input Capacitance VDUT terminal		22 (5)		µF
R_{INT}	Internal resistance of DUT pin 3 in measurement mode (6)	1	5	10	Ω
V_{INT}	Voltage drop between VDUT pin 2 and DUT pin 3 in measurement mode @ full range value			10	mV
L_{INT}	Parasitic inductance between VDUT pin 2 and DUT pin 3		10		nH
Digital I/O					
V_{IH}	Digital Input High Voltage (Except RESET)	0.6 V_{CC}		V_{CC} +0.5	V
V_{IH1}	Digital Input High Voltage (RESET)	0.85 V_{CC}		V_{CC} +0.5	V
V_{IL}	Digital Input Low Voltage	-0.5		0.3 V_{CC}	V
V_{OH}	Digital Output High Voltage (I_{OH} = 300µA)	V_{CC}-0.7			V
V_{OL}	Digital Output Low Voltage (I_{OL} = -6 mA)			0.7	V

NOTES

(1) For proper operation, VCC must be able to provide a 500mA start-up (peak) current required by the DC-DC converter during power-up of the instrument. After power-up, the current required by the QD-1011 is typically 200mA.

(2) The QD-1011 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, 2.5ms @ 256 samples.

(4) The maximum measurement range is dependent on the DUT supply voltage for measurement ranges of 10mA or higher.
For a 10mA instrument and V_{DUT} upto 5V, I_{DDQmax} is 10mA. I_{DDQmax}=8mA @ V_{DUT}=6V, I_{DDQmax}=6mA @ V_{DUT}=7V.
For a 20mA instrument and V_{DUT} upto 5V, I_{DDQmax} is 20mA. I_{DDQmax}=16mA @ V_{DUT}=6V, I_{DDQmax}=12mA @ V_{DUT}=7V.
For a 30mA instrument and V_{DUT} upto 5V, I_{DDQmax} is 30mA. I_{DDQmax}=24mA @ V_{DUT}=6V, I_{DDQmax}=18mA @ V_{DUT}=7V.

(5) Typically an on-board 22µF decoupling capacitor is present on the VDUT analogue input. This value can be changed on demand.

(6) Depends both on the instrument measurement range and driving capability.

ACCURACY & RESOLUTION

The accuracy and measurement resolution of the QD-1011 is function the measurement range, the capacitive loading condition and the number of measurement samples, as listed in the table below. Alternatively, in function of the actual loading condition and the desired measurement range and resolution the number of samples can be selected.

$\Delta I_{DDQ\ RMS} = f(C_L, \#Samples)\ [nA]$ (5)				
Measurement Range (1)	C_L			**# Samples** (2)
	0.0 – 0.5 µF(3)	**0.5 – 2.0 µF**(3)	**1.0 – 10.0 µF**(4)	
0 – 100 µA	*20*	*50*	*330*	**1**
	15	*25*	*230*	**4**
	10	*15*	*110*	**16**
0 – 1 mA	*50*	*90*	*500*	**1**
	30	*60*	*300*	**4**
	15	*20*	*150*	**16**
0 – 10 mA	*360*	*400*	*550*	**1**
	200	*220*	*290*	**4**
	125	*130*	*180*	**16**
0 – 30 mA	*2200*	*2200*	*2200*	**1**
	700	*700*	*700*	**4**
	220	*220*	*220*	**16**

(1) The measurement range of the QD-1011 instrument is fixed upon assembly.
(2) The QD-1011 measurement time is depending on the number of samples taken. Typically 116µs @ 1 sample, 146µs @ 4 samples, 260µs @ 16 samples.
(3) Instrument optimized for C_L=1µF
(4) Instrument optimized for C_L=10µF
(5) If the VDUT power supply injects a high amount of external noise such as switching noise, the noise inside the 20kHz instrument input bandwidth will be added to instrument's inherent noise and the total resolution will be degraded, especially at high IDDQ and high CL values.

ABSOLUTE MAXIMUM RATINGS

PARAMETER	WITH RESPECT TO	MIN	MAX	UNITS
V_{CC}	GND	-0.5	+ 7	V
V_{DUT}	GND	-0.5	+ 10	V
Digital Inputs	GND	-0.5	V_{CC} + 0.5	V
Digital Output	GND	-0.5	V_{CC}	V
Digital Output	GND	-50	0	mA
I_{DDT}	GND		30 (2)	A
I_{DDQ} permanent	GND		6	A
Operating Temperature Range		-40 (3)	+70	°C
Storage Temperature		-40	+125	°C
Lead Temperature (5sec) (1)			+260	°C

(1) Manual soldering is recommended using Sn96Ag4 solder
(2) Duration of the current pulse 1ms max, duty ratio 1% max.
(3) When the instrument is intended for use below 0°C, a special HW trimming must be requested.

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.

Operating Modes

The QD-1011 has two main operating modes, namely bypass and measurement mode. During bypass mode the instrument provides a low resistance path between ATE supply and DUT. During measurement mode the actual measurement(s) take(s) place. When operating in bypass mode the instrument can be programmed. The programming operation allows to select and/or to configure the desired measurement approach and to set the desired pass/fail level(s) in function of the active firmware. To configure the instrument a simple programming protocol is used. The minimal bypass time is function of the switching time of the DUT.

The normal measurement operation can be divided in an initial settling period (typically 100µs) followed by a capture, processing (typically 20µs) and read-out period (typically 20µs). At the end of the capture/processing period, a pass/fail flag at the PF/DOUT output indicates the pass/fail result of the measurement (logic ‘1’ = pass, logic ‘0’ = fail). 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-1011 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.

The QD-1011 has also a dedicated BIST mode that verifies the operation of the instrument. Executing the BIST function takes typically 250µs. At the end of the BIST a pass/fail flag at the PF/DOUT output indicates the result of the test (logic ‘1’ = pass, logic ‘0’ = fail). More information on how to perform a BIST can be found in application note AN0012.

More information on how to perform measurements with the QD-1011 can be found in application note AN0007.

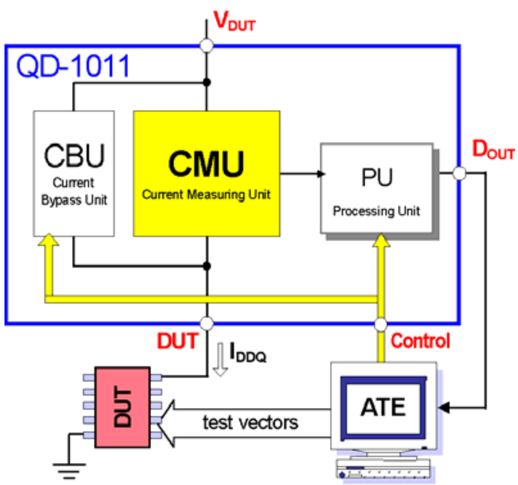


Figure 1. QD-1011 Application

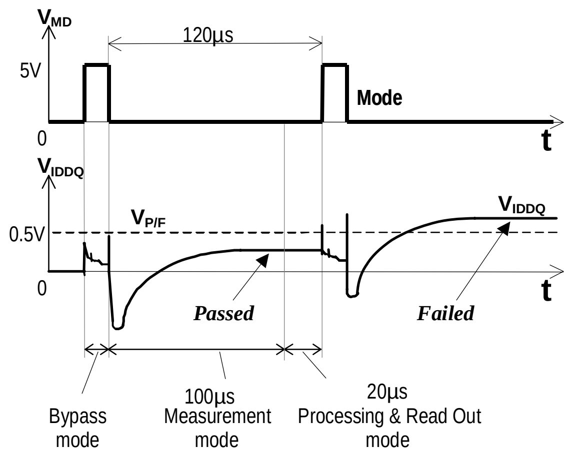


Figure 2. QD-1011 Typical Measurement Cycle

Data Protocols of the QD-1011

The QD-1011 accepts a data stream only when operating in bypass mode, as illustrated in figure 3. Depending on the actual firmware, at maximum three operating modes can be selected and a Built-In Self Test (BIST) mode. The actual modes that can be selected are firmware dependent. The QD-1011 supports a double data rate protocol, the data provided on the MD pin is read on both edges of the CLK signal. Even though data is loaded using the MD input, which normally is used to select between bypass and measurement mode, the bypass switch of the instrument remains active during the data entry phase.

The 16-bits pass/fail reference value(s) provided through the input data stream is(are) loaded into the QD-1011’s on-board memory.

The QD-1011 also supports the read back of the measurement value(s) and/or the result(s) of the data processing as a serial bit string. The read back can be done only during bypass mode and data is shifted out at the DOUT output synchronised by the CLK pin, as illustrated in figure 3. The QD-1011 supports a double data rate protocol. This overcomes the limitations imposed by the ATE due the time needed by the ATE resources to measure the analog output voltage and the potential measurement resolution problem of the ATE instrumentation. The ability of the ATE to convert the bit string into a value may be the limiting factor to use this option.

The base communication protocols are described in detail in application note AN0012.

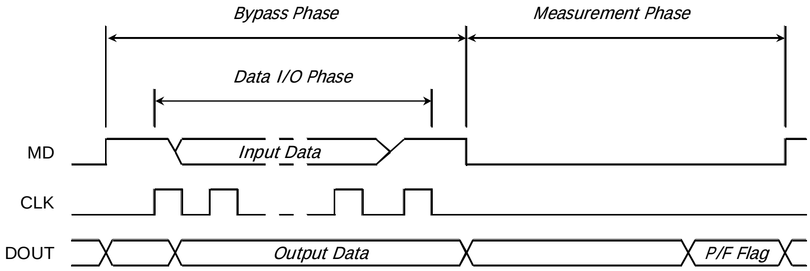


Figure 3. QD-1011 input/output data stream concept.

NOTES:

1. To assure that the instrument always starts operating from a well-known state, an internal power on reset circuit ensures bypass operation and sets the QD-1011 in normal mode. During power-up the Pass/Fail reference is cleared; as a result the QD-1011 needs to be reconfigured each time after a power-down, power-up cycle. The power-up cycle takes maximum 15ms.
2. After power-up, it takes an additional 50µs before the bypass is fully closed. During that time no DUT switching actions should be performed.

MEASUREMENT STRATEGIES

The QD-1011 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-1011 digitises the measured value with a 16-bit resolution. This value can be read out using the serial interface.
- The QD-1011 can be used as a delta-I_{DDQ} instrument. The delta approaches currently supported 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 instrument 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-1011 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.

TYPICAL APPLICATIONS

Figures 4 and 5 show the recommended QD-1011 positioning when used as IDDQ (supply) instrument. Figure 4 shows the application diagram for QD-Ax package types. Figure 5 shows the application diagram for QD-Bx package types. The drawing only shows how the instrument needs to be inserted in the supply path; it does not show the instrument's control lines (MD, CLK, DOUT) that need to be connected to ATE channels.

Figures 6 and 7 show the recommended layout, focussing on DUT supply and ground connections. Figure 6 shows the recommended layout for QD-Ax package types. Figure 7 shows the recommended layout for QD-Bx package types.

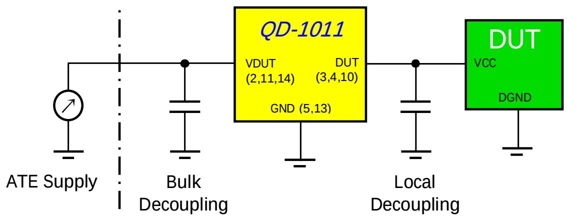


Figure 4. QD-1011 application diagram for QD-Ax packages

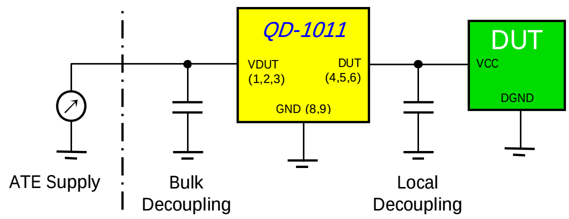


Figure 5. QD-1011 application diagram for QD-Bx packages

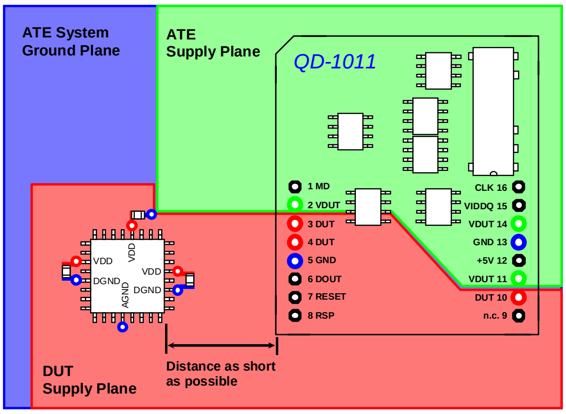


Figure 6. Recommended layout for QD-Ax packages

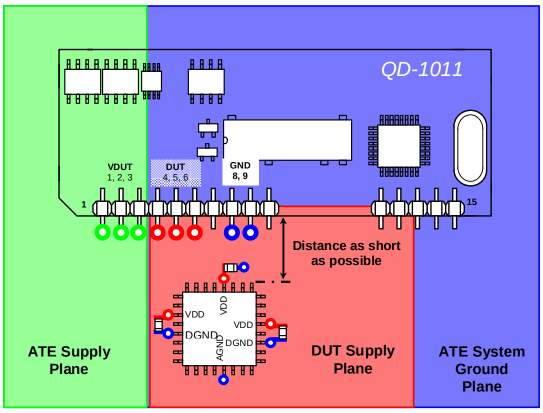


Figure 7. Recommended layout for QD-Bx packages

APPLICATIONS HINTS

The requirements/recommendations to guarantee optimum performance of the QD-1011 instrument are listed below:

- The QD-1011 should be placed as close as possible to the DUT.
- All connections to the QD-1011 should be well designed not to degrade the instrument's accuracy.
- The ATE is expected to deliver a good quality V_{DUT} reference signal (DUT supply voltage reference) for the DUT. The VDUT pin must ***not*** be left ***floating***.
- For QD-Ax packages, VDUT pin 2 and DUT pin 3 are the main supply pins with lowest parasitics. These pins should be connected as close as possible to the DUT to maximise the instrument performance, see figure 6. Preferably these pins are connected using a plane. This recommandation is also applicable for QD-Bx packages for pins number 3 and 4.
- The value of the on-pin decoupling capacitance (C_L) is preferable in the 100nF – 1µF range, higher values can be handled but increase the instrument's susceptibility to external noise.
- Global decoupling capacitors should be placed at the VDUT side of the instrument.
- Although the QD-1011 has on-board decoupling, it is recommended to decouple V_{CC} and V_{DUT} also externally by ceramic multilayer capacitors 100nF close to the supply and ground pins.
- For optimal performance of the QD-1011 instrument, both GND pins must be connected to the same ground level as the DUT supply being monitored. Preferably these pins are connected using a ground plane.

QD-1011 PIN DESCRIPTION

The QD-1011 pin description is function of the package type and is given below.

PACKAGE TYPE QD-AX

Pin #	Name	Type	Function
1	MD(9)	I	Mode control ("H" = Bypass, "L" = Measurement) – Serial Data input
2	VDUT(7) (8)	I	Main DUT supply reference input
3	DUT(7)	O	Main DUT supply pin
4	DUT(7)	O	Auxiliary DUT supply pin
5	GND(6)	S	Instrument ground for VDUT, DUT and VIDDQ
6	DOUT(1) (5)	O	Pass/Fail flag – Serial Data output
7	$\overline{\text{RESET}}$(3) (4) (9)	S	Instrument reset
8	NC		Not Connected
9	NC		Not Connected
10	DUT(7)	O	Auxiliary DUT supply pin
11	VDUT(7) (8)	I	Auxiliary DUT supply reference input
12	VCC(2)	S	Positive supply voltage
13	GND(6)	S	Instrument ground
14	VDUT(7) (8)	I	Auxiliary DUT supply reference input
15	VIDDQ	O	Buffered analog output of the Current Measurement Unit
16	CLK(10)	I	Clock input

(1) By default, the logic high level is VCC. Upon request, the logic high level can be linked to VDUT or an "open drain" output can be provided allowing the QD-1011 to interface to any logic voltage scheme using an external pull-up resistor.

(2) For proper operation, VCC must be able to provide a 500mA start-up (peak) current required by the DC-DC converter during power-up of the instrument. After power-up, the current required by the QD-1011 is typically 200mA.

(3) The QD-1011 is reset when a low level is present on the RESET pin for more than 50ns. A QD-1011 reset takes maximum 15ms starting from the rising edge of the reset signal, during this reset period no instrument communication should occur.

(4) There is no requirement to connect the reset pin for normal operation of the QD-1011. This pin can be left floating.

(5) A pass/fail flag at the DOUT output indicates the pass/fail result of the measurement (logic '1' = pass, logic '0' = fail).

(6) For optimal performance of the QD-1011 instrument, both the GND pins must be connected to the same ground level as the DUT supply being monitored. Preferably these pins are connected using a ground plane.

(7) Although both the multiple VDUT pins and multiple DUT pins are connected internally, the indiviual pins have different parasic serial inductance and resistance. The main pins have the lowest parasitics, because the Current Bypass Unit is connected directy between these pins. Therefore, optimal performance is reached when the QD-1011 instrument's position is such that the main supply pins 2 and 3 are as close as possible to DUT, see figure 6.

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

(9) This pin is pulled up internally, no external pull-up resistor is required.

(10) This pin is pulled down internally, no external pull-down resistor is required.

PACKAGE TYPE QD-BX

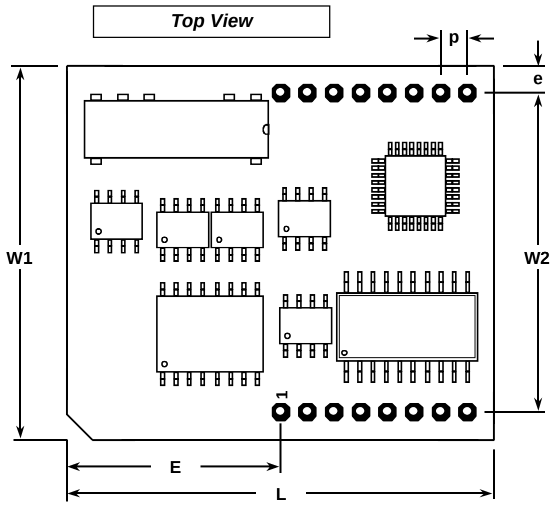
Pin #	Name	Type	Function
1	VDUT(7) (8)	I	Auxiliary DUT supply reference input
2	VDUT(7) (8)	I	Auxiliary DUT supply reference input
3	VDUT(7) (8)	I	Main DUT supply reference input
4	DUT(7)	O	Main DUT supply pin
5	DUT(7)	O	Auxiliary DUT supply pin
6	DUT(7)	O	Auxiliary DUT supply pin
7	VIDDQ	O	Buffered analog output of the Current Measurement Unit
8	GND(6)	S	Instrument ground for VDUT, DUT and VIDDQ
9	GND(6)	S	Instrument ground
10	VCC(2)	S	Positive supply voltage
11	MD(9)	I	Mode control ("H" = Bypass, "L" = Measurement) – Serial Data input
12	CLK(10)	I	Clock input
13	DOUT(1) (5)	O	Pass/Fail flag – Serial Data output
14	$\overline{\text{RESET}}$(3) (4) (9)	S	Instrument reset
15	NC		Not Connected

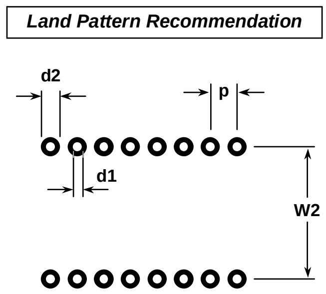
(1) By default, the logic high level is VCC. Upon request, the logic high level can be linked to VDUT or an "open drain" output can be provided allowing the QD-1011 to interface to any logic voltage scheme using an external pull-up resistor.
(2) For proper operation, VCC must be able to provide a 500mA start-up (peak) current required by the DC-DC converter during power-up of the instrument. After power-up, the current required by the QD-1011 is typically 200mA.
(3) The QD-1011 is reset when a low level is present on the RESET pin for more than 50ns. A QD-1011 reset takes maximum 15ms starting from the rising edge of the reset signal, during this reset period no instrument communication should occur.
(4) There is no requirement to connect the reset pin for normal operation of the QD-1011. This pin can be left floating.
(5) A pass/fail flag at the DOUT output indicates the pass/fail result of the measurement (logic '1' = pass, logic '0' = fail).
(6) For optimal performance of the QD-1011 instrument, both GND pins must be connected to the same ground level as the DUT supply being monitored. Preferably these pins are connected using a ground plane.
(7) Although both the multiple VDUT pins and multiple DUT pins are connected internally, the indiviual pins have different parasitic serial inductance and resistance. The main pins have the lowest parasitics, because the Current Bypass Unit is connected directy between these pins. Therefore, optimal performance is reached when the QD-1011 instrument's position is such that the main supply pins 3 and 4 are as close as possible to DUT as shown in figure 7.
(8) The VDUT pin must be permanently connected to a voltage source and must not be left floating.
(9) This pin is pulled up internally, no external pull-up resistor is required.
(10) This pin is pulled down internally, no external pull-down resistor is required.

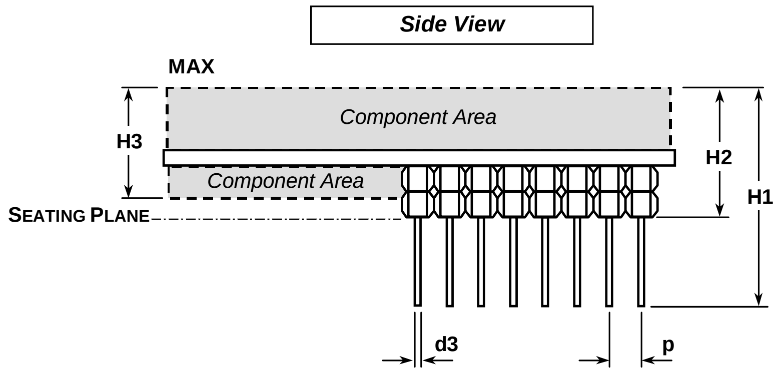
PACKAGE DESCRIPTION

The QD-1011 interface board has a 15 or 16 pins footprint depending on the package type. The QD-1011 instrument can have four types of packages: *Type QD-A1*: horizontal orientation & 16 square pins; *Type QD-A2*: horizontal orientation & 16 round pins; *Type QD-B1*: vertical orientation & 15 square pins. *Type QD-B2*: horizontal orientation & 15 square pins. The package descriptions for each type are given below.

PACKAGE TYPE QD-A1



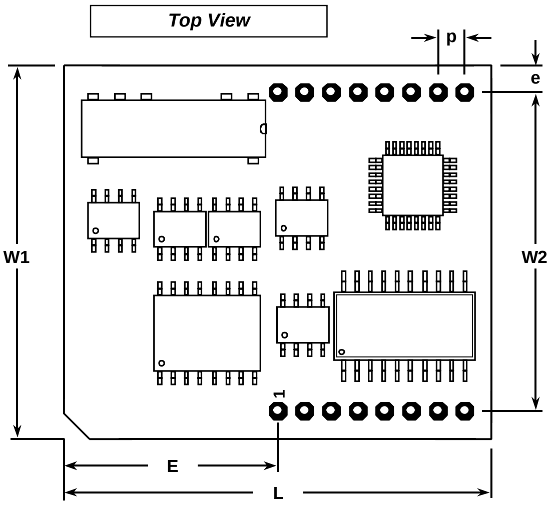


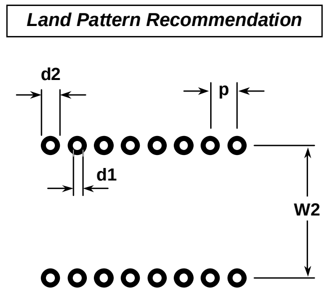


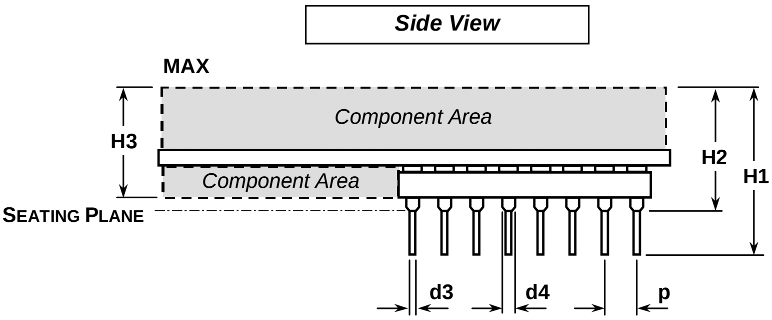
Unit	W1	W2	L	p	d1	d2	d3
inches	1.40	1.20	1.60	0.10	0.039	0.067	0.025
mm	35.56	30.48	40.64	2.54	1.0	1.70	0.64 square

Unit	H1	H2	H3	E	e
inches	0.728	0.492	0.354	0.80	0.10
mm	18.50	12.50	9.00	20.32	2.54

PACKAGE TYPE QD-A2



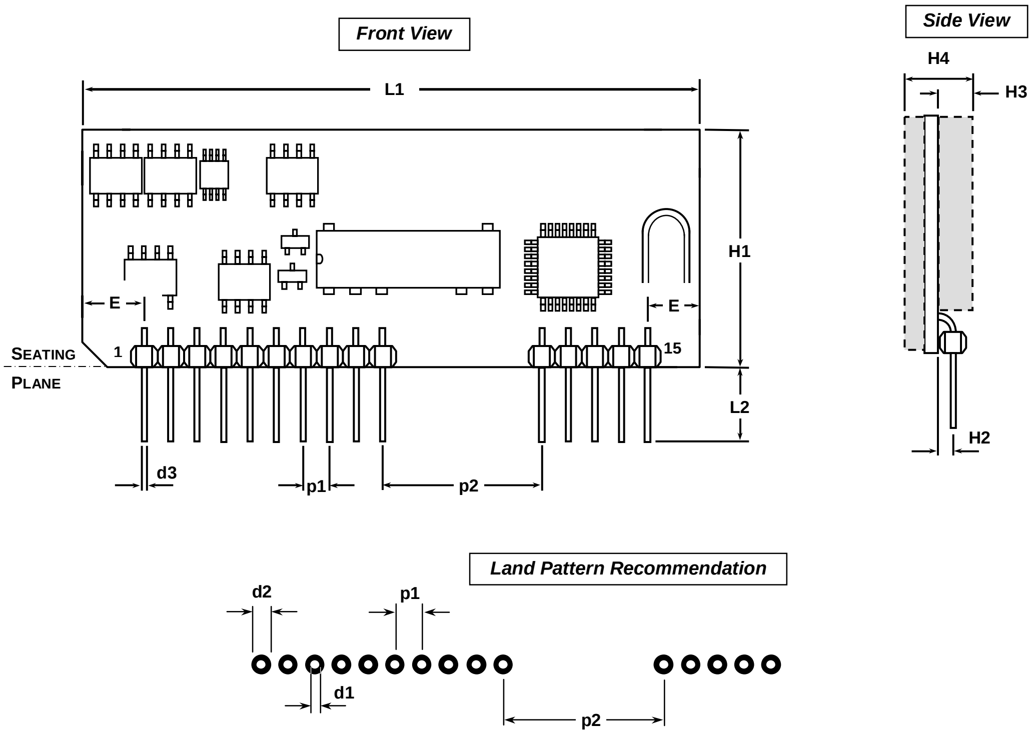




Unit	W1	W2	L	p	d1	d2	d3	d4
inches	1.40	1.20	1.60	0.10	0.035	0.067	0.020	0.039
mm	35.56	30.48	40.64	2.54	0.90	1.70	0.50	1.00

Unit	H1	H2	H3	E	e
inches	0.591	0.453	0.354	0.80	0.10
mm	15.00	11.50	9.00	20.32	2.54

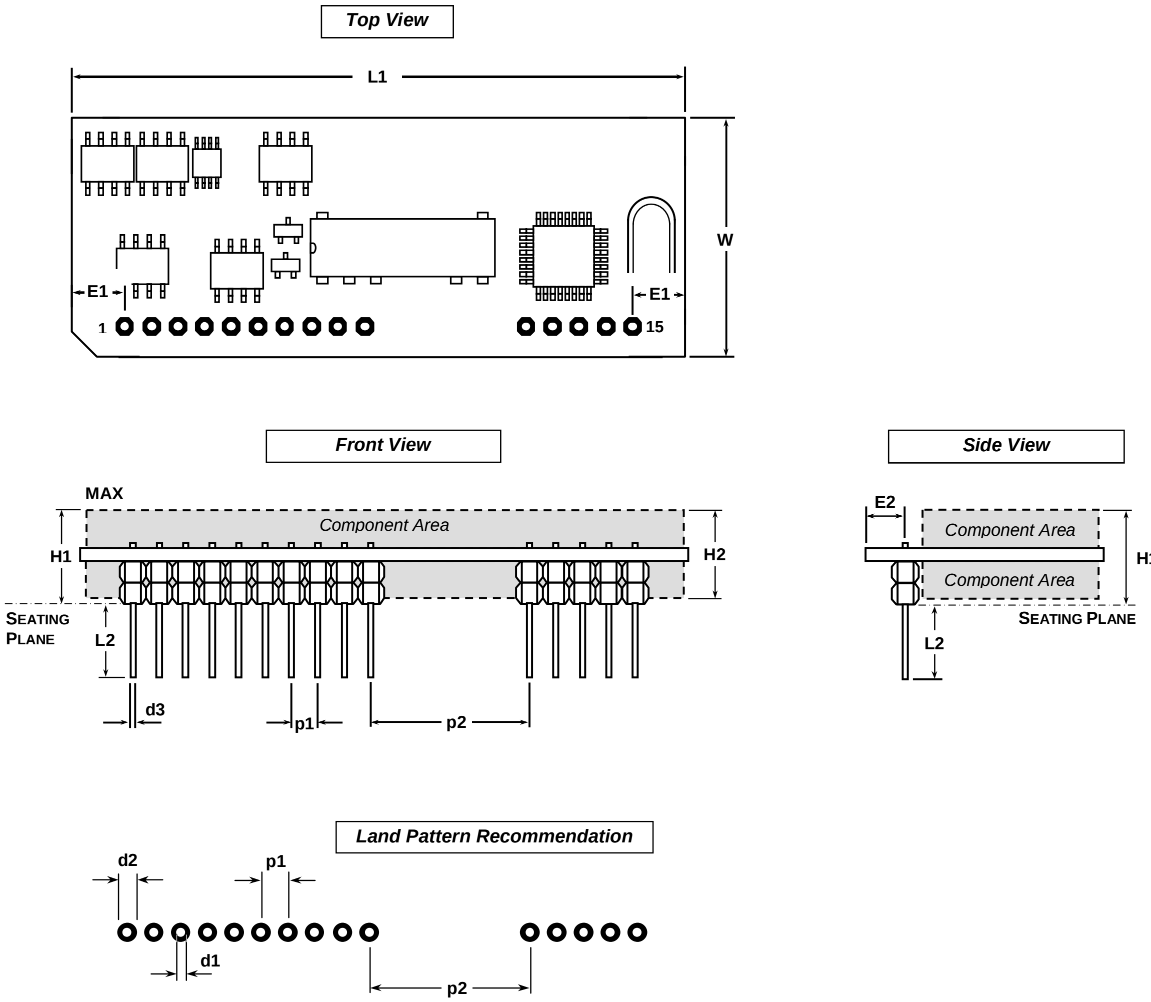
PACKAGE TYPE QD-B1



Unit	*H1*	*H2*	*H3*	*H4*	*L1*	*L2*	*E*
inches	0.95	0.049	0.177	0.354	2.288	0.228	0.194
mm	24.13	1.25	4.50	9.00	58.10	5.80	4.92

Unit	*p1*	*p2*	*d1*	*d2*	*d3*
inches	0.10	0.60	0.039	0.067	0.025
mm	2.54	15.24	1.0	1.70	0.64 square

PACKAGE TYPE QD-B2



Unit	*W*	*H1*	*H2*	*H3*	*L1*	*L2*	*E1*	*E2*
inch	0.95	0.492	0.354	0.177	2.288	0.228	0.194	0.138
mm	24.13	12.50	9.00	4.50	58.10	5.80	4.92	3.50

Unit	*p1*	*p2*	*d1*	*d2*	*d3*
inch	0.10	0.60	0.039	0.067	0.025
mm	2.54	15.24	1.0	1.70	0.64 square

LIST OF APPLICATION NOTES

The QD-1011 is functionally identical to the QD-1010. All applications notes concerning the QD-1010 that are applicable to the QD-1011 are included in the list below:

AN0007	Performing measurements with the QD-1010
AN0012	QD-1010 Mode Selection Protocols
AN0016	Calibrating the QD-1010
AN0017	QD-1010 Reference Setting & Readout Protocols when operating in window comparison I_{DDQ} mode
AN0018	QD-1010 Reference Setting & Readout Protocols when operating in Vector-to-External Reference delta I_{DDQ} mode
AN0026	QD-10xx Reference Setting & Readout Protocols when operating in standard I_{DDQ} mode
AN0027	QD-10xx Reference Setting & Readout Protocols when operating in delta I_{DDQ} mode
AN0033	QD-1011 Configuration Setting & Readout Protocols when operating in Current Ratios mode
AN0039	QD-1011 Configuration Setting & Readout Protocols when operating in Window Delta I_{DDQ} mode
AN0053	QD-10xx Configuration Setting & Readout Protocols when operating in pre & post stress delta I_{DDQ} mode