

## Low Duty Cycle?

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**The phrase ‘low’ (‘limited’ or ‘restricted’) duty cycle appears in a large number of ISM band allocation descriptions, as a favourite method of allowing multiple users without calling for the complicated radio hardware that other access schemes (multiple channel, spread spectrum or listen before talk) require.**

The principle behind a low duty cycle system is very simple: by restricting the duration and rate of repetition of any one user’s transmissions it becomes statistically unlikely that they will coincide (collide) with those of other, similarly limited, systems. In practice, the actual restriction is specified as a ‘duty cycle’, usually between 0.1% and 10%, depending on the band and the intended usage. In layman’s terms this reduces to “you stab the button at random and hope like hell that you’re the only one transmitting at that instant”.

There are certain implications that result from this type of operation: The transmitter must be designed for efficient use of the available time. It must switch on and off cleanly (not generating AM splatter, like a GSM cellphone does) and the switching needs to be as fast as possible to maximise the time allowed for data transmission. The data coding must minimise the amount of time lost in preamble and synchronising sequences, and the overall data rate should be as high as practical (within other limitations, such as channel bandwidth).



BiM3B Transceiver

At some point, a collision with another transmission and resulting loss of data is inevitable. The overall design of the link must allow for this. In the simplest case, this is handled by ‘user feedback re-transmission’ (the light doesn’t turn on, so press the button again). Although amusingly simple, this is sufficient for a large proportion of simple control systems, including almost all car radio-keys.

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Where more sophisticated systems are considered, and data integrity must be maintained, then a more effective means of dealing with data loss is needed. Sending the same data more than once will reduce (but not eliminate) the probability of completely losing a vital piece of information. In such a case, the interval between re-transmissions must not be constant (a randomising function is required), or there is the risk of another, identical system in close proximity falling 'in step' and the retransmissions always colliding.

Where no data loss is allowable (forexample, in a data download application from a data logger), then a transmit/acknowledge protocol must be used. This requires transceivers at both ends of the link (opposed to the transmitter/receiver pair used by the simpler methods) and the transmission of a 'data received successfully' message by the destination end after each burst. The failure to receive such a message within a given time window will then cause the originating unit to re-send the same data. In this way, the transmission will be repeated until successfully received.

Additionally, once the complexity of a transceiver system has been implemented, then the user has the option of using other protocols beyond transmitting at random, as required (such as master/slave polling or master synchronised time slots), provided the actual transmission durations are within the spec limits.

## European Duty Cycle Limited SRD Bands

169MHz 0.1% to 10%, depending on the sub-band and transmit power.  
433MHz 10% duty cycle, wideband (> 25kHz channel) 10mW transmitters.  
(no restrictions on sub-1mW units, or narrowband systems).  
868MHz Variously 0.1% to 100%, depending on the sub-band.  
2.45GHz RFID allocation 15%.

See **ERC-REC 70-03** for more information.

In addition to the duty cycle limits, this specification also states absolute transmission time limits too (otherwise a "10% duty cycle" system could transmit constantly for a year and then stay quiet for nine...!)

Maximum total time on in any hour:

3.6 seconds 0.1% duty cycle

36 seconds 1 %

360 seconds 10%

Maximum length of any given transmission:

0.72 seconds 0.1% duty cycle

3.6 seconds 1 %

36 seconds 10%

Minimum 'off' time between transmissions:

0.72 seconds 0.1% duty cycle

3.6 seconds 1 %

36 seconds 10%

## **About Radiometrix**

Established in 1985 and headquartered in London, Radiometrix continues to be recognised as the leading global developer of narrow and wideband radio communication modules. Our diverse product range is suitable for a wide variety of licensed and licence-exempt ISM/SRD wireless applications, and is available worldwide through our global sales and distribution network.

For more information on the company, please visit our website:

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