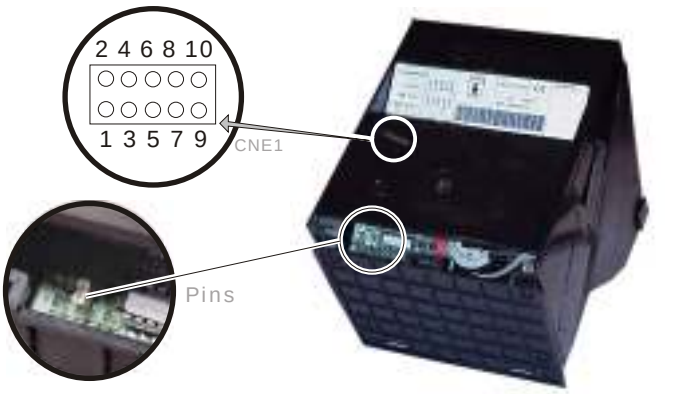
1. Conventional protocol

Within the conventional operating system, there are three functioning modes whose only difference lies in the manner of controlling pin 7 (control) of the CNE1 connector.



A 3-pin connector and a Molex bridge are used to select the following conventional HOPPER U operation:

Position of the pins	Mode of operation
	Negative logic digital signal control
	Positive logic digital signal control
	Pulse control

Digital signal control of negative logic

In this operation mode, the machine activates the hopper and starts the return of coins applying a 0 logic (< = 0.5 volts) in pin 7 (control) of the exterior connector, and stops it by applying a 1 logic (voltage between 4 and 40 volts) or leaving said pin on stand by.

This voltage causes the control card to be activated and starts the motor in the extraction direction for the coins using an H-bridge controlled by two sets of MOSFET transistors, one in canal P and another in canal N.

Positive logic digital control

The operating principle is the same as above, the only difference being that inverted logic is used. That is, the extraction process is activated a 1 logic (between 4 and 40 volts) and pin 7 (control) of the exterior connector and the process is detained by applying a 0 logic (voltage between 0 and 0.5 volts) in this pin.

Pulse control

When this operating mode is used, coins are extracted from the payout unit by applying pulses to pin 7 (control) of the CNE1 connector. The characteristics of the pulses should be:

- Positive logic pulses (stand by to low-level signal).
- Minimum duration for both high and low levels: 5 milli sec.
- Maximum duration 1 sec.
- The pulse is validated on the descending flank.

1.1. Signals

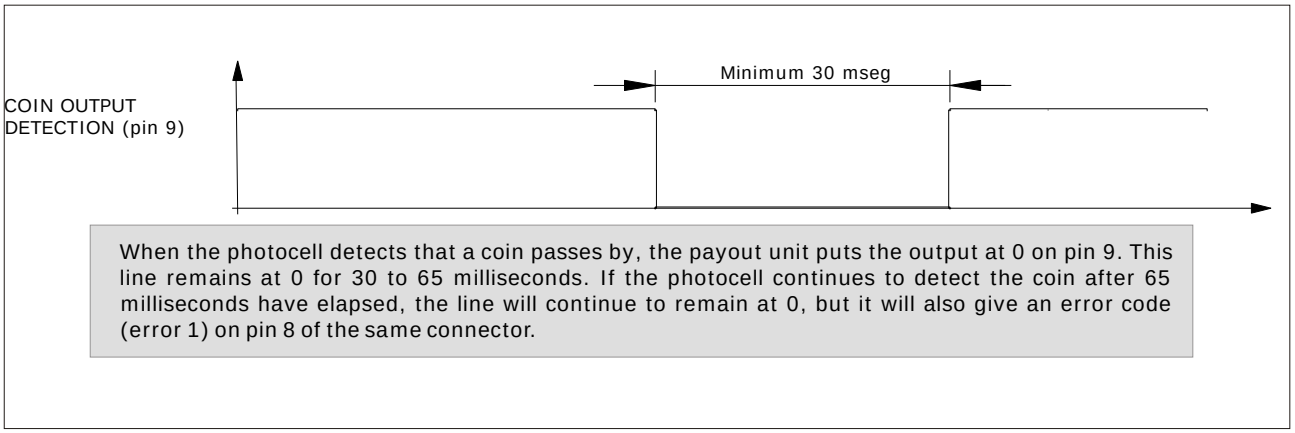
The following signals are those used to control and communicate the conventional HOPPER U with the machine:

Control

Using the control signal via pin 7 of the exterior connector, the machine controls the activation / deactivation of the HOPPER U extraction system. The format of this signal depends on the operating mode selected (positive logic, negative logic or pulses) on the control card as described in the previous section.

Coin exit

As explained, the HOPPER U detects the exit of a coin by using an optical sensor (opto-reflexive) that communicates with the machine using a 30 ms or longer pulse via pin 9 of the CNE1, which is generated with a transistor using an open collector which is active at 0, that is, on stand by when the signal is at high level.



When the photocell detects that a coin passes by, the payout unit puts the output at 0 on pin 9. This line remains at 0 for 30 to 65 milliseconds. If the photocell continues to detect the coin after 65 milliseconds have elapsed, the line will continue to remain at 0, but it will also give an error code (error 1) on pin 8 of the same connector.

Errores

The HOPPER U can detect operating errors of which it informs the machine so that the latter make take appropriate measures at all times.

The HOPPER U can detect the following errors:

Nº Error	Description	Meaning
Error 1	Exit error	Coin exit Has been Detected over a period of time That is superior to the maximum pre-set (by default, 65 ms.)
Error 2	Detection of coin exit during stand by	Coin exit has been detected within the payout unit or shut down.
Error 3	Permanent jam detected	The payout unit is unable to clear up the jam The maximum pre-set time has been surpassed.
Error 4	Maximum interval detection	A number of intervals superior To the pre-set maximum.
Error 5	Motor not detected	Motor unable to start.
Error 6	Sensor failure coin exit	The coin exit sensor connector is Loose or malfunctioning.
Error 7	Hardware failure Detection exit coin	The hardware related with the coin is malfunctioning

The error signal is communicated to the machine via pin 8 of the exterior connector and is generated by an open collector transistor. It is a signal that is active at 0 so that on stand by it is at high level.

Format of the error signal

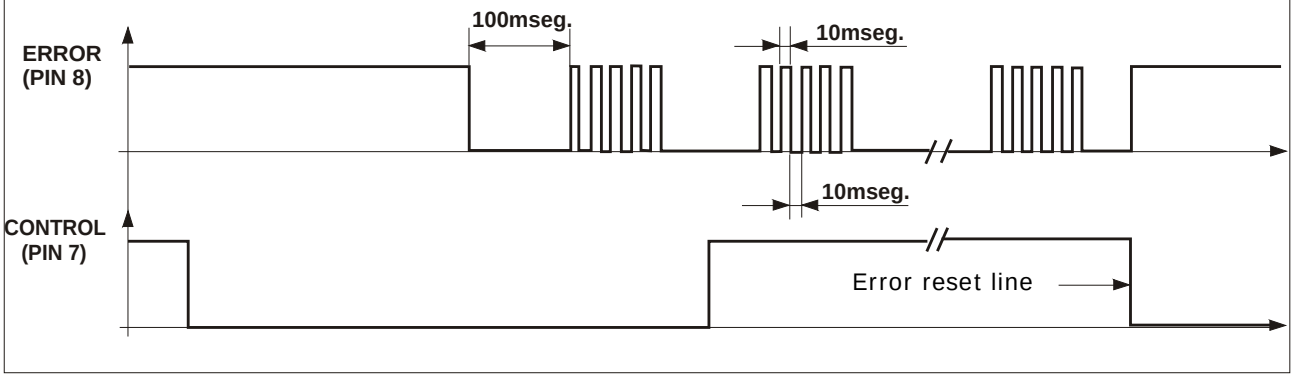
The error signal starts with a 100-ms pulse at 0 volts at (T on/T off = 10 ms/10ms). The number of pulses generated is equal to the code of the error detected and the sequence is repeated until a new hopper activation order appears via the control signal.

This picture represents the signal corresponding to error 5 in which the format of the trains of pulses can be observed and how they disappear when the hopper detects an activation signal.

NOTE

It is very important that the machine makes use of the error signal and communicates it to technical services in order to effect its correction before any possible malfunctions.

As an example, the graph brings together the Error and Control signals based on the "NEGATIVE LOGIC" mode.



Empty status (optional)

The HOPPER U can also incorporate a coin empty status detector consisting of a photocell (photocell and phototransistor) located in the lower part of the hopper. This signal is communicated to the machine via pin 10 of the exterior connector (with an open collector transistor) applying a low level (0 volts) when the HOPPER U is NOT empty and a high level when it IS empty.

Fill up (optional)

The HOPPER "U" can incorporate a "full" coin detector that consists of a photocell (photodiode and phototransistor) located at the top of the hopper. The signal emitted by the photocell is communicated to the machine through the exterior connector (by means of a transistor on an open collector), thereby applying a low level (0 volts) when the payout unit IS full and a high level when it is NOT full.

NOTES

Interval

When the HOPPER U must extract various coins, the time transpiring between the extraction of one and another is known a an interval. When an interval over 5 seconds is detected, the unit inverts the direction of the motor for 1.5 seconds to agitate the coins in the hopper so that their resulting distribution favours their extraction.

In the pulse operating mode, if several consecutive intervals are produced, coin extraction is terminated and the HOPPER U communicates error 4 to the machine.

The maximum amount of time that a unit should be in operation without extracting coins is between 20 and 30 seconds. Beyond this time it is safe to assume that the unit is empty or malfunctioning.

Jam

The HOPPER U control card has a consumption detector so that if a jam occurs, the direction of the motor changes for one second to free the jammed coins.

Exit signal filtering

When the machine goes into operation, the HOPPER U waits to receive the coins exit signal. This signal is considered correct when it reaches a duration of 18 ms.

After the established 18 ms, there is a pause before the cycle terminates. After the cycle terminates, 10 ms should transpire before a correct exit is determined.
If the duration of the exit signal is over 1 sec., the signal will be considered erroneous. In this case, the HOPPER should be put out of service and quickly detained.