

Technical Specification for the new RCJ Soccer Ball

29th December, 2008

Preamble

Answering to the request for a soccer ball for RCJ tournaments that would be more robust to interfering lights, less energy consuming and mechanically more resistant, the RCJ Soccer Technical Committee defined the following technical specifications with the special collaboration from EK Japan and HiTechnic.

It is expected that balls complying to this specification will progressively replace the old nonmodulated IR light balls used until now, between 2009 and 2010.

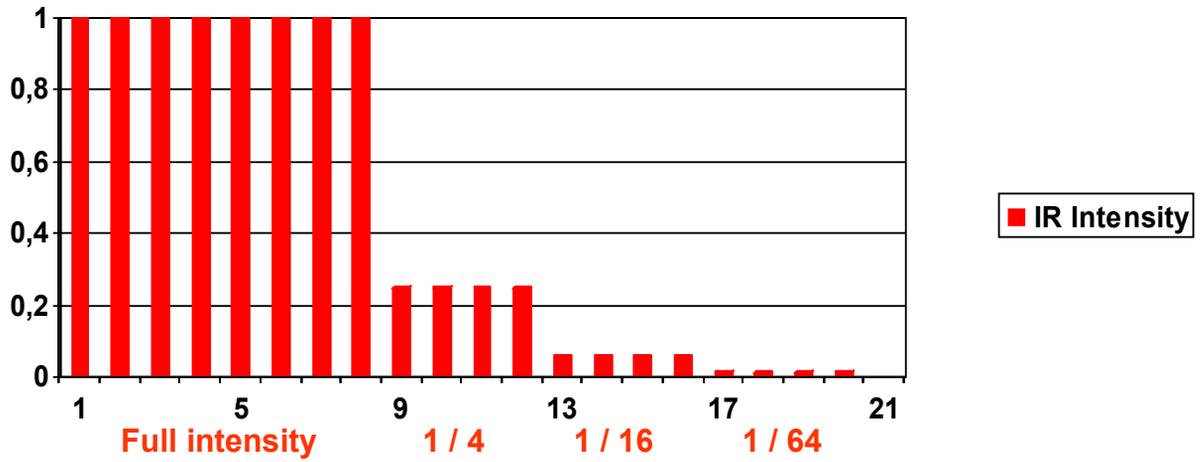
Producers of these balls must apply for a certification process upon which they can exhibit the RCJ-compliant label and their balls used in RCJ tournaments.

Balls with these specifications can be detected using specific sensors from HiTechnic (IRSeeker - information on distance and angle) but also common IR remote control receivers (TSOP1140, TSOP1240, GP1UX511QS, ... - on-off detection with a possible gross indication of distance).

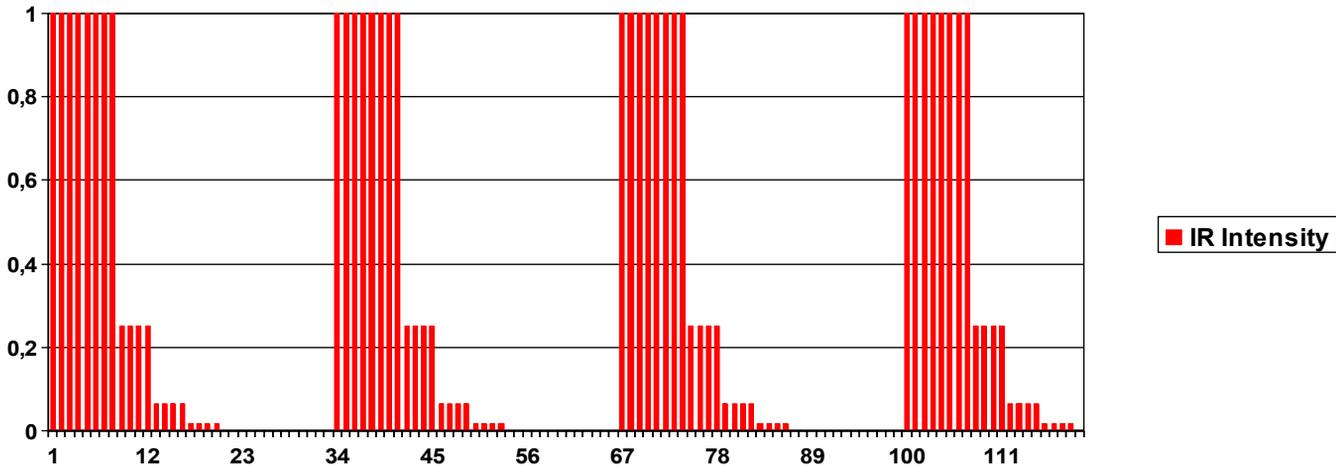
Specifications

- 1. IR light:** The ball emits infra-red (IR) light of wavelengths in the range 920nm - 960nm, pulsed at a square-wave carrier frequency of 40kHz. The ball should have enough ultra bright, wide angle LEDs to minimize unevenness of the IR output.
- 2. Diameter:** The diameter of the ball shall be in the range 74mm - 80mm. A well-balanced ball shall be used.
- 3. Drop Test:** The ball must be able to resist normal game play. As an indication of its durability, it should be able to survive, undamaged, a free-fall from 1.5 meters onto a hardwood table or floor.
- 4. Modulation:** The 40kHz carrier output of the ball shall be modulated with a trapezoidal (stepped) waveform of frequency 1.2kHz. Each 833-microsecond cycle of the modulation waveform shall comprise 8 carrier pulses at full intensity, followed (in turn) by 4 carrier pulses at 1/4 of full intensity, four pulses at 1/16 of full intensity and four pulses at 1/64 of full intensity, followed by a space (i.e. zero intensity) of about 346 microseconds. The peak current level in the LEDs shall be within the range 45-55mA. The radiant intensity shall be more than 20mW/sr per LED.
- 5. Battery Life:** If the ball has an embedded rechargeable battery, when new and fully charged it should last for more than 3 hours of continuous use before the brightness of the LEDs drops to 90% of the initial value. If the ball uses replaceable batteries, a set of new high-quality alkaline batteries should last for more than 8 hours of continuous use before the brightness of the LEDs drops to 90% of the initial value.
- 6. Coloration:** The ball shall be neutral in color. In particular, it must not have any green, blue or yellow coloration (to avoid confusion with the colors of the field and goals).

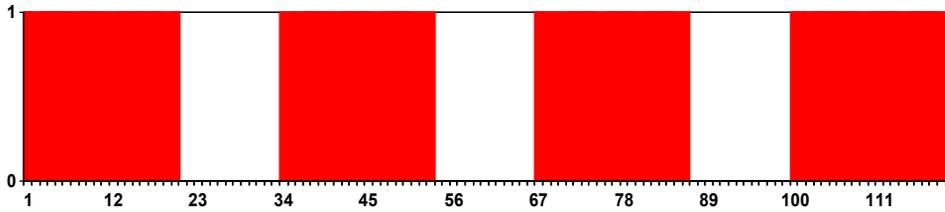
Infrared Waveform Diagram



Infrared Waveform Diagram, 1 Trapezoid
Each IR pulse is 12.5 μ s wide.

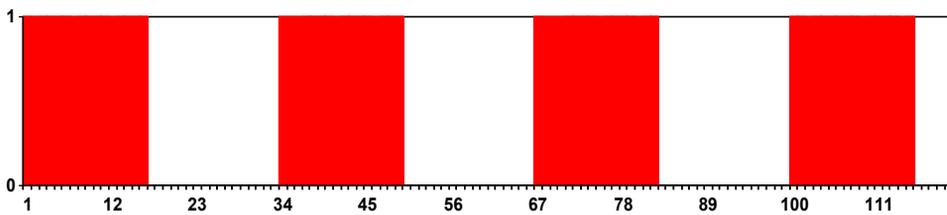


Robot's perspective



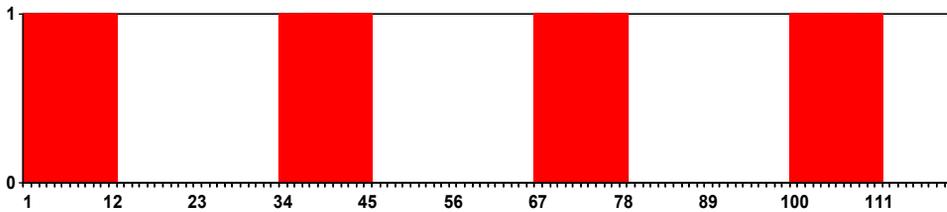
IR Intensity

Best view, 20 / 33 pulses seen = 61%



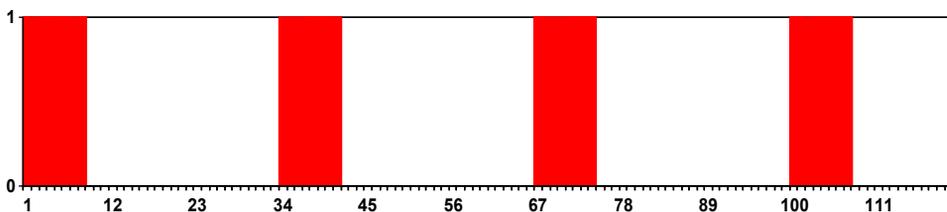
IR Intensity

Good view, 16 / 33 pulses seen = 48%



IR Intensity

Medium view, 12 / 33 pulses seen = 36%



IR Intensity

Bad view, 8 / 33 pulses seen = 24%