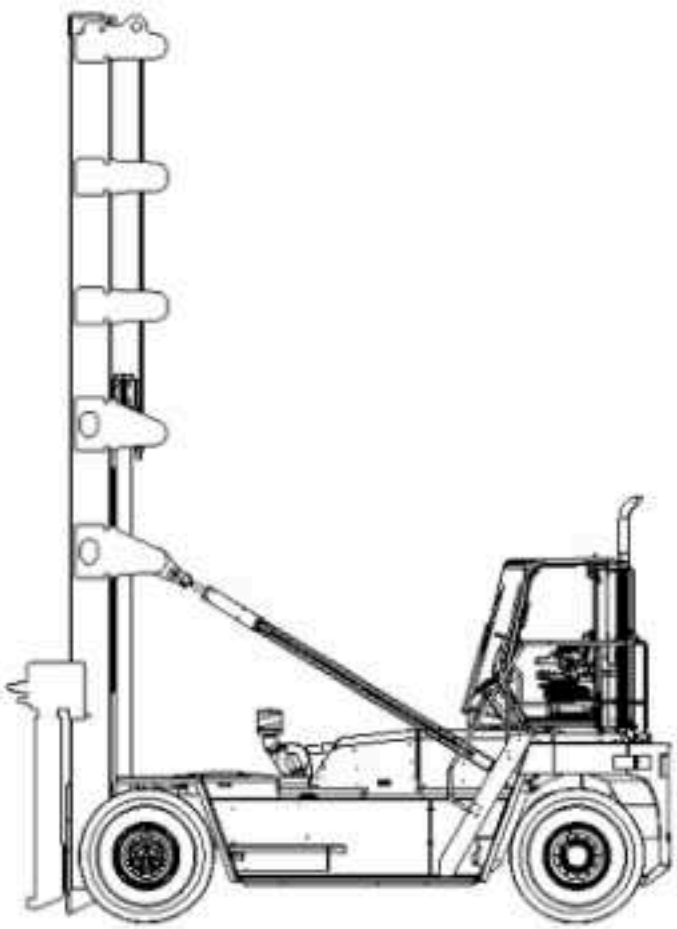
SERVICE MANUAL

B214 (H400-500HD-EC)



FORM 1627712 Rev. 08/14

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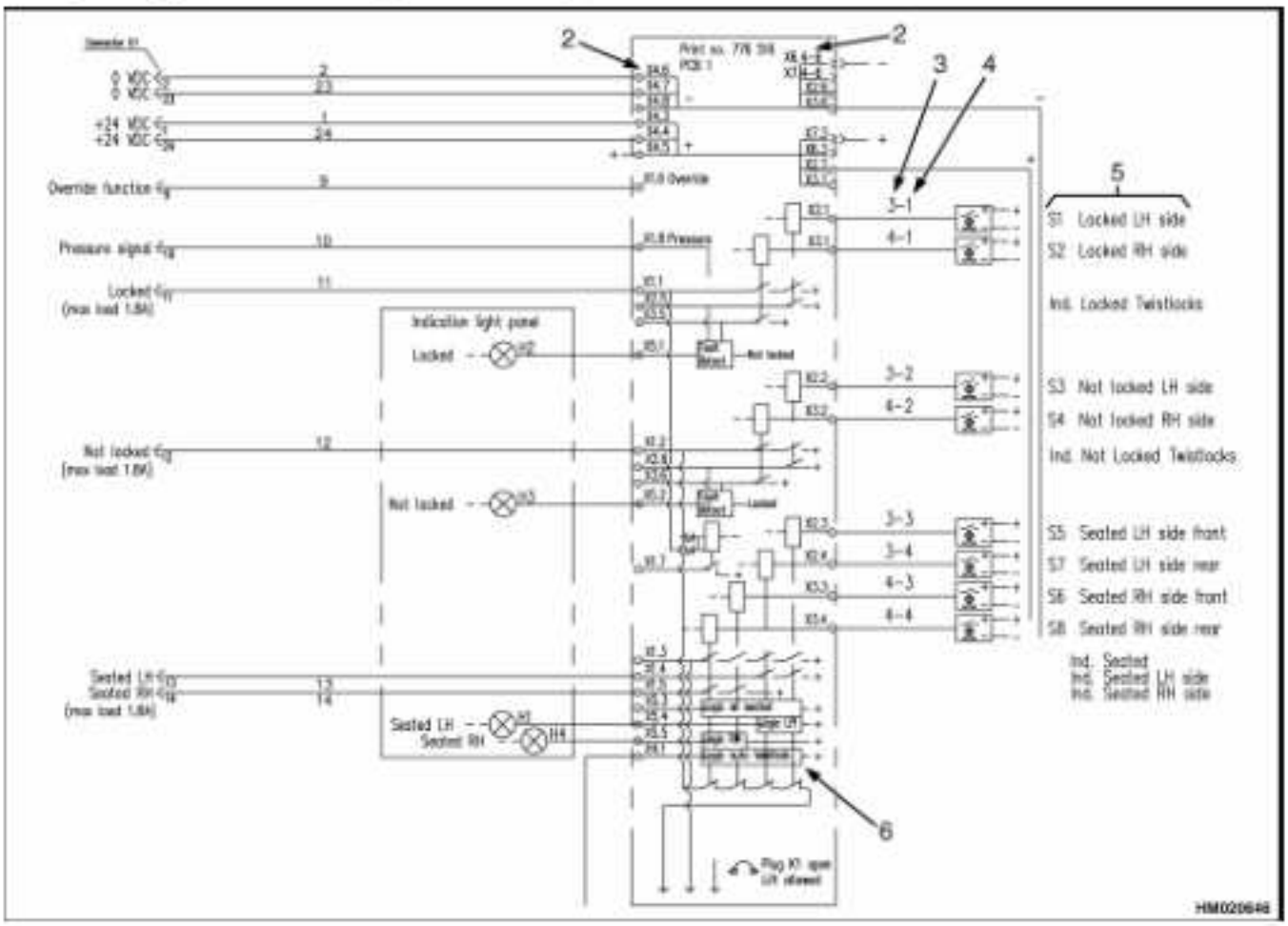
This section is for the following models:

H14.00-20.00XM [A214];
H16.00-18.00XM-12EC (H400-450H-EC) [A214];
H16.00-18.00XM/XMS-12 (H400-450HD/HDS) [A236];
H16.00-22.00XM-12EC (H400-500HD/HDS-EC) [B214];
H16XM-12, H18XM-12, H20XM-12, H22XM-12 (H400HD, H450HD, H500HD, H550HD) [B236];
H16XM-12EC, H18XM-12EC, H22XM-12EC (H400HD-EC, H450HD-EC, H500HD-EC) [C214]

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The electrical schematic shows the logic of the PCBs in relation to the different signals. The correct electrical schematic for your attachment is shown on **Hyster Hypass Online**. Figure 20 shows part of an electrical schematic. If the logic is controlled by an integrated circuit, it will be indicated on the schematic by boxed text such as "Logic auto twist lock" or "Fault detect".



1. 24-PIN LIFT TRUCK ELECTRICAL CONNECTOR
2. SOCKET IDENTIFICATION NUMBER
3. CABLE NUMBER
4. CABLE WIRE NUMBER
5. FUNCTION
6. INTEGRATED CIRCUIT

Figure 20. Electrical Schematic Section

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Table 2. Limiting Values

Total Solids	340 ppm maximum
Total Hardness ($CaCO_3$, $MgCO_3$)	170 ppm maximum
Chloride (Cl)	40 ppm maximum
Sulfate (SO_4)	100 ppm maximum
pH	7.0 to 8.0

Charge Air Cooling System

The turbocharger uses the energy from the exhaust gas stream to compress the intake air, which can heat up to well over 200°C (392°F). Compressed intake air is cooled by leading it through the charge air cooler before it enters the engine. Cooling the intake air improves engine performance and lowers emission values.

Transmission Oil Cooling System

The cooling system for the transmission is described in **Transmission 0peration and Diagnostics, (TE13 and TE17)** 1300 SRM 1271.

It contains a thermostat valve, which is installed between the torque converter outlet port and the transmission cooling core. This thermostat starts opening at 87°C (189°F) and is completely opened at 102°C (216°F). At temperatures below 87°C (189°F), oil flow is directly returned to the transmission. At temperatures above 102°C (216°F), the entire oil flow from the outlet port passes through the transmission cooling core before it is returned to the transmission.

Hydraulic Oil Cooling System

General

Heat generated in the various hydraulic components is absorbed by the hydraulic oil, which returns to the hydraulic tank. Oil from the hydraulic tank is continuously pumped by a separate 23 cc gear pump through the in series connected systems for hydraulic oil cooling, brake cooling and oil filtration. Bypass valves protect these systems against too high pressure.

A236/B236 trucks have a slightly different system compared to B214/C214 trucks. The difference is in the connection and setting of bypass valves, and in the sequence of hydraulic oil cooling and brake cooling. See Figure 7.

Hydraulic Cooling Unit

Pump supply is led through the cooling core, irrespective of oil temperature. For B214/C214 series a 500 kPa (72.5 psi) bypass valves protects the cooling core against high pressure caused by high oil viscosity at low temperatures.

A sensor at the entry side of the core provides an electric signal to a relay on the core, which switches on three electrically driven fans when oil temperature has reached 70°C (158°F). When temperature has dropped to 65°C (149°F), the sensor switches the fans off. The fans pull air from above the hood towards the front of the truck.

Brake Cooling

To prevent axle seals from leaking, maximum pressure to the brake chambers must be limited to 140 kPa (20 psi). The brake chambers themselves have very low hydraulic flow resistance, even at low temperatures.

For A236/B236 series, brake cooling pressure is limited by a 140 kPa (20 psi) bypass valve that connects to the return side of the brake chambers.

For B214/C214 series, brake cooling pressure is limited by a 100 kPa (14.5 psi) valve bypassing the filter, plus a 200 kPa (29 psi) valve bypassing brake chambers and filter. See Figure 7.

Oil Filtration

The function of the 20 micron spin-on filter is to remove the bigger particles released from the brake discs. The filter is protected by a 100 kPa (14.5 psi) bypass valve. There is no warning signal when the filter is clogged. Timely filter replacement interval is indicated in the periodic maintenance schedule.

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Table 7. APC200 Fault Codes (Continued)

Fault Code	Fault Explanation	APC200 Action	Troubleshooting
55.04	Analog input 5 (pin P1) related fault: analog input value is below the minimum value calibrated.	Controller will flag the fault, and will use the lowest clipped value in its settings.	Check the wiring between the controller and the device connected to this analog input. Check this device connected. Check if the calibration is done correctly recalibrate if necessary.
55.05	Analog input 5 (pin P1) related fault: analog input value is above the maximum value calibrated.	Controller will flag the fault, and will use the highest clipped value in its settings.	Check the wiring between the controller and the device connected to this analog input. Check this device connected. Check if the calibration is done correctly recalibrate if necessary.
56.00	Analog input 6 (pin S1) related fault: analog input is shorted to ground or measured input value is below the minimum value.	Depending on the function that is assigned to this pin: - Temperature Sensor: controller will use the lowest clipped value in its settings (which results in bad temperature compensation. - Pressure Feedback: the controller will revert to limp home mode. - Pressure Sensor: the controller will revert to shut down mode. - Other: the controller will use the lowest clipped value.	Check the wiring between the controller and the device connected to this analog input. Check this device connected. Check if the calibration is done correctly recalibrate if necessary.

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Pressure Switch

The pressure switch signals if system pressure is applied by the clutch supply valve to the intensifier valves.

Test

When system pressure is above 16.5 bar (239 psi), the internal resistance of the pressure switch is 1 kOhm. When no pressure is applied, the internal resistance is 2 kOhms. The APC200 controller measures the actual resistance and determines that the following conditions exist:

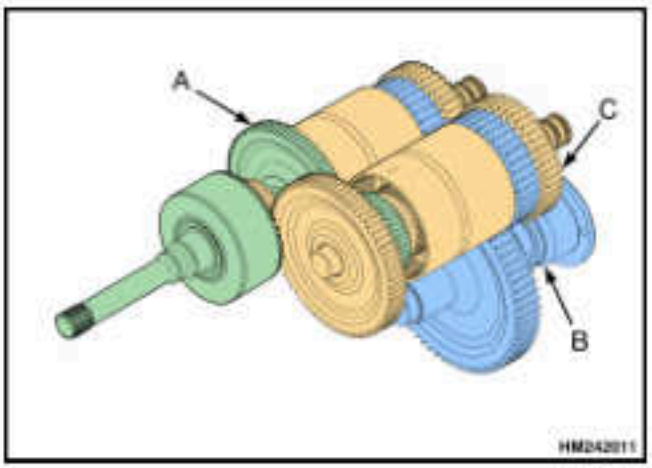
- 0 to 500 Ohms - Short circuit.
- 500 to 1,500 Ohms - System pressure applied.
- 1,500 to 4,000 Ohms - No system pressure.
- 4,000 Ohms or higher - Open circuit.

Verify the pressure circuit resistance by opening the Monitor screen in the Dana Dashboard software. View either the Pressure Switch Resistance Gauge or the Analog Input Signal for the pressure switch (Analog input 0). The location of the pressure switch is shown in Figure 6.

Speed Sensor

The speed sensors determine the rotation speed of the different gear groups. The APC200 controller calculates the speed ratios between the different groups and compares the calculated values with the programmed values. If deviation exceeds an allowable value, the APC200 controller generates a fault code and eventually enters a protection mode. See Figure 14. The following are a few examples of speed inputs and ratios that are monitored by the APC200 controller:

- Converter Speed Ratio
  - The ratio between engine speed and turbine speed is called the converter speed ratio. The converter speed ratio is a measure of the power being transferred through the converter. This ratio is a major factor for the APC200 controller to determine if a higher or lower gear is to be selected during the automatic selection mode. During calibration, a sudden change in converter speed ratio is used to determine the clutch piston position at the moment the clutch starts clamping.
- Transmission Ratio
  - Each selected transmission gear has a specific transmission ratio. When one of the direction clutches is closed and the output speed has reached a certain value for checking, the actual ratio is compared with the specified ratio. If deviation exceeds 5%, one of the clutches is assumed to be slipping. A fault is flagged and the APC200 controller enters the Shut Down Mode.
- Gear Ratio
  - If the turbine, drum, or output speed sensor fails, the APC200 controller calculates the 'actual ratio' based on the value of the remaining sensors. This allows continued operation of the transmission. Speed sensor failure is indicated by a fault code. If the engine speed sensor fails, or if more than one speed sensor fails, the APC200 controller will enter the Limp Home Mode and flag a fault.
- Maximum Torque During Inching
  - The APC200 programming interprets the inching pedal position as the required pressure for the inching clutch. The heat generated in the inching clutch is proportional to the power transferred by the torque converter (converter speed ratio). When the power is transferred at an excessively high level for an extended period of time, the APC200 controller will release pressure in the clutch and flag a fault.



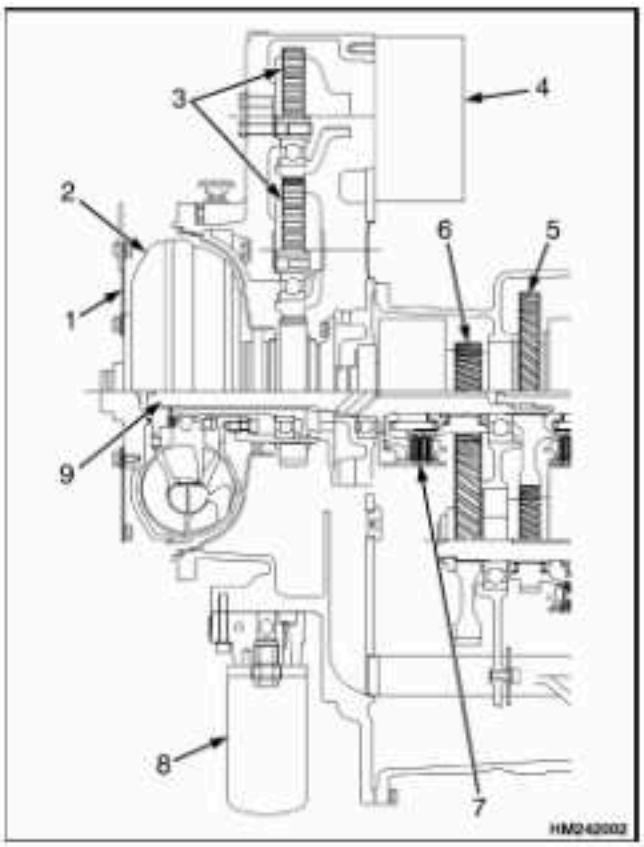
A. TURBINE SPEED
B. OUTPUT SPEED
C. DRUM SPEED

Figure 14. Schematic Speed Sensor Locations

Test

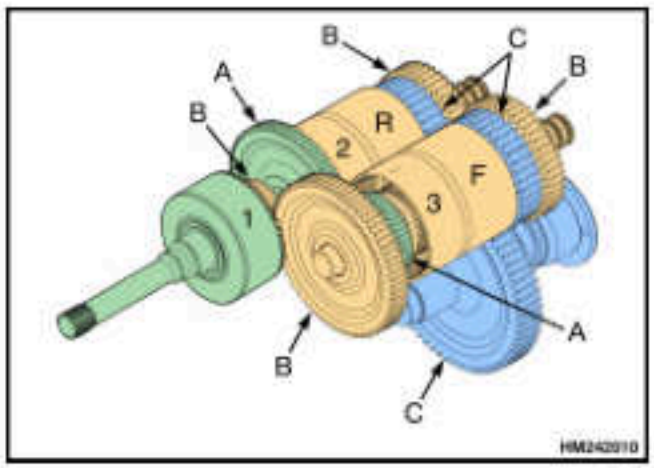
Dana Dashboard software shows functionality of each of the speed sensors under 'Speed Monitor'. Electrical functionality can be tested by using the schematic shown in Figure 15. Observe the correct sensor polarity. Pin 1 must be connected to 12 Volt+. Pin 2 must be connected to 12 Volt . For the engine speed sensor, pin A must be connected to 12 Volt+.

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1. DRIVE PLATE
2. TORQUE CONVERTER
3. PUMP DRIVE GEAR
4. TRANSMISSION PUMP
5. INPUT GEAR
6. INTERCONNECTING GEAR
7. CLUTCH
8. TRANSMISSION FILTER
9. TRANSMISSION INPUT SHAFT

Figure 1. Transmission Input Section



A. INPUT GEARS
B. INTERCONNECTING GEARS
C. OUTPUT GEARS

Figure 2. Gear Engagement

If clutches belonging to one group would be engaged simultaneously, the transmission would lock. Erroneous clutch engagement is prevented by the transmission control system.

Different speeds are obtained by engaging either the forward or the reverse clutch, and by engaging the 1st, 2nd, or 3rd speed clutch.

When the transmission is in **NEUTRAL**, the forward clutch and the reverse clutch are disengaged, while one of the speed clutches remains engaged.

The clutches consist of a hub which carries friction discs with internal splines, and a drum which carries steel discs with external splines. See Figure 3.

The friction discs and the steel discs are alternately installed. By pressurizing the clutch piston, the friction discs and the steel discs are clamped together, which causes the hub and the drum to rotate as one unit. When hydraulic pressure is released, the return springs force the piston back against the clutch housing and allows the hub and drum to rotate independently. The drum, steel discs, piston, spacer, and return springs rotate at the same speed. The hub and friction discs rotate at the same speed.

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