

# IQS211A Datasheet

## Single Channel Capacitive Proximity/Touch Controller with movement detection

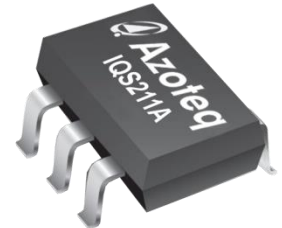
The IQS211A ProxSense® IC is a self-capacitance controller designed for applications where an awake/activate on proximity/touch function is required. The IQS211A is an ultra-low power solution that uses movement detection for applications that require long term detection. The IQS211A operates standalone or I<sup>2</sup>C and can be configured via OTP (One Time Programmable) bits.

### Features

- Pin compatible with IQS127/128/227/228
- **Automatic Tuning Implementation (ATI)**
- On-chip movement detection algorithm
- Forced activation when movement detected
- Minimal external components
- 25mm detection distance
- Up to 60pF sensor load (with effective movement detection)
- Multiple **One-Time-Programmable (OTP)** options
- **Standalone** direct outputs:
  - Primary output (configurable)  
Default: **ACTIVATION**
  - Secondary output (configurable)  
Default: **MOVEMENT**
- **1-Wire streaming** interface:
  - 1-Wire & event CLK signal
  - Valuable for debugging &
- **Special configurations:**
  - Activation based on capacitive load at

**RoHS2**  
Compliant

6 pin TSOT23-6  
Representations only,  
not actual markings



- **Separate MOVEMENT output selection:** power-on  
Pulse Frequency Modulation (PFM, default), Pulse Width Modulation (PWM), Latched, or PWM only active in activation
- **Low power consumption:** 80uA (50 Hz response), 20uA (20 Hz response) and 2uA (LP mode, optional zoom to scanning mode with wake-up)
- **Low power options:**
  - Low power without activation
  - Low power within activation
  - Low power standby modes with proximity wake-up / reset wake-up
- **Internal Capacitor Implementation (ICI)**
- Supply voltage: 1.8V to 3.3V
- Low profile TSOT23-6 package

### Applications

- Wearable devices
- Movement detection devices (fitness, anti-theft)
- White goods and appliances
- Human Interface Devices
- Proximity activated backlighting
- Applications with long-term activation

#### Available Packages

T <sub>A</sub>	TSOT23-6
-20°C to 85°C	IQS211A

# 1 Packaging and Pin-Out

The IQS211A is available in a TSOT23-6 package.

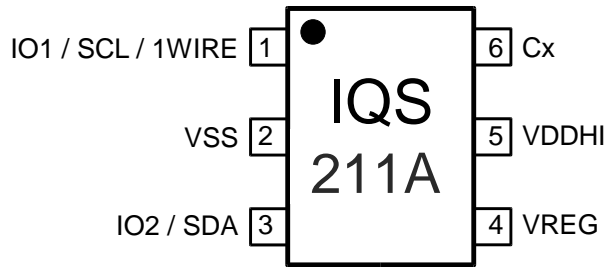


Figure 1.1 IQS211A pin-out (TSOT23-6 package)

Table 1.1 Pin-out description

IQS211A in TSOT23-6			
Pin	Name	Type	Function
1	PRIMARY I/O	Digital Input/Output	Multifunction <b>IO1 / SCL</b> (I <sup>2</sup> C Clock signal) / <b>1WIRE</b> (data streaming)
2	VSS	Signal GND	
3	SECONDARY I/O	Digital Input/Output	Multifunction <b>IO2 / SDA</b> (I <sup>2</sup> C Data output)
4	VREG	Regulator output	Requires external capacitor
5	VDDHI	Supply Input	Supply: 1.8V – 3.6V
6	Cx	Sense electrode	Connect to conductive area intended for sensor

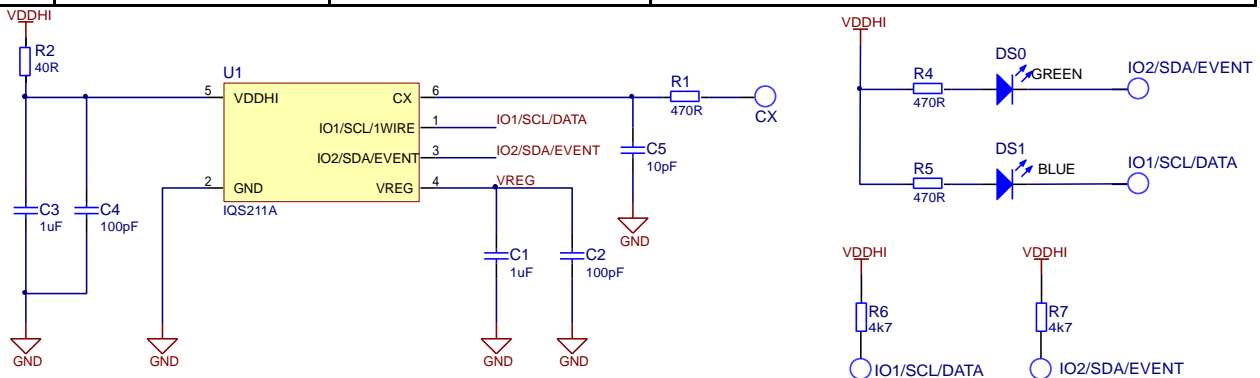


Figure 1.2 IQS211A reference schematic

Figure 1.2 shows the following:

- Schematic for default power mode, see guide for capacitor selection in low power modes below:

Low power scan time	8ms (default) - 32ms	64ms	128ms	256ms
Capacitor recommendation	C1 = 1µF C3 = 1µF	C1 = 1µF C3 = 2.2µF	C1 = 2.2µF C3 = 4.7µF	C1 = 4.7µF C3 = 10µF

- C5 = 10pF load. This can be changed for slight variations in sensitivity. The recommended value is 1pF to 60pF, depending on the capacitance of the rest of the layout.
- R1 = 470Ω 0603 for added ESD protection



- \* R2: Place a 40Ω resistor in the VDDHI supply line to prevent a potential ESD induced latch-up. Maximum supply current should be limited to 80mA on the IQS211A VDDHI pin to prevent latch-up.

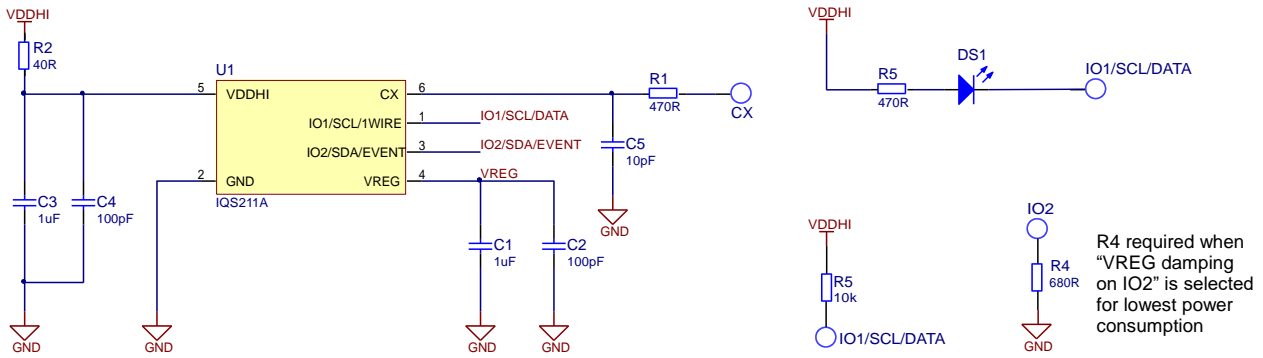


Figure 1.3 IQS211A reference schematic for ultra-low power (ULP) modes with VREG damping through IO2 selected (OTP bank3:bit3)



## 2 Configuration Options

The IQS211A offers various user selectable options. These options may be selected via I<sup>2</sup>C setup or one-time programmable (OTP) configuration. OTP settings may be ordered pre-programmed for bulk orders or in-circuit programming techniques may be implemented during the product testing phase. I<sup>2</sup>C setup allows access to all device settings while entering direct output mode as soon as selected by the MCU.

Azoteq offers a Configuration Tool (CT210 or later) and associated software that can be used to program the OTP user options for prototyping purposes. For further information regarding this subject, please contact your local distributor or submit enquiries to Azoteq at:

[ProSenseSupport@azoteq.com](mailto:ProSenseSupport@azoteq.com)



## 2.1 User Selectable OTP options

OTP bank 0								IQS211A 000000xx TSR (ordering code)							
Bit7		6		5		4		3		2		1		Bit 0	
Base Value / Sensitivity multiplier				Scan times				Prox wake-up				Low-power scan time			
00 – 150 counts / 0 01 – 75 / 1 10 – 100 / 2 11 – 200 / 3				Idle / Active 00 - 9/9ms 01 - 9/64 10 - 32/32 11 - 32/64				0 – Active direction  1 – Both directions				000 - 9ms 001 - 32ms 010 - 64ms 011 - 96ms 100 - 128ms 101 - 160ms 110 - 192ms 111 - 256ms			
OTP Bank 1								IQS211A 0000xx00 TSR							
Bit7		6		5		4		3		2		1		Bit 0	
Touch late release (50%)				Filter halt / Wake-up threshold				Touch threshold				Movement threshold			
0 – Disabled 1 – Enabled				00 – 4 counts (+2 LP) 01 – 2 (+2 LP) 10 – 8 (+2 LP) 11 – 16 (+2 LP)				000 – 6/256 of LTA 001 – 2/256 010 – 16/256 011 – 32/256 100 – 48/256 101 – 64/256 110 – 80/256 111 – 96/256				00 – 3 counts 01 – 6 10 – 15 11 – 2			
OTP Bank 2								IQS211A 00xx0000 TSR							
Bit7		6		5		4		3		2		1		Bit 0	
Reseed after no movement time				Movement output type				Output / User interface selection							
000 - 2s 001 - 5s 010 - 20s 011 - 1min 100 - 2min 101 - 10min 110 - 60min 111 - always halt				00 -Normal (PFM) 01 - PWM 10 - Constant Movement , clears upon no movement timeout 11 - PFM combined with activation output				000 -Activation(IO1) & Movement(IO2) 001 -Movement Latch(IO1) and Movement (IO2) 010 - Movement(IO1) & Input(IO2) 011 - Touch (IO1), Prox (IO2) 100 - 1Wire (IO1) & Clk (IO2) (only on events) 101 - I2C (polling) no wakeup 110 - I2C with reset indication+RDY toggle on SCL 111 - I2C (polling) + Wakeup + RDY toggle on SCL							
OTP Bank 3								IQS211A 0x0000000 TSR							
Bit7		6		5		4		3		2		1		Bit 0	
Reserved				VREG damping through IO2				AC Filter				Halt charge / Reseed on IO1			
				0 – Disabled 1 – Enabled				0 – Normal 1 – Increased				0 – Disabled 1 – Enabled			
												0 – Normal / Halt charge / Reduce sensitivity 1 – PWM / Reduce sensitivity			
OTP Bank 4								IQS211A x00000000 TSR							
Bit7		6		5		4		3		2		1		Bit 0	
Reserved				ATI partial				Auto activation (when compensation multiplier > 7)				ATI target			
				0 – Disabled 1 – Enabled				0 – Disabled 1 – Enabled				00 – 768 counts 01 – 1200 10 – 384 11 – 192			



## 2.2 I2C registers

Table 2.1 I2C communications layout

I2C Communications Layout											
Address/ Command/ Byte	Register name/s	R/W	Default Value	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
00H	<a href="#">PRODUCT_NUM</a>	R	0x3D								
01H	<a href="#">VERSION_NUM</a>	R	0x01								
10H	<a href="#">SYSFLAGS0</a>	R/W		Movement	Movement Constant	PROX	TOUCH	Show Reset	ATI Busy	Filter Halt	LP Active
41H	<a href="#">Movement Value</a>	R									
42H	<a href="#">CS_H</a>	R									
43H	<a href="#">CS_L</a>	R									
83H	<a href="#">LTA_H</a>	R									
84H	<a href="#">LTA_L</a>	R									
90H	<a href="#">Touch Threshold_H</a>										
91H	<a href="#">Touch Threshold_L</a>										
C4H	<a href="#">MULTIPLIERS</a>	R/W		n/a	n/a	n1	n0	p3	p2	p1	p0
C5H	<a href="#">COMPENSATION</a>	R/W		0-255							
C6H	<a href="#">PROX_SETTINGS0</a>	R/W		Base Value/ SensMult for Partial: 00 – 150/0 01 – 100/1 10 – 200/2 11 – 250/3		Reseed	Redo ATI	Active Scan Time 000 – 8ms (normal) 001 - +32ms Sleep 010 - +64ms Sleep 011 - +256ms Sleep		Idle Scan time 000 – 8ms (normal) 001 - +32ms Sleep 010 - +64ms Sleep 011 - +256ms Sleep	
C7H	<a href="#">PROX_SETTINGS1</a>	R/W		0 – Auto reseed is in seconds 1 – Auto reseed is in minutes	If UI type 011: 0- Halt charge/Reseed 1- Reduce sensitivity  If UI type 000: 0- Normal 1- PWM touch out	Halt Charge/Reseed on IO1, with IO1 set as output	00 – Normal (PFM) 01 – PWM 10 – Constant Movement , clears upon no movement timeout 11 – PFM combined with activation output		000 – Activation(IO1) & Movement(IO2) 001 – Movement Latch(IO1) and Movement (IO2) 010 – Movement(IO1) & Input(IO2) 011 – Touch (IO1), Prox (IO2) 100 – 1Wire (IO1) & CLK (IO2) (only on events) 101 – I2C (polling) no wakeup toggle on SCL 110 - I2C with reset indication +RDY toggle on SCL 111 – I2C (polling) + Wakeup + RDY toggle on SCL		
C8H	<a href="#">PROX_SETTINGS2</a>	R/W		0 – Prox Timeout of 2s 1 – Prox timeout of 20s	n/a	AUTO Activation on start up	n/a	Touch Late Release (50%)	Partial ATI enabled	Auto ATI off	Increase AC filters, increase touch threshold with 10counts, halt with 4
C9H	<a href="#">ATI_TARGET</a>	R/W		x * 8 = ATI target							
CAH	<a href="#">LP_PERIOD</a>	R/W		x * 16ms = sleep time							
CBH	<a href="#">PROX_THRESHOLD</a>	R/W									
CCH	<a href="#">TOUCH_THRESHOLD</a>	R/W									
CDH	<a href="#">MOVEMENT_THRESHOLD</a>	R/W									
CEH	<a href="#">AUTO_RESEED_LIMIT</a>	R/W		in Seconds or Minutes, based on PROX_SETTINGS1 bit 7.							



### 3 Specifications

#### 3.1 Absolute maximum ratings

The following absolute maximum parameters are specified for the device:

*Exceeding these maximum specifications may cause damage to the device.*

- Operating temperature -20°C to 85°C
- Supply Voltage (VDDHI – VSS) 3.6V
- Maximum pin voltage VDDHI + 0.5V (may not exceed VDDHI max)
- Maximum continuous current (for specific Pins) 10mA
- Minimum pin voltage VSS – 0.5V
- Minimum power-on slope 100V/s
- ESD protection ±8kV (Human body model)
- Package Moisture Sensitivity Level (MSL) 1

Table 3.1 IQS211A General Operating Conditions

DESCRIPTION	Conditions	PARAMETER	MIN	TYP	MAX	UNIT
Supply voltage		V <sub>DDHI</sub>	1.8	3.3V	3.6	V
Internal regulator output	$1.8 \leq V_{DDHI} \leq 3.6$	V <sub>REG</sub>	1.62	1.7	1.79	V
Default Operating Current	3.3V, Scan time = 9	I <sub>IQS211DP</sub>		77	88	μA
Low Power Example Setting 1*	3.3V, Scan time =160	I <sub>IQS211LP160</sub>			2**	μA

\*Scan time in ms

\*\*Defined for low target counts (192)

Table 3.2 Start-up and shut-down slope Characteristics

DESCRIPTION	Conditions	PARAMETER	MIN	MAX	UNIT
Power On Reset	V <sub>DDHI</sub> Slope ≥ 100V/s @25°C	POR	1.2	-	V
Brown Out Detect	V <sub>DDHI</sub> Slope ≥ 100V/s @25°C	BOD	-	1.5	V

Table 3.3 Input signal response characteristics (IO1/IO2)

DESCRIPTION	MIN	TYP	MAX	UNIT
Reseed function	15	20	25	ms
Halt charge / Reduce sensitivity function	50	n/a	n/a	ms

Table 3.4 Communications timing characteristics

DESCRIPTION	MIN	TYP	MAX	UNIT
t <sub>comms_timeout</sub>	-	20	-	ms



Table 3.5 Digital input trigger levels

DESCRIPTION	Conditions	PARAMETER	MIN	TYPICAL	MAX	UNIT
All digital inputs	VDD = 3.3V	Input low level voltage	1.19	1.3	1.3	V
All digital inputs	VDD = 1.8V	Input low level voltage	0.54	0.6	0.76	V
All digital inputs	VDD = 1.8V	Input high level voltage	0.9	1.0	1.2	V
All digital inputs	VDD = 3.3V	Input high level voltage	1.90	2.1	2.20	V



## 4 Package information

### 4.1 TSOT23-6

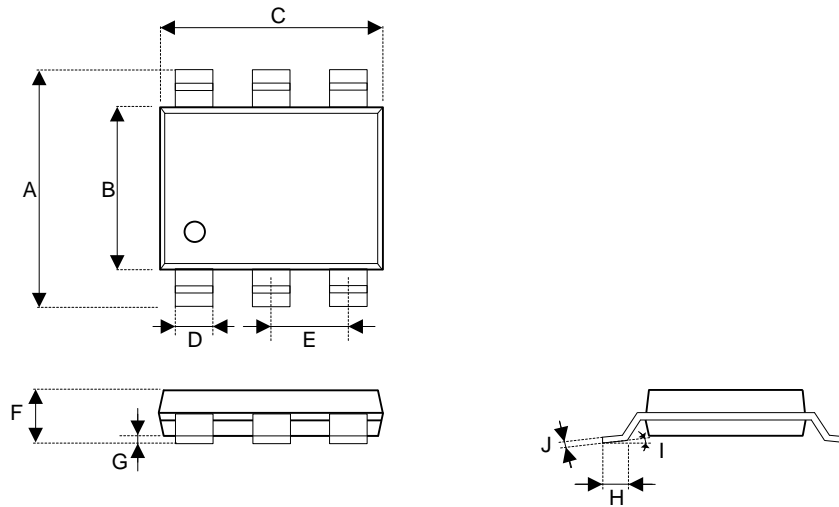


Figure 4.1 TSOT23-6 Packaging<sup>i</sup>

Table 4.1 TSOT23-6 Dimensions

Dimension	Min (mm)	Max (mm)
A	2.60	3.00
B	1.50	1.70
C	2.80	3.00
D	0.30	0.50
E	0.95 Basic	
F	0.84	1.00
G	0.00	0.10
H	0.30	0.50
I	0°	8°
J	0.03	0.20

<sup>i</sup> Drawing not on Scale



## 4.2 MSL Level

**Moisture Sensitivity Level (MSL)** relates to the packaging and handling precautions for some semiconductors. The MSL is an electronic standard for the time period in which a moisture sensitive device can be exposed to ambient room conditions (approximately 30°C/85%RH see J-STD033C for more info) before reflow occur.

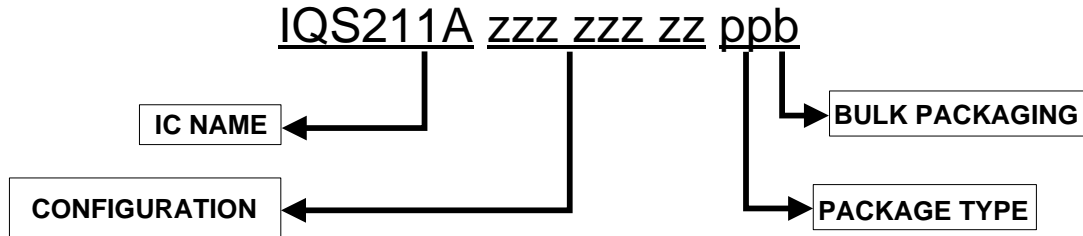
Package	Level (duration)
TSOT23-6	MSL 1 (Unlimited at ≤30 °C/85% RH) Reflow profile peak temperature < 260 °C for < 30 seconds



## 5 Ordering and Part-number Information

### 5.1 Ordering Information

Please check stock availability with your local distributor.



<b>IC NAME</b>	IQS211A	=	Self Capacitive Touch IC
<b>CONFIGURATION</b>	zzz zzz zz	=	IC configuration (hexadecimal) <b>Default 000 000 00</b> (other configurations available on request)
<b>PACKAGE TYPE</b>	TS	=	TSOT23-6 package
<b>BULK PACKAGING</b>	R	=	Reel (3000pcs/reel) – MOQ = 3000pcs MOQ = 1 reel (orders shipped as full reels)

### 5.2 Label Information

<b>REVISION</b>	x	=	IC Revision Number
<b>TEMPERATURE RANGE</b>	t	=	-20°C to 85°C (Industrial)
<b>DATE CODE</b>	P	=	Internal use
	WWYY=	=	Batch number

### 5.3 Device Marking – Top

There are 2 marking versions for IQS211A:

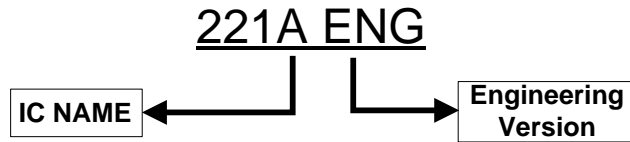


Figure 5.1 IQS211A engineer version, marked as 221A.

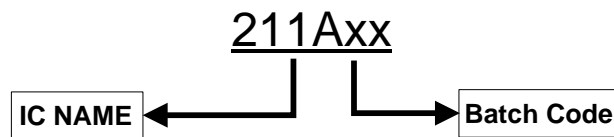


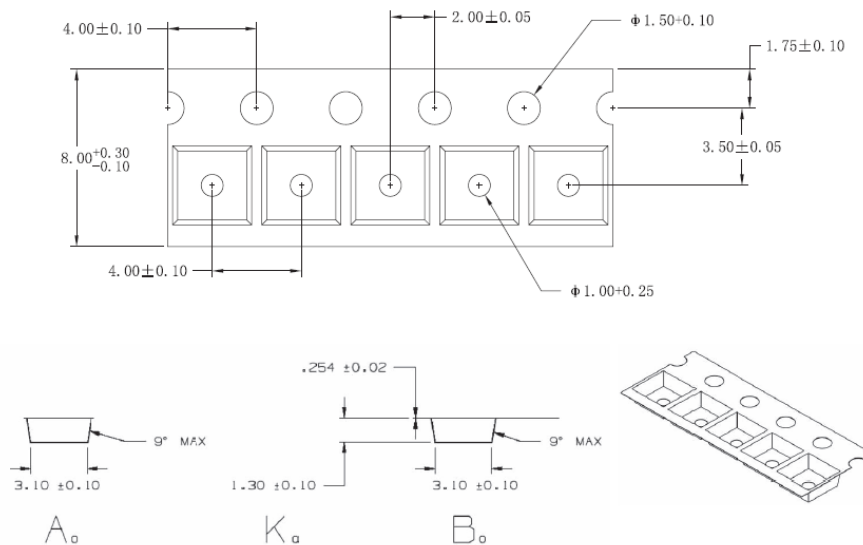
Figure 5.2 Production version marking of IQS211A.

<b>IC NAME</b>	221A ENG	=	IQS211A Engineering version
	211A	=	IQS211A Production version
<b>Batch Code</b>	xx	=	AA to ZZ

### 5.4 Device Marking - Bottom

Some batches IQS211A will not have any bottom markings. These devices are configured after marking, and may have variations in configuration – please refer to the reel label.

Other batches will display the version and unique product code on the chip on the bottom marking.



NOTE:  
1. Material is PC;  
2. Material : 3000.

### TSOT23-6 Tape Specification



Revision History

Revision Number	Description	Date of issue
V0.9	IQS211A preliminary datasheet	23 November 2015
V1.0	First release	December 2015
V1.01	Updated Ordering information and Marking	December 2015
V1.10	Latch-up prevention details added	September 2016
V1.2	Temperature range updated	28 September 2017

**Appendix A Contact Information**

	<b>USA</b>	<b>Asia</b>	<b>South Africa</b>
<b>Physical Address</b>	6507 Jester Blvd Bldg 5, suite 510G Austin TX 78750 USA	Rm2125, Glittery City Shennan Rd Futian District Shenzhen, 518033 China	109 Main Street Paarl 7646 South Africa
<b>Postal Address</b>	6507 Jester Blvd Bldg 5, suite 510G Austin TX 78750 USA	Rm2125, Glittery City Shennan Rd Futian District Shenzhen, 518033 China	PO Box 3534 Paarl 7620 South Africa
<b>Tel</b>	+1 512 538 1995	+86 755 8303 5294 ext 808	+27 21 863 0033
<b>Fax</b>	+1 512 672 8442		+27 21 863 1512
<b>Email</b>	info@azoteq.com	info@azoteq.com	info@azoteq.com

Please visit [www.azoteq.com](http://www.azoteq.com) for a list of distributors and worldwide representation.

The following patents relate to the device or usage of the device: US 6,249,089; US 6,952,084; US 6,984,900; US 7,084,526; US 7,084,531; US 8,395,395; US 8,531,120; US 8,659,306; US 8,823,273; US 9,209,803; US 9,360,510; EP 2,351,220; EP 2,559,164; EP 2,656,189; HK 1,156,120; HK 1,157,080; SA 2001/2151; SA 2006/05363; SA 2014/01541; SA 2015/023634

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