5 ways to receive an optimal RPM signal

The rpm signal of engines, gear boxes and other components acts very often as control factor for acoustic and vibration measurements besides interpretation as independent value (NVH – Noise, Vibration , Harshness). For getting a correlation between cause and effect which is necessary in signal evaluation the test engineer needs to choose a suitable RPM measuring procedure. Different technologies require review regarding conditions, possible limitations, test preparation and scattering results. A faulty choice of measuring procedure can question the result of enhanced test series.

High accuracies can be reached by tapping of the original RPM signal. RPM marker can be detected by inductive or optical sensors. The advantage of high accuracy is combined with high effort in setup which can be critical due to high density of components in the engine compartment. Comfortable and time saving methods to receive RPM signal can be tapping over vehicle CAN or standardized ISO 15765/4 diagnosis protocol OBD2. For both following procedures with optical or inductive sensors the signal latencies are in the foreground. This takes account of the high demands for high-resolution signal correlation in upper order ranges either.

RPM acquisition with optical sensors

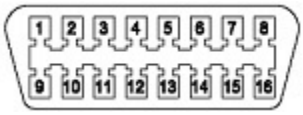
Optical sensors in different versions and with various reflecting technologies offer a simple and cost-effective solution for precise RPM acquisition in terms of circuitry. LED optics are being used as light source with limited range. If there are bigger distances to be covered the light damping and effects with interfering light have to be considered. Opto amplifiers with high accurate laser light sources can provide remedy for both conditions. It has to be decided if a single beam light barrier or a reflective scanner is the right solution in an optical measuring procedure. With single beam light barriers there is a direct visual contact between light emitter and receiver. Both components which have to be installed separate from each other require wiring of power supply and effective signal. If there is suitable reflection area existing across the light emitter then reflexion scanners can be used. This technology provides light emitter and receiver in one common housing in a compact shape where the light beam gets reflected by scattered light from the rotating object. It has to be looked after reflective properties of RPM marker on the rotating measuring object as well as on marker size considering the response time of the optical sensor even in highest RPM ranges to provide a secured result.

The reflective marker is being realized ideally over a glas beads foil to be attached. The very often used Tippex marker can be a suitable solution either. The response time of the opto amplifier should be specified in the lower millisecond range. Narrow mounting areas like in the engine compartment or in miniaturized assemblies refuses the close mounting of the optical sensors. Relief can be produced through using optical fibers with an opto amplifier locally separated and upstream mounted. The distance between opto amplifier and measuring object can be up to 2m (with fiber optics up to 100m). 2 options can be chosen: plastic or more robust glass fibre optics. The decision is defined through operating conditions. For a more flexible line with narrow bending radiuses the less cost intensive 2 wire plastic fiber optic is the most common solution. The application cases are limited through lower and restricted range of operation temperature and through material blurring caused by aging. In cases with thermo critical operating conditions the glass fibre optics provide the more robust alternative. Glass fibre cables in special coated quality allow environmental temperatures up to 250°C. The almost unrestricted photoconductivity even in longer distances indicate the application on decentralized measuring locations in large facilities. Close areas require compliance with larger bending radiuses when equipped with glass fibre optics.

RPM acquisition with inductive sensors

Comparable accuracies can be delivered through inductive sensors. These transducers are offered in various miniaturized versions and with integrated signal conditioning. Inductive sensors are used on ferromagnetic gear wheels and shafts. The low current winding which is integrated in the sensor head is reacting on distance change of the rotating object. In case that teeth are missing in a gear wheel this is being detected in a change of the inductive process and can be interpreted in the post-processing electronic evaluation. This process is known as „60-2“ or „missing teeth“ within RPM measuring technology. Inductive sensors guarantee a trouble-free operation in a wide range of environmental conditions. In case that the power supply can be provided through the DAQ system then setup effort is reduced to a minimum.

RPM acquisition over OBD2 (WWH-OBD)



The RPM tapping over standardized diagnosis sockets of vehicles is showing a more comfortable way in regard of setup effort. The output protocol of the diagnosis interface is defined for all worldwide registered vehicles over the mandatory OBD2-Standard ISO 15765/4 (WWH-OBD = ISO

27145). If the control unit of the vehicle operates acc. to OBD2 standard then the output rate for RPM values is specified with 20Hz minimum. With professional handling of the required handshake process and the interpretation of the data protocol the setup effort is reduced to almost zero: connecting of OBD cable, waiting for appr. 5 sec. to establish data communication and the RPM information is availabe. Another significant advantage: this works with corporate vehicles as well as on third-party vehicles. With using this comfortable and economical RPM source there have to be considered the limits of this technology either. For measuring of highly dynamical RPM changes the handshake process can cause a „stair shape“ of the RPM signal in the upper RPM range. This effect is determined by the vehicle electronics itself: empirically the quality of RPM signal increases with the quality of the vehicle.

Based on the process related conditions the comfortable OBD2 data access is being used for getting RPM information as control parameter for order analysis as well as accompanying indicator in the traditional multi-channel measuring technology.

RPM acquisition over vehicle CAN

CAN

A compromise between reachable update rate and necessary preparation effort can be provided by RPM tapping directly from vehicle CAN. Deviating from OBD2 interface (handshake process) the CAN access is realized in a monitoring procedure. Depending on CAN bus load this access can reach a signal update rate of appr. 100 Hz average. This benefit requires access to the necessary description file (e.g. DBC..) or at least to the structure of the RPM relevant CAN message.

RPM acquistion over FMS (Fleet Management System)

If there is no OBD2 interface existing in pre-series vehicles or prototypes in the truck industry then RPM information can be accessed over the standardized FMS inteface acc. to SAE J1939. FMS information is transmitted with different priorities in the broadcast mode. The output rate for RPM information is provided with 50Hz acc. to SAE standard.

All mentioned RPM test methods in one case

The RPM measuring system rpmSET offered from DUETTO-Engineering combines all previously described measuring procedures in one compact equipment case. The optical and inductive sensors which are included in the scope of supply have been approved by experienced acoustical engineers and pre-assembled to be ready for operation. The output of RPM information is realized optionally as TTL pulse sequence, as proportional analog voltage and as CAN message simultaneously. The current RPM value can be shown in big figures on the integrated display. This variety of functions establishes the system as an essential tool in the professional acoustical measuring industry as well as in vibration laboratories.

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