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Dart Controls Application Note
Equipment Modernization Using Digital Controls

We see an increasing number of plants across the spectrum of industries that are upgrading their motion control systems. Specifically, the need for increased productivity, quality product yield, and information (think validation) is driving demand for digital control. Dart Controls has led innovation in the market for DC brush and brushless motor controls for years, and continues to develop new products to address customer needs when upgrading older analog systems.

There are several considerations for choosing the right Dart Digital Control product for your application. This paper will highlight those issues that need to be considered before ordering any product, saving time and money in the process. To start, we will describe in some detail what Dart Digital Controls are and how they operate, then discuss key considerations for successful application.

Digital DC Drives

Dart Digital DC Drives are also known as MicroDrives. Dart MicroDrives are microprocessor-based, closed-loop SCR drives for DCPM brush motors. Note: They will not work with field or shunt wound DC motors (see ASP Series later). Dart MicroDrives are all NEMA 4X **panel** or **stand alone enclosed** models. They all have the ability to operate in Rate, Time (in process) or Follower (% of Master) modes. They all offer a scalable display which can be configured to display meaningful operator information in direct-reading engineering units such as RPM, FPM, GPM; time in process in MM:SS or % of Master (Follower Mode).

There are two Series of MicroDrives – the MD3/MD10 Series and the MD40/50 Series:

- MD3/10 Series – these are the most basic. The software that runs this series is a 'pulse comparison' algorithm intended for CONTINUOUS operation. If the application calls for frequent starts/stops or speed changes, consider instead the MD40/50 Series. The MD3/10 Series is designed for equipment that needs consistent and repeatable speed (time) through a process – baking, heat treating, drying, etching, washing, heat shrink, welding, etc. The MD3/10 Series is not designed to work well in applications where motor loads or set speeds are dynamic, and it does not offer signal follower / serial interface options. The MD3/10 Series requires encoder feedback (it is a closed-loop control) with a minimum 500 pulses and a maximum 50,000 pulses/minute to perform well. We see many applications where this series is used with inadequate pulse/revolution feedback, or the MD3/10 is asked to start/stop or change speed often – bad application.
- MD40/50 Series – The MD3/10 was developed first. Due to its unique, integrated control and programmable display, and configurable operating mode we began to see them applied in

applications described above as 'bad'. For that reason, the MD40/50 Series was developed. This series addressed several of the MD3/10 series' application limitations by:

- Incorporating a true PID velocity loop algorithm
- Offering analog (4-20mA) and digital serial interface options
- Adding features such as configurable Set Speed or Actual (Tachometer) speed display

These additional features make the MD40/50 series more flexible, and most likely to be the BEST choice for ANY application. The MD40/50 series requires a minimum of 250 pulses/minute and will accept up to 600,000 pulses/minute. Response to frequent start/stop, speed or load changes is much improved using the available PID parameters for response tuning. The factory or field installable signal follower / serial interface enables direct interface to supervisory controllers (think plc) which further enables strategies such as remote interface, web-based applications, and remote troubleshooting.

Digital Potentiometers

Digital Potentiometers have become increasingly popular given their ability to be added to any existing 'analog' control – DC SCR, AC VFD, BLDC, Regen, PWM – any brand or model. They provide a precise, repeatable speed setting not attainable from a traditional analog potentiometer. They offer the same integrated, programmable digital display and multi-mode operation (Rate, Time and Follower) as the MD series. The only stipulation is that the control used with the digital potentiometer accept a 3-wire speed pot input, and that the reference voltage (from the control – typically Speed Pot High) is at minimum 2.5VDC measured from Speed Pot High to Speed Pot Low (Common) on the control.

Digital Potentiometers include the Dart DP4, and ASP Series – they all take the speed pot reference voltage from the control they are connected to and scale it back to the control on the Speed Pot Wiper connection. The DP4/ASP Series are NOT signal generators (see Dart DP10 at www.dartcontrols.com for this), and they are not variable resistors. The DP4/ASP output is **digitally scaled** by the DP4/ASP display setting and sent back to the associated control. All DP4/ASP Series are panel-mount devices offering NEMA 4X rating when installed in a similarly rated enclosure.

- DP4 Series – These are true digital potentiometers. They are open-loop devices, meaning no encoder feedback is required. Their value / popularity comes from the programmable display and repeatable setting they offer
- ASP10 Series – this series is identical in characteristic and performance to the MD3/10 Series above – it literally uses the same software. The difference is there is NO DC control built in. It is a closed-loop device, so encoder feedback is required.
- ASP40 Series – this series is identical to the MD40/50 Series – it uses the same software as the MD40/50. It also offers the same availability of analog (4-20mA) or serial interface options. It is a closed-loop device, so an encoder is required.

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Encoders

For MD/ASP Series that require encoder feedback, the Dart PU Series is an excellent choice. However, the maximum output is 20 pulses/revolution (Model PU-40E/R). This means, to meet the minimum 250 to 500 pulses/minute requirement discussed earlier, the PU Series must be mounted on a minimum 12.5 to 25 RPM location (depending on MD/ASP model used). Some applications require speeds lower than this. The solution is to use a higher PPR output encoder.

The specification for encoders to be used with Dart products when higher PPR is needed:

- 5-24VDC, with 5VDC ideal (powered from MD/ASP 5VDC supply)
- Incremental type (not absolute)
- Single channel (dual output or quadrature not required)
- NPN, open collector, sinking source (any one of these may be used to describe the output type)
- Pulses/revolution – highest PPR output without exceeding MD/ASP maximum (see previous)

Encoder cabling is also a consideration. Any cable run from encoder / sensor head over 6 feet should be shielded, starting as close to the sensor as possible, and the shield grounded on one end (not both). Encoder cable runs over 100 feet should use larger than normal gage wire to minimize signal loss. In all cases, encoder cables should NOT be bundled with AC power or motor armature wiring.

Application Considerations

Before purchasing any Dart Digital Control product, please consider the following in your application:

- How will the motor to be controlled be operated – continuous, or start/stop/multi-speed?
- If using a closed-loop control, what location options for encoder installation are available? What is the operating speed range of the encoder installation point? Will my selected encoder produce enough pulses/minute at the lowest speed, and not too many at the highest speed?
- If the existing motor control is being replaced, is it supplying field voltage to the motor as well as armature voltage?
- If the existing motor control is being kept, will it accept a 3-wire speed pot input? If yes, what the speed pot circuit reference voltage?
- Does my new Digital Control need to follow a remote signal to change the motor speed?
- Where am I going to install the control – in a panel or ?

For more information, or to discuss you application please feel free to contact me directly.

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