

General Description

1.1 The ML15KS Conveyor control system is used for the control of conveyors up to 15km in length and can provide both lock-out control as well as Pre Start Warning and Audio Communications along the length of the conveyor.

The component parts are housed either as a 19” rack mount module (for fitting into an existing rack panel) or else can be supplied in a free standing IP66 (Nema 4x) type wall mounted cabinet. Suitable 19” rack mount cabinets can also be supplied upon request.

The control assembly incorporates a heavy-duty output relay that interfaces with the external motor starter circuit.

The following facilities are provided:

1. Control of the conveyor along its entire length by means of pullwire and lockout devices
2. Optional signaling facilities along the entire length of the conveyor - by means of the lockout box signaling button.
3. Optional communication facilities along the length of the conveyor - by means of audio amplifiers or Athos Handsets
4. Extension of the communication facilities to other systems and if used underground to the surface.
5. Locked out key position indicator. Numerical indication of the particular key (or conveyor transducer) is provided on a console display along the conveyor.
6. Optional Pre-Start Alarm (PSA) warning broadcast along the length of the conveyor for a pre-set time before the conveyor starts.
7. Voltage free outputs are available for PSA confirm, signal and lockout.
8. Lockout I.D. is available as a Binary Coded Decimal output and also as a 4-20ma signal in order to accommodate various data transmission formats to surface control and monitoring systems.
9. Lockout indication is provided on each lock out box by means of high intensity LED lockout indicator. Semaphore flags are optional
10. Low voltage control and Pre-Start Alarm circuitry – safe to work on with power -on
11. Failsafe monitoring circuitry automatically detects and display interconnecting pullcable faults.
12. Single cable signaling and Pre-Start Alarm option.

1.2 Single Cable System Configuration:

The single cable system is split into two subsystems:

1. Optional Pre-Start Alarm (PSA)
2. Lockout and Signaling

1. - Optional Pre- Start Alarm (PSA)

Two methods of PSA can be supplied:

One method that is used is to initiate a customers standard PSA system (which may use a separate cable along the length of the conveyor or haulage system) during the starting cycle. Our main console can provide a heavy-duty output contact during the starting sequence that initiates external horns either mounted at the drive ends or else throughout the length of the system. On short conveyors this is usually the preferred method. After a pre-determined time the PSA relay contacts open and the PSA (120v supply) to the external horns is removed.

For longline conveyors our system can utilize spare conductors in the existing lockout pullcable and uses our combined lockout/PSA units to sound PSA throughout the length of the conveyor. Typically our combined units replace a lockout box and are usually installed at 150m intervals along the length of the conveyor. For Conveyors that use pullkeys at both sides of the conveyor, the combined units can be spaced at 300m apart but fitted on alternate sides so that they are arranged at 150m. centers.

Each combined PSA units incorporate a lockout box that is attached to an amplifier assembly housing an electronic PSA pcba, speaker and rechargeable battery. During the PSA cycle, the console initiates a remote oscillator that broadcasts a warning tone over every combined lockout key/amplifier in the system. The charging of the internal battery that is required to power the high performance amplifier contained within each unit is achieved by supplying a constant current charge down the same pullcable. At the end of the system the PSA conductors are terminated with the PSA Termination unit. If PSA is used the main console MUST recognize the specific warning tones otherwise the conveyor will not be allowed to start. An override keyswitch is fitted to the console should PSA not be required.

2. - Lockout & Signaling

A combined maximum total of 150 standard or combined lockout/amp. units, TW15 Monitor units or

direct Belt Alignment units may be connected on one system. Standard lockout boxes are usually installed at 75-100m intervals along the length of the installation with modified PSA/lockout boxes being installed where required (usually 150m). As mentioned this number also includes any connected conveyor protection devices that incorporate the numerical I.D. pcba assembly. Interconnection to ALL devices is by means of an interconnecting pullcable terminated in the lockout boxes and in our other devices on terminal strips. The system is fitted with a remote Signal Termination Unit that is combined in one assembly when our PSA system is used throughout the length of the conveyor.

1.3 Pre-Start Alarm

The PSA system incorporating the combined lockout/PSA units is internally powered from a 48v supply within the control console. The operation of the console start switch (local or remote) energizes the PSA initiate relay. This relay enables the two-tone generator housed in the remote PSA termination unit. At the same time each combined lockout/PSA unit sounds the generated PSA signal.

When the main console monitors the PSA tones, Conveyor Run contacts are provided after a pre-determined time has elapsed.

The PSA sounds for a time determined by the main console timer circuits. Normally the conveyor actually starts after five or six seconds of PSA but the PSA continues for three or four seconds after the conveyor has started. This practice covers the initial slow start up of long line conveyors and any timed sequence starting of motors. Non standard times can be provided.

Should any of the PSA conductors not be healthy throughout the system pullcable cable the PSA tones will either not be initiated or received. Should the console PSA detection circuitry not detect the correct PSA signal produced by the remote PSA Termination unit, then the console will not activate the motor start interface relay.

The combined lockout/PSA units are installed at strategic intervals along the length of the installation as is deemed necessary by the end user. Typically our PSW amplifier/speakers produce in excess of 104 dB at 3 ft distance and project sound in both directions along the length of the conveyor.

Note: Should modified lockout/PSA boxes not be required, during the PSA initiate sequence an additional output contact is available from the console. This contact will be closed during the PSA sequence and can be used to initiate user supplied external PSA equipment. Alternatively a keyswitch mounted on the unit bypasses PSA monitoring and the conveyor will start AFTER the expiry of the normal Pre and Post start timers.

1.4 Lockout and Signaling System

1.4.1 Lockout

The lockout circuitry operates from a separate 12v dc supply with the console. The supply is carried by the +ve and -ve lockout conductors in the interconnecting pullcable through all lockout boxes and conveyor protection devices to the remote Signal Termination unit.

The Termination unit uses the 12v dc supply to generate an 800-1200Hz square wave signal that is passed down the same lockout conductors to be detected at the control console.

If a lockout unit is operated (locked out) or a line fault occurs, the circuit is broken and the signal from the termination unit is interrupted. The Control unit detects this condition and automatically shuts down the conveyor.

The console has the ability to detect the type of fault present on the two lockout conductors ie. Lockout, Short, Open or CLEAR (Healthy). Output contacts are provided for remote monitoring.

1.4.2 Signaling and Audio link

As an option each lockout box can be fitted with a "Signal" button. Operation of this switch generates a 1khz tone which can be broadcast over an amplifier situated at the Console unit. Consequently, signals may be initiated from any of the lockout boxes along the length of the conveyor to the Control unit.

Operation of the pullcable attached to each lockout box, in addition to actuating the lockout circuit can also initiate a 2 second duration signal tone .

2.0 Operation

2.1 General

The PSA, Lockout and Signaling system provides greater operational safety for personnel in that:

- a) An Audible warning tone (PSA) is broadcast before and during start-up of the conveyor.
- b) The conveyor may be stopped and lockout out from any position along its length.

- c) Any failure in either PSA or lockout circuits will automatically result in a failure to start during the “Start” period. Any failure in the lockout circuit will result in a Stop condition.
- d) The system uses one interconnecting pullcable between all lockout boxes and any suitable conveyor protection device. The pullcable is rated at 1000lbs breaking strain and carries both the signaling and PSA initiation signals, battery charging supply (where applicable) which use low voltage supplies that can be worked safely without having to disconnect the supply.

2.2 The PSA, Lockout and Signaling system provides greater operational maintenance performance in that:

- a) Indication of Power On, Clear, Lockout, Pilot (Run), Open Circuit, Short Circuit and Signal clearly displayed on Console.
- b) Full function test facilities provided to aid maintenance
- c) Numerical indication of up to 150 locked out pullkey or conveyor protection devices
- d) Connections provided for interface with data transmission systems
- e) Internal power supply indications
- f) NORMAL -OPEN-SHORT-CLEAR-LOCKOUT conditions are continually monitored by the Console
- g) Voltage free contacts are provided for lockout, signal and PSA confirmed.
- h) Signals and PSA initiation systems use a single interconnecting pullcable
- i) Lockout boxes are manufactured using high strength zinc alloy die cast enclosures
- j) Direct on line switching action in lockout boxes
- k) Lockout boxes are moisture and dustproof to International standards
- l) Lockout boxes are fitted with double-ended stainless steel pullshafts, lockout buttons, LED lockout indicator and printed circuit boards for numerical indication.
- m) Pullcable breaking strain exceeds 1000lb.
- n) Optional Athos Portable handsets can be used to provide audio communications along the length of the conveyor between any two portable Athos units.

The operation of the system ie. Starting of the conveyor and PSA sequencing is controlled by the STOP/START switch on the Console unit or by an external STOP/START switch.

3.0 Addition of Conveyor Protection Devices

Appropriate conveyor protection devices such as our Belt Alignment -Tear Unit can be supplied fitted with the appropriate numerical I.D. assembly that automatically trips the conveyor should a conveyor Belt fault occur. The protection devices are wired directly into the nearest conveyor lockout box at locations deemed appropriate by the user. When operated the protection devices provide a lock out on the signaling system at the same time as displaying their numerical I.D. on the Console display.

A range of conveyor protection devices that are suitable for use with the numerical I.D. system are available and these include:

- a) Belt Alignment / Tear Unit
- b) Belt Alignment Unit
- c) Back Spillage Unit
- d) Universal Switch
- e) Material Detector

In addition our six channel TW15KS monitor can provide a common conveyor trip with numerical identification of lockout position when connected to up to six simple conveyor protection devices. A voltage free C/O contact in each protection device is required. This arrangement allows any protection device to be used at any point along the length of the conveyor WITHOUT requiring additional cable along the conveyor. All protection devices would cause a lockout on the conveyor system until the fault had been corrected. Eg.

- a) Belt Slip and Speed Unit
- b) Brake Proving Switch
- c) Temperature detectors - insertion and surface mount
- d) Vibration sensors

A range of analogue trip amplifiers and control units are available should the motor control circuits not provide the required intelligence to handle the device input.

4.0 **Interconnecting Pullcable**

The interconnecting lockout cable that we use within our system designs, is specially manufactured for use as a **pullcable** on conveyor systems. The pullcable is a braided armor multi-conductor cable with a green or red PVC covering as an outer jacket. The cable is extremely robust and has a breaking load in excess of 1000lb.

Depending upon the design of the system and required features, the pullcable has either 4 or 6 conductors (see separate sheet). The pullcable has a maximum outside diameter of 13.5mm.

The use of the same cable to operate the lockout box pullshafts as is used for the electrical signaling/audio and PSA circuit provides an automatic fail-safe system. This is because if the cable between lockout boxes is broken thereby rendering the pullcable/pullkey facility inoperable, the conveyor will automatically stop, maintaining an extremely high degree of safety. In addition installation costs are reduced as only one cable is installed along the length of the conveyor for PSA, lockout and installed conveyor protection devices.

Also as the control circuit passing from the TW15KS console through each lockout box is **low voltage** and current ie. max. of 48vdc, the lockout system is inherently safe to work on even with the power switched ON.