

**Coal Load-out Conveyor**

**Introduction**

A coal load out conveyor has a belt weigher with a Modbus interface. A 105U-G Modbus RTU module is connected to the weigher and transmits the accumulated weight value to a control panel approx 1km away.

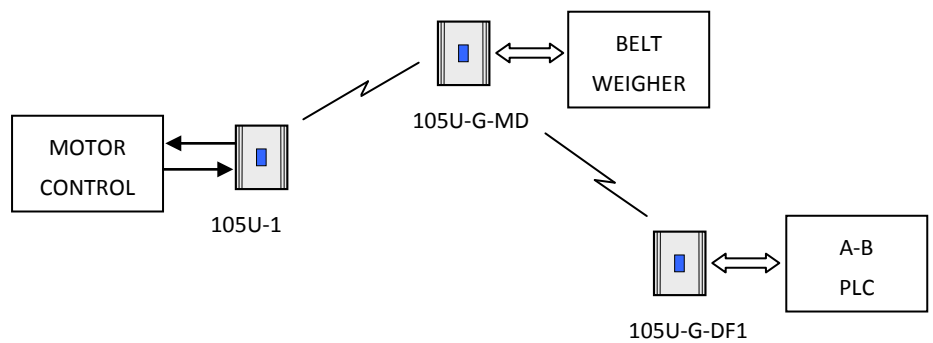
The conveyor is also monitored and controlled from the control panel via a 105U-1 wireless I/O module at the motor control panel, at the foot of the conveyor.

The control panel has an Allen-Bradley SLC5 PLC controlling the load out operation. A 105U-G DF1 module is connected to the PLC to transfer signals from the weigher and conveyor motor control.



**Belt Weigher**

The belt weigher measures the accumulated weight transferred, conveyor speed and instantaneous weight rate (tonnes/hour). The belt weigher has a RS485 port and provides a Modbus RTU Slave interface for serial transfer of these values. A 105U-G Modbus Master unit is connected to the belt weigher - the 105U-G will read these values at a pre-set period (10 secs) and transfer these values to the 105U-G at the control panel.



The distance to the control panel is approx 1km, through a congested warehouse area. A test using unity gain dipole antennas showed a strong radio path, so these antennas are used at both sites. The antenna at the belt weigher is mounted beside the weigher panel, mounted on the handrail beside the conveyor. As there is a lot of steelwork around the conveyor facility, including light poles beside the antenna, a lightning surge protector is not used.

Power is available at the belt weigher panel. A small 220V/24VDC power supply is used to power the 105U-G module. Spare space is available in the belt weigher panel for mounting the module. Screened twisted pair wire is used to connect the RS485 ports on the weigher and 105U-G. RS485 is polarity sensitive - if the communications isn't working, reverse the wires. The RS485 port on the weigher is fixed at 9600 baud, 7 data bits, even parity and 2 stop bits. The serial port of the 105U-G is configured to be the same.

The belt weigher provides the weight, speed and rate as Modbus registers 40001, 40002 and 40003. The 105U-G reads these registers and puts the values into its I/O registers 0001, 0002 and 0003. Note the 105U-G will transmit a "change message" whenever one of the I/O registers changes. To avoid jamming the radio channel with continuous transmissions, the Modbus poll time must be carefully selected. The 105U-G Modbus Master interface is configured to provide the read polls to the weigher. The Modbus registers are 16 bit, and will therefore change every time they are read - resulting in change messages being transmitted to the control panel on each read. A poll time of 10 seconds is selected.

The three I/O registers are configured (or "mapped") to I/O registers 0101, 0102 and 0103 at the 105U-G at the control panel.

**Conveyor Motor Controller**

A 105U-1 is installed at the motor controller at the foot of the conveyor to provide monitoring and control of the conveyor. "Run" and "Fault" signals are connected to the 105U-1 and these are transmitted to the control panel. The control panel transmits a control "on/off" message to the 105U-1, which appears as a discrete output contact (DO1) - this contact is connected into the control circuit of the conveyor motor.

The 105U-1 is installed in a small IP66 enclosure beside the motor controller. Power is available from the motor controller and a small 220V/24VDC power supply is used to power the 105U-1. The "run" input is connected to an auxiliary contact on the motor contactor, and the fault input is connected to a fault relay contact which closes on a "fault" trip.

The DO contact is connected to a 12VDC relay mounted in the motor controller. The 12V power is sourced from the battery output of the 105U module. A surge suppression diode is connected across the relay.

A radio path check showed that a reliable radio path to the control panel does not exist between the motor controller and the control panel, because of a large steel hopper immediately in front of the motor controller. Tests showed that a good radio path existed if the antenna was installed above the hopper or to one side, however either solution required installing a long length of coaxial cable. An alternative was to use the 105U-G at the weigher as a repeater, as a good radio path existed between the motor controller and the weigher (the hopper did not obstruct this path) - this alternative was selected. A unity-gain dipole antenna is mounted on the side of the motor controller enclosure and all transmissions to the control panel are via the weigher unit acting as a repeater.

The input mappings to the control panel are as shown. An output reset time is configured on DO1 to stop the conveyor if communications is lost from the control panel. The reset time is set to the minimum value of 45 seconds. The update time at the control panel module for the control on/off signal is 30 seconds. If the 105U-1 at the conveyor does not receive an update, DO1 will reset and stop the conveyor.

### **Control Panel**

The control panel contains an Allen-Bradley SLC5 PLC, which controls the load-out plant. A 105U-G DF1 module is connected to the RS232 port on the PLC. This PLC port is configured as a full-duplex (point-to-point) DF1 link.

This 105U-G passes across the weight, speed and rate values from the weigher, and the run and fault signals from the motor controller. The 105U-G also transmits the control on/off signal to the motor controller.

The PLC port is configured for 9600 baud, 8 data bits, no parity and 1 stop bit - and the 105U-G serial port is configured as the same. The A-B PLC is configured to act as the DF1 "command initiator" - either DF1 unit can do this. The PLC will read the values from the 105U-G and write the control on/off signal value to the 105U-G. The I/O mapping for the control on/off signal is shown, as well as the update time set to 30 seconds.

The PLC also monitors the communications status of each remote module. For the weigher module, the PLC monitors the status register associated with the accumulated weight register. This register is 0101 and the associated status register is 5101. The 105U unit at the weigher reads the accumulated weight value every 10 seconds, and this will generate a change message every 10 seconds when the conveyor is running. At the control panel, a "comms fail time" of 12 seconds is set - if a new weight value is not received in 12 seconds, register 5101 will show a comms fail. The PLC monitors this register to determine if communications is active to the weigher module.