

Vishay Precision Group Canada ULC (**KELK**)

Design Guidelines for Optical Gage Orders

Engineering Note EN390

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1. Revision History

Revision	Date	Description	Author	Approved by
A	Nov 29, 2018	Original release	PH / SV	TZ

2. About this document

This document provides guidelines for processing projects which include Accuscan, Accuspeed, Accuband, and Accucrop. They do not cover Accuplan. It provides guidelines wherever there are choices to be made.

3. Network Design Rules

Port EN1 - Is typically used as the Level 2 network connection, the connection to the host computer. This is an existing network referred to the customer's network.

Port EN0 - Is typically used as the Level 1 connection to the WAGO Discrete IO. This is considered the Level 1 network, aka Gage Network or KELK Network. It supports all the KELK supplied devices, Maintenance PC Operators' PC(s), Accuspeed(s), Accuscan, and Accucrop. Typically, one switch is required to support all this. The default address is 192.9.200.xxx.

For a Close Loop system, C965C, or when there is more than one C965A scanner connected to one Floor Mounted Cabinet, aka Electronics Unit cabinet, a second network switch is typical.

Traditionally the Level 1 network was physically a separate network from Level 2 network. Customers had concerns about the resultant traffic and as such KELK included the switches to create the Level 1 Gage network. Creating this separate network would often lead to cable runs longer than 100 meters, which then required fibre cables and media convertors. More recently the trend is to use the existing customer's network for all gage connections. This is typically done using managed switches provided by the customer. The managed switches support the creation of Virtual LANs which addresses the traffic concerns. The customer typically provides the managed switches. Typically, the system leaves KELK with the KELK unmanaged switches and the customer switches are retrofit on site during installation.

Rules for # of Media convertors

If a scanner power supply is over 85 meters away from electronics unit cabinet, four media convertors are required; two in the scanner power supply, one with discrete IO module and one with the network switch.

If Electronics Unit is over 85 meters away from L2, one media convertor is required. The customer is expected to supply the other media convertor on their side.

If the Operator's PC is 85 meters away from Electronics Unit, two media convertors are required - one for the network module, and one desktop media convertor for the PC side, example *07446. One media convertor has two copper connections and as such can be connected to a maximum of two PCs.

The 85 meters noted since the scanner is to scanner power supply include 15 meters of cable.

4. Installation Height for Accuband and Accuscan

4.1 Field of View Information

The customer input for this calculation is requested using the drawing

J:\ApplicationsEngineering\ProjectEngineering\Calculations\Width Gage Roll Table Details.pdf

Use the roll face length when calculating the installation height. Typically, maximum side guide opening will be greater than the roll face by about 100mm. The basic mill design idea is the side guide opening must be greater than the maximum material width, and the roll face determines the maximum material width. Maximum material width is typically part of the Hot Strip Mill name 1680mmHSM or 84”HSM.

There are odd cases where the roll face is significantly larger than the side guide opening. This typically occurs in the roughing mill area where the mill has been designed to roll plate as well as hot strip.

4.2 Lens Selection, Installation Height, and Nozzle Selection

4.2.1 Accuband C965ABC

The calculation is done using the spread sheet; J:\Applications Engineering\Project Engineering\Calculations\Geometry 2016.xlsm

If there is an existing KELK gage being replaced or anywhere else on the mill, use the same lens. If there is a change in the maximum hop or maximum side guide opening recalculate the installation height. When all the gages have the same lenses the spare camera works for all gages. Otherwise a separate spare camera needs to be purchased. Changing lenses on site is not practical and not recommended.

If there is no existing KELK gage use the 50mm lens. If the customer has issues with the height there are options to go higher or lower using 60mm and 40mm lens, respectively. The 50 and 60mm lenses use the “long” nozzle. The 40mm lens uses the “extra-long” nozzle.

If there is an existing platform select a lens that accommodates the scanner arrangement. This may require adding a riser onto the existing platform. Be sure to maintain the relationship of the nozzle to the scanner. Moving the nozzle further away from the scanner will obstruct the field of view.

When the model is C965C the Accuband scanner is accompanied by an Accuspeed Laser. The installation height must support both the Accuband and Accuspeed. Avoid having the Accuspeed under the floor of the Accuband platform, consider the practicality of servicing the Accuspeed, keep them on the same platform level. The choices for Accuspeed are ASD2100 and ASD3500.

4.2.2 Accuscan HMD2048

The calculation is done using the spread sheet J:\Applications Engineering\Project Engineering\Calculations\HMD2048 GEOMETRY.xlsm. The customer input for this calculation is requested using the “Roll Face” drawing. The installation height needs to consider the Accuspeed model to insure they are at similar installation heights. The choices are ASD2100 and ASD3500. In the case where the model is Accuband C965C-RX-CL, there is one Accuspeed at the crop shear entry with the Accuscan HMD and another at the rougher exit with the Accuband scanner, the same Accuspeed model must be used in both locations.

5. Calibration Equipment Selection

5.1 Calibrator

The calibrator must fit between the side guides. Select the size which covers at least 75% of the field of view not less. There are two lengths available for HSMs, Long and Short. For plate mills there is an Extra Long calibrator which is twice the length of the Long calibrator.

5.2 Calibrator Carrier

Use the table found on the calibrator carrier outline drawing to select the carrier size. The calibrator size is not the deciding factor; the roll spacing is.

6. Estimating Width Accuracy beyond 2200mm

The C965 D&S specifies the width accuracy as $\pm 0.4\text{mm}$ for material width up to 2200mm. For material width greater than 2200mm use "**maximum material width**" divided by **4096**. rule of thumb is based on: 0.5 pixel uncertainty in 2048 pixels which is effectively 1 part in 4096.

7. iba PDA

PL055226 the iba PDA kit supports logging 256 signals. These signals can come from multiple gages. Each of which requires the KELK iba Client software. The data can be stored in one folder or two folders. These folders are known as "data stores". The iba license includes two data stores. The iba license includes USB dongle. Each gage that will store data requires KELK client software which does currently have a part number.

If more than 256 signals are required, the customer must purchase *08512 which adds 1024 additional signals. This is the smallest increment. If additional data stores are required, then *08959 must be purchased. This added two more data stores. See J:\Applications Engineering\Project Engineering\Calculations\Operator's Interface and Software.pdf

8. Accucrop Design Detail

8.1 Crop Shear Drive Interface Modification

In projects which use the Accucrop closed loop controller the customer's drive must be modified to accommodate the KELK control signal. This control signal is the Torque reference, sometime referred to as the Current reference. The details of this modification are defined in TS5111. Some drives include this Torque feature as standard, example ABB AC800 series. most do not. Some customers have the "know how" to make this drive modification on their own. Often a third party is contracted to make the modification. Typically, there is a fee for "design" and three days on site to implement and test.

8.2 Remote Crop Shear Adaptor, RCA

The RCA was designed to work with both Analog and Digital drives. Its is mounted in the drive panel. When used in Analog drives the relay on the RCA is used to Intercept and reroute the existing current reference. In this way the output of the RCA is either the KELK Reference or the existing reference. When used with a digital drive the existing current reference is in the digital domain and never passes through the RCA. The KELK torque reference is in the

analogue domain. It enters the digital drive via an A to D channel on the drive. The selection is made in the digital domain inside the drive.

The RCA provides these features:

- 1) Convertors the differential analogue signal from Accucrop to a singled ended analogue single +/- 10 Volts
- 2) Provides electrical isolation between the KELK Controller and the crop shear drive
- 3) Provides the rate of change limiter
- 4) Supports selecting between the existing current reference and the new KELK current reference via An output selector relay. For analogue drives this relay passes either the existing current reference or the new KELK current reference to the drive. For digital drives only the new KELK current references passes through the relay. The existing current reference is a virtual switch in the digital domain.

The maximum distance between the RCA and the Accucrop controller is 100 meters, point 1) is used to support this. The RCA should be mounted inside the crop shear drive cabinet, where the distance between the output of the RCA and input of the drive is less than 1 meter.

8.3 Absolute and Incremental Encoder Design Details

Accucrop is supplied with one incremental encoder for shear speed feedback. This encoder has 6000 pulse per revolution. The absolute encoder is a 13 bit SSI device. The KELK encoders are physically the same and include a through shaft. A mount bracket is included.

If the customer's equipment has an existing through shaft KELK will provide one coupling sized for this existing shaft. If there is no existing through shaft on the customer side and the customer does not have an alternative device with a through shaft, KELK will provide a sized coupling for both ends of the encoder and the customer will modify the existing installation to insert the KELK encoder between. Some customers have preference for some coupling and they provide their own couplings. These should be of the zero backlash type.

If the customer has an existing incremental encoder with 6000 pulses this can be used with the KELK system provided the signals are properly split and isolated.

Another solution involves incremental encoders which have dual outputs, for example 2048ppr, for the customer's existing control system and 6000ppr for the new KELK system. One physical encoder with two electrical outputs.

Absolute encoders are always separate device, one for the customer's existing equipment and one for the new KELK system.

Another solution involves using hollow shaft encoders. KELK can provide this option. The diameter of the hole is 1", and there are options for reducer bushing. This option has the potential for simpler levelling / alignment.

8.4 Accucrop Accuracy Calculation

The first calculation is carried out using the top section of the spread sheet J:\Applications Engineering\Project Engineering\Calculations\ accucrop system accrcuacy primary.xlsx. This requires the shear radius, the park angle and the maximum crop length. This is a simple calculation which is intended as a starting point. This determines the best possible accuracy for these parameters. It also defines the location of the HMD for RX model or the Accuband scanner for the CSE model. The second part of the sheet will introduce factor which degrade the performance

8.5 Digital IO Assignments

The Accucrop controller supports Digital input and Outputs using the WAGO Discreet IO module. It includes 16 digital inputs and 8 digital outputs. Some signal assignments are fixed and other are configurable, see the table below

Accucrop Digital Input Assignment			
CH #	Fixed Assignment	Typical & Configurable	Additional Selections
0	System Selector		Cut Inhibit
1	Auto Mode		Process Interlock
2	Immediate Cut		Positive Ski
3		Continuous Cut	Emergency Cut
4		Spot HMD 1 Interlock	Fly Wheel 1
5		Spot HMD 2 Interlock	Fly Wheel 2
6		Bar In Shear Zone, Entry	Maintenance Mode
7	Shear Drive Ready		Jog Forward
8		Bar In Shear Zone, Exit	Jog Backward
9		Bar In Zone Healthy	Emergency Stop
10	Cut Mark Healthy		Backup HMD Healthy
11			Extra Long Tail Cut
12			Offline Freeze Bar Q
13		Measure Roll MIV	
14	Metal in Mill 1		
15		Metal In Mill 2	

Accucrop Digital Output Assignment			
CH #	Fixed Assignment	Typical & Configurable	Additional Selections
			Divide Cut Park In Progress
0	System Adaptor Enable		Auto Mode Enabled
1		Head Cut Complete	Continuous Cut In Progress
2		Tail Cut Complete	Head Park Position
3		Cut Aborted	Tail Park Position
4		Shear Parked	Manual Cut Ready
5		Auto Cut Ready	Head Cut Missed
6		Accuband Comm. Health	Head Cut In Progress
7		Accucrop Healthy	Tail Cut In Progress