# APPLICATION NOTE: Motor-Phasing/wiring: non-standard, AKD - positive feedback count with a CW rotation as viewed from the lead exit end, for KBM(s) motor.

## AKD-drive to KBM(s) frameless motor, with non-standard connections.

### A. Phase leads per the outline-drawing:

KBM-motor phasing is defined with a C.C.W. rotation of the rotor as viewed from the lead-exit end of the motor; this is a clockwise (C.W.) rotation, looking into the shaft/torque end-bell of most standard housed motors (Like: AKM, BH/MH, series motors). KBM-series wire label convention is meant to be the same as the AKM, BH/MH, series motors; but its specific wiring identification is most easily identified from the lead-exit end, due to it being frameless.
The AKD – drive, standard configuration of the phases: U,V,W, are with a C.W. rotation of the rotor as typically viewed from the torque end-bell (shaft end or mounting end-bell) of the motor, for a positive feedback count (this is the same direction in which the KBM(S) is phased: U,V,W).

The system standard is to connect: motor, to the Drive using the Drive's phasing configuration, for drive phase U -> motor phase U, drive phase V -> motor phase V, etc.; however, for non-standard positive feedback count with a C.W. rotation of the rotor as viewed from the lead exit end, the motor-drive phase connections are most easily accomplished by labeling motor phases: U,V,W, to C,B,A; and connecting AKD – drive per the following information (similar to standard RBE's phasing configuration). It is to this end, that this applications note has been written.

**B. CONVENTION:** The non-standard electrical connections between the AKD-drive to KBM(s) - frameless motor for a positive feedback count, unless specifically stated otherwise, is based upon a **C.W. rotation of the rotor as viewed from the lead-exit end of the motor**, for a positive count direction of the position-loop. **Hence the words: C.W. rotation of the rotor, will refer to this specific convention, through-out this document.** In addition, if applicable, to help clarify one motor phase or Hall feedback signal, to another, an underlined last letter is utilized under the point of electrical reference; hence, phase-AB, reads: phase-A with respect to phase-B, leads B, by 120-degrees, with a C.W. rotation of the rotor); or where, a positive Hall-2 (H2) signal, also defined as Hab (Ha/drive-Hu)] for the defined convention), reads: Hall signal: H2 (Hab) is positive and in phase with motor's Bemf, phase-A, with respect to motor phase-B, with a C.W. rotation of the rotor, **viewed from the lead-exit end.**

### C. MOTOR TO DRIVE CONNECTIONS:

M-Violet (W) = phase: **A**= typical Kollmorgen cable: blue-wire = drive: AKD (**U**)....Hall(u) = Hu/Hab/ H2 (orange)
M-Brown (V) = phase: **B**= typical Kollmorgen cable: white-wire = drive: AKD (**V**)....Hall(v) = Hv/Hbc/H1 (brown)
M-Blue (U) = phase: **C**= typical Kollmorgen cable: black-wire = drive: AKD (**W**)....Hall(w) = Hw/Hca/ H3 (yellow)
M-Green/Yellow-strip GND/PE.

1) Wire colors for a given motor-phase can be different than stated herein; so use the outline-drawing of the motor for the determination of the correct color of a phase with the specified rotation reference.
   Motor(M)-Violet [phase: A or W], Motor(M)-Brown[phase: B or V], & Motor(M)-Blue [phase: C or U], are common KBM motor series colors and, only represent the wire connections from the motor armature; consult the motor wiring document [outline, HD, or WD] for true wire colors, or connector pin-outs (if applicable).



Page: 1: 4.

2) Hall phasing check: with a C.W. rotation of the rotor:

(a) H2 (Orange) or Hab (Ha/drive-Hu) should be high in phase with the Bemf of motor phase: AB;
(b) H1 (Brown) or Hbc (Hb/drive-Hv) should be high in phase with the Bemf of motor phase: BC;
(c) H3 (Yellow) or Hca (Hc/drive-Hw) should be high in phase with the Bemf of motor phase: CA.

3) If the feedback device (resolver/ENDAT/Biss sine-encoder/Hiperface) needs to be aligned with the Bemf of the motor, please see **FEEDBACK DEVICE ALIGNMENT**, [below].

**D. AKD – feedback setup:** From the specific human-machine-interface(HMI) drive software: AKD: WorkBench.exe, go to the feedback dial and turn the motor rotor by hand in the C.W. direction as viewed from the lead-exit end/side of the motor [or C.C.W. from the other end]. (1) Drive variable – AKD: PL.FB, should count up; if it is not counting up, switch two of the feedback wires and make it so it does count up! {Resolver:(sin(+) & sin(-), or Encoder: A & A-not, or Sine-encoder: Sin+ & Sin-} ---- For sine encoder utilization with serial transmission (ENDAT/BISS/Hiperface/etc.) - see **SERIAL TRANSMISSION**, [below].

**E. FEEDBACK DEVICE ALIGNMENT:**

1) If feedback device alignment is required:

a. For the Drive: AKD – series, use the Commutation Alignment, procedure/function within the AKD drive GUI: WorkBench.exe, to establish commutation angle variable: MOTOR PHASE.

b. For manual setting [same as AKM]: Find the null-position via a 24-volt DC power source by connecting the (+) to motor-phase: A [W]; and, (-) to motor-phase: B [V]; if AKD set: MOTOR PHASE, = 0.0; NOTE: Allow motor-phase: C [U], to float (and not short to anything).
[Based on published AKM data-pub.]

**F. SERIAL TRANSMISSION:**

1) For ENDAT/BISS sine encoder utilization with serial transmission (ENDAT/BISS/Hiperface/etc.), due to mechanical mounting orientation with respect to the motor armature, it is possible to have the feedback counts go in the correct direction (sine-cosine communication working) and the serial transmission (ENDAT/Hiperface/etc.) not commutate properly for the communication of the motor. If this is the case, switch encoder sine connections with the cosine connections (positive-for-positive, negative-for-negative). This will allow the serial transmission Drive – AKD: PL.FB, to count in the correct/same direction and also present the communication data to the drive in the proper order; **double check Drive – AKD: PL.FB**, should count up, for a C.W. rotation [or a C.C.W. rotor rotation from the other end of the motor].

a. Drive – AKD, Serial transmission (ENDAT/BISS/Hiperface/etc.) feedback sine-encoders require synchronization between the absolute position and sine/cosine feedback signals.

If you are using an Endat encoder you can do the following:

**(1)** Determine the direction of the sine/cosine feedback.

* Set the feedback type to Endat 2.1 (FB1.SELECT = 30).
* Turn the motor's rotor C.W. as viewed from the from the lead exit end of the motor, to determine if the encoder feedback: **AKD: PL.FB,** is counting in the positive direction [or a negative direction, if not connected per this writ; otherwise return to section: D., above].

NOTE: For a conventional framed motor, the encoder's typical front mount is facing the motor's shaft-end (mounting end-bell) of the motor; thus, an encoder mounted in the opposite direction, but connected the same, will count in the opposite direction.

**(2)** Determine the direction of the absolute position feedback counts, received by serial Transmission, by the following:

* Set the feedback type to Endat 2.2 (FB1.SELECT = 31).
* Turn the motor's rotor C.W. as viewed from the from the lead exit end of the motor, to determine if the encoder feedback: **AKD: PL.FB,** counts in the same direction as the sine/cosine feedback received in G.1)a.(1) [above].
* If it counts in the opposite direction, then switch the Sine and Cosine, signals (positive-for-positive, negative-for-negative), and repeat the above test.

## G. DIRECTION OF ROTATION PURSUANT TO THE COMMAND:

Once the encoder transmission of the serial position feedback and the sine/cosine position feedback is in synchronization (if applicable) and properly commutating motor, if the motor is not turning in the desired direction by the desired Position command signal, user can reverse the motor's direction by setting drive variable: DRV.DIR, to 1.

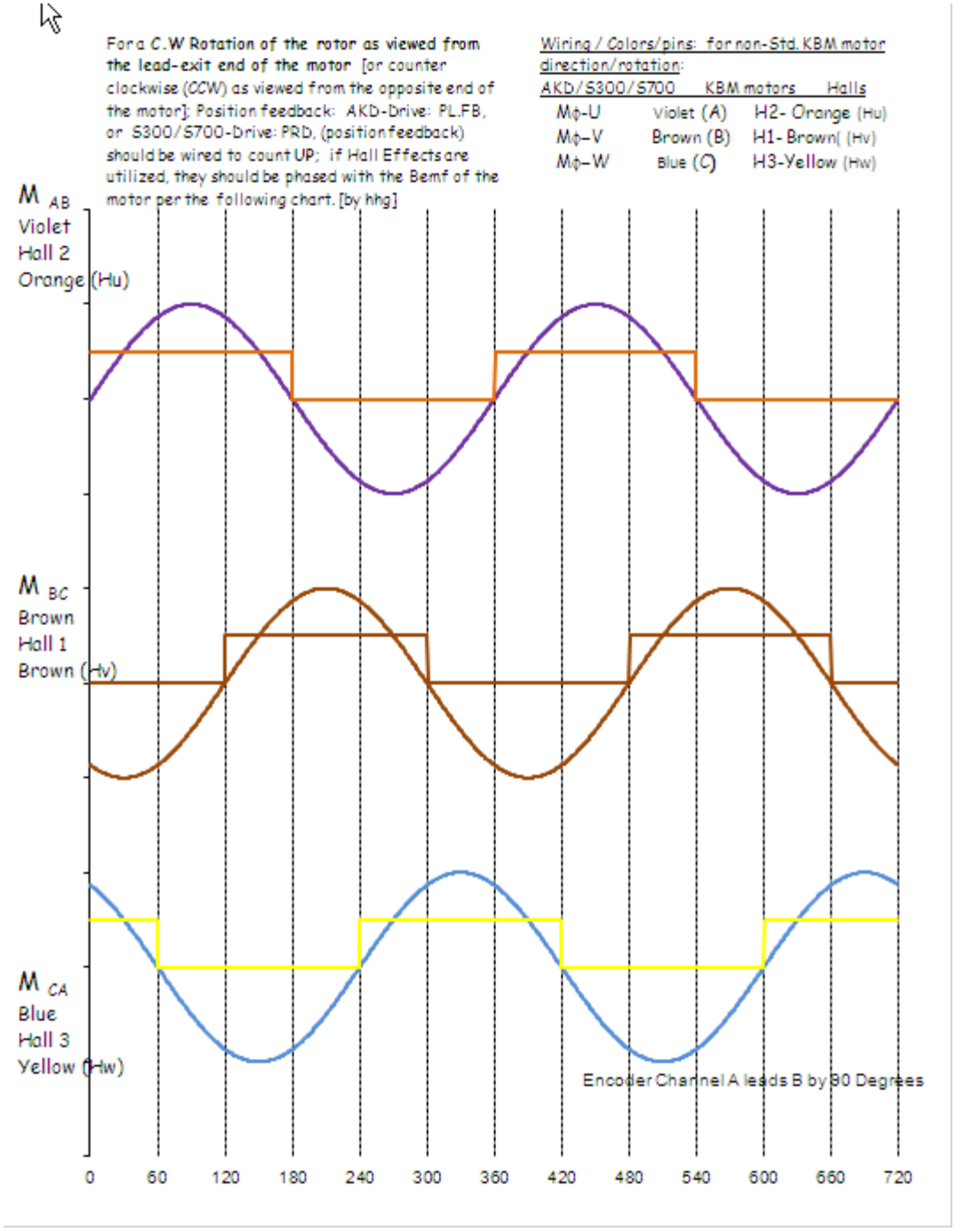
## H. HALL COMMUNICATION:

Kollmorgen drives as well as most other drive manufactures reference the hall-effect/com-coder feedback (for initial communication on a power-up cycle) in phase with the Bemf of the motor [with Hall edges lining up with the Bemf line-line zero crossing] with Hall outputs going positive when the Bemf is positive, **for the same direction of shaft rotation as the utilized convention for determining the motor phasing**.

Hence, Kollmorgen motors with motor phases **labeled: A, B, & C,** such as Kollmorgen's RBE-series/BM-series, typically utilize a **C.W.** (clockwise) **rotor rotation convention for the determination of the motor phasing,** as viewed from the lead exit end; thus, when the motor shaft/rotor is rotated in the same direction as the phasing convention (C.W. direction as viewed from the lead exit end), the appropriate Hall signals will be going positive with the Bemf of the motor and in phase with the Bemf of the motor.

**In contrast:** for the KBM-series the motor phases are **labeled: U, V, & W,** and the **rotor rotation convention for the determination of the motor phasing is C.C.W., as viewed from the lead exit end;** thus, when the motor shaft/rotor is rotated in the same direction as the phasing convention (C.C.W. direction as viewed from the lead exit end), the appropriate Hall signals will be going positive with the Bemf of the motor and in phase with the Bemf of the motor. **If this is your application,** please see APPLICATION NOTE: **AKD to KBM - Motor phasing std connection for Pos FB CCW rotation lead-exit-end U_V_W typical Blue - Brown – Violet.**

**I. HALL SIGNALS –versus- MOTOR PHASES (of a presentment as an oscilloscope plot):**




**NOTATION:** If any description appears to be unclear, or a mistake is found; or, if you feel something needs to be added, please send your comments to Hurley.Gill@Kollmorgen.com.