

Application Note

HIOKI WIRELESS MINI LOGGER LR8512 FOR ENGINE LOAD TESTING



Wireless Pulse Logger : LR8512

Engine Load Testing And Its Importance

Engines, particularly diesel ones, are expensive and known to have a long lifespan. Engines are built to run within an environment and load limit. However, the improper operation conditions often kill the engines prematurely. Overload is one of the top three common reasons [1]. An overloaded engine cannot reach its rated Revolutions per Minute (RPM) under a full load of fuel and water tanks capacity [2]. Continued operation of an overloaded engine leads to excessive black smoke emission during cruising, high exhaust temperature beyond manufacturer's specification, excessive fuel consumption, slow acceleration, reduced engine life, and exhaust flow components failure.

Engine RPM As Engine Load Test Parameter

Engine RPM denotes the number of times the engine crankshaft rotates around its axis and translates to the torque or power produced. The piston movements during engine cylinder combustion drive the crankshaft's rotational motion [3]. In engine commissioning test, the RPM test is one of the tests to ensure that the end user complies with the engine build specifications.

The engine RPM measurement involves the measurement of the crankshaft gear's rotational speed. This gear contains a fixed number of teeth (Figure 1.0).



Figure 1.0 Crankshaft gear with fixed teeth

Conventional Engine RPM Measurement Methods

There are two conventional methods of measuring RPM [4] before proximity sensors' introduction:

- i) Tachometers with mechanical sensors (contact on rotating body to be measured) or optical sensors (infrared light/ laser beam). The measured RPM is displayed either on a calibrated analog dial or digital display. A common drawback for this method is that it requires space for instrument mounting and thus does not suit engine mounted at constraint spaces.
- ii) Stroboscopic using intense flash that strobos at high frequency. The measured rotating object will appear to be stationary when the frequency of the light synchronized with the RPM of the object. It takes multiple adjustments to get the synchronized frequency and requires manual logging of the result.

Hioki LR8512 Pulse Logger For Engine RPM Testing

Hioki LR8512 pulse logger is convertible to be used for engine RPM measurement. It can be used independently for this sole purpose or paired with LR8410 central logger together with other logging modules for simultaneous measurement of various parameters (e.g. DC voltages and temperature) with RPM measurement. This feature is particularly useful during engine commissioning where engine RPM and other parameters measurement are required. The LR8512 logger connection cable connects the logger to the magnetic or electrical pickup transducer that is mounted close to the engine gear area (Figure 2.0). The pickup transducer will return a signal when a gear teeth passes by the location the transducer [5].

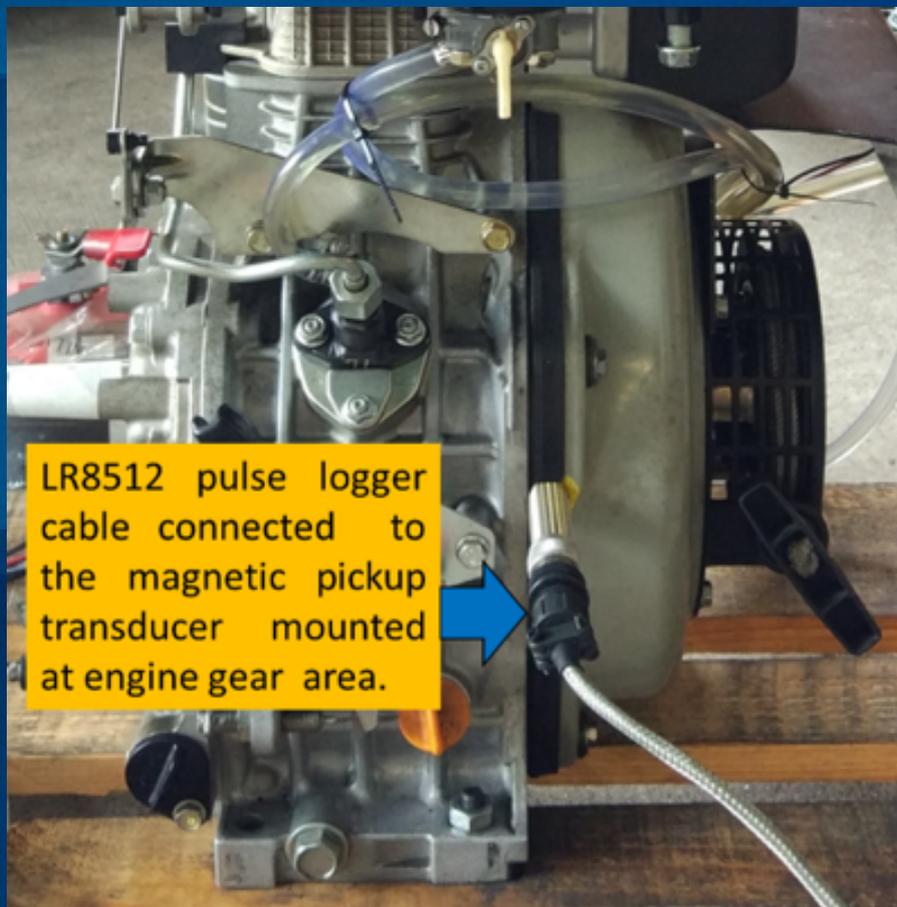


Figure 2.0 Example of LR8512 probe set up for engine rpm testing

One complete rotation through all the teeth on the gear signifies one revolution. This number of teeth needs to be keyed into the logger as reference and can be done wirelessly (via Bluetooth) using LR8410 as shown in Figure 3.0 with an example of a gear with 97 teeth.

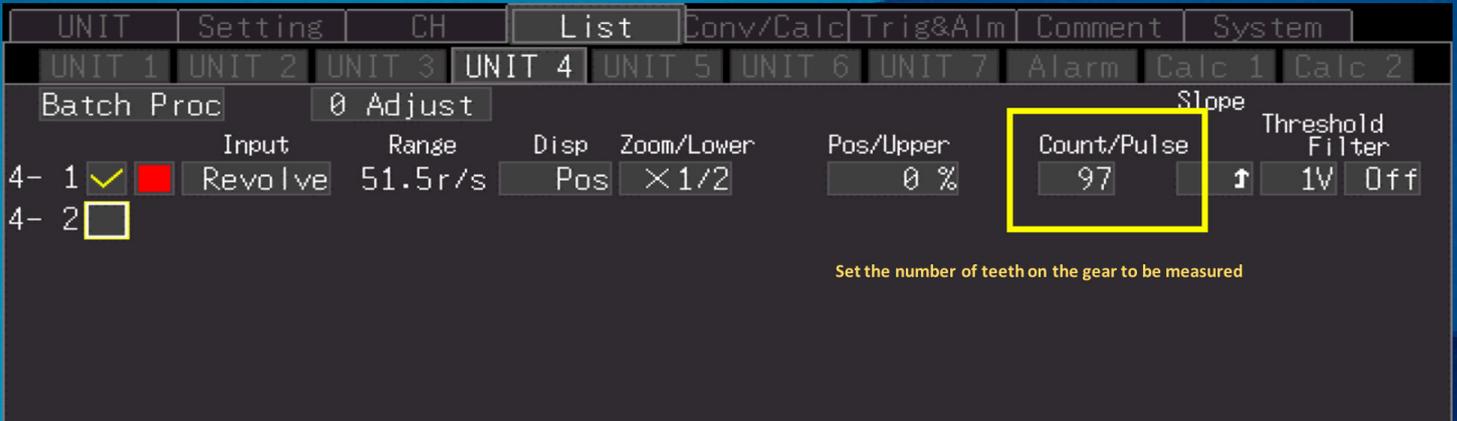


Figure 3.0 LR8512 gear teeth setting (viewed on LR8410)

The LR8512 reports RPM in r/sec (Figure 4.0). Users can also report in other units using the 'Scaling' function. Example for reporting in r/min unit set the scaling ratio value to '60' and the unit to 'r/min' (Figure 5.0).



Figure 4.0 LR8512 display in 'r/ sec' unit

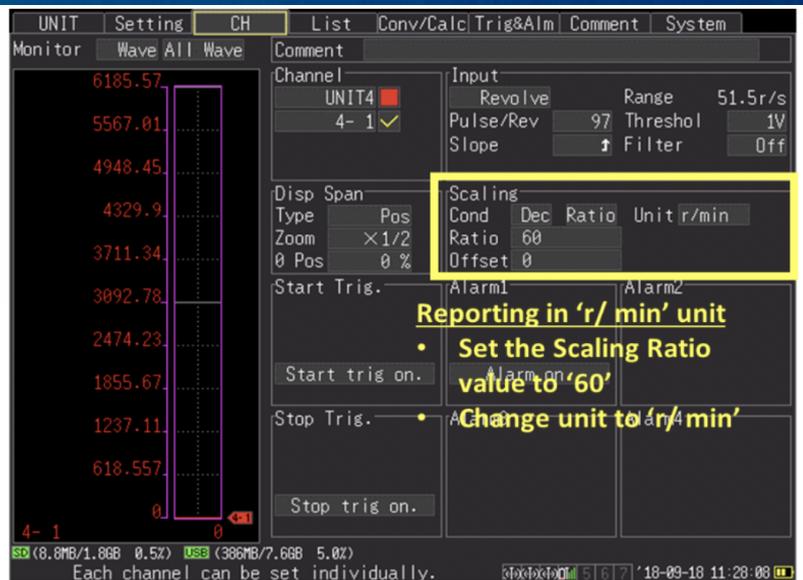


Figure 5.0 LR8512 setting to convert from 'r/sec' to 'r/min' unit (viewed on LR8410)

Hioki LR8512 is suitable for real-time engine rpm monitoring with the following key features:

- Compact size to fit constraint spaces such as engine bays
- Bluetooth wireless data sending for real-time monitoring (accessible thru Android smart devices installed with free 'Wireless Logger Collector' app within 30m line-of-sight)
- Stand-alone use or pair with LR8410 together with other data loggers (up to 7 modules) for simultaneous measurement of various parameters (Multiple loggers data are combined automatically in a single csv file for user's convenience)
- 2 channels for 2 locations simultaneous tracking
- 500,000 data points per channel



■ Specifications (Accuracy guaranteed and Post-adjustment accuracy guaranteed for 1 year)

No. of input channels	2 channels (common GND)
Measurement modes	Integrating (cumulative/Instant), Revolution, Logic (Records an 1/0 for each recording interval)
Supported input format	Non-voltage "a" contact (always-open contact point), open collector, or voltage input (DC 0 V to 50 V)
Recording intervals	0.1 to 30 sec, 1 to 60 min, 16 selections
Recording modes	Instantaneous value
Dimensions, Weight	85W×61H×31D mm (3.35W×2.40H×1.22D in), 95 g (Not including the battery)

■ Pulse input

Pulse input cycle	200 μs or higher when the filter is set to OFF (must be 100 μs or higher in H period and L period.) 100 ms or higher when the filter is set to ON (must be 50 ms or higher in H period and L period.)		
Measurement	Range	Max. Resolution	Measurement Range
No. of revolutions	5000/n [r/s] f.s.	1/n [r/s]	0 to 5000/n [r/s]

*n is the number of pulses, 1 to 1000, per revolution.

Summary

Aside from the small size, the Hioki LR8512 mini logger's easy set up features for engine rpm testing makes it an ideal tool for this purpose. The remote monitoring feature enables real-time monitoring and automated data retrieval of test data. Engine RPM testing is particularly useful for engines commissioning for warranty coverage by engine manufacturers.

References

1. <https://mvdirona.com/TechnicalArticles/DieselEngineOverload/AvoidingDieselEngineOverload.htm>
2. <http://www.scottmarinepower.com/techtips/2015/9/24/full-power-engine-speed-readings-proper-engine-loading-aka-wide-open-throttle>
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