How Standards on Discontinuous Disturbances Jeopardise Measurement Repeatability

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***Abstract*—Civilian standards define the characteristics and performance of disturbance analysers. Unfortunately, these standards include some contradictory prescriptions and vague indications. As a result, todays' disturbance analysers implement very different algorithms. While the disturbance analysers give homogenous results in the specific tests prescribed in the standard, the results of their disturbance measurements may be quite heterogeneous as soon as the application scenario widens, such as in a real-world measurement. In this paper, we discuss the disturbance measurement method introduced in latest editions of civilian standards as well as in recent publications, and make evidence of problems that arise when applying the new methodology, validating our claims with lab experiments and real-world disturbance measurements.**

***Keywords*—Click, CISPR 16-1-1, CISPR 14-1, IF threshold, Disturbance superposition**

I. Introduction

Today, two international standards regulate the measurement of electromagnetic (EM) disturbances of household appliances, known also as radio frequency interferences. CISPR 16-1-1 standard [1] defines the "specification for radio disturbance and immunity measuring apparatus and methods", whereas CISPR 14-1 standard [2] prescribes the "requirements for household appliances, electric tools and similar apparatus". In other words, CISPR 16-1-1 standard defines the characteristics and performance of disturbance analysers and it defines the measurement methods, whereas CISPR 14-1 standard should state the characteristics of household appliances and it should prescribe the specific limits to pass the tests and thus be able to be put on the market. Unfortunately, the current situation is much more complex. Today, CISPR 14-1 standard includes indications on how the disturbance analyser should perform the measurements, indications which are partially in contrast with what prescribed in CISPR 16-1-1 standard. Additionally, both standards include inaccuracies.

In [3], authors highlight an inconsistency in the current edition of CISPR 16-1-1 standard [1], §9. Specifically, to be CISPR-compliant, the analyser must pass a range of tests, listed in [1], Table 17 and Table F.1. However, two of these tests (test 2 and test 3) cannot be passed when strictly adhering to prescriptions in [1]. Also in [4], authors, although writing that there is no inconsistency in CISPR 16-1-1, state that the measurement method described in the standard "appears to be inapplicable to test signals 2 and 3".

CISPR 14-1 standard [2] relaxes the reference limit for discontinuous disturbance measurements in presence of a superimposed continuous disturbance. When a discontinuous disturbance is measured in presence of a continuous one, then the duration and time measurement may be based upon a limit which is changed on-the-go. Unfortunately, the current edition of CISPR 14-1 is vague on when and how the reference limit may be modified. In this paper, we show that the same disturbance measurement can lead to very different results depending on the algorithm that defines the reference limit on-the-go.

Specifically, the remainder of the paper is structured as follows. In Sect. II, we discuss disturbance measurements and summarise the existing inconsistency in CISPR 16-1-1 standard. In Sect. III, we give details on the dynamic adjustment of the reference limit for continuous disturbance, as mentioned in CISPR 14-1 standard. In Sect. IV, we discuss our lab measurements performed with a disturbance analyser that implements different dynamic threshold adjustment algorithms. In Sect. V, we discuss other solutions that have been recently proposed to overcome the inconsistency in CISPR 16-1-1 standard, such as a filtered IF detector for disturbance analysers, and we report on a lab test that should stress the performance of this new detector. Finally, we conclude the paper in Sect. VI.

II. Disturbance measurements

CISPR distinguishes between continuous and discontinuous disturbances. The latter are also called 'clicks' and are supposed to be less disturbing than continuous disturbances. A disturbance whose quasi-peak (QP) amplitude is constantly above the reference "QP limit of continuous disturbance" ("QP limit" throughout the rest of this paper) is classified as continuous disturbance. Instead, a disturbance is a click if *(i)* the QP level exceeds the QP limit, *(ii)* its duration is not longer than 200 ms and *(iii)* it is separated from a subsequent disturbance by at least 200 ms. The duration and spacing of clicks must be measured on the Intermediate Frequency (IF) output (see §C.3.2 in [2]), which is the instantaneous, unweighted value of the tuned input signal. A click can contain a number of pulses. Still, its total duration, measured from the beginning of the first to the end of the last pulse, must not be longer than 200 ms (not considering exceptions).

In practice, to measure clicks generated by an appliance under test, a disturbance analyser with embedded QP and IF outputs shall be used. If the IF output falls below the QP limit, a click evaluation must be performed. The QP amplitude must be measured 250 ms after the last falling edge in the IF output (see §9.2 in [1]). If the QP amplitude is above the

QP limit, the duration of the click is determined as the time the IF output is above the QP limit. Additionally, if the IF output has already exceeded the QP limit during the 200 ms preceding the disturbance, the total duration of the disturbance is determined from the first time the IF output exceeded the QP limit, regardless if it falls below the QP limit in between the various disturbances.

Indeed, CISPR 16-1-1 standard, §9.2 states "the analyser shall be equipped with a channel to measure the duration and spacing of discontinuous disturbances; the input of this channel shall be connected to the IF output of the measuring receiver. For these measurements, only the part of the disturbance has to be considered which exceeds the IF reference level of the receiver", where, "the IF reference level is the corresponding value in the IF output of the measuring receiver to an unmodulated sinusoidal signal, which produces a quasi-peak indication equal to the limit for continuous disturbances". Thus, CISPR 16-1-1 standard clearly prescribes that duration measurements of a click must be performed by referring to the IF outputs. The only threshold to be considered is the limit for continuous disturbances, valid for both QP and IF output. No additional thresholds are mentioned throughout CISPR 16-1-1 standard.

The issue with tests 2 and 3 in [1] arises from the superposition of clicks and a background noise consisting of 200 Hz CISPR pulses, whose level must be regulated such that the QP reading is 2.5 dB below the QP limit. Because of the QP weighting prescribed in [1], the IF output of these CISPR pulses is 2.2 dB above the QP limit.[1] As soon as the click prescribed in tests 2 and 3 makes the QP output exceed the QP limit, a disturbance is detected. Being the IF output already above the QP limit since the beginning of the test (due to the background noise), the disturbance duration is longer than 200 ms and thus the disturbance is classified as continuous (rather than as a click). The conclusion is that tests 2 and 3 cannot be passed per definition.

However, the latest edition of CISPR 14-1 standard [2] relaxes the strict prescriptions of CISPR 16-1-1 standard in the case of a superposition of clicks and continuous disturbances. According to [2], §5.4.3.7 "if clicks have to be measured under the superposition of continuous disturbances it is allowed to increase the reference level for the time measurements to a value just above the signals produced by the continuous disturbance at the IF output of the receiver". This relaxation "is allowed only if the continuous disturbance is at least 2 dB below the QP limit".

This new relaxation introduced in [2] makes it possible to pass tests 2 and 3 prescribed in [1]. Indeed in these tests, as authors write in [4], the click duration may be measured considering a dynamic threshold rather than the sole QP limit. While such an approach is easily applicable in the prescribed tests, it is not really applicable in real-world measurements. In the next section, we discuss the different problems that arise when applying the new relaxation of a dynamic IF threshold, and we briefly explain how we handled them in our lab experiments later discussed in detail in Sect.IV.

[1] See [3] for a detailed derivation of figures discussed here.

III. Dynamic IF threshold

The latest edition of CISPR 14-1 standard [2] (§5.4.3.7) allows relaxing the threshold for click time measurements in the case of a superposition of clicks and continuous disturbances. However, because the new indications are vague, the entire click measurement procedure becomes unclear.

The relaxation presupposes the presence of a "continuous disturbance" which is at least 2 dB below the QP limit. According to the general definition in the current CISPR 16-1-1 standard, a continuous disturbance is an input signal which causes a QP output *above* the "quasi-peak limit for continuous disturbance" and an IF output which remains above the (QP) limit for longer than 200 ms. Thus, a signal which causes a QP output that never exceeds the QP limit should not be classified as a disturbance. Hence, the strictly necessary condition for the relaxation seems to be never satisfied. In the experiments we conducted, we relaxed the IF threshold when a "background permanent signal" (as opposed to a "continuous disturbance") caused a QP output 2 dB below the QP limit and an IF output above the QP limit.

The current CISPR 14-1 standard allows relaxing the limit for time measurements only; the presence or absence of a disturbance shall still be detected at the QP output, considering the QP limit. This means having two distinct limits. By applying the relaxation, it might happen that a disturbance is detected (a QP output above the QP limit) but it cannot be characterised in time and spacing (an IF output below the increased IF reference limit). In the experiments we conducted, we assumed that when this paradoxical situation occurred, the disturbance should be ignored.

The current CISPR 14-1 standard does not prescribe an exact margin to apply when increasing the limit, it rather reports "to increase the reference level for the time measurements to a value *just above* the signals". However, this figure plays a crucial role in the outcome of tests. In the experiments we conducted, we used a margin of 1 dB (from the IF output). This value is aligned with minimum tolerances in CISPR 16-1-1. In [4] authors propose an increment Δ=4 dB from the QP limit (for two of the tests they report on), an empirical choice which has been specifically shaped based upon tests 2 and 3 described in Table 17 in [1]. Because this figure refers to the QP limit, it is not directly comparable with the one suggested in [2], although it is still related to it. For example, considering the 200 Hz CISPR pulse signal mentioned in tests 2 and 3 of Table 17 in [1], the 4 dB increment from the QP limit is equivalent to setting the dynamic IF threshold to 1.8 dB above the IF output produced by the background permanent signal.

The current CISPR 14-1 standard does not prescribe the time when the dynamic IF threshold should be increased. However, the outcome of disturbance tests depend upon this. In the experiments we conducted, we tested two possible interpretations: the threshold was increased instantaneously and 1 s after the maximum peak value was detected.

The current CISPR 14-1 standard does not prescribe when the QP value should be evaluated in order to decide whether the IF threshold can be increased or not. With no time-frame between the maximum peak reading, used to determine the level of the new IF threshold, and the QP reading, used to determine if the threshold can be increased, most clicks would pass undetected. This because the QP output has a slow time response by nature. Also this figure plays a crucial role for the outcome of the test. In the experiments we conducted, we tested two possible interpretations on when the QP should be evaluated, instantaneously and 250 ms after the maximum peak value has been detected. This time-frame is coherent with the delay that CISPR 16-1-1 standard prescribes to evaluate the presence or not of disturbances.

The current CISPR 14-1 standard does not prescribe for how long a certain dynamic IF threshold is valid. In simplistic lab tests, such as in CISPR 16-1-1 tests 2 and 3, the background permanent signal produces a steady homogeneous IF output. Thus, the dynamic IF threshold can be set to this value and kept fixed. Instead, in an actual disturbance measurement of a household appliance, the background permanent signal produces an unsteady IF output. In the experiments we conducted, the dynamic IF threshold was valid for 1 s and then lowered again to the QP limit.

IV. Actual Click Measurements using the Dynamic IF Threshold Method

Different interpretations on when and how the IF threshold should be increased bring very different outcomes in real-world measurements of household appliances' disturbances. We tested the following three possible interpretations.

Algorithm 1: The disturbance analyser continuously monitors Pk and QP signals and works at runtime. If the Pk value is above the reference limit but the QP value is 2 dB or more below the reference limit then the IF threshold is increased to 1 dB above the Pk value.[2] This new IF threshold value is valid for 1 s, or until a higher IF signal is detected while the QP value is still 2 dB or more below the reference limit. The relaxed IF threshold is kept fixed while the QP value is above the QP limit minus 2 dB.

Algorithm 2: The QP value is evaluated 250 ms after the maximum peak value has been detected, rather than instantaneously as in Algorithm 1. Thus, the disturbance analyser has to monitor Pk and QP signals and buffer 500 Pk values.[3] If at sample n the QP value is 2 dB below the QP limit and at sample *n-500* the IF value is above the QP limit, the IF threshold is increased to 1 dB above the IF value of sample *n-500*. This new IF threshold value is valid for 1 s, or until a higher IF signal is detected while respecting the condition on the QP value, evaluated after 500 samples. The relaxed IF threshold is kept fixed while the QP value is above the QP limit minus 2 dB.

Algorithm 3: Similar to Algorithm 2, the disturbance analyser monitors Pk and QP signals, buffers 500 Pk values, and checks if at sample n the QP value is 2 dB or more below the QP limit and at sample *n-500* the IF value is above the QP limit. In this case, the IF threshold is not increased immediately to 1 dB above the IF value of sample *n-500*. Rather, the new threshold value becomes valid 1 s after that sampling instant. This new IF threshold value is valid for 1 s, or a second later than a higher IF signal is detected while respecting the condition on the QP value, evaluated after 500 samples. The relaxed IF threshold is kept fixed while the QP value is above the QP limit minus 2 dB.

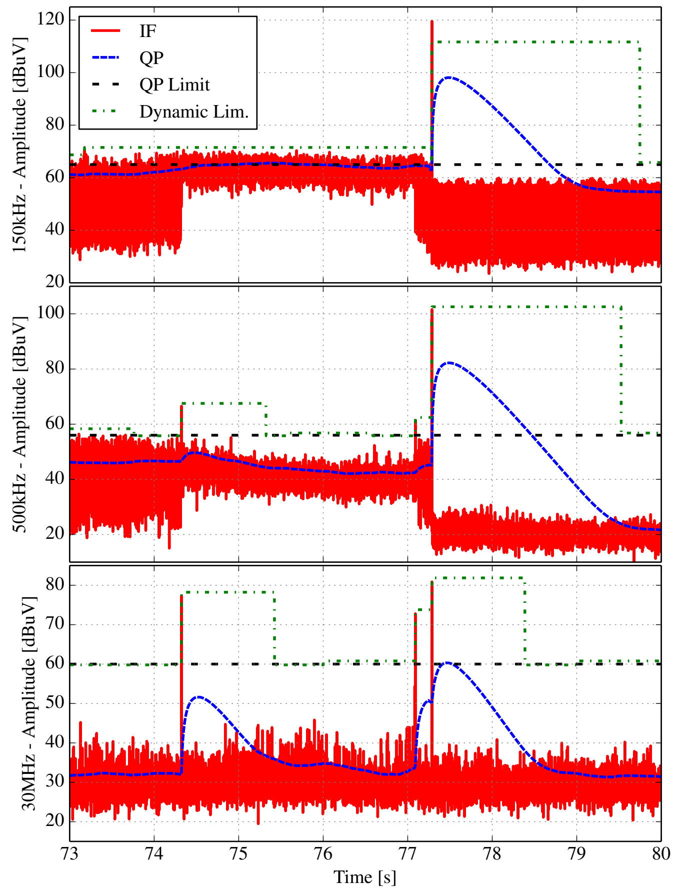


Fig. 1. Algorithm 1 in a click test of BOSCH-PSC570RE 220V drill. The dynamic IF threshold is changed instantaneously and the QP is evaluated when the Pk exceeds the limit. With this relaxation, only a single click (of 13 ms) in 150-kHz channel is detected. Instead, if the limit (QP limit) is fixed and the same for both QP and IF output, in 150-kHz channel, a continuous disturbance is measured. In the other channels, a click of 193 ms is measured.

The first measurements have been conducted on a BOSCH-PSC570RE 220V drill. The results shown in Figs. 1, 2 and 3 are related to the last four seconds of functioning of the drill. Just after second 77, the drill trigger was released. Disturbances have been monitored on all required channels: 150 kHz, 500 kHz, 1.4 MHz, and 30 MHz. Results in the 1.4 MHz-channel were similar to those in the 500 kHz channel, and are thus not shown.

By adhering strictly to prescriptions in CISPR 16-1-1 standard, the sole reference limit that should be taken into account is the QP limit (black dashed line in figures) which is respectively 65 dBuV, 56 dBuV, 56 dBuV, and 60 dBuV for the four channels. Following this strict approach, in the final stage (73-80 s), a continuous disturbance was detected in the 150-kHz channel, due to a QP output above the reference limit and an IF output continuously above the reference limit. In the other three channels, a click of 193 ms was measured, a click

[2] In the remainder of this paper, we refer to the IF output as the output of a Peak detector calculated over 500 μs. This figure represents the maximum sampling period which satisfies CISPR 16-1-1 prescriptions.

[3] Compliant with CISPR 16-1-1 prescriptions on time tolerance, IF and QP output are sampled at least every 500 μs. Thus, the number of samples to buffer is 250 ms / 500 μs =500.

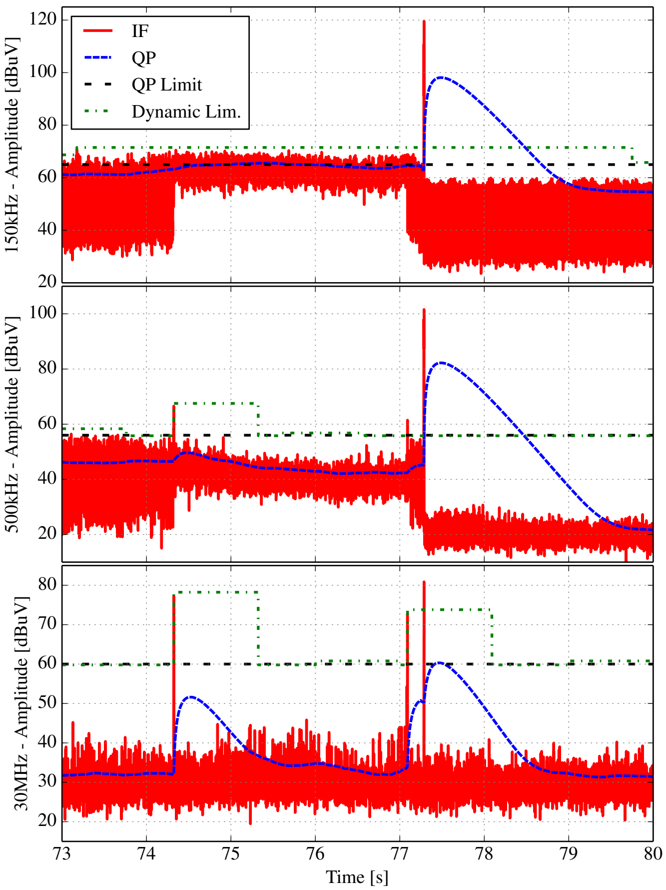


Fig. 2. Algorithm 2 in a click test of BOSCH-PSC570RE 220V drill. The dynamic IF threshold is changed instantaneously and the QP is evaluated 250 ms after the IF exceeds the limit. In 150-kHz channel, a click (of 13 ms) is measured, in 500-kHz channel, a click of 193 ms is measured, and in 30-MHz channel a click (of 16 ms) is measured.

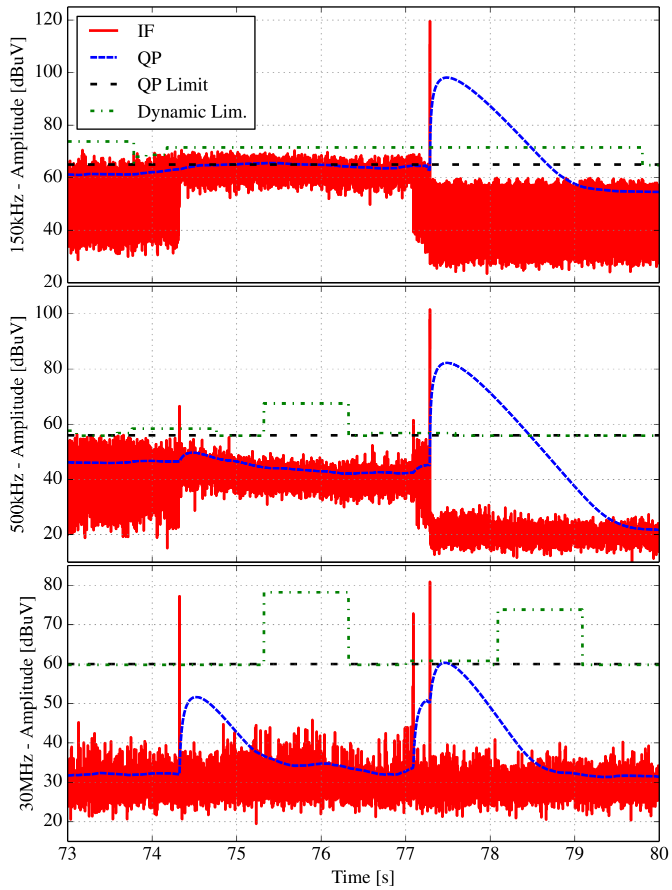


Fig. 3. Algorithm 3 in a click test of BOSCH-PSC570RE 220V drill. The new dynamic IF threshold becomes valid 1 s after sampling the IF and the QP is evaluated 250 ms after the IF exceeds the limit. In 150-kHz channel, a click (of 13 ms) is measured. In the other channels, a click of 193 ms is measured.

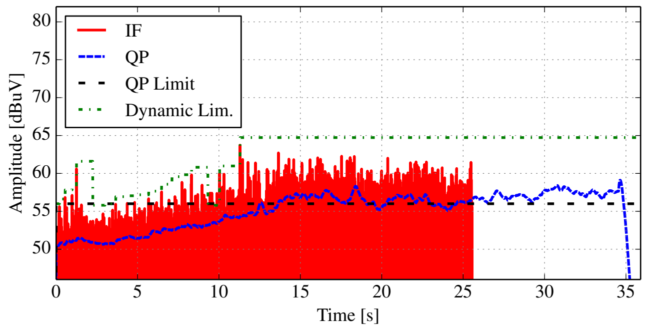
made of two single IF spikes spaced by 180 ms (around 77th second) that caused the QP reading to exceed the reference limit (evaluated after 250 ms). In the specific measurement we conducted, the drill would not have passed the test.

The results when implementing Algorithm 1 are shown in Fig. 1. Because the QP value was evaluated instantaneously, the IF threshold was adjusted based upon each click itself. The results are awful: except for a click in the 150 kHz, no further disturbances have been detected in none of the four channels.

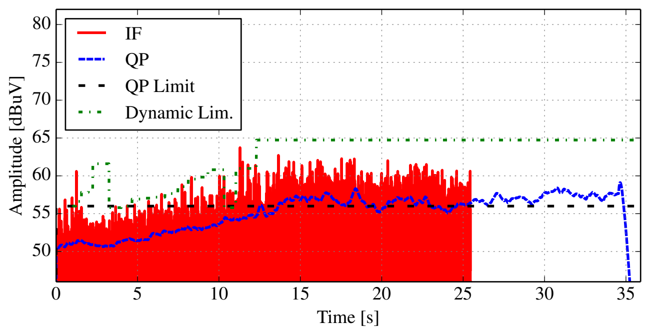
The results when implementing Algorithm 2 are shown in Fig. 2. In the 150-kHz channel, the disturbance was classified as a click (of 13 ms) rather than as a continuous disturbance as when referring to the QP limit, when adhering to the strict CISPR 16-1-1 prescriptions. In the 500-kHz channel, a click of 193 ms was measured (same result as with the QP limit); the dynamic IF threshold was not increased after second 77 because the QP output, evaluated 250 ms after the IF exceeded the QP limit, was already less than 2 dB below the QP limit. In the 30-MHz channel a click of 16 ms was measured instead of a click of 193 ms because the dynamic IF threshold was quite high, just after second 77. This was due to the high-level IF spike and the still very low QP output which was still more than 2 dB below the QP limit.

The results when implementing Algorithm 3 are shown in Fig. 3. In the 150-kHz channel, the disturbance was classified as a click (of 13 ms) rather than as a continuous disturbance as when referring to the QP limit. In the other channels the results were similar to those obtained with the strict CISPR 16-1-1 QP limit approach.

We have further experimented with Algorithms 2 and 3 in real-world disturbance measurements. Fig. 4 shows the results of two different click measurements on a PT-ID5001 220V drill; subfigure (a) is related to Algorithm 2 and subfigure (b) is related to Algorithm 3. They both show the 500-kHz measurement of the drill functioning; after second 35, the drill trigger was released. By adhering strictly to prescriptions in CISPR 16-1-1, the sole reference limit that should be taken into account is the QP limit at 56 dBuV. Practically, the drill emitted a unique continuous disturbance for most part of the functioning. Different results were obtained implementing Algorithms 2 and 3. With Algorithm 2, the household appliance passed the test with only a click of duration 16.5 ms at second 34, occurring when the drill trigger was released. With Algorithm 3, the household appliance failed the test because of the continuous disturbance it produced, roughly at second 11.5 that lasted for around 1 s (it also produced the 16.5 ms click as



(a) Algorithm 2



(b) Algorithm 3

Fig. 4. Click test of PT-ID5001 220V drill, 500 kHz measurement. If the limit (QP limit) is 56 dBuV for both QP and IF output, the household appliance fails the test because of the continuous disturbance it produces. (a) If the dynamic IF threshold is changed instantaneously and the QP is evaluated 250 ms after the IF exceeds the limit, the household appliance passes the test with a click of duration 16.5 ms. (b) If the dynamic IF threshold is changed with 1 s delay and the QP is evaluated 250 ms after the IF exceeds the limit, the household appliance fails the test because of the continuous disturbances it produces.

with Algorithm 2). Note that the result with Algorithm 3 was dependent on the margin by which the dynamic IF threshold was increased. By tuning this margin to 1.5 dB, instead of 1 dB as in our experiments, the disturbance analyser would have detected only the 16.5 ms click, and thus the household appliance would have passed the test.

V. Options to pass CISPR 16-1-1 tests

The dynamic threshold method was mentioned also in [3] as an "escamotage" to pass CISPR 16-1-1 tests 2 and 3. However, the method was dismissed as not really applicable in real-world measurements. In fact, as we have seen in our experiments, this method introduces high-level discontinuities because it is based upon conditional statements. These have different impacts in the different scenarios and cause measurement results to become unpredictable.

A. 1-kHz Impulsive Background Noise

Authors wrote in [3] that the easiest solution to correct the existing inconsistency in current CISPR 16-1-1 standard [1] was partially reviewing the background noise that tests 2 and 3 prescribe. Indeed, by simply increasing the prescribed Pulse Repetition Frequency (PRF) of the background noise from 200 Hz to 1 kHz, the difference between QP and IF outputs becomes sufficiently small (2,1 dB) so that the IF level stays below the QP limit. With such a noise, tests 2 and 3 could be passed without resorting to any complex, conditional-based algorithm.

However, in [4], authors stated that CISPR 16-1-1 tests 2 and 3 would be useless if the PRF of the background noise was changed, unfortunately without further motivating their point of view. Tests 2 and 3 aim at guaranteeing that disturbance analysers are capable of correctly detecting short clicks even in presence of a background noise. This noise has been thought and modelled to stress the capability of analysers in QP weighting even when the asymptotic floor of the QP detector decay is just below the QP limit (2.5 dB rather than several dBs lower as in the other CISPR 16-1-1 tests). Further, the noise was chosen to be impulsive because it was easier to generate in lab tests, compared to a white noise with similar QP output as it was prescribed in the very first editions of CISPR 16-1-1 standard; the white noise was prohibitive in terms of energy the lab generators had to produce. There is no evidence of a specific motivation for the 200-Hz impulsive background noise. On the other hand, if that model was thought to represent real-world phenomena such as the arching effect of brush motors, higher PRFs would actually be more adequate for todays' appliances.

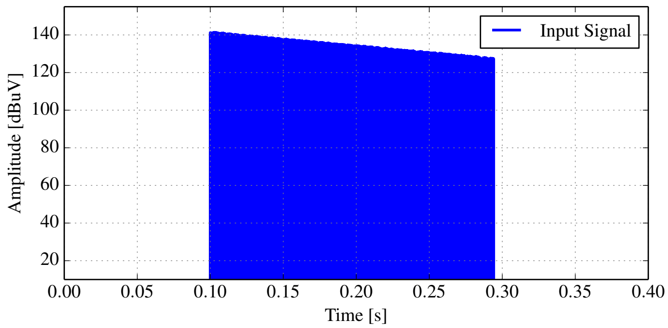
We believe there are no substantial differences in replacing an impulsive noise with 200 Hz PRF that causes a QP output 2.5 dB below the QP limit and an IF output 2.2 dB above the QP limit, with an impulsive noise with 1 kHz PRF that still causes a QP output 2.5 dB below the QP limit and an IF output 0.4 dB below the QP limit. Tests 2 and 3 would still stress the analysers' capability of QP weighting in a very restricted weighting area.

B. The Quasi-IF (QIF) detector

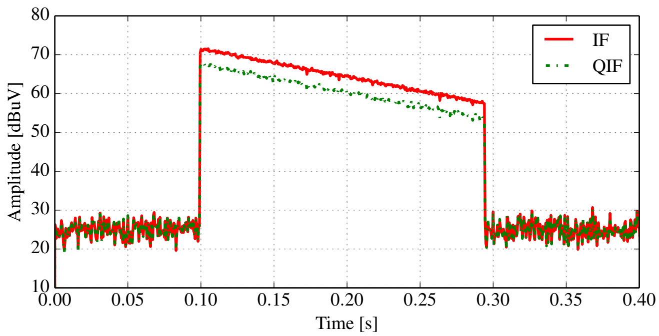
In [3], an alternative way to overcome the problems that arise when performing CISPR 16-1-1 tests 2 and 3 was a new detection called Quasi-IF (QIF). The new output consisted of a single pole LP filter which smoothed the instantaneous IF output with a time constant long enough to avoid counting the 200-Hz-CISPR-pulse background noise as a disturbance but short enough to capture short clicks as currently prescribed in [1], *i.e.*, 110 μs. In [4], authors express their concern about such a solution, and report on a new test where the input was a burst of an impulsive decreasing ramp.

We reproduced a lab experiment following the indications in [4]. Specifically, the input signal consisted of a burst of pulses separated by 500 μs and having logarithmic decreasing amplitude. The decrease was 14 dB, whereas the burst duration was 190 ms. In [4], there are no specifications about the impulse they used. We have assumed that impulses should be CISPR compliant. Hence, in the lab experiment shown in Fig. 5, the impulses had a width of 11.5 ± 0.6 ns, and a spectral density of 107 dBuV/MHz $\pm$ dB @ 30 MHz, with a spectral flatness of 2 dB. The impulse amplitude was regulated to make the QP output exceed the QP limit by 1 dB. Fig. 5(a) shows the impulsive ramp input signal.

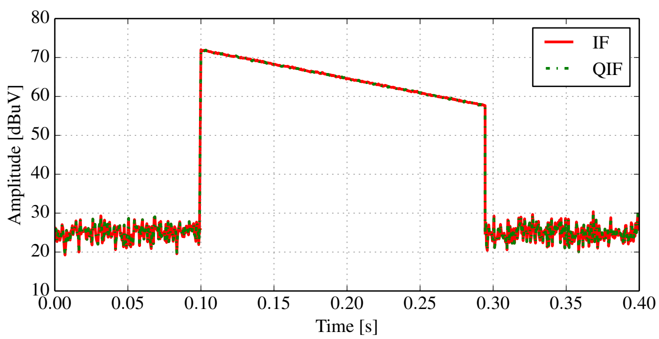
From Fig. 5(b), we can see that there are no differences between the shape of the IF output and that of the QIF output to an input made of CISPR compliant pulses. As written in [3],



(a) Impulsive Ramp Input



(b) IF and QIF Output to Impulsive Ramp Input



(c) IF and QIF Output to CW Ramp Input

Fig. 5. (a) Input signal: a burst of pulses having logarithmic decreasing amplitude, width of 11.5 ± 0.6 ns, spectral density of 107 dBuV/MHz $\pm$ dB @ 30 MHz, and spectral flatness of 2 dB. (b) IF and QIF output to the burst impulsive decreasing ramp: IF and QIF shapes are the same, amplitudes differ by roughly 4 dB and durations are the same (LP filter had $\tau = 28\ \mu$s). (c) IF and QIF output to a 190-ms long 500-kHz continuous wave burst with 14-dB decreasing amplitude input: IF and QIF output are the same.

adopting a time constant $\tau = 28\ \mu$s for the LP filter, the QIF output to CISPR pulses is 4 dB less than a traditional IF output. Instead, the QIF output to a non-impulsive input signal is exactly the same as the IF output. Fig. 5(c) shows the results with 190-ms long 500-kHz continuous wave burst with 14-dB decreasing amplitude input. In fact, the time constant of the QIF detector was optimised to reduce the effect of the background CISPR-compliant impulsive noise prescribed in tests 2 and 3 [1]. This 4 dB difference is exactly what is needed to pass tests 2 and 3. Thus, it is not a surprise if this value is also aligned with the figure suggested in [4] as parameter Δ to increase the dynamic IF threshold from the QP limit. Conceptually, the solutions proposed in [3] and [4] have the same aim but follow different implementation approaches. The first represents a linear physical system that brings smooth transitions and agreement between boundary values, whereas the second is a conditional-statement based software solution that pays little attention to boundaries and thus leads to complex, unpredictable behaviours.

Unfortunately it was not possible to reproduce the results shown in [4] as the authors did not provide any details on the detector they implemented to obtain results in Fig. 9, [4]. We limit to observe that the ”filtered video detector” mentioned in [4], which they claim to behave as the QIF detector, made the output have a completely different shape compared to the IF output. The filtered video detector output had a shorter duration, with a sharp rising edge and a smooth falling edge in the overall flat shape, while still presenting an impulsive structure.

VI. Conclusion

Current CISPR 16-1-1 standard defines the specifications of disturbance analysers and prescribes compulsory tests that disturbance analysers have to pass. However, some of these tests cannot be passed per definition. In the past years, instead of reviewing the inaccuracies that characterise normative text, the trend has rather been adding complexity to the measurement system. Current CISPR 14-1 standard, which should describe only the requirements for household appliances, gives indications on how disturbance analysers have to perform the measurement, not only going beyond its original scope, but also clashing with the prescriptions in CISPR 16-1-1 standard. The new edition of CISPR 14-1 standard, as well as a recent scientific publication, promotes a complex, conditional-based algorithm which modifies the threshold for continuous disturbance on-the-go, based upon the disturbance itself. However, there are neither parameters nor technical details on how such an algorithm should be implemented and applied. As we have shown in this paper, different algorithms may well bring similar results in the basic lab tests prescribed in the standards but give very different outcomes in real-world measurements of household appliances. Further, there are no reasons why the dynamic threshold method should be adopted. Without a clear motivation for such a conditional-based approach, except that of merely enabling to pass CISPR 16-1-1 performance tests that have been decided on paper, other solutions seem more suitable to overcome the inconsistency in CISPR standards.

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