

WPC(Qi) 국제규격 현황 및 인증시험 절차 소개

5 March 2019

Wireless Power Transfer Technology Center
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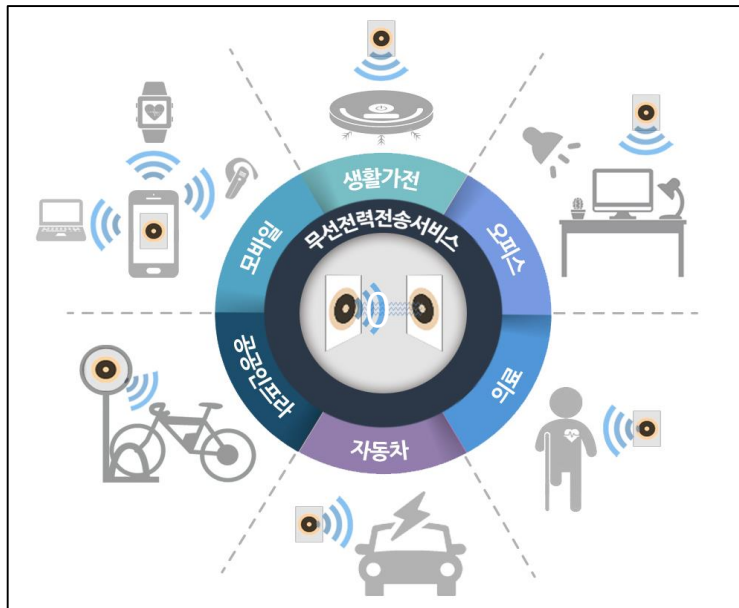


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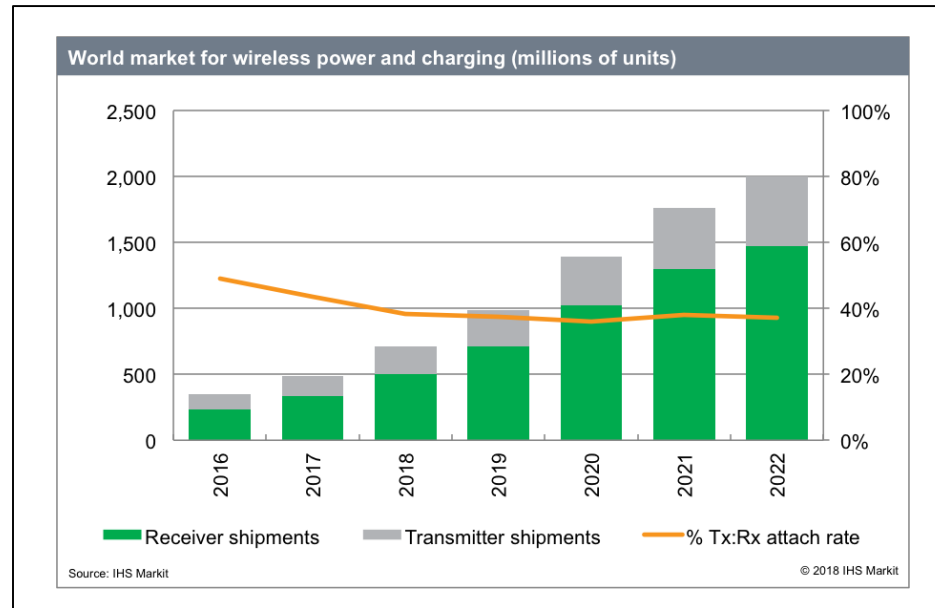
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Wireless Power Consortium(WPC)

무선전력전송 기술은 다양한 분야에서 활용이 가능하며
4차 산업혁명에서 핵심기술로 평가되고 있음



무선전력전송 기술의 활용 시나리오



세계 무선전력전송 시장전망

2017: 500 million wireless power products

- 400 million mobile phones
- 100 million wireless phone chargers

Wireless Power Consortium(WPC)

- WPC(Wireless Power Consortium) 란 ?

: 자기유도 방식의 무선전력전송 산업 분야 주요 제조업체 그룹 중심으로 무선전력전송 관련 제품(휴대폰, 가전제품, 전기차 등)의 국제규격(Qi)를 제정하는 단체

- 회원사 현황

: 삼성과 Apple을 포함한 653개의 기업 및 기관이 회원으로 활동

		Apple Inc.		
		SONY CORPORATION	 Innovation for the Real World	
 Invented for life		 INCORPORATED		
		 POWER BY		
	 life.augmented			

Power Classes

- Power Class 0

- This is the legacy technology, used to load the battery of devices such as mobile phones, tablets, and small accessories

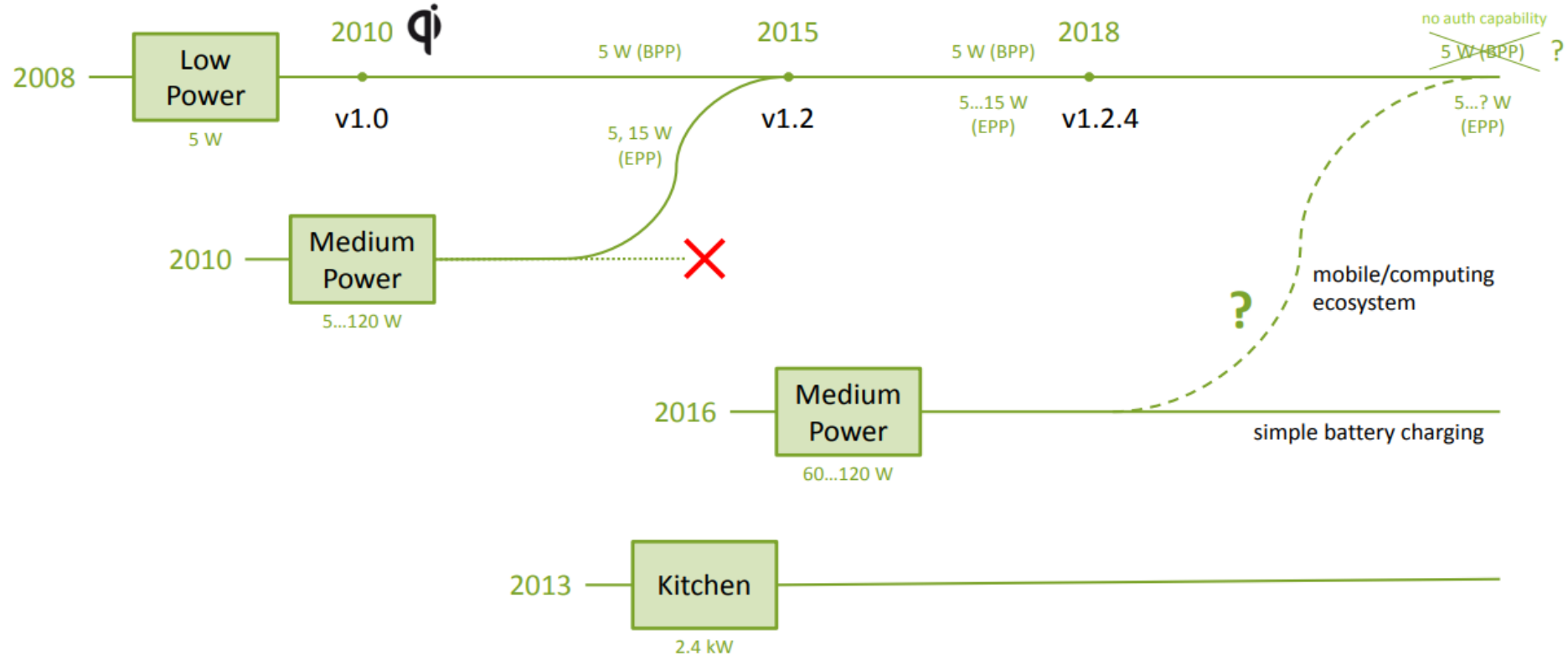
- Power Class 1

- This is a still new, but very active area of research for the WPC.
- This one will allow to transfer up to 200W, and will therefore potentially be used with laptops, personal care devices, power tools, and drones.

- Power Class 2

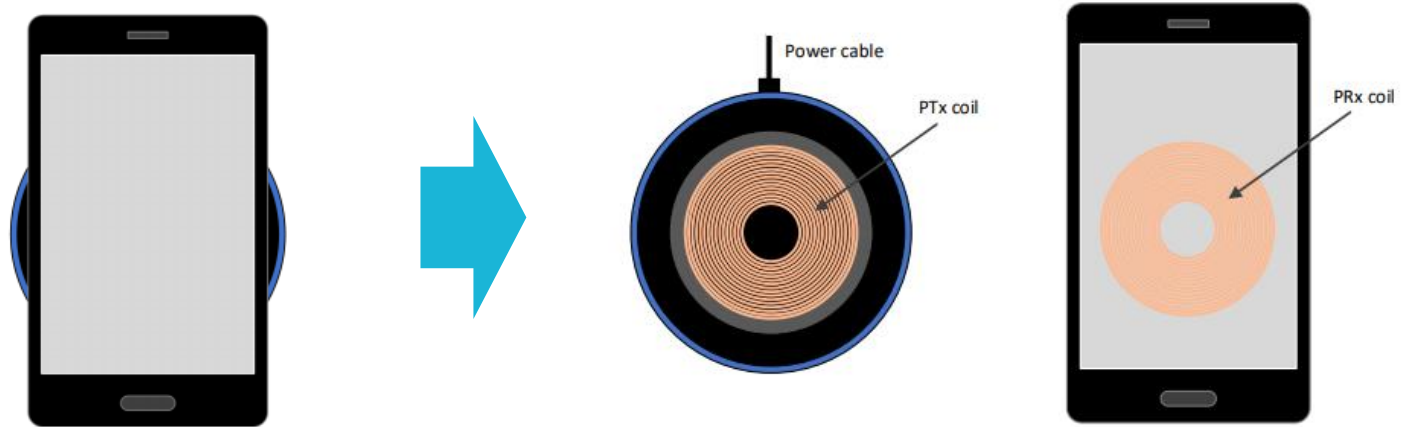
- This is a still new, but very active area of research for the WPC.
- The emerging kitchen wireless power standard builds on the success of Qi wireless charging for mobile devices. It delivers up to 2,200 watts of power wirelessly, enabling a variety of smarter, cord-free cooking devices and scenarios, from cordless blenders and mixers to more versatile cooktops and rice cookers.

Power Classes - Loadmap

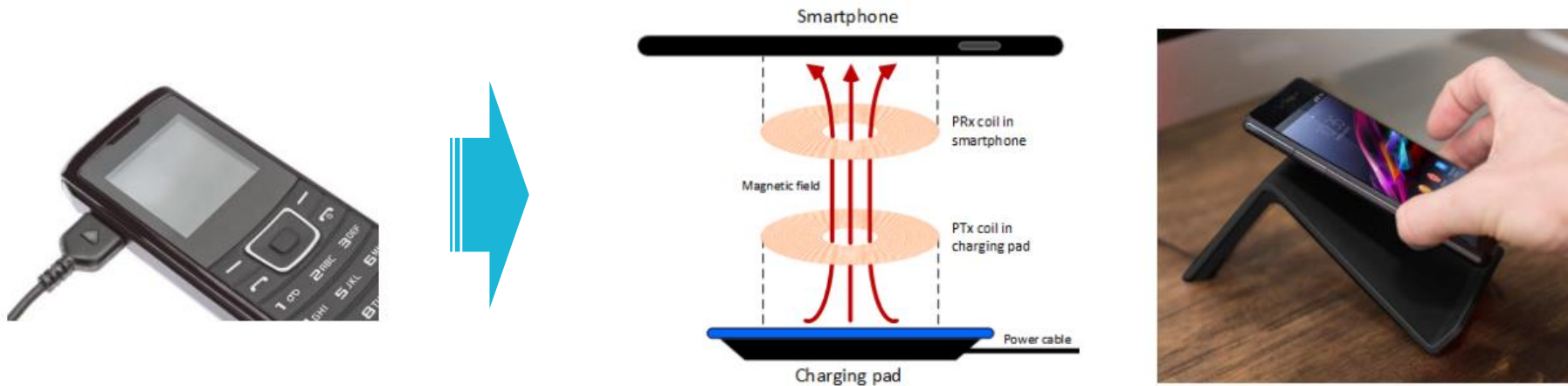


Power Classes – PC0(5W~15W)

- Mobile Phones
- Wireless Chargers
- Tablets
- Small Accessories



- * BPP(Baseline Power Profile): up to 5W
- * EPP(Extended Power Profile): up to 15W with FOD function



Power Classes – PC1(30W~200W)

- Power Tools
- Garden Tools
- Home Appliances
- Medical Applications
- Laptops
- Tablets
- eBikes



- Power Tools -

Power	65 W
Voltage	10.8 & 18 V
Current	3 A
Battery Capacity	2 .. 4 Ah

- Garden Tools -

Power	60 W
Voltage	18 V
Current	2.2 .. 2.3 A
Battery Capacity	12.5 Ah

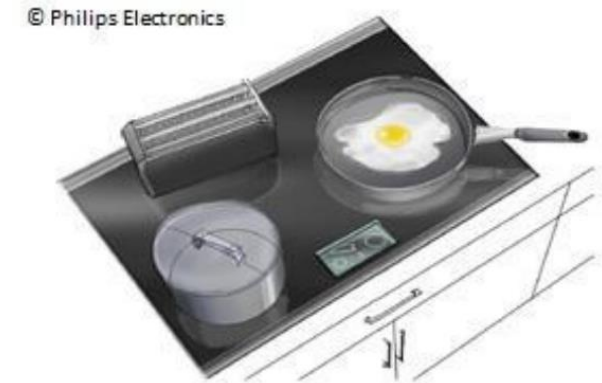
- eBikes -

Power	180 W
Voltage	36 V
Current	2 / 4 A
Battery Capacity	13 Ah

* 출처 : INTRODUCING NEXT WPC POWER LEVEL by Bosch

Power Classes – PC2(300W~2400W)

- Small Kitchen Appliances
- Built-in Kitchen Appliances
(stoves and induction cooktops)
- Cookware
- Kitchen Counters
- Dining Room Furniture



WPC(Qi) 국제규격 인증 절차

- **Compatibility**

- Create an open ecosystem
- Protect consumer and industry investments

- **High Efficiency**

- Promote responsible use of energy
- Minimize heating of products

- **Intuitively Safe**

- Prevent interference with IMD*, car electronics, and other products
- Make FCC approval easy

* IMD = Implanted Medical Device, a pace maker for example.



WPC(Qi) 국제규격 인증 절차

- **Current version of the Qi specification**

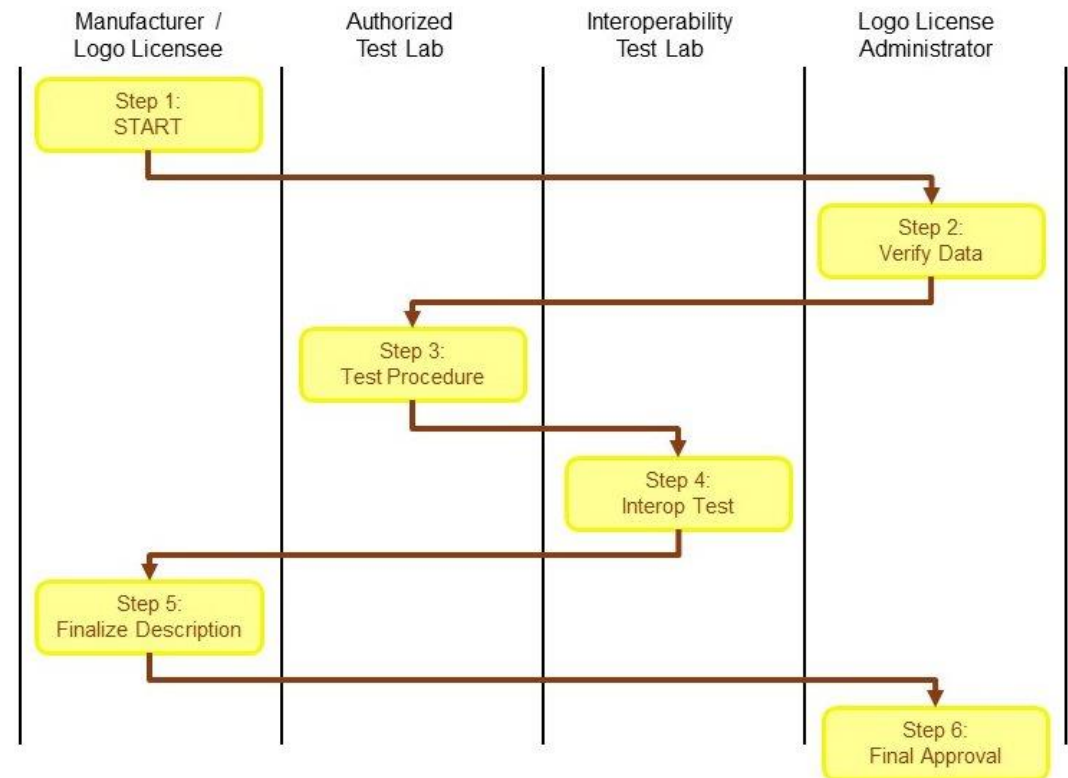
- ✓ The current version of the Qi specification has version number 1.2.4.
- ✓ The Qi specification that is available for public download has version 1.2.3.
- ✓ Version 1.2.4 is available only to members of the Wireless Power Consortium.

- **History of the Qi specification**

- ✓ Version 1.0
 - Qi transmitter delivers 5 Watt power into a Qi phone.
 - High flexibility in design of Qi receivers
 - Limited flexibility in the design of Qi transmitters
- ✓ Version 1.1
 - Increased design freedom for transmitters.
 - Increased sensitivity of "Foreign Object Detection".
 - The possibility to power a Qi transmitter with a USB charger.
- ✓ Version 1.2
 - Fast charging.
 - The possibility for Tx/Rx up to 15 Watt power.
 - An improved thermal test for transmitters
 - Improved timing requirements
 - Changed limits for Foreign Object Detection improve the sensitivity.

WPC(Qi) 국제규격 인증 절차

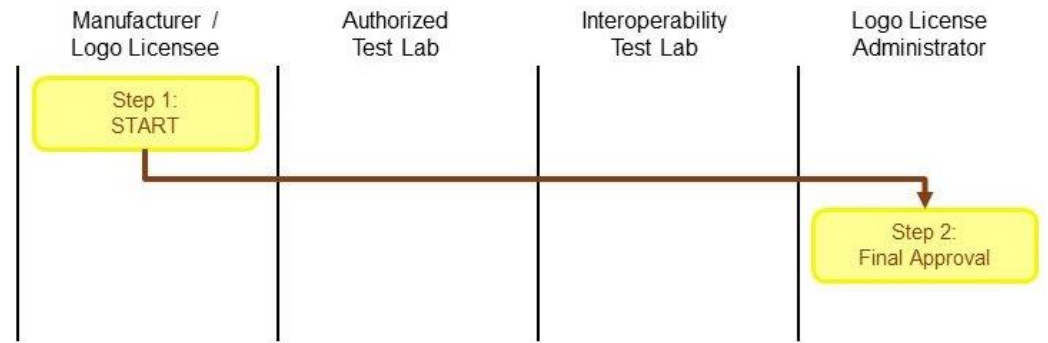
- Step 1 & 2: administration
- Step 3: Test by an Authorized Test Lab
 - Using the test procedures described in Part 3 of the Qi Specification.
- Step 4: Test by an Interoperability Test Lab
 - Verifies that the new product is compatible with all previously certified products.
 - By Eurofins in Belgium or by TTA in Korea
- Step 5 & 6: administration



WPC(Qi) 국제규격 인증 절차

❖ Special Case: Similar Products

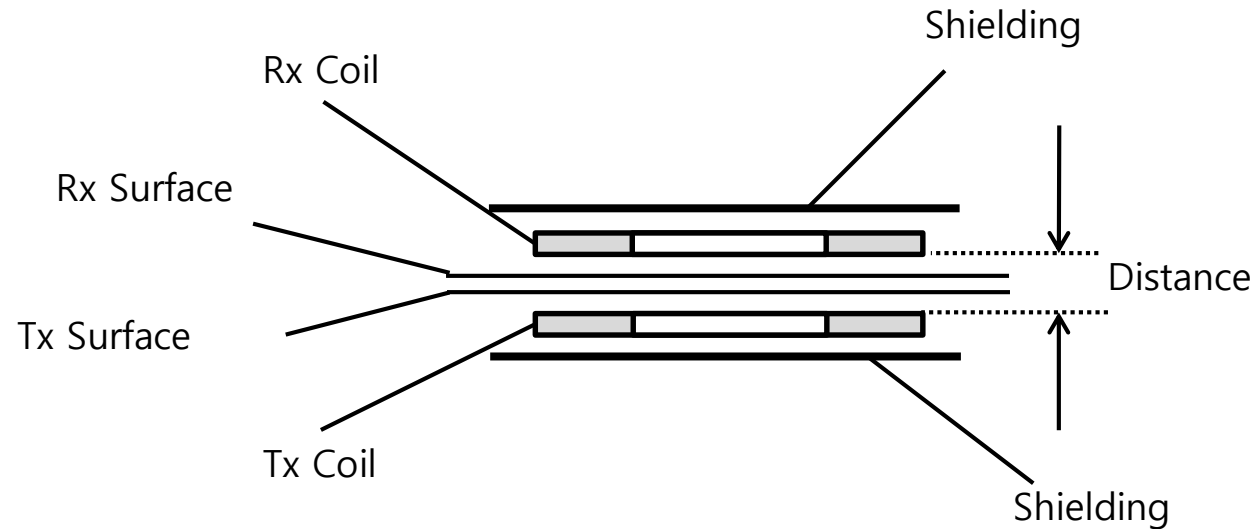
- Testing is not necessary when the new product is identical with a previously certified product, for example
 - Other color
 - Other brand
- Simplified registration procedure
 - Administration only



WPC(Qi) 국제규격 인증 절차

❖ When are products not similar?

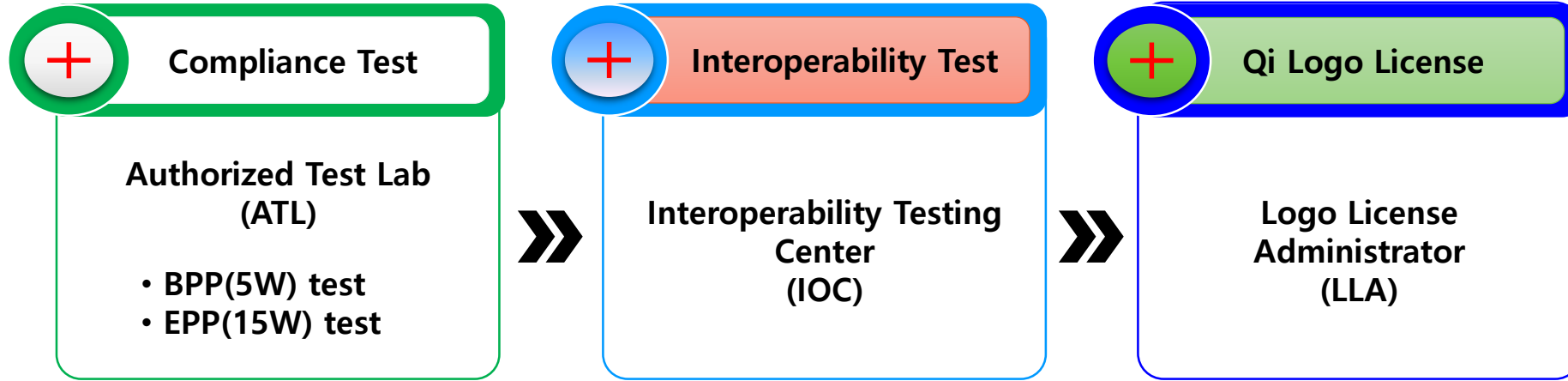
- Any change of magnetic properties:
 - Different coil
 - Different shielding
 - Change in coil-surface distance
 - Change in 'friendly metals'



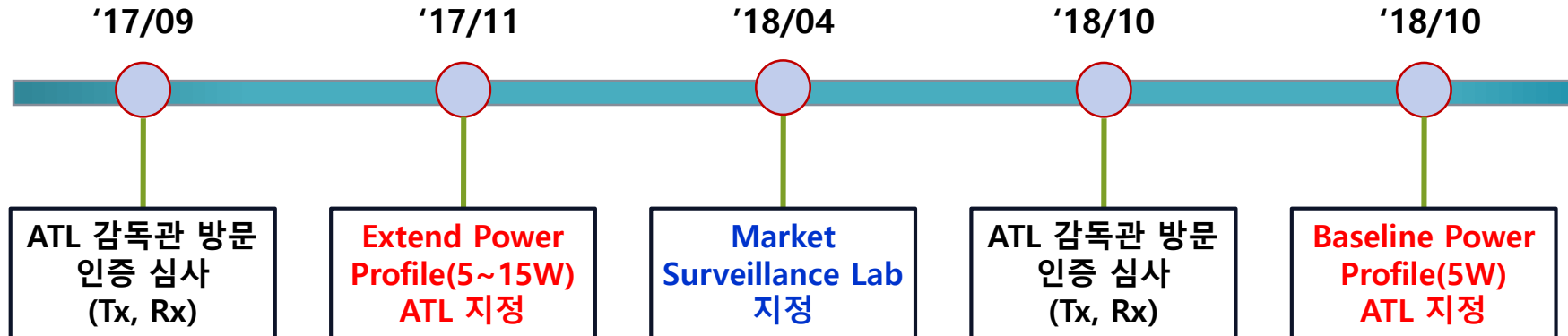
- Change in F/W that influences control protocol and communication between Rx and Tx.

WPC(Qi) 국제규격 인증 절차

• Process of Certification



• (재)경북테크노파크 무선전력전송기술센터



인증시험 절차 소개

No		BPP	EPP	Results
1	Magnet presence check	O	O	Not Run
2	#1	O	O	Not Run
3	MP.TX.COM.MOD.TC1	X	O	Not Run
4	MP.TX.COM.MOD.TC2	X	O	Not Run
5	#2	O	O	Not Run
6	#3(a)	O	O	Not Run
7	#3(b)	O	O	Not Run
8	#3(c)	O	O	Not Run
9	#3(d)	O	O	Not Run
10	#4	O	O	Not Run
11	#5	O	O	Not Run
12	#5(a)	O	O	Not Run
13	#6	O	O	Not Run
14	#6(a)	O	O	Not Run
15	#7(a)	O	O	Not Run
16	#7(b)	O	O	Not Run
17	#7(c)	O	O	Not Run
18	#8(a)	O	O	Not Run
19	#8(b)	O	O	Not Run
20	#8(c)	O	O	Not Run
21	#8(d)	O	O	Not Run
22	#9	O	O	Not Run
23	#11	O	O	Not Run
24	#13	O	O	Not Run
25	#13(a)	O	O	Not Run
26	#13(b)	O	O	Not Run
27	#13(c)	O	O	Not Run
28	#14	O	O	Not Run
29	MP.TX.SYSCTRL.IDCONFIG.ACK.1.TC0	O	X	Not Run
30	MP.TX.SYSCTRL.IDCONFIG.ACK.1.TC1	X	O	Not Run

No		BPP	EPP	Results
31	MP.TX.SYSCTRL.NEG.RESPCOR.TC1	O	O	Not Run
32	MP.TX.SYSCTRL.NEG.RESPCOR.TC2	O	O	Not Run
33	MP.TX.SYSCTRL.NEG.RESPTIME.TC1	X	O	Not Run
34	MP.TX.SYSCTRL.NEG.RMPOW.TC2	X	O	Not Run
35	MP.TX.SYSCTRL.NEG.RMPOW.TC3	O	O	Not Run
36	MP.TX.SYSCTRL.NEG.END.TC1	O	O	Not Run
37	MP.TX.SYSCTRL.NEG.WPID.TC1	O	O	Not Run
38	MP.TX.SYSCTRL.NEG.WPID.TC2	O	O	Not Run
39	MP.TX.SYSCTRL.NEG.WPID.TC3	O	O	Not Run
40	MP.TX.SYSCTRL.NEG.WPID.TC4	O	O	Not Run
41	MP.TX.SYSCTRL.NEG.WPID.TC5	O	O	Not Run
42	#16	O	O	Not Run
43	#16(a)	O	O	Not Run
44	#16(b)	O	O	Not Run
45	#17(a)	O	O	Not Run
46	#17(b)	O	O	Not Run
47	#18	O	O	Not Run
48	#20(a)	O	O	Not Run
49	#20(b)	O	O	Not Run
50	#21	O	O	Not Run
51	MP.TX.SYSCTRL.POWXFER.LDSTP.TC1	O	O	Not Run
52	MP.TX.SYSCTRL.POWXFER.LDSTP.TC1b	O	O	Not Run
53	MP.TX.SYSCTRL.POWXFER.LDSTP.TC2	O	O	Not Run
54	MP.TX.SYSCTRL.POWXFER.LDSTP.TC2b	O	O	Not Run
55	#22	O	O	Not Run
56	MP.TX.SYSCTRL.POWXFER.RENEG.TC1	O	O	Not Run
57	#23(a)	O	O	Not Run
58	#23(b)	O	O	Not Run
59	#23(c)	O	O	Not Run
60	#23(d)	O	O	Not Run

인증시험 절차 소개

No		BPP	EPP	Results
61	#23(e)	O	O	Not Run
62	#23(f)	O	O	Not Run
63	MP.TX.PERF.POWGUARANT.8W.TC1	X	O	Not Run
64	MP.TX.PERF.POWGUARANT.15W.TC1	X	O	Not Run
65	MP.TX.PERF.POWGUARANT.12W.TC1	X	O	Not Run
66	MP.TX.PERF.POWGUARANT.15W.TC2	X	O	Not Run
67	#24	O	X	Not Run
68	PTX-POW-TEMP-EPP	X	O	Not Run
69	#25(a) - Part1	O	O	Not Run
70	#25(a) - Part2	O	O	Not Run
71	#25(a) - Part3	O	O	Not Run
72	#25(b) - Part1	O	O	Not Run
73	#25(b) - Part2	O	O	Not Run
74	#25(b) - Part3	O	O	Not Run
75	#25(c) - Part1	O	O	Not Run
76	#25(c) - Part2	O	O	Not Run
77	#25(c) - Part3	O	O	Not Run
78	#25(d) - Part1	O	O	Not Run
79	#25(d) - Part2	O	O	Not Run
80	#25(d) - Part3	O	O	Not Run
81	MP.TX.PERF.FOD.MP.TC1	X	O	Not Run
82	MP.TX.PERF.FOD.MP.TC1a	X	O	Not Run
83	MP.TX.PERF.FOD.MP.TC2	X	O	Not Run
84	MP.TX.PERF.FOD.MP.TC2a	X	O	Not Run
85	MP.TX.PERF.FOD.MP.TC3	X	O	Not Run
86	MP.TX.PERF.FOD.MP.TC3a	X	O	Not Run
87	MP.TX.PERF.FOD.MP.TC4	X	O	Not Run
88	MP.TX.PERF.FOD.MP.TC4a	X	O	Not Run
89	MP.TX.PERF.FOD.MP.TC5	X	O	Not Run
90	MP.TX.PERF.FOD.MP.TC5a	X	O	Not Run

No		BPP	EPP	Results
91	MP.TX.PERF.FOD.MP.TC6	X	O	Not Run
92	MP.TX.PERF.FOD.MP.TC6a	X	O	Not Run
93	MP.TX.FOD.BEFOREPOWER.FO.ABSENT.TC1	X	O	Not Run
94	MP.TX.FOD.BEFOREPOWER.FO.ABSENT.TC1a	X	O	Not Run
95	MP.TX.FOD.BEFOREPOWER.FO.PRESENT.TC1	X	O	Not Run
96	MP.TX.FOD.BEFOREPOWER.FO.PRESENT.TC1a	X	O	Not Run
97	MP.TX.FOD.BEFOREPOWER.FO.PRESENT.TC2	X	O	Not Run
98	MP.TX.FOD.BEFOREPOWER.FO.PRESENT.TC2a	X	O	Not Run
99	MP.TX.FOD.BEFOREPOWER.FO.CRITIC.TC1	X	O	Not Run
100	MP.TX.FOD.BEFOREPOWER.FO.CRITIC.TC1a	X	O	Not Run
101	MP.TX.FOD.CALIBRATE.FO.ABSENT.TC1	X	O	Not Run
102	MP.TX.FOD.CALIBRATE.FO.ABSENT.TC1a	X	O	Not Run
103	MP.TX.FOD.OPERATE.FO.CRIT.TC1	X	O	Not Run
104	MP.TX.FOD.OPERATE.FO.CRIT.TC1a	X	O	Not Run
105	MP.TX.FOD.OPERATE.FOD.REACT.TC1	X	O	Not Run
106	MP.TX.FOD.OPERATE.FOD.REACT.TC1a	X	O	Not Run
107	MP.TX.FOD.OPERATE.FOD.RESPSUP.TC1	X	O	Not Run
108	MP.TX.FOD.OPERATE.FOD.RESPSUP.TC1a	X	O	Not Run
109	MP.TX.FOD.OPERATE.FOD.ENDPOW.TC1	X	O	Not Run
110	MP.TX.FOD.OPERATE.FOD.ENDPOW.TC1a	X	O	Not Run
111	#26	X	O	Not Run
112	#27	X	O	Not Run
113	#28	X	O	Not Run
114	#29	X	O	Not Run
115	#30	X	O	Not Run
116	#31	O	X	Not Run
117	ptx-pow-ovp-epp	X	O	Not Run
118	ptx-pow-ovp-epp-2	X	O	Not Run
119	ptx-pow-ovp-epp-3	X	O	Not Run

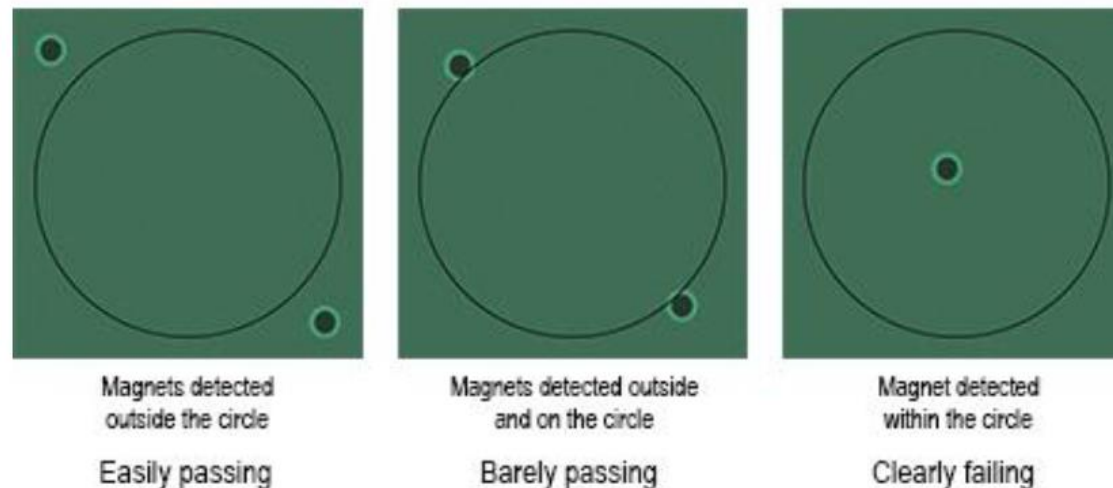
인증시험 절차 소개

1) Magnet presence check

- Magnets appear as dark areas on the viewing film.
- The test passes if no dark areas appear within the circle (diameter = 7.0 cm) drawn on the viewing film when the film is positioned at each of the center markings on the surface of the BSUT.



Figure 35. Sample test results of magnet presence check

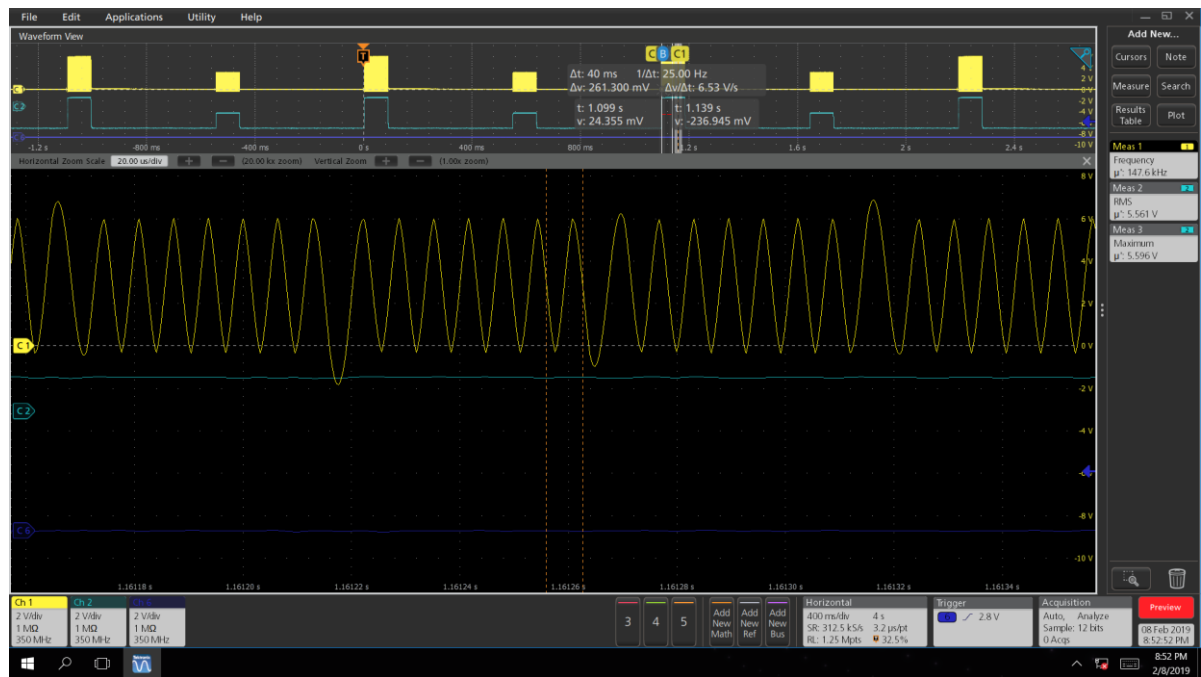
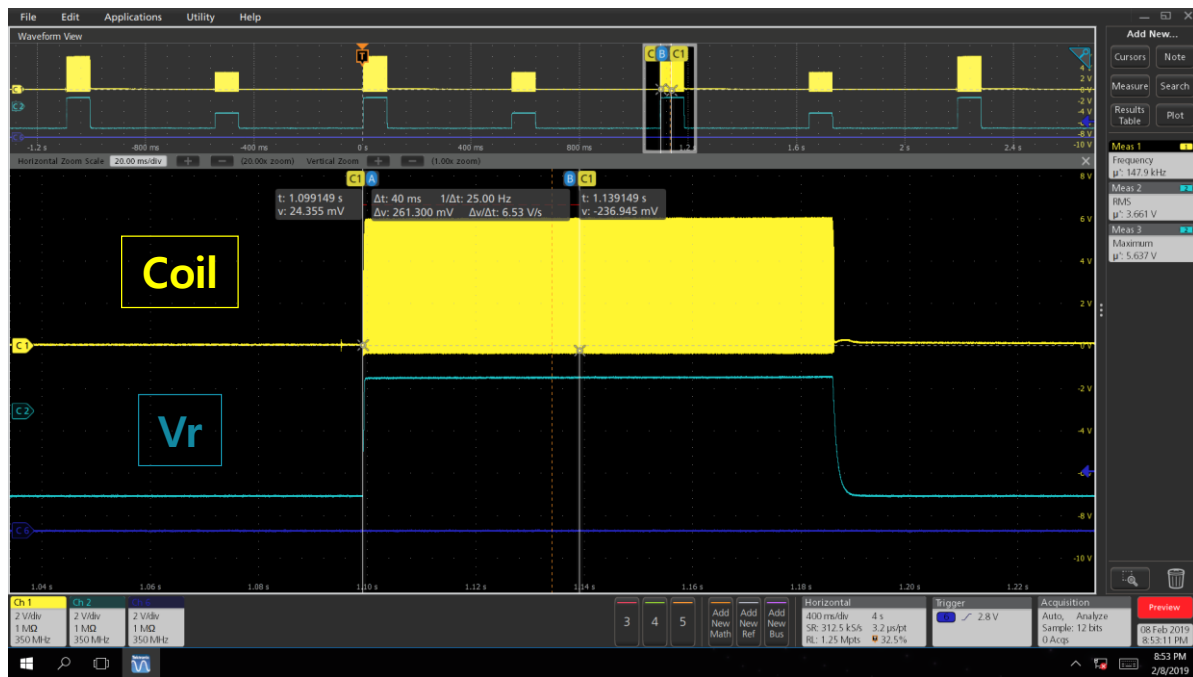


인증시험 절차 소개

2) Ping Phase

- [Test #3(a)] Digital Ping: Power Signal characteristics (ex. A11a)

Parameter	Minimum	Target	Maximum	Result
V_r	3.0 V	6.0 V	9.0 V	5.561 V
f_{op}	145.0 KHz	146 KHz	148.0 KHz	147.6 KHz

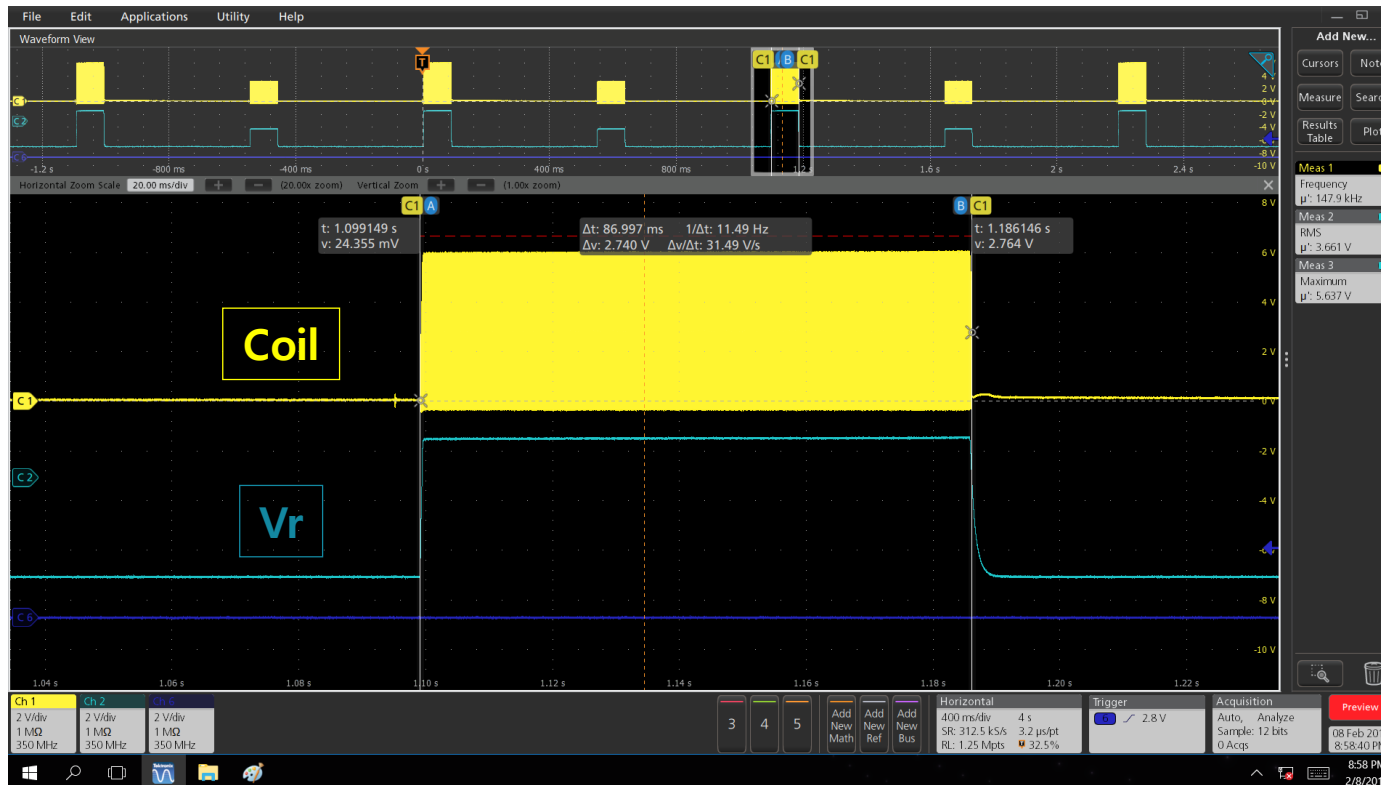


인증시험 절차 소개

3) Ping Phase

- [Test #4] Digital Ping: no Response

Parameter	Maximum	Result
t_{pingtest}	98.0 ms	86.997 ms

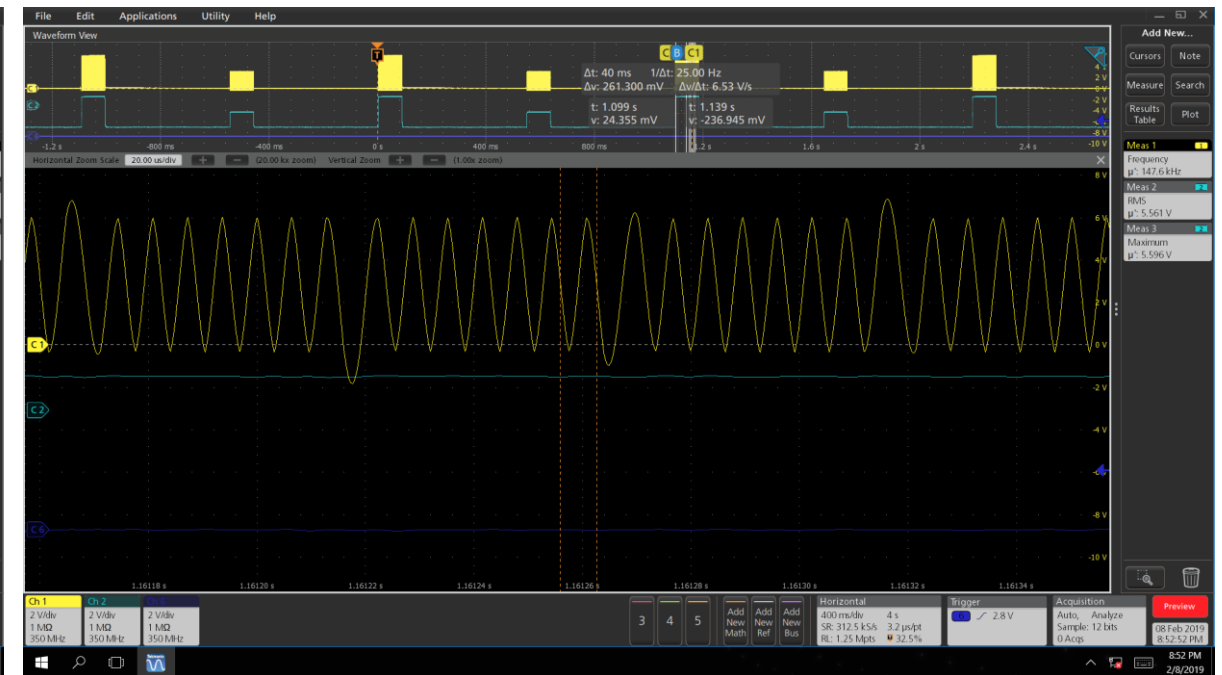
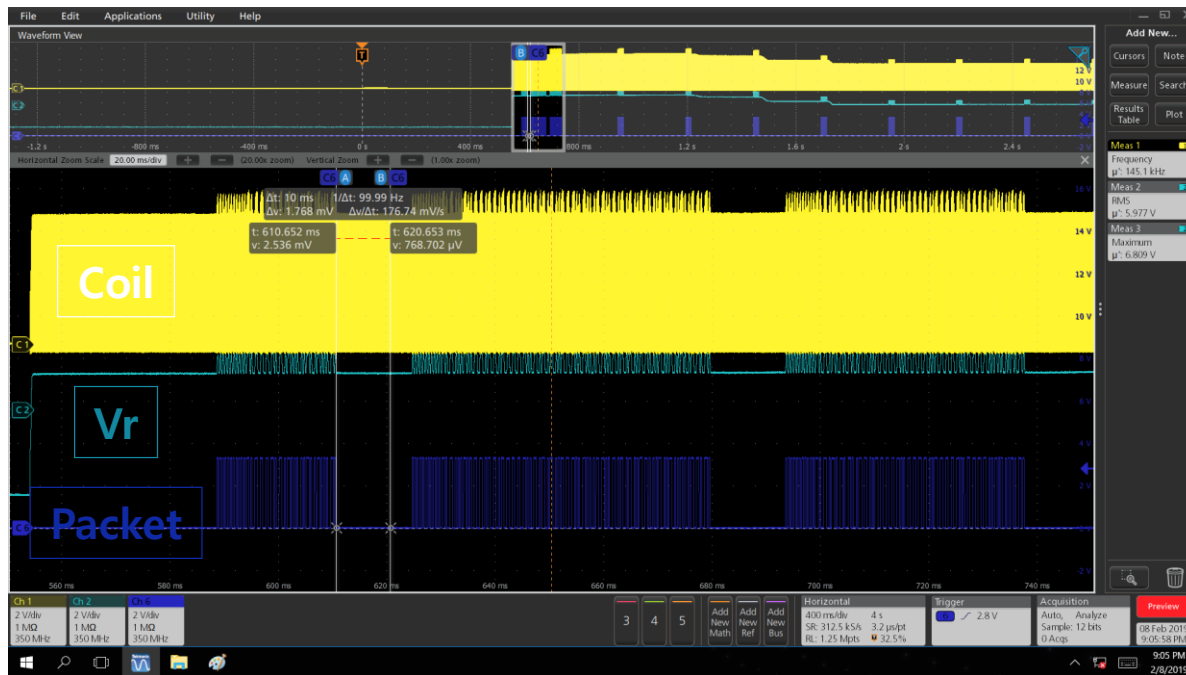


인증시험 절차 소개

4) Ping Phase

- [Test #5] Digital Ping: Signal Strength (ex. A11a)

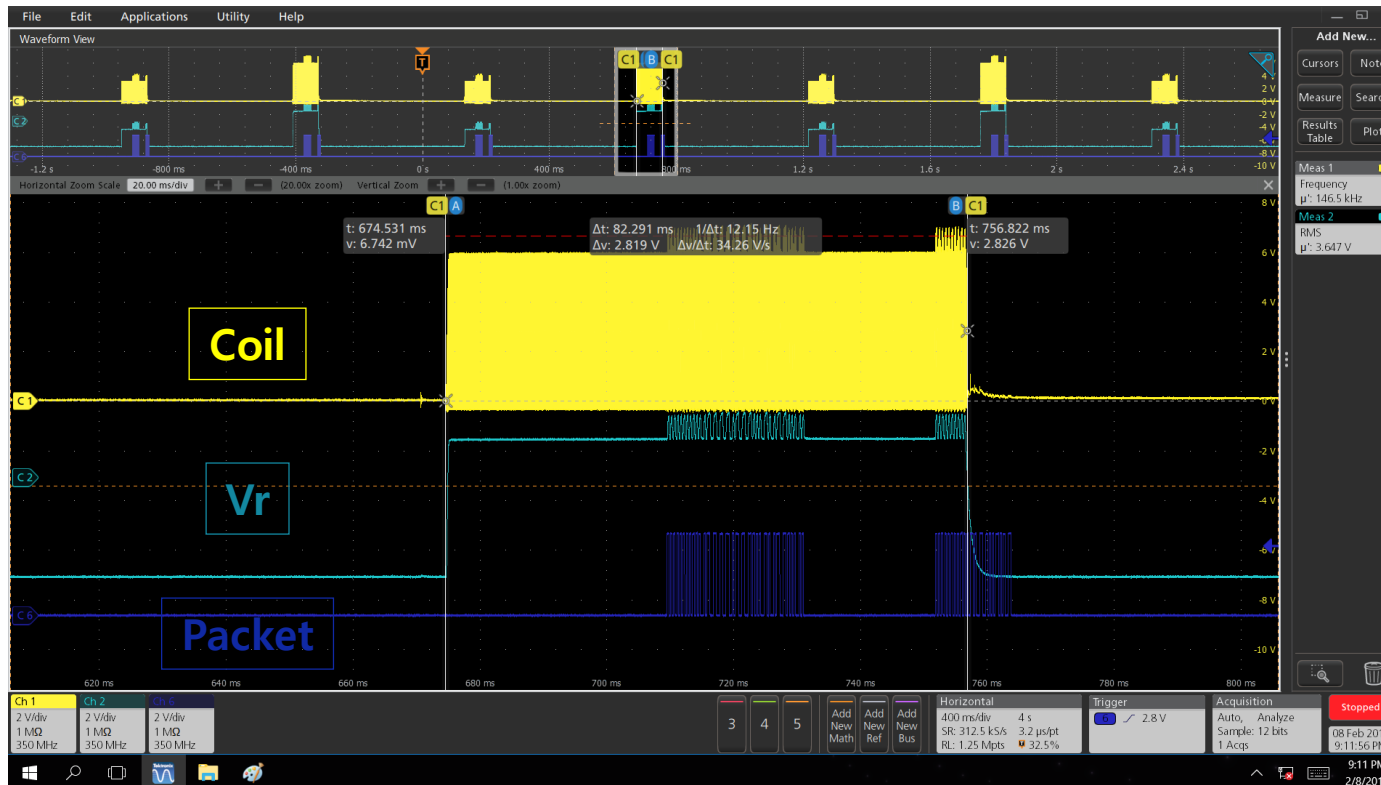
Parameter	Minimum	Target	Maximum	Result
V_r	3.0 V	6.0 V	9.0 V	5.708 V
f_{op}	145.0 KHz	146 KHz	148.0 KHz	147.9 KHz



인증시험 절차 소개

5) Identification & Configuration Phase - [Test #9] Packet Timing

Minimum	Parameter	Maximum	Result
77.0 ms	$t_{\text{packettiming}}$	111.0 ms	82.291 ms



인증시험 절차 소개

6) Power Transfer Phase - [Test #20] power control

Volt.	Min.	Meas.	Max.	Unit
V_1	6.900	6.961	7.100	V
V_2	7.200	7.311	9.000	V
V_3	7.165	7.317	7.457	V
V_{\min}	6.961	6.961	-	V
V_{\max}	7.311	7.364	7.399	V

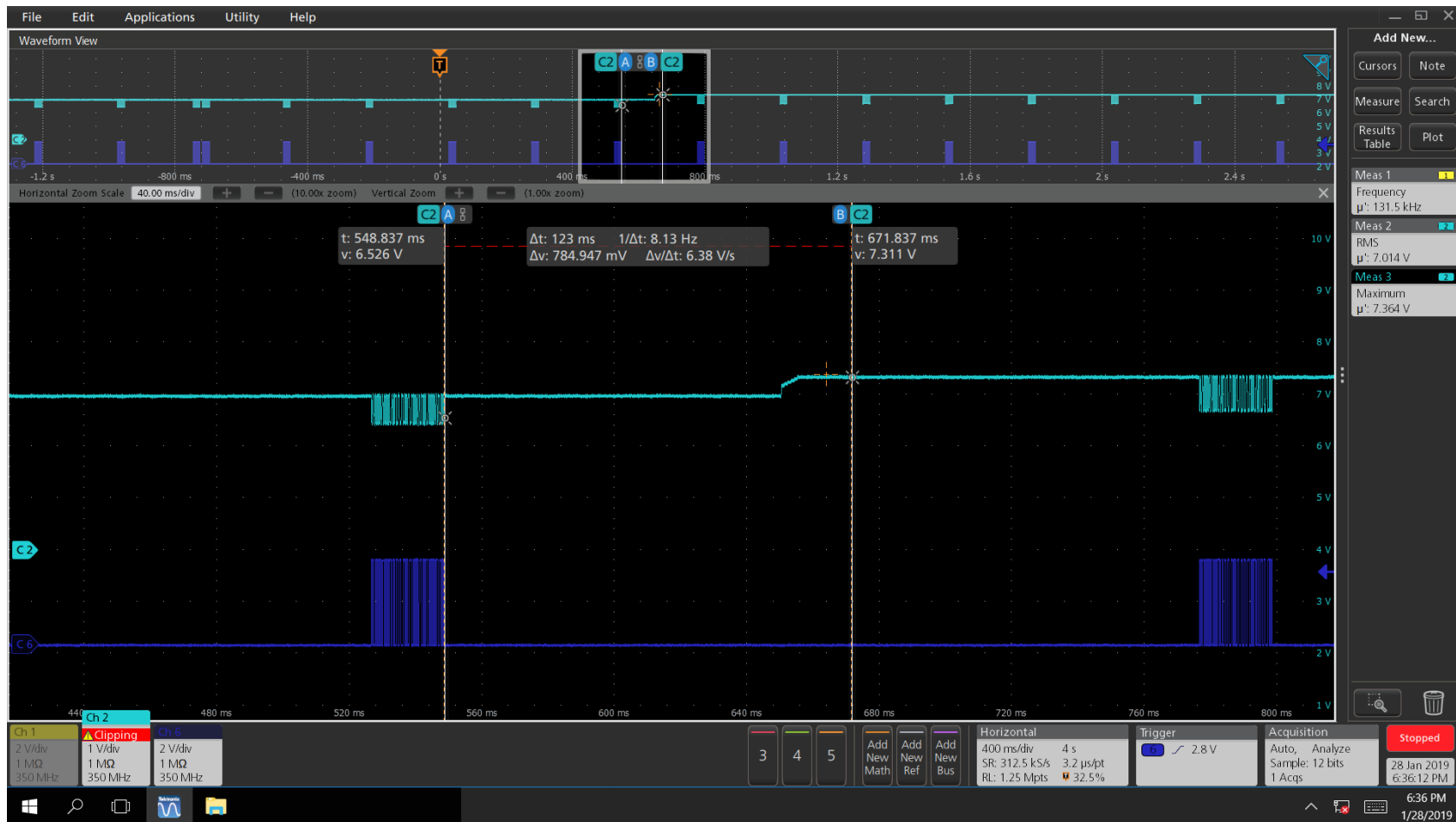
Pass

Table 23. Limits for Test #20(a)

Voltage	Minimum	Target	Maximum	Unit
V_1	6.9	7.0	7.1	V
V_2	7.2	N.A.	9.0	V
V_3	$V_2 - 2\%$	V_2	$V_2 + 2\%$	V
V_{\min}	V_1	V_1	N.A.	V
V_{\max}	V_2	V_2	$V_2 + \frac{V_2 - V_1}{4}$	V

인증시험 절차 소개

6) Power Transfer Phase - [Test #20] power control



인증시험 절차 소개

6) Power Transfer Phase - [Test #20] power control

Volt.	Min.	Meas.	Max.	Unit
V_1	6.900	7.058	7.100	V
V_2	7.200	7.048	9.000	V
V_3	6.907	7.065	7.189	V
V_{\min}	7.058	7.058	-	V
V_{\max}	7.048	7.145	7.046	V

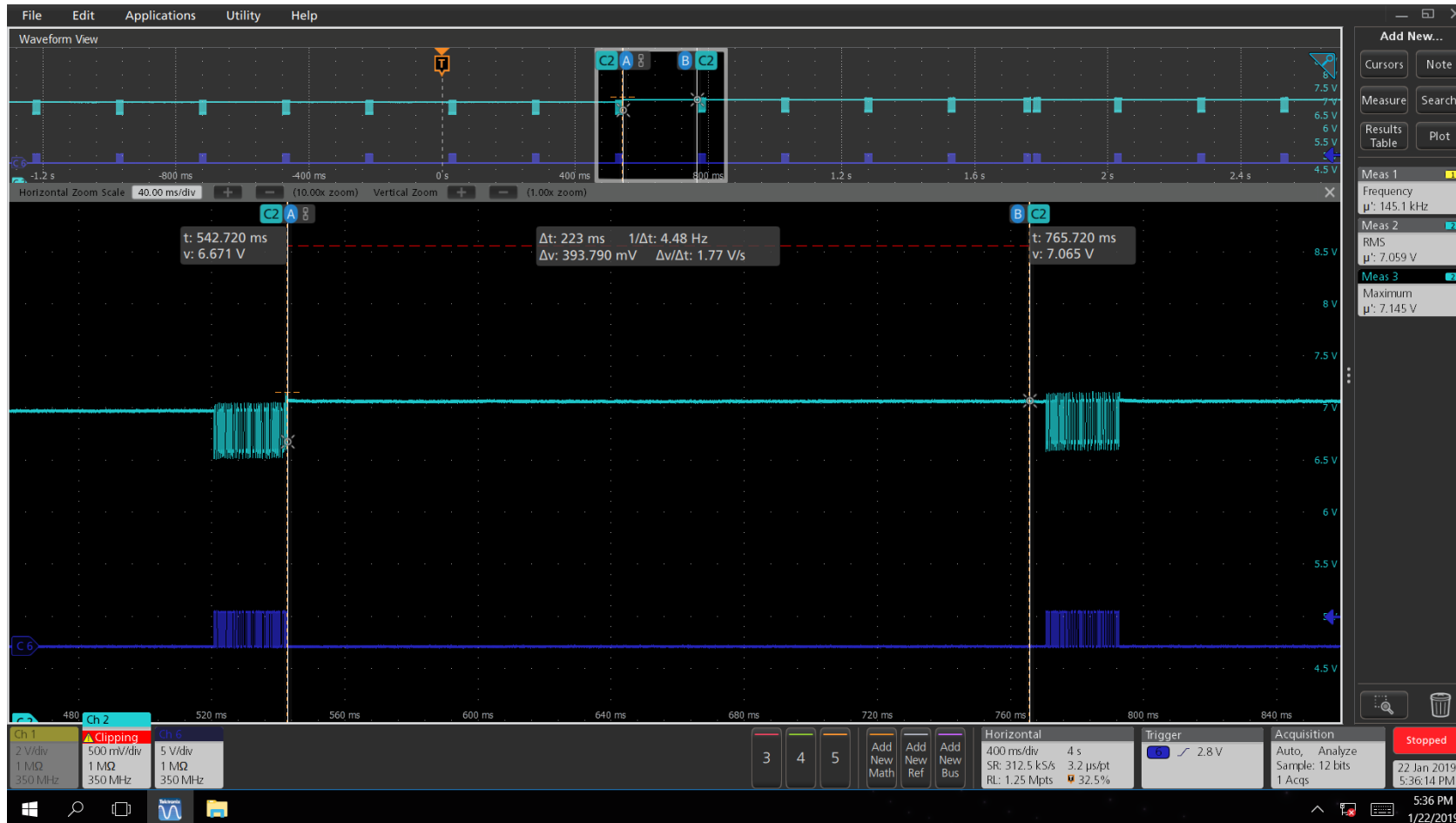
Fail

Table 23. Limits for Test #20(a)

Voltage	Minimum	Target	Maximum	Unit
V_1	6.9	7.0	7.1	V
V_2	7.2	N.A.	9.0	V
V_3	$V_2 - 2\%$	V_2	$V_2 + 2\%$	V
V_{\min}	V_1	V_1	N.A.	V
V_{\max}	V_2	V_2	$V_2 + \frac{V_2 - V_1}{4}$	V

인증시험 절차 소개

6) Power Transfer Phase - [Test #20] power control



인증시험 절차 소개

6) Power Transfer Phase

- [MP.TX.SYSCTRL.POWXFER.LDSTP.TC1b] power control

Table 25. Limits for test MP.TX.SYSCTRL.POWXFER.LDSTP.TC1 and .TC1b

Volt.	Min.	Meas.	Max.	Unit
V_1	11.400	11.919	12.600	V
V_2	13.000	13.111	16.000	V
V_3	12.849	13.072	13.373	V
V_{\min}	11.919	11.919	-	V
V_{\max}	13.111	13.335	13.409	V

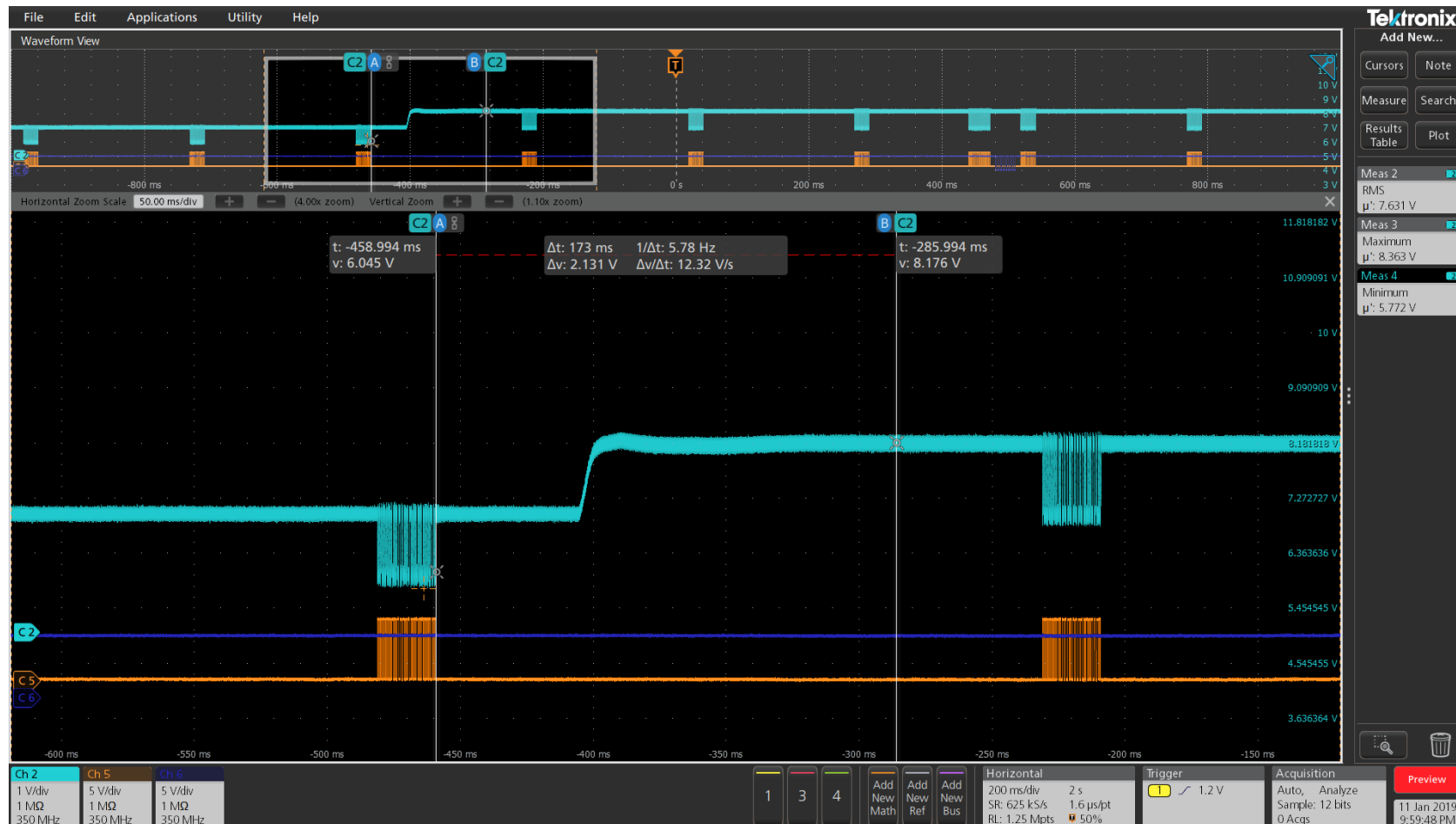
Pass

TPR	Voltage	Minimum	Target	Maximum	Unit
TPR#1F (.TC1)	V_1	6.9	7.0	7.1	V
	V_2	7.2	N.A.	9.0	V
	V_3	$V_2 - 2\%$	V_2	$V_2 + 2\%$	V
	V_{\min}	V_1	V_1	N.A.	V
	V_{\max}	V_2	V_2	$V_2 + \frac{V_2 - V_1}{4}$	V
TPR#MP1B (.TC1b)	V_1	11.4	12.0	12.6	V
	V_2	13.0	N.A.	16.0	V
	V_3	$V_2 - 2\%$	V_2	$V_2 + 2\%$	V
	V_{\min}	V_1	V_1	N.A.	V
	V_{\max}	V_2	V_2	$V_2 + \frac{V_2 - V_1}{4}$	V

인증시험 절차 소개

6) Power Transfer Phase

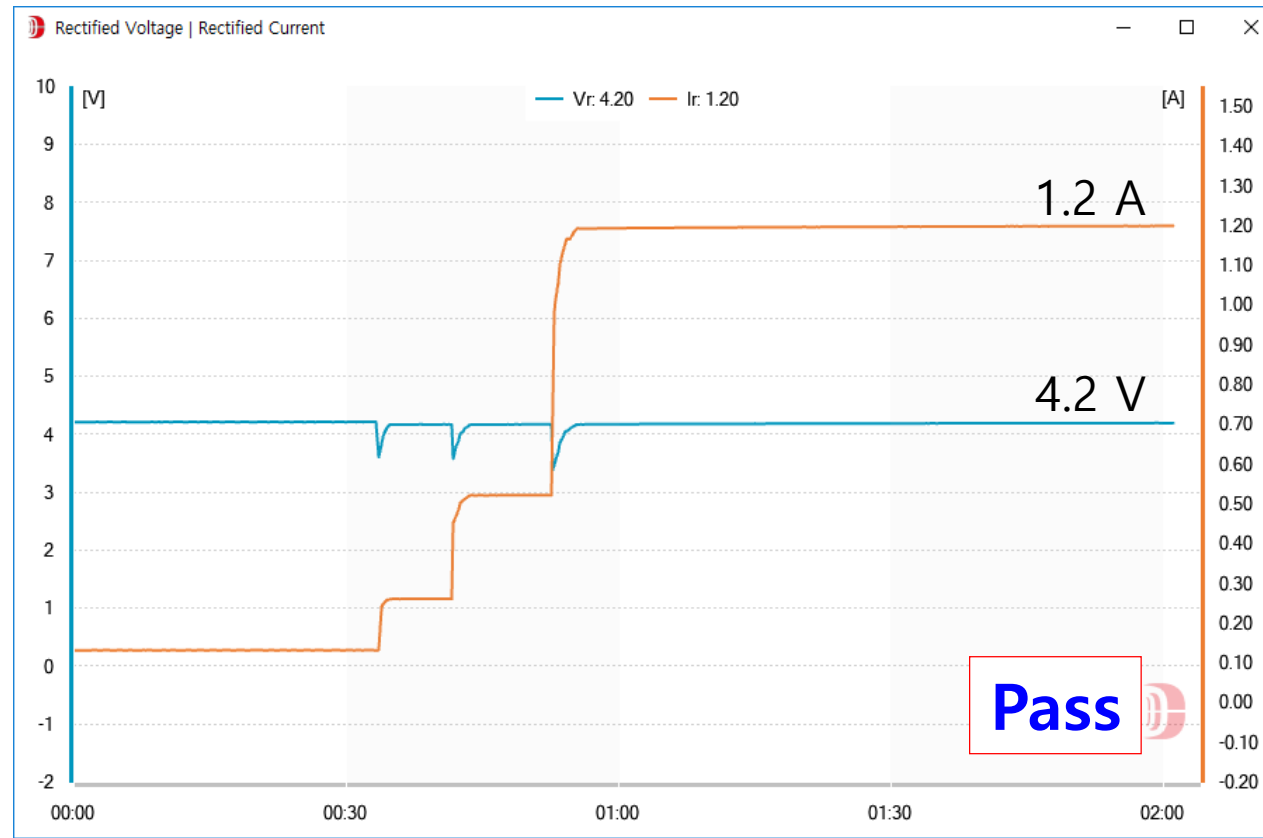
- [MP.TX.SYSCTRL.POWXFER.LDSTP.TC1b] power control



인증시험 절차 소개

7) Guaranteed Power

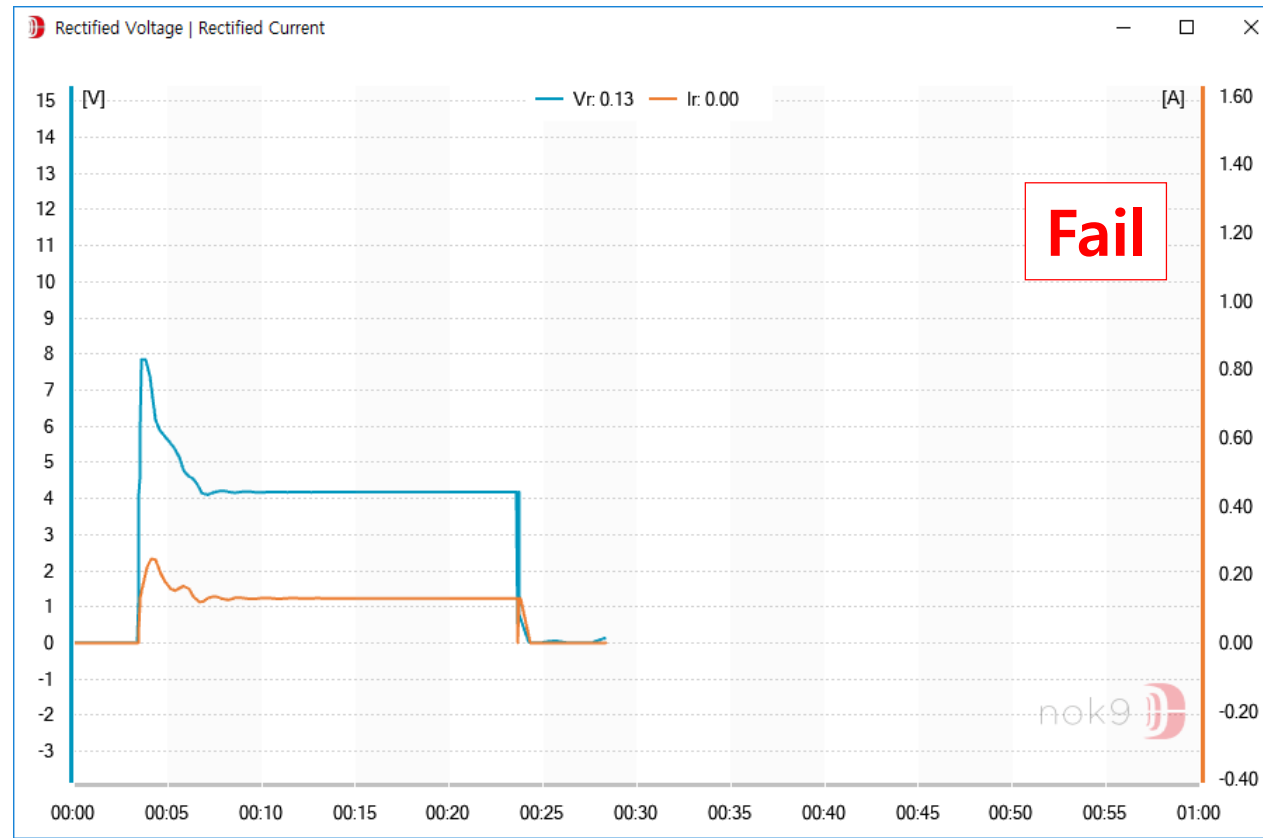
- Test #23(a) Guaranteed power



인증시험 절차 소개

7) Guaranteed Power

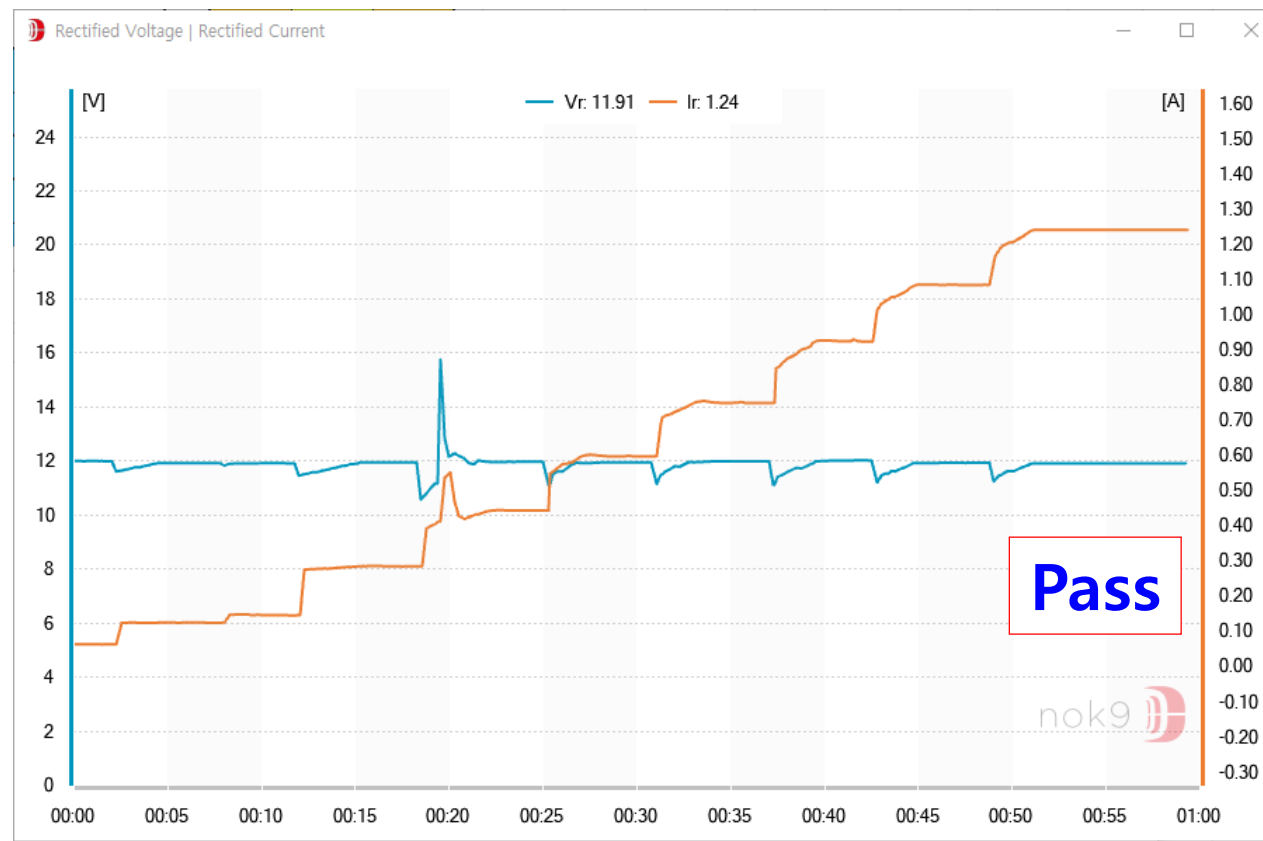
- Test #23(a) Guaranteed power



인증시험 절차 소개

7) Guaranteed Power

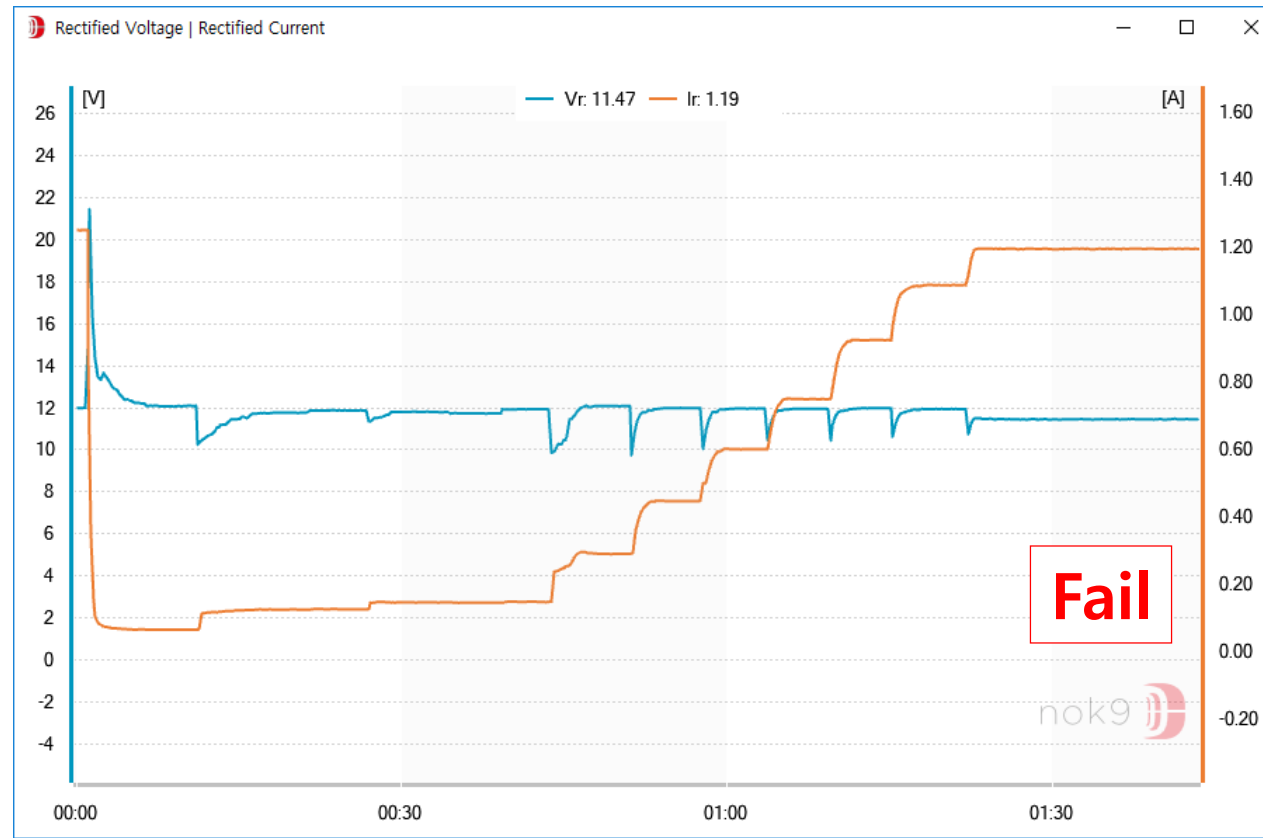
- [MP.TX.PERF.POWGUARANT.15W.TC1] Guaranteed power



인증시험 절차 소개

7) Guaranteed Power

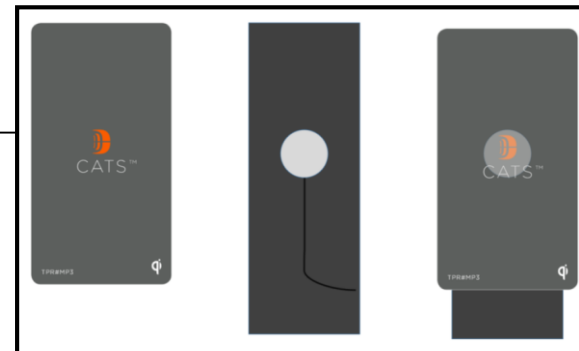
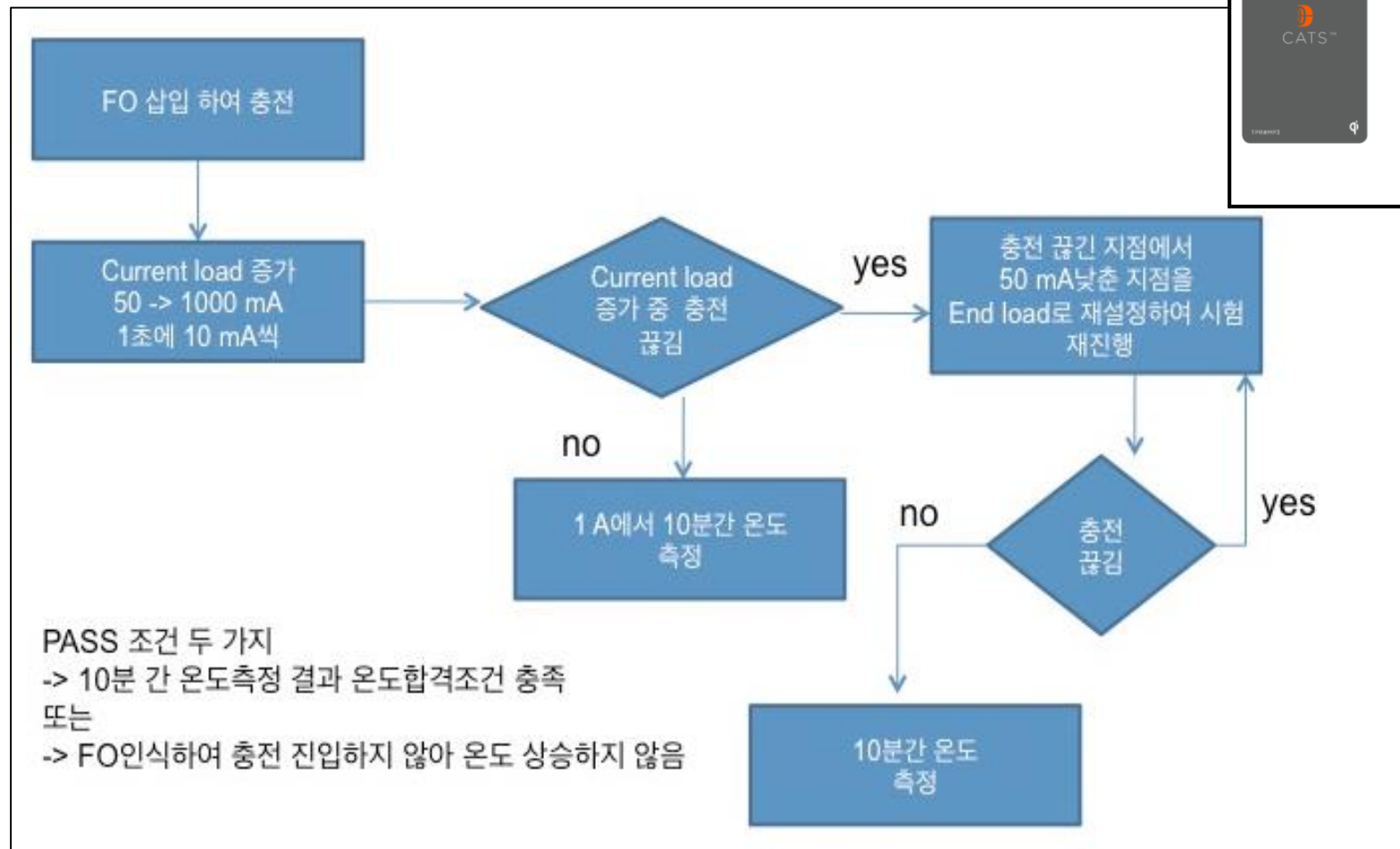
- [MP.TX.PERF.POWGUARANT.15W.TC1] Guaranteed power



인증시험 절차 소개

8) Foreign Object Detection

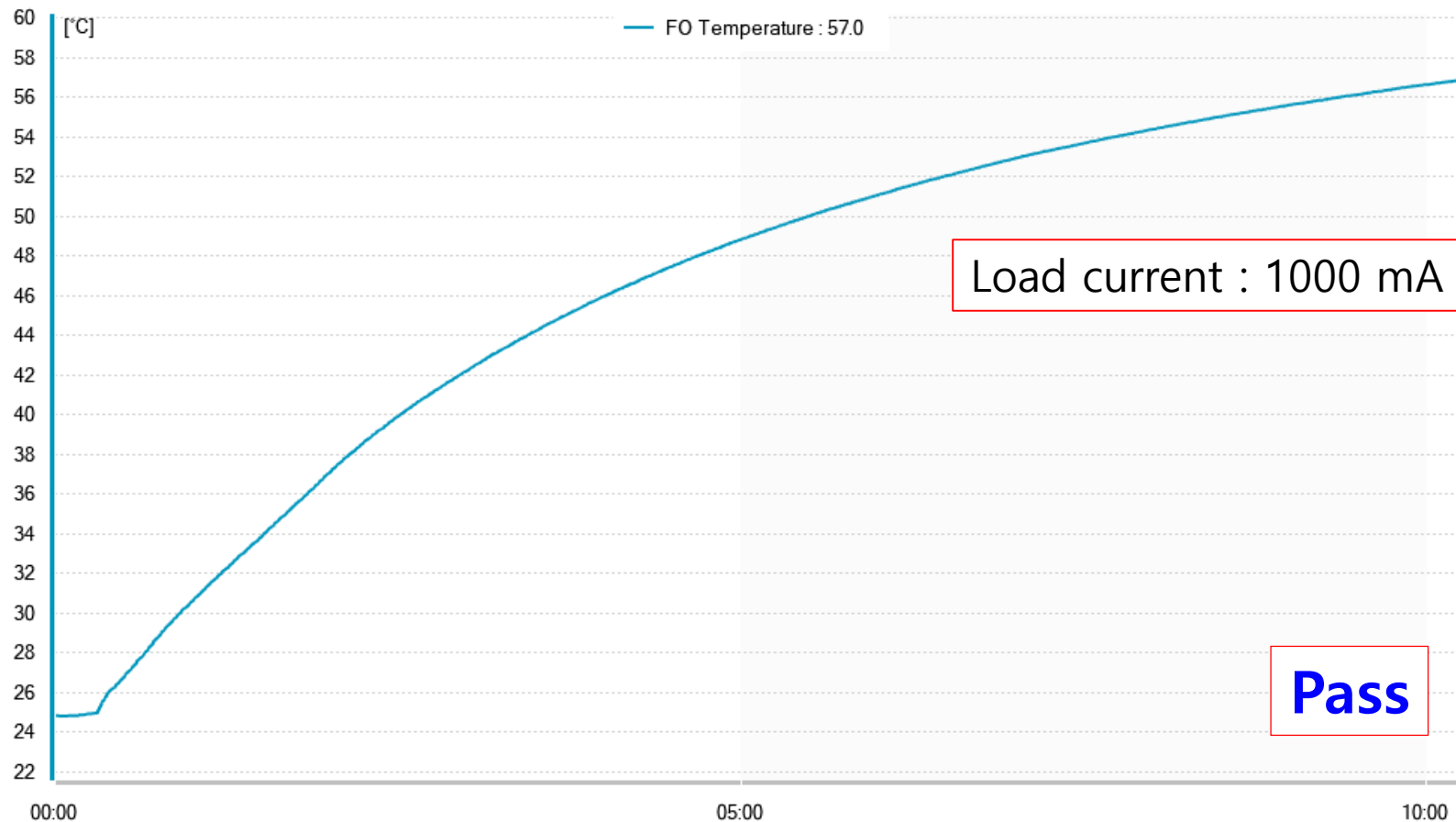
- [Test #25(a)] Heating Prevention



인증시험 절차 소개

8) Foreign Object Detection

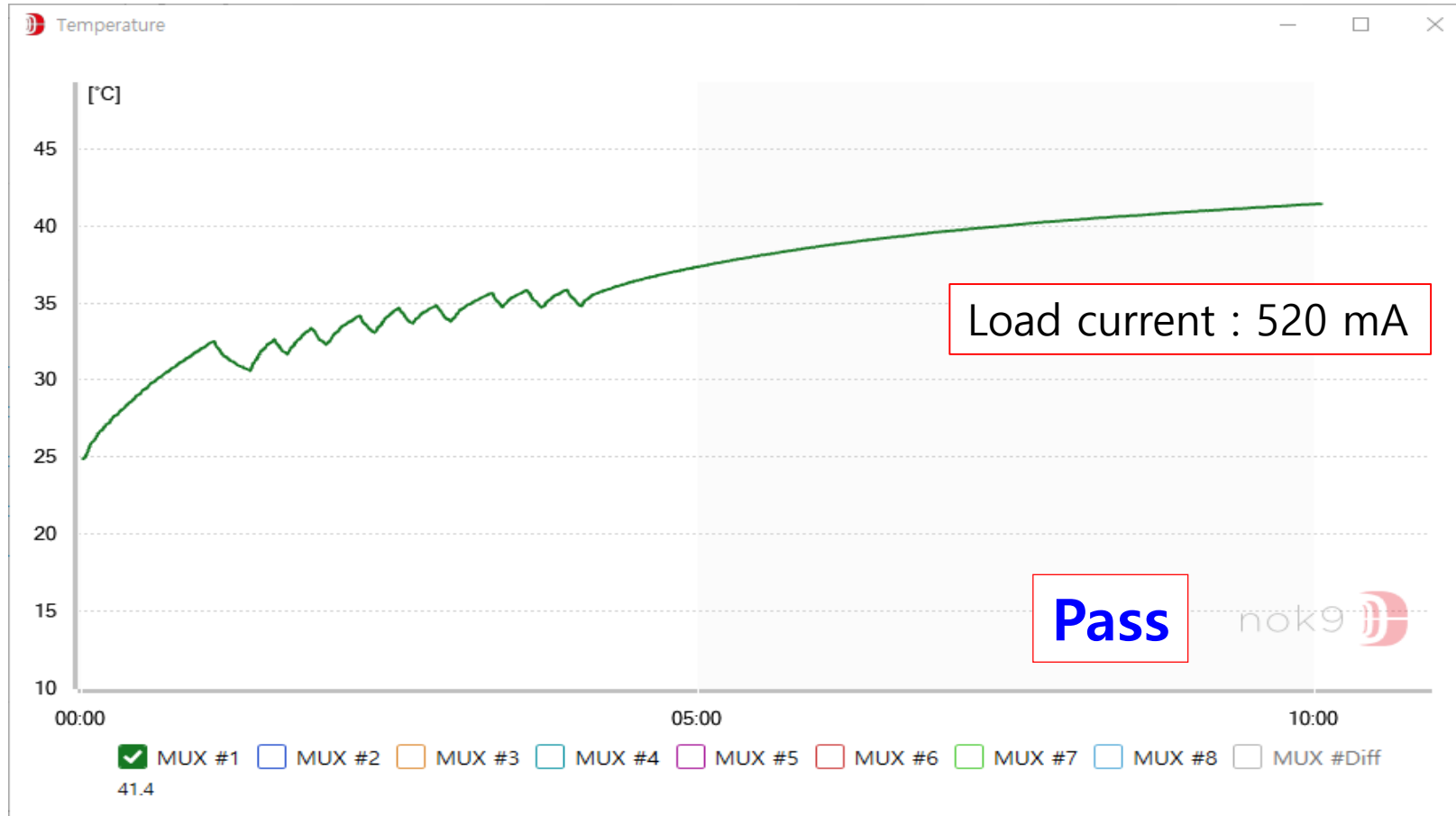
- [Test #25(a)] Heating Prevention



인증시험 절차 소개

8) Foreign Object Detection

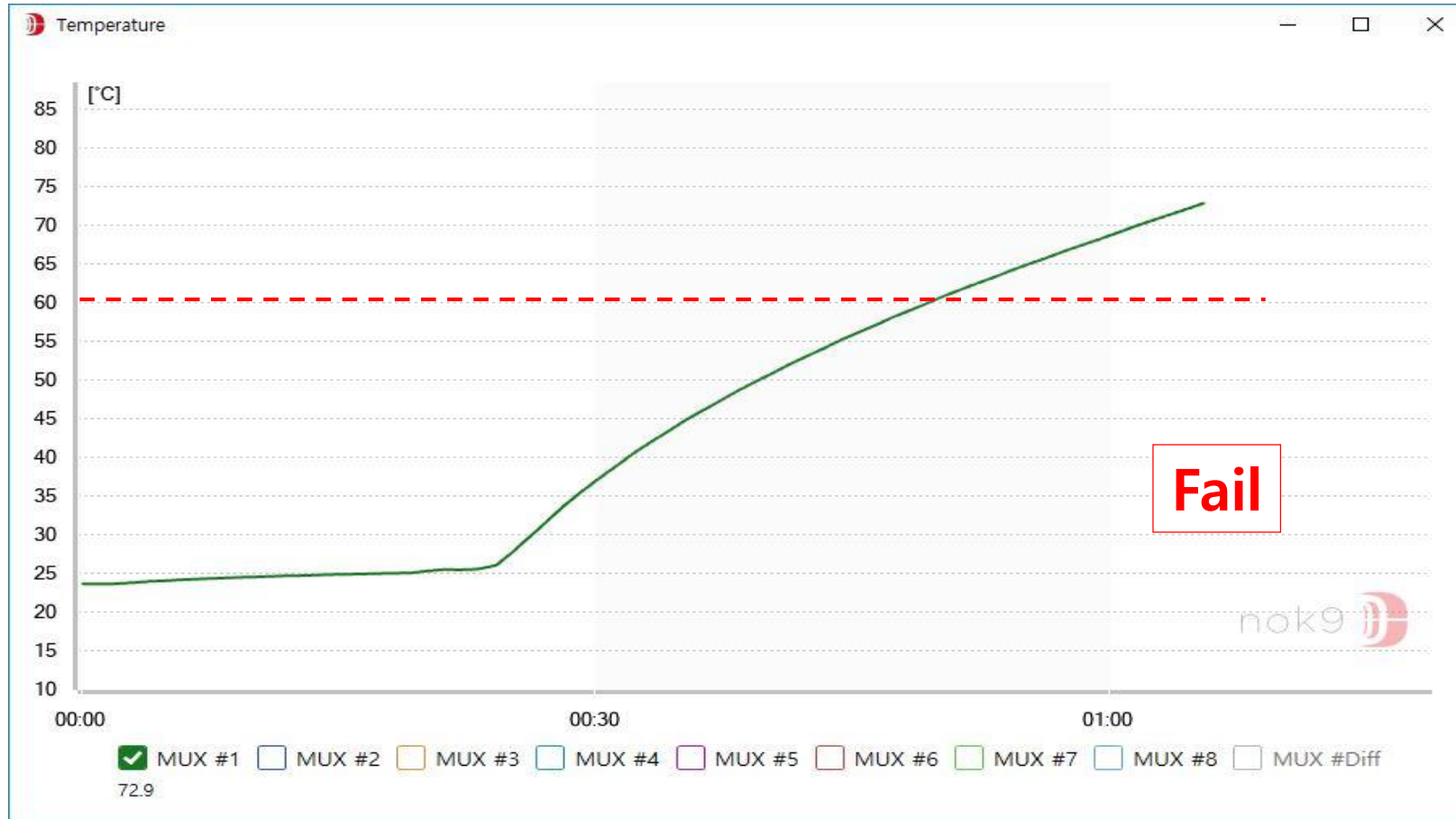
- [Test #25(a)] Heating Prevention



인증시험 절차 소개

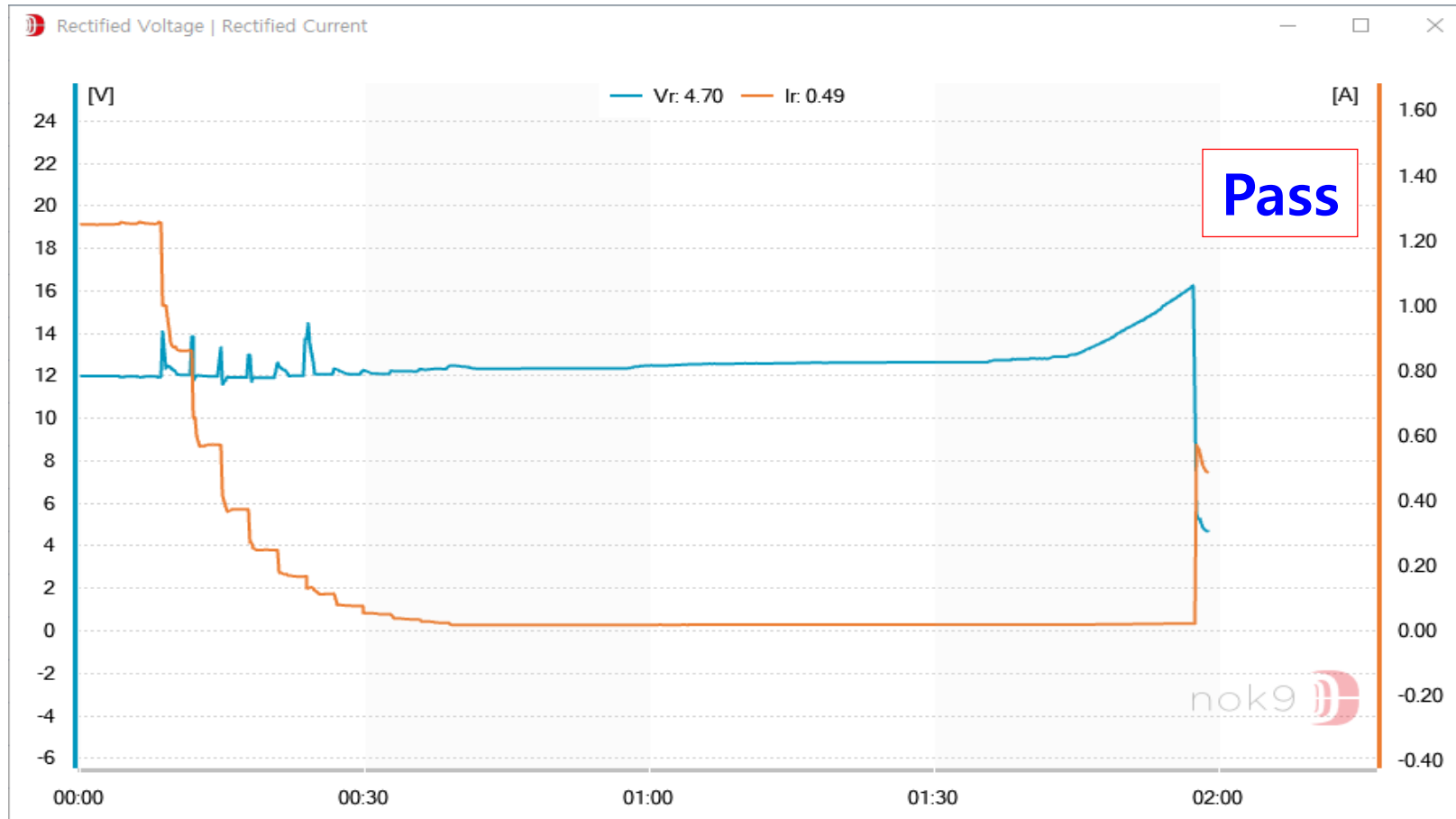
8) Foreign Object Detection

- [Test #25(a)] Heating Prevention



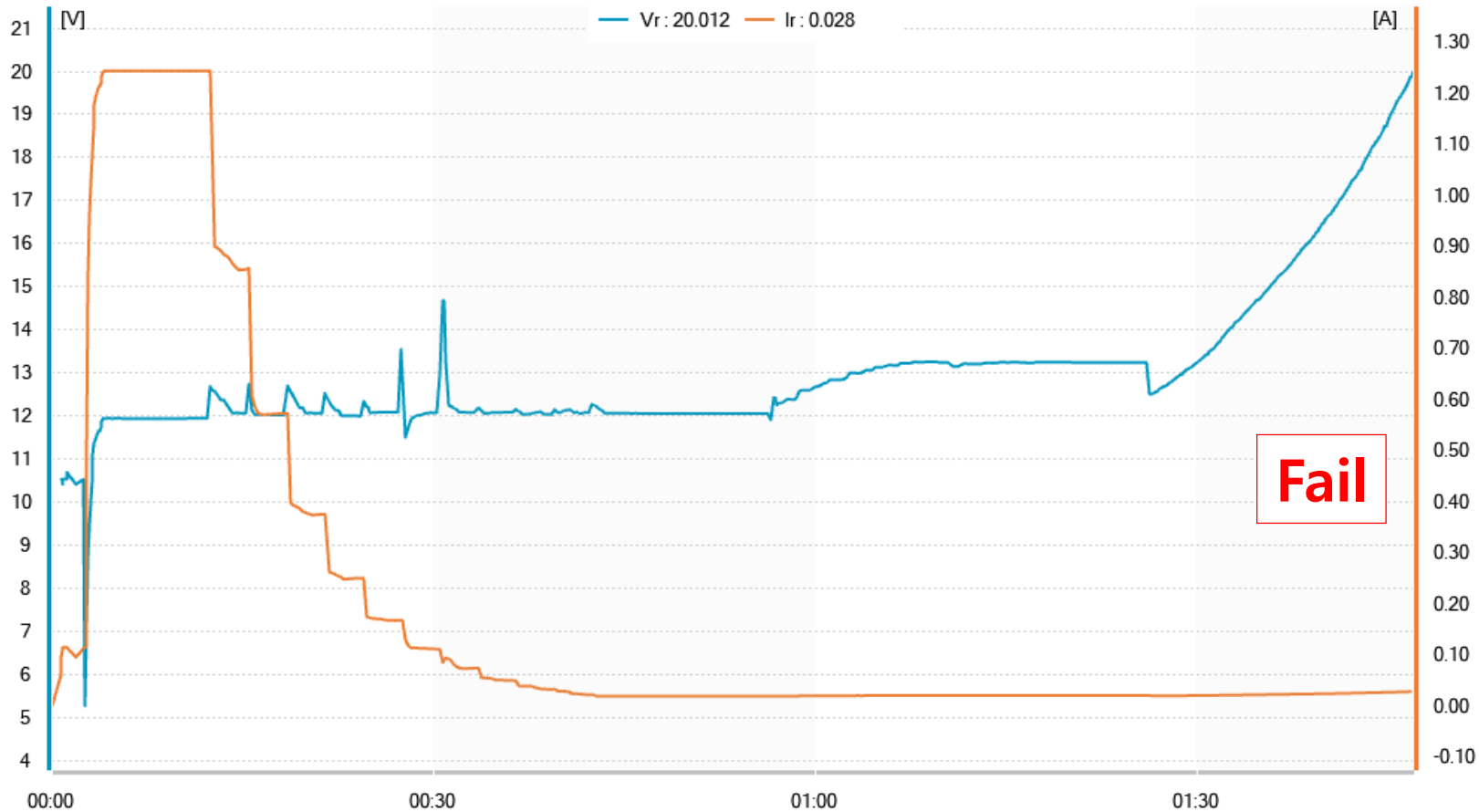
인증시험 절차 소개

9) Maximum Voltage - [ptx-pow-ovp-epp]



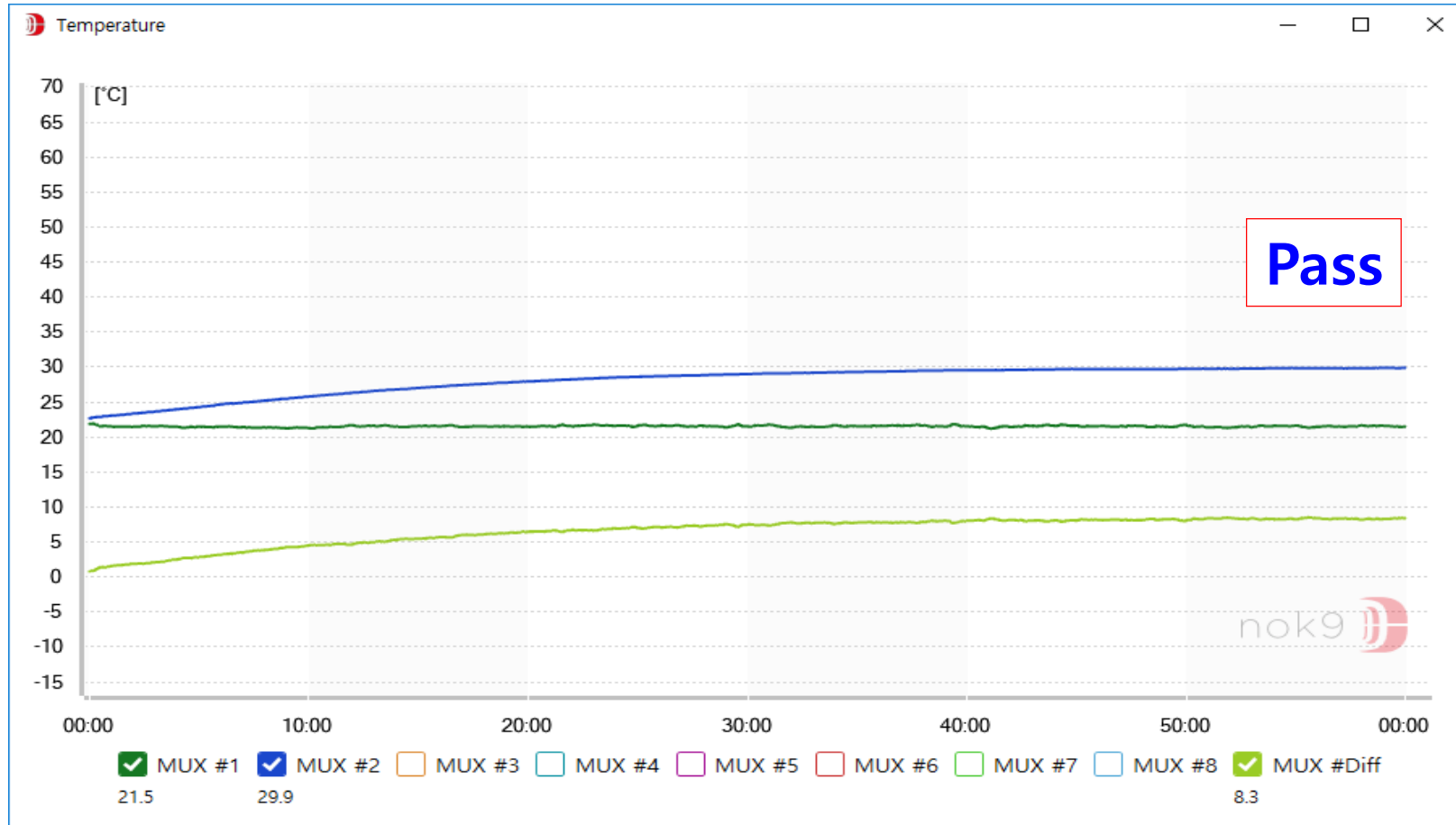
인증시험 절차 소개

9) Maximum Voltage - [ptx-pow-ovp-epp]



인증시험 절차 소개

10) Thermal Performance - [PTX-POW-TEMP-EPP]



인증 획득 지원방안



제품 설계 및 기술 지원

- 표준별, 전력별 공인인증 최신 정보 제공
- 기술세미나 및 전문 워크샵 개최
- 전문가 매칭(1:1 멘토링) 및 애로기술 지원

사전시험 및 인증시험 지원

- 사전 성능평가 시험 지원(디버깅 환경 제공)
- 무선충전 제품 개발 환경 지원(open lab 운영)
- 5W ~ 15W급 무선충전 인증시험 지원

(재)경북테크노파크 무선전력전송기술센터

- 센터건축 규모 : 대지: 1500평, 연면적: 577평 (연구동: 458평, 실험동: 119평)
- 연구동 구조 : 2층 규모 (1층: Qi 인증시험실, 기술개발실, 2층: 행정실, 회의실, 오픈랩)
- 실험동 구조 : 대형 무선충전 차폐실(10.5 m x 19.5 m x 8 m), 컨트롤실, 장비실
- 센터 운영 : 2018년 5월 1일



(재)경북테크노파크 무선전력전송기술센터

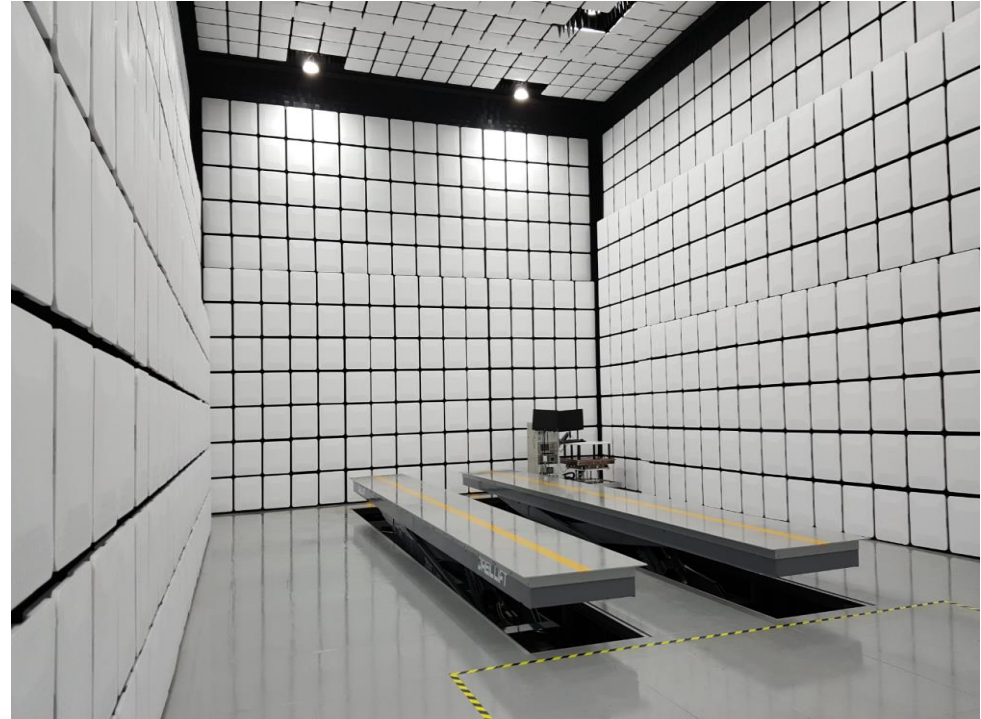


- WPC(Qi) 국제규격 인증시험실 -



- AirFuel 국제규격 성능시험실-

(재)경북테크노파크 무선전력전송기술센터



- 중대형 무선충전 차폐실 -



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