Technical Bulletin

The Power of WAI

COM
Inte 2020

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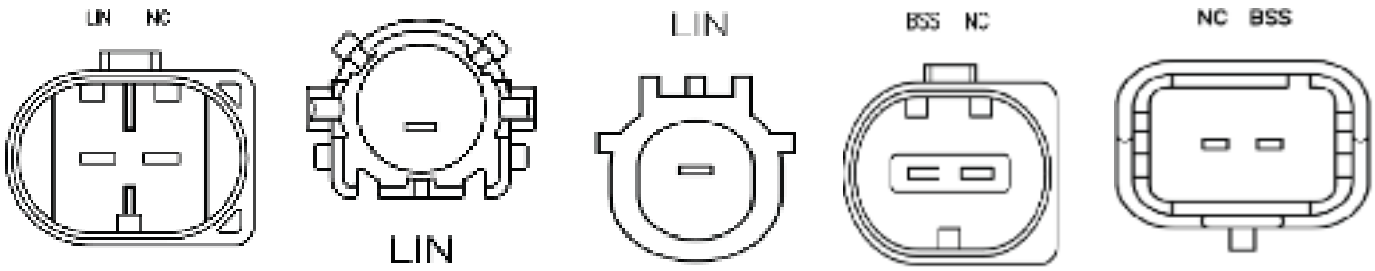
COM Regulators 2020

- The command structure is as follows.
  Break character which alerts the slave there is data coming
  - Sync character which is used by the slave to align the data rate.
  - Command ID to instruct the slave of the action to be performed
  - Data bytes to or from the slave. The number of bytes varies based on the command.
  - Check sum byte which determines the integrity of the data. The Check sum type differs based on the version of LIN.

BSS:

- BSS has not evolved much. Furthermore there really is only one version of BSS. Although depending on the tester manufacturer. It may be broken into 3 versions based on the alternator error report.
  - BSS 1: only Electrical error reported
  - BSS 2: only Mechanical error reported.
  - BSS 3: Mechanical and Electrical error reported.
- Data Rate is fixed at 1200Bps
- BSS is a bit synchronous and the bit states are pulse width modulated.
- Each command/data frame is 19 bits preceded by 3 sync pulses minimum.
- BSS command structure is a register driven interface.
  - The master addresses the desired register and the purpose.
  - The master or slave fills in the register value depending on the purpose of the access to the register.
  - Parity testing is used to determine the validity of the data and acknowledge is provided.
- LIN/BSS vs. Manufacturer Connectors:
- Valeo, Bosch, Denso, Mitsubishi, Hitachi etc… LIN and BSS regulator connector interface varies based on the connector used by the manufacturer or the vehicle manufacturer using the regulator. But no matter the number of terminals in the connector. Only one pin is required to support the interface the rest of the terminals have no function. Shown below are a few of the typical connector interfaces.



COM Regulators 2020

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Multifunction Function regulators…
Unlike LIN and BSS COM regulators which have a minimal terminal interface, Multifunction regulators are made up of multiple wire/terminal interfaces. The terminals are responsible for a number of functions as listed below

- Controlling set point
- Load/Field status
- Feedback for Soft Start and LRC
- Overcoming losses in the battery charging circuit
- Enabling/turning on the regulator operation
- Reporting error conditions (ie Loss of stator, Sense etc.…)
- Active output to power some auxiliary function (ie Choke)

There are a number of terminal names/functions for these signals that support multifunction regulators. Also in many cases there is more than one name for a terminal that performs the same function. The names are abbreviated to acronyms or single letter indicators which in many cases can be cryptic. Leading to confusion and misunderstanding there function. Common terminal names are PCM, RCV, RC, C, RLO, P-D, IGN/PWM, IGN, Lamp, L, Li, K, F, FR, DF, DFM, M, S, Sta etc.…The next section is meant to help remove the confusion and define the terminal/functions.

Voltage Set Point Control terminals:
This group of terminals can be grouped into voltage set point control terminals. These terminals control the set point of the regulator through PWM (pulse width modulation) or Voltage level. Common names for these terminals are RCV, SIG, RC, RLO, P-D, IGN/PWM, and C.
Most of the set point controlled multifunction regulators fall into the category of PWM controlled regulators.
Car manufacturers such as Ford, GM, Hyundai, Toyota etc.… have adopted these various PWM schemes described below.

PWM:

- RC/SIG (Remote Control) is 125Hz PWM signal. The controllable range is from 5 to 95% Duty Cycle. Outside of the controllable range the regulator turns off or returns to the default set point. Ford's PCM interface uses RC/SIG.
- RVC (Remote Voltage Control) is a 125Hz PWM signal. The controllable range is from 10 to 90% Duty Cycle. Outside controllable range the regulator returns to default set point. The RVC interface also has the ability report fault condition. If no Stator/no rotation is detected the regulator pull the RVC Line to ground. GM adopted/developed this PWM interface.
- Reverse RVC uses the same 125Hz PWM signal as standard RVC. The big difference with reverse RVC is the set point control. Reverse RVC reduces the set point as the PWM Duty Cycle increase. Car manufacturers such as Hyundai use this PWM interface.
- RLO is the slowest PWM interfaces of the PWM type interfaces. RLO center PWM frequency is 8Hz. RLO is also a reverse PWM interface, 1% (15V) to 82% (12.6V) Duty Cycle. Duty Cycle greater the 82%DC result in 12.6V set point. Toyota adopted this PWM interface.
- P-D regulators use what is considered a ½ regulator circuit topology. Unlike the classic regulator circuit the vehicle PCM is responsible for the field control. The PCM PWM field control output drives the D terminal (Driver circuit) of the regulator. The P terminal (Phase) is connected to the Stator. The PCM uses the stator signal from the P terminal as an indication of field load. These P-D type regulators are produced be Mitsubishi/Hitachi and used in Mazda and Kia Cars.
- IGN/PWM 28V regulator IGN interface serves two purposes. The input can be used as a standard ignition line or PWM input. The PWM input center frequency is 200Hz. The PWM range is 8% to 96% Duty Cycle. Duty Cycle = or > than **96% results in the default set point. Mitsubishi produces these truck regulators.**

Level Controlled:
C, G (computer controlled) terminal regulators are controlled by a voltage level. Grounding the C terminal reduce the voltage to a known set point. Opening or connecting the terminal to B+ raises the voltage to a known set point.

COM Regulators 2020

5. Graphical Display for:

- **a.** Voltage set point setting/measurement
- **b.** Duty Cycle for COM or Multi function
- **c.** COM regulator ID information
- **d.** COM regulator Mechanical, Electrical and Temperature error information

Shown below in figures 2 and 3 are front panel views of the WAI1000.

Fig 2

Fig 3

Both testers are capable of testing COM and Multifunction regulators. But, since COM regulators are the focus of this article the tester application examples will be focused on COM regulators. Below are three COM regulator test examples using the VRC2010, WAI1000, and VRC2010/WAI1000 combination.

Shown below in **Figure 4** is a COM regulator test example with the VRC2010. The COM connections are shown as dotted lines since the connection will be determined by the COM type (LIN or BSS).

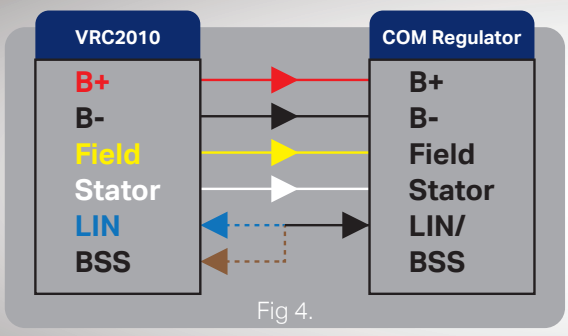

Fig 4.

In this test topology the COM regulator is being bench tested. The VRC2010 is the alternator simulation source and is responsible controlling VSP (Voltage set point) of the COM regulator. In order to test the COM regulator with the VRC2010 the regulator COM connection must be connected to the correct protocol (LIN or BSS). Once the proper protocol connection has been connected the VRC2010 will establish communication with the regulator. If Communication has been properly established the Volt Meter display will display the VSP (Voltage set point) selected on the COM Voltage selector switch. Otherwise the regulator will remain at its default voltage set point. At this point the COM regulator is ready for testing.

COM Regulators 2020

Shown below in **Figure 5** is a COM regulator/Alternator installed in a Vehicle test example with the WAI1000. The COM connection will be determined by the COM type (LIN or BSS).

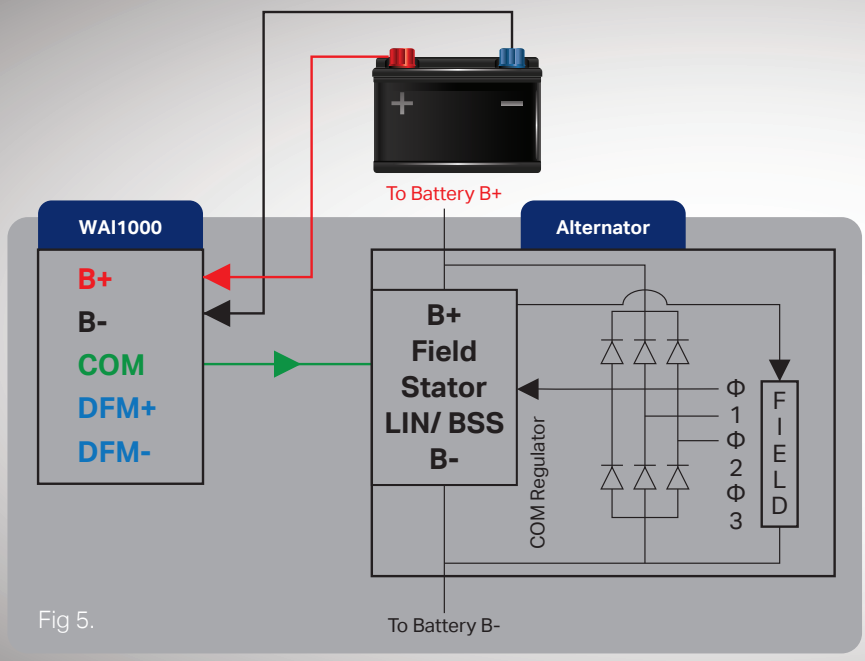

Fig 5.

In this test topology the COM regulator/Alternator is being tested in a Vehicle. In the Vehicle test example the WAI1000 is responsible for controlling and displaying status of the COM regulator. Also it should be noted the ECU/PCM communication is disconnected from the COM regulator since the WAI1000 will be taking the place of the ECU/PCM during testing as shown in figure 5. Most importantly the Vehicle should be switched off while connecting tester. After all connections are established the Vehicle may be started. In order to test the COM regulator with the WAI1000, COM is selected from the top level menu. The WAI1000 will determine the COM type (LIN or BSS) and speed. Once communication is established the display will display Protocol version, ID information, Errors, VSP (Voltage set point) and Duty cycle. At this point the COM regulator is ready for testing.

Shown below in **Figure 6** is a COM regulator test example with a VRC2010/WAI1000 combination. The COM connection will be determined by the COM type (LIN or BSS).

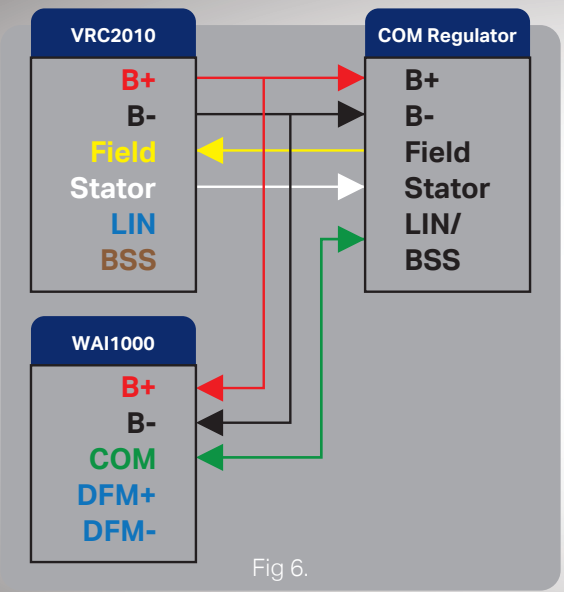

Fig 6.

In the above test topology the COM regulator is being bench tested. The VRC2010 is the alternator simulation source and the WAI1000 is responsible for controlling and displaying status of the COM regulator. In order to test the COM regulator with the WAI1000, COM is selected from the top level menu. The WAI1000 will determine the COM type (LIN or BSS) and speed. Once communication is established the display will display Protocol version, ID information, Errors, VSP (Voltage set point) and Duty cycle. At this point the COM regulator is ready for testing.
The Above three test examples were meant to show the reader how WAI Tester line can be applied to test COM regulators. It is also important to note the VRC2010 and WAI1000 testers are very capable testers. Along with COM regulators they are capable of testing a wide variety of Multi-function regulators. Also with multifunction regulators the VRC2010 and WAI1000 are capable of performing on their own and in combination depending on the test application.

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