



**GAMBLING COMMISSION (GREAT BRITAIN)**

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**INDEPENDENT RNG CERTIFICATION REPORT**

FOR

HILLSIDE (UK SPORTS) LP

CERTIFICATE NUMBER:  
71182HSLGB001

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**SECTION 1. GENERAL INFORMATION**

License Holder:	Hillside (UK Sports) LP Unit 1.1, First Floor Waterport Place 2 Europort Avenue Gibraltar
Product Name:	ComScire Quantum Number Generator: PureQuantum™ Model PQ4000KU
Supplier:	ComScire
Product Description:	PureQuantum™ Model PQ4000KU. The PQ4000KU is a quantum random number generator used for cryptographic purposes as well as online gaming and other applications requiring high levels of security and randomness properties.
Product Version:	PureQuantum™ Model PQ4000KU
RNG Type:	Hardware
Scope of Testing:	Remote Gambling and Software Technical Standards (“RTS”) – June 2017, Level 1 testing against RTS 7A
Testing Laboratory:	eGaming Compliance Services Limited, trading as ‘eCOGRA’ 2/F Berkeley Square House Berkeley Square London W1J 6 BD United Kingdom
Testing Laboratory Accreditation:	A UKAS accredited testing laboratory No. 4656 ISO/IEC 17025:2005, issued by the United Kingdom Accreditation Service
Test Engineers:	Sthembiso Mvelase, Sphamandla Langa, Rachel Chinyoka, Pooveshan Gounden
Test Supervisor:	Gary Lupton-Smith
Testing Start Date:	16 October 2017
Certificate Date:	20 November 2017
Certificate Number:	71182HSLGB001
Result of Testing:	Compliant (Refer to Test Results under Schedule 1)

I hereby certify that the abovementioned RNG complies with the requirements of RTS 7A of the UKGC's Remote Gambling and Software Technical Standards – June 2017, as described in Section 4 of this report.

Gary Lupton-Smith

A handwritten signature in black ink, appearing to read "Gary Lupton-Smith".

Technical Services Manager, eCOGRA

## SECTION 2. INTRODUCTION

eCOGRA has been appointed by HILLSIDE (UK SPORTS) LP to evaluate and certify the ComScire Quantum Number Generator product against compliance with the relevant Remote gambling and software technical standards – June 2017, and to highlight any exceptions identified during testing.

➤ **ComScire Quantum Number Generator: PureQuantum™ Model PQ4000KU**

This certification report highlights our key findings as a result of the evaluation conducted during the period 16 October 2017 to 10 November 2017.

## SECTION 3. HARDWARE DETAILS

The scope of the RNG evaluation and certification applies solely to the RNG provided in the tables below:

### Random Number Generator

RNG	Description	Interface
Primary RNG	PureQuantum™ Model PQ4000KU	USB interface

**SECTION 4. REVIEW FINDINGS**

The key findings of our evaluation of the RNG for compliance with the relevant sections of the Remote Gambling and Software Technical Standards – June 2017, are as follows:

RTS Requirement	RTS Implementation Guidance	Testing Applied	Assessment	Comments
<b>RTS 7 – Generation of random outcomes</b> <i>(Aim: To ensure that games and other virtual events operate fairly)</i>				
<b>RTS requirement 7A</b> Random number generation and game results must be ‘acceptably random’. Acceptably random here means that it is possible to demonstrate to a high degree of confidence that the output of the RNG, game, lottery and virtual event outcomes are random, through, for example, statistical analysis using generally accepted tests and methods of analysis. Adaptive behaviour (i.e. a compensated game) is not	<b>RTS implementation guidance 7A</b> a. RNG’s should be capable of demonstrating the following qualities: i. the output from the RNG is uniformly distributed over the entire output range and game, lottery, or virtual event outcomes are distributed in accordance with the expected/theoretical probabilities ii. the output of the RNG, game, lottery, and virtual event outcomes should be unpredictable, for example, for a software RNG it should be computationally infeasible to predict what the next number will be without	Refer to “1. Tests Performed” under “Schedule 1 – RNG Testing” below.	Compliant	

RTS Requirement	RTS Implementation Guidance	Testing Applied	Assessment	Comments
<p>permitted.</p> <p>Where lotteries use the outcome of other events external to the lottery, to determine the result of the lottery (for example, using numbers from the National Lottery) the outcome must be unpredictable and externally verifiable.</p>	<p>complete knowledge of the algorithm and seed value</p> <p>iii. random number generation does not reproduce the same output stream (cycle), and that two instances of a RNG do not produce the same stream as each other (synchronise)</p> <p>iv. any forms of seeding and re-seeding used do not introduce predictability</p> <p>v. any scaling applied to the output of the random number generator maintains the qualities above.</p> <p>c. For games or virtual events that use the laws of physics to generate the outcome of the game (mechanical RNGs), the mechanical RNG used should be capable of meeting the requirements in a. where applicable and in addition:</p> <p>i. the mechanical pieces should be constructed of materials to prevent decomposition of any component over time (e.g. a ball shall not disintegrate)</p>			



RTS Requirement	RTS Implementation Guidance	Testing Applied	Assessment	Comments
	ii. the properties of physical items used to choose the selection should not be altered iii. players should not have the ability to interact with, come into physical contact with, or manipulate the mechanics of the game. d. Restricting adaptive behaviour prohibits automatic or manual interventions that change the probabilities of game outcomes occurring during play. Restricting adaptive behaviour is not intended to prevent games from offering bonus or special features that implement a different set of rules, if they are based on the occurrence of random events.			

## **SCHEDULE 1. RNG TESTING**

### **1. TESTS PERFORMED**

The scope of the evaluation consisted of an assessment of the following components:

- Documentation review;
- Source code review;
- Statistical and mathematical analysis;
- RNG range; and
- RNG scaling.

The RNG evaluation was performed to ensure the following requirements were met:

- The data must be randomly generated;
- The data must be unpredictable; and
- The series cannot be reproduced.

The test suite used to perform the evaluation consisted of the following:

- Chi-Squared Tests
- Wald-Wolfowitz (Runs Tests
- Expected probabilities for shuffled decks
- Diehard Test Suite

### **2. TEST RESULTS**

Numerous recognised statistical and mathematical tests were performed to certify the RNG operated in compliance with RTS 7A of the Remote Gambling and Software Technical Standards – June 2017, including tests for probability (to ensure the expected occurrences), randomness (so that one cannot predict the following occurrence with any degree of certainty) and uniformity (to determine that each possible outcome is equally likely over the long-term). The acceptance criteria for the statistical tests should pass the tests at a 95% confidence level.

1. OUTPUT BASED TESTING ON SCALED RANGES: 0-33, 0-36, 0-51, 0-66, 0-99, 0-500, 0-999

a. OUTPUT BASED TESTING ON SCALED RANGES RESULTS

OUTPUT BASED TESTING				CLIENT GENERATED DATA			eCOGRA GENERATED DATA		
				Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3
Tests Number	Sample size	Test Range	DoF	P-value	P-value	P-value	P-value	P-value	P-value
1	3 000 000	0-33	33	0.05154	0.30361	0.57560	0.04278	0.47522	0.22933
2	3 000 000	0-36	36	0.21951	0.89358	0.95688	0.16060	0.05006	0.93872
3	3 000 000	0-51	51	0.67184	0.79086	0.11211	0.09250	0.81717	0.56121
4	3 000 000	0-66	66	0.04571	0.08254	0.35396	0.42111	0.25545	0.08139
5	3 000 000	0-99	99	0.38228	0.75081	0.92634	0.57336	0.97352	0.21927
6	3 000 000	0-500	500	0.82703	0.38278	0.64627	0.37672	0.02713	0.46879
7	3 000 000	0-999	999	0.99441	0.09927	0.57186	0.69682	0.27345	0.72762

b. SCALED DATA RANDOMNESS TEST SUCCESS (✓) OR FAILURE (×) SUMMARY

OUTPUT BASED TESTING				CLIENT GENERATED DATA			eCOGRA GENERATED DATA		
				Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3
Tests Number	Sample size	Test Range	DoF	P-value	P-value	P-value	P-value	P-value	P-value
1	3 000 000	0-33	33	✓	✓	✓	✓	✓	✓
2	3 000 000	0-36	36	✓	✓	✓	✓	✓	✓
3	3 000 000	0-51	51	✓	✓	✓	✓	✓	✓
4	3 000 000	0-66	66	✓	✓	✓	✓	✓	✓
5	3 000 000	0-99	99	✓	✓	✓	✓	✓	✓
6	3 000 000	0-500	500	✓	✓	✓	✓	✓	✓
7	3 000 000	0-999	999	✓	✓	✓	✓	✓	✓

**2. OUTPUT BASED TESTING ON SHUFFLED DECKS**

**a. OUTPUT BASED TESTING ON SHUFFLED DECKS RESULTS**

OUTPUT BASED TESTING				CLIENT GENERATED DATA			eCOGRA GENERATED DATA		
				Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3
Tests Number	Sample size	Test Range	DoF	P-value	P-value	P-value	P-value	P-value	P-value
1	3 000 000	5 Card Hands	8	0.93870	0.47408	0.45315	0.56904	0.37145	0.73236
2	3 000 000	7 Card Hands	9	0.44669	0.09647	0.12693	0.82022	0.61623	0.04994
3	3 000 000	5-7 Card Multiples Combinations	17	0.97120	0.26622	0.37617	0.95204	0.26959	0.31616
4	3 000 000	5-7 Card Suit Combinations	29	0.75744	0.91498	0.07738	0.49122	0.88268	0.66855

**b. SHUFFLED DECKS RANDOMNESS TEST SUCCESS (✓) OR FAILURE (✗) SUMMARY**

OUTPUT BASED TESTING				CLIENT GENERATED DATA			eCOGRA GENERATED DATA		
				Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3
Tests Number	Sample size	Test Range	DoF	P-value	P-value	P-value	P-value	P-value	P-value
1	3 000 000	5 Card Hands	8	✓	✓	✓	✓	✓	✓
2	3 000 000	7 Card Hands	9	✓	✓	✓	✓	✓	✓
3	3 000 000	5-7 Card Multiples Combinations	17	✓	✓	✓	✓	✓	✓
4	3 000 000	5-7 Card Suit Combinations	29	✓	✓	✓	✓	✓	✓

**3. DIEHARD TESTS**

**a. DIEHARD TEST RESULTS**

DIEHARD TEST		CLIENT GENERATED DATA			eCOGRA GENERATED DATA		
Test Name	Sample Size	Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3
BIRTHDAY SPACINGS TEST	48 000 000	0.2615	0.0529	0.3838	0.1680	0.0937	0.0131
OVERLAPPING 5-PERMUTATION TEST	48 000 000	0.7663	0.1661	0.0104	0.0886	0.2127	0.6364
THE BITSTREAM TEST	48 000 000	0.1518	0.0539	0.0010	0.1772	0.1098	0.0066
COUNT-THE-1's TEST bytes	48 000 000	0.0109	0.0328	0.0796	0.0483	0.0742	0.0846
MINIMUM DISTANCE TEST	48 000 000	0.6396	0.4067	0.9500	0.1235	0.8094	0.4408
SQUEEZE TEST	48 000 000	0.1214	0.9329	0.0588	0.8275	0.7534	0.2284
RUNS TEST	48 000 000	0.1227	0.0118	0.1063	0.0603	0.1204	0.5246
CRAPS TEST	48 000 000	0.1377	0.3500	0.5805	0.2499	0.3863	0.4398

**b. DIEHARD TESTS SUCCESS (✓) OR FAILURE (✗) SUMMARY**

DIEHARD TEST		CLIENT GENERATED DATA			eCOGRA GENERATED DATA		
Test Name	Sample Size	Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3
BIRTHDAY SPACINGS TEST	48 000 000	✓	✓	✓	✓	✓	✓
OVERLAPPING 5-PERMUTATION TEST	48 000 000	✓	✓	✓	✓	✓	✓
THE BITSTREAM TEST	48 000 000	✓	✓	✓	✓	✓	✓
COUNT-THE-1's TEST bytes	48 000 000	✓	✓	✓	✓	✓	✓
MINIMUM DISTANCE TEST	48 000 000	✓	✓	✓	✓	✓	✓
SQUEEZE TEST	48 000 000	✓	✓	✓	✓	✓	✓
RUNS TEST	48 000 000	✓	✓	✓	✓	✓	✓
CRAPS TEST	48 000 000	✓	✓	✓	✓	✓	✓

### **3. CONCLUSION**

Our test results produced statistically acceptable outcomes that were free of any significant statistical bias or predictability. Based on the testing conducted, the RNG is compliant with the requirements of RTS 7A of the UKGC's Remote gambling and software technical standards – June 2017.