

Ingersoll-Rand Industrial U.S., Inc.

SAR COMPLIANCE REPORT

Report Type:

FCC SAR assessment report

Model:

RTS025PQ4, RTS060PS6, RTS060PH6, RTS060PS8,
RTS060PH8, RTS140PS8, RTS140PH8, RTS225PS8,
RTS225PH8

REPORT NUMBER:

2311A1829SHA-003

ISSUE DATE:

Jun 5, 2024

DOCUMENT CONTROL NUMBER:

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Applicant: Ingersoll-Rand Industrial U.S., Inc.
525 Harbour Place Drive Davidson NC 28036 United States Of
America

Manufacturer: Ingersoll-Rand Industrial U.S., Inc.
525 Harbour Place Drive Davidson NC 28036 United States Of
America

FCC ID: 2ATB3-RTSSTM55WB

SUMMARY:

The equipment complies with the requirements according to the following standard(s) or Specification:

KDB447498 D01 General RF Exposure Guidance v06

FCC Part2.1091, FCC Part2.1093 FCC Part1.1307(b)

PREPARED BY:**REVIEWED BY:**

Project Engineer
Teddy Yin

Reviewer
Wakeyou Wang

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Revision History

Report No.	Version	Description	Issued Date
2311A1829SHA-003	Rev. 01	Initial issue of report	Jun 5, 2024

1 GENERAL INFORMATION

1.1 Description of Equipment Under Test (EUT)

Product name:	Mechanical Pulse Wrench
Type/Model/PMN/HVIN:	RTS025PQ4, RTS060PS6, RTS060PH6, RTS060PS8, RTS060PH8, RTS140PS8, RTS140PH8, RTS225PS8, RTS225PH8
Description of EUT:	The EUT is Mechanical pulse wrench with WIFI 2.4G/ 5G, Zigbee and BLE functions. All models are fully same except for the head part's shape and size. The details are in the following table. RTS060PS6 was tested as representative.
Rating:	DC 20V
EUT type:	<input checked="" type="checkbox"/> Table top <input type="checkbox"/> Floor standing
Software Version:	/
Hardware Version:	/
Sample Identification No.:	A240305-21-001
Sample received date:	Jan 31, 2024
Date of test:	Jan 31~Apr 3, 2024

Model	Output shaft					Impact hammer & Spring			
	1/4" Hex	3/8" Ring with Hole	3/8" Pin	1/2" Ring with Hole	1/2" Pin	A	B	C	D
RTS025PQ4	■					■			
RTS060PS6			■				■		
RTS060PH6		■					■		
RTS060PS8					■		■		
RTS060PH8				■			■		
RTS140PS8					■			■	
RTS140PH8				■				■	
RTS225PS8					■				■
RTS225PH8				■					■

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Impact hammer & Spring : Model A, B, C, D



1.2 Technical Specification

BLE

Frequency Range:	2402-2480MHz
Support Standards:	Bluetooth LE 5.3
Type of Modulation:	GFSK
Channel Number:	40
Data Rate:	1Mbps, 2Mbps
Channel Separation:	2MHz

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Antenna Information:	2.03dBi, Chip antenna
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Zigbee

Frequency Range:	2405-2480MHz
Support Standards:	Zigbee
Type of Modulation:	O-QPSK
Channel Number:	16
Data Rate:	250kbps
Channel Separation:	5MHz
Antenna Information:	2.03dBi, Chip antenna

WIFI2.4G

Frequency Range:	2412MHz ~ 2462MHz
Support Standards:	IEEE 802.11b, IEEE 802.11g, IEEE 802.11n-HT20, IEEE 802.11n-HT40
Type of Modulation:	IEEE 802.11b: DSSS (CCK, DQPSK, DBPSK) IEEE 802.11g: OFDM (64-QAM, 16-QAM, QPSK, BPSK) IEEE 802.11n-HT20: OFDM (64-QAM, 16-QAM, QPSK, BPSK) IEEE 802.11n-HT40: OFDM (64-QAM, 16-QAM, QPSK, BPSK)
Channel Number:	11 Channels for 802.11b, 802.11g and 802.11n(HT20) 7 Channels for 802.11n(HT40)
Data Rate:	IEEE 802.11b: Up to 11 Mbps IEEE 802.11g: Up to 54 Mbps IEEE 802.11n-HT20: Up to MCS7 IEEE 802.11n-HT40: Up to MCS7
Channel Separation:	5 MHz
Antenna Information:	0.71dBi, PCB antenna

WIFI5G

Frequency Range:	UNII-1: 5150 MHz - 5250 MHz UNII-2a: 5250 MHz - 5350 MHz, UNII-2c: 5470 MHz - 5725 MHz(5600-5650 MHz excluded in Canada) UNII-3: 5725 MHz - 5850 MHz
Support Standards:	IEEE 802.11a, IEEE 802.11n-HT20, IEEE 802.11n-HT40
Type of Modulation:	IEEE 802.11a: OFDM (64-QAM, 16-QAM, QPSK, BPSK) IEEE 802.11n-HT20: OFDM (64-QAM, 16-QAM, QPSK, BPSK) IEEE 802.11n-HT40: OFDM (64-QAM, 16-QAM, QPSK, BPSK)
Channel Number:	For 5150 - 5250MHz band: Channel 36 - 48 For 5250 - 5350MHz Band: Channel 52 - 64 For 5470 - 5725MHz Band: Channel 100 -140(5600-5650 MHz excluded in Canada) For 5725 - 5850MHz Band: Channel 149- 165
Data Rate:	IEEE 802.11a: Up to 54 Mbps

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	IEEE 802.11n-HT20: Up to MCS7 IEEE 802.11n-HT40: Up to MCS7
Channel Separation:	20 MHz
Antenna Information:	1.25dBi, PCB antenna

1.3 Description of Test Facility

Name:	Intertek Testing Services Shanghai
Address:	Building 86, No. 1198 Qinzhou Road(North), Shanghai 200233, P.R. China
Telephone:	86 21 61278200
Telefax:	86 21 54262353

The test facility is recognized, certified, or accredited by these organizations:	CNAS Accreditation Lab Registration No. CNAS L0139
	FCC Accredited Lab Designation Number: CN0175
	IC Registration Lab CAB identifier.: CN0014
	VCCI Registration Lab Registration No.: R-14243, G-10845, C-14723, T-12252
	A2LA Accreditation Lab Certificate Number: 3309.02

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2 SAR Assessment

Test result: Pass

2.1 SAR Test Exclusion Limit

100 MHz – 6 GHz and ≤ 50 mm

MHz	5	10	15	20	25	mm
150	39	77	116	155	194	SAR Test Exclusion Threshold (mW)
300	27	55	82	110	137	
450	22	45	67	89	112	
835	16	33	49	66	82	
900	16	32	47	63	79	
1500	12	24	37	49	61	
1900	11	22	33	44	54	
2450	10	19	29	38	48	
3600	8	16	24	32	40	
5200	7	13	20	26	33	
5400	6	13	19	26	32	
5800	6	12	19	25	31	
MHz	30	35	40	45	50	mm
150	232	271	310	349	387	SAR Test Exclusion Threshold (mW)
300	164	192	219	246	274	
450	134	157	179	201	224	
835	98	115	131	148	164	
900	95	111	126	142	158	
1500	73	86	98	110	122	
1900	65	76	87	98	109	
2450	57	67	77	86	96	
3600	47	55	63	71	79	
5200	39	46	53	59	66	
5400	39	45	52	58	65	
5800	37	44	50	56	62	

Note: 10-g Extremity SAR Test Exclusion Power Thresholds are 2.5 times higher than the 1-g SAR Test Exclusion Thresholds indicated above.

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100 MHz – 6 GHz and > 50 mm

MHz	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	mm
100	474	481	487	494	501	507	514	521	527	534	541	547	554	561	567	mW
150	387	397	407	417	427	437	447	457	467	477	487	497	507	517	527	
300	274	294	314	334	354	374	394	414	434	454	474	494	514	534	554	
450	224	254	284	314	344	374	404	434	464	494	524	554	584	614	644	
835	164	220	275	331	387	442	498	554	609	665	721	776	832	888	943	
900	158	218	278	338	398	458	518	578	638	698	758	818	878	938	998	
1500	122	222	322	422	522	622	722	822	922	1022	1122	1222	1322	1422	1522	
1900	109	209	309	409	509	609	709	809	909	1009	1109	1209	1309	1409	1509	
2450	96	196	296	396	496	596	696	796	896	996	1096	1196	1296	1396	1496	
3600	79	179	279	379	479	579	679	779	879	979	1079	1179	1279	1379	1479	
5200	66	166	266	366	466	566	666	766	866	966	1066	1166	1266	1366	1466	
5400	65	165	265	365	465	565	665	765	865	965	1065	1165	1265	1365	1465	
5800	62	162	262	362	462	562	662	762	862	962	1062	1162	1262	1362	1462	

< 100 MHz and < 200 mm

MHz	< 50	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	mm
100	237	474	481	487	494	501	507	514	521	527	534	541	547	554	561	567	mW
50	308	617	625	634	643	651	660	669	677	686	695	703	712	721	729	738	
10	474	948	961	975	988	1001	1015	1028	1041	1055	1068	1081	1095	1108	1121	1135	
1	711	1422	1442	1462	1482	1502	1522	1542	1562	1582	1602	1622	1642	1662	1682	1702	
0.1	948	1896	1923	1949	1976	2003	2029	2056	2083	2109	2136	2163	2189	2216	2243	2269	
0.05	1019	2039	2067	2096	2125	2153	2182	2211	2239	2268	2297	2325	2354	2383	2411	2440	
0.01	1185	2370	2403	2437	2470	2503	2537	2570	2603	2637	2670	2703	2737	2770	2803	2837	

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2.2 Assessment Results

From the manufacturer's statement,

The longest wi-fi message is 17 + 87 bytes = 104 bytes x 11.5 bits/byte = 1,196 bits

The transmit rate may be from 1 Mbps to 54 Mbps.

Take the worst case of 1 Mbps in a 100mS period. Actual performance limit for an operator would be 2 to 3 fastenings per second in short bursts so there cannot be more than 1 in any 100mS time period.

$1\mu\text{S} \times 1,196\text{bits} = 1.2\text{mS}$

1.2mS over a 100mS period is 1.2%

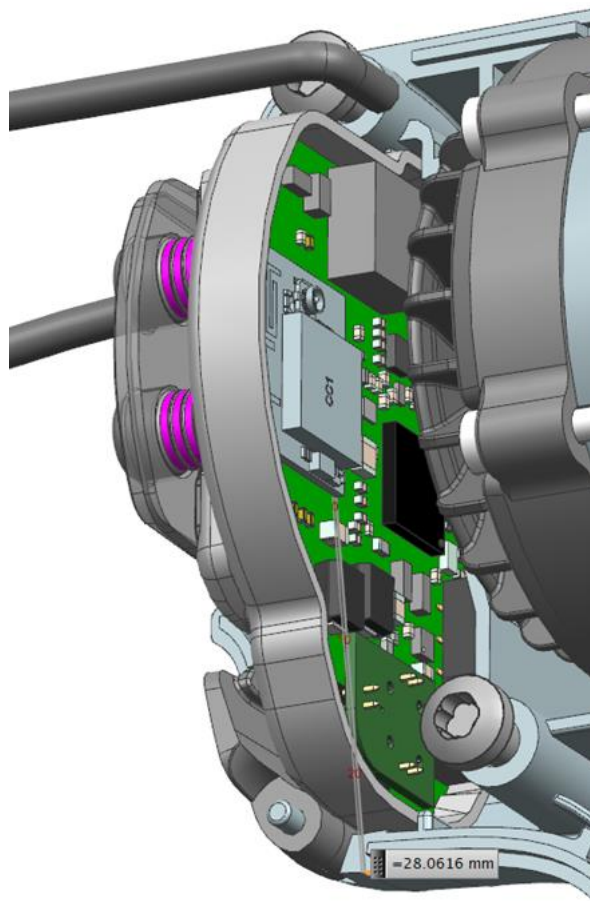
The above estimate represents a worst case.

Say pulse is 100% on, so $n=1$ and $t = 1.2\text{mS}$

Duty cycle = $1.2/100 = 0.012$

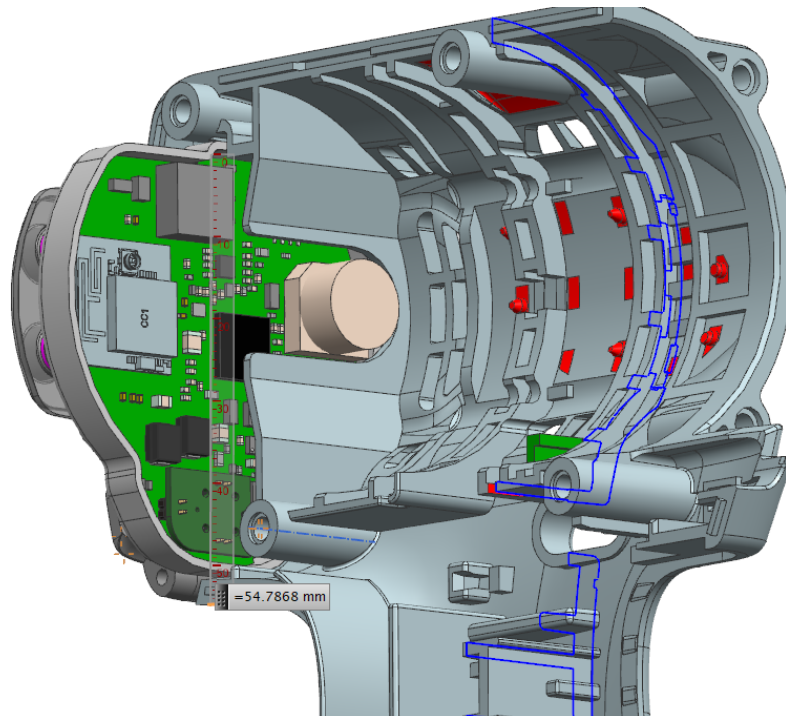
Correction factor in dB = $10\log [1.2/100] = 10\log(0.012) = -19.2\text{dB}$

From the diagram, the nearest distance between the antenna of WIFI 2.4G/5G module and the user's hand is 28.0616mm



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From the diagram, the nearest distance between the antenna of BLE/ZIGBEE module and the user's hand is 54.7868mm



Maximum AV EIRP of WIFI2.4G:

Device	Conducted Power (dBm)	Gain of Antenna (dBi)	Correction factor(dB)	AV EIRP (dBm)	AV EIRP (mW)
WIFI	24.74	0.71	-19.2	6.25	4.217

Maximum AV EIRP of WIFI5G:

Device	Conducted Power (dBm)	Gain of Antenna (dBi)	Correction factor(dB)	AV EIRP (dBm)	AV EIRP (mW)
WIFI	14.18	1.25	-19.2	-3.77	0.420

Maximum PK EIRP of BLE:

Device	Conducted Power (dBm)	Gain of Antenna (dBi)	PK EIRP (dBm)	PK EIRP (mW)
BLE	0.17	2.03	2.20	1.660

Maximum PK EIRP of Zigbee:

Device	Conducted Power (dBm)	Gain of Antenna (dBi)	PK EIRP (dBm)	PK EIRP (mW)
Zigbee	-0.36	2.03	1.67	1.469

The higher EIRP of WIFI 2.4G&5G is 4.217mW. The higher EIRP of BLE & Zigbee is 1.660mW. So the total highest EIRP adjusted with tune-up tolerance is $4.217+1.660= 5.877\text{mW} < 48\text{mW}$ (Test Exclusion Thresholds of 2450MHz at 25mm). Therefore, the SAR requirement is deemed to be satisfied without test.

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Note: WIFI2.4G, WIFI5G can not transmit simultaneously. BLE, ZIGBEE can not transmit simultaneously.

***** END *****