Technical Note 193

# IPC speed follower

## Setup instructions

The ACH580 and ACQ580 drives support a standard software feature called Intelligent pump control (IPC) that allows for multidrive systems to operate without a programmable logic controller (PLC) or building automation system. IPC was developed around the use of a transducer providing a feedback signal to all the drives in the system, and then the drives adjusting their output frequency to maintain a setpoint by using the drives' built in PID control loop. In an IPC system, usually the setpoint is a fixed value programmed into the drives. A minimum quantity of two drive and motor combinations are required for implementation of IPC, with a maximum of eight drive and motor combinations. Many systems will have at least one extra drive in standby mode as a backup. If a drive or motor were to fail the standby drive will start running automatically through the IPC control logic. Figure 1 shows a traditional example of a multidrive system using IPC. The drive-to-drive communication link is how the drives communicate with one another to control speed and automatic redundancy.

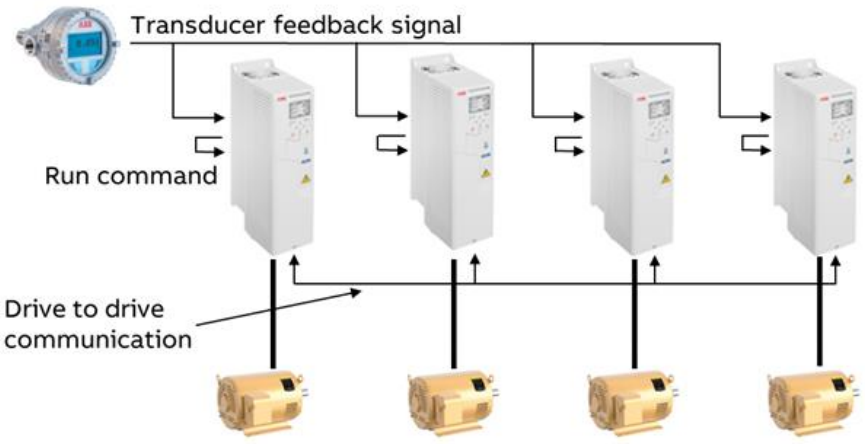


**Figure 1: Traditional IPC configuration when running PI control loop on the drives**

Instead of a transducer feedback signal being connected to multiple drives there are many applications that exist where a simple speed signal is given instead, but automatic redundancy is not provided by a remote controller. The speed signal many times is a 0 – 10 VDC or 4 - 20 mA signal, and provided by a building automation controller, PLC, or maybe even a simple rotary potentiometer knob. This technical note will discuss how to setup a multidrive system to operate in a speed follower setup, and still provide automatic system redundancy and balanced run times. The IPC software feature will be used as a base to accomplish this functionality. This technical note supplements the drive firmware manual and expands on the functionality of IPC by providing guidance on how to configure speed follower setup along with optional features signal loss and damper control.

**Use cases**

In this implementation of IPC, not all the drive motor combinations in a system need to be running at the same time, and the number of motors allowed to be running is a fixed quantity. For example in a duplex system, only quantity one motor would run at a time. Another example would be a system made up of quantity four drive and motor combinations. Here the system would be setup to only allow quantity two or three motors run at a time, depending on if single or dual redundancy is needed.

Figure 2 shows an example of the drives being connected to a speed reference source. The speed reference source can be simple like a potentiometer knob or a more advanced PLC.

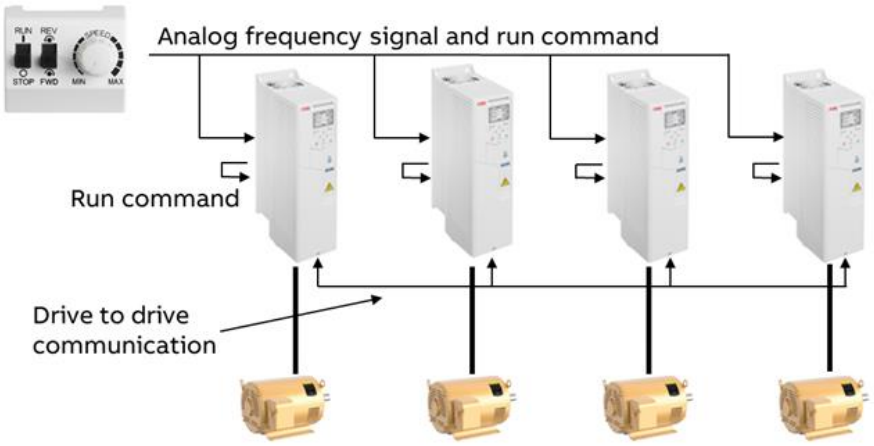


**Figure 2: Redundant multidrive motor configuration with a common speed or frequency reference**

An example application where this type of speed follower setup could be used are parallel exhaust fans. In a simple exhaust fan system, a fixed speed reference may be programmed for the drives to run the fan, however automatic redundancy is not part of the control system. By using this IPC speed follower setup if one drive or motor fails the backup drive will come online right away preventing a major gap of no air flow. This can be critically important if the air being exhausted is hazardous to breath. With this setup there is no running across a shop floor trying to figure out how to turn on the backup drive.

Another example application is a pump skid or system in which a separate controller is monitoring the water pressure in the line and sending a speed signal to multiple drives, but the controller is not monitoring the fault status of the drives and commanding backup drives online automatically. By using the setup described in this technical note, the external controller can be left in the system if desired, and automatic system redundance provided by IPC can be enabled, providing some piece-of-mind for the user. In a pumping application, the IPC logic will also automatically rotate in and drop off the pumps making sure seals do not dry out over a long period of time.

A multicell cooling tower could also use this functionality. If the towers are made up of several separate cells with one fan each, this speed follower setup could be used. The idea is at least one tower cell is a backup providing redundancy.

To commission the drives in the system for IPC speed follower, it is recommended to start with Primary Settings: Primary Settings → Pump features → Multipump control → Intelligent pump control (IPC). Set each drive up with a unique node number, adjust the number of drives in the system, and how many are allowed to run at once.

Important setup notes:

1. Setup drive node numbers and synchronization first, so modifications made to one drive are copied to others. It is recommended to allow synchronization for analog input (AI), process PID, and IPC parameters.
2. The minimum and maximum number of motors allowed to run at the same time must be set to the same value.
3. This number should be at least one less than the total number of drive motor combinations in the system, as at least one backup drive motor pair must exist in the system.

Table 1 provides a list of parameters and their value for setting up the drive to act in speed follower mode with automatic system redundancy. Some values in the list are default settings when the drive is setup for PID control mode and IPC. Note the description column for advice on how to set each parameter value. After the initial setup of IPC using Primary Settings, it may be easier to navigate through the complete parameter list to adjust and verify settings.

**Table 1 Parameter values**

| Parameter number | Parameter name | Setting | Description |
|---|---|---|---|
| 12.15 | AI1 unit selection | V or mA | When paralleling a common signal to drive "V" is used |
| 12.17 | AI1 min | Site specific | Usually 0 – 10 V is supplied in parallel to all the drives, with a linear speed control range of 0 – 60 Hz. If operating above 60.0 Hz parameter 12.20 needs adjustment along with parameter 30.14. If using mA input signal, then adjust group 12 parameters accordingly. |
| 12.18 | AI1 max | Site specific | |
| 12.19 | AI1 scaled at AI1 min | Site specific | |
| 12.20 | AI1 scaled at AI1 max | Site specific | |
| 19.11 | Ext1/Ext2 selection | Ext2 | Default setup for PID control uses Ext2 |
| 20.06 | Ext2 commands | In1 Start | Default setup of PID control uses In1 Start |
| 20.08 | Ext2 in1 source | DI1 | Default setup of PID control uses DI1 |
| 28.15 | Ext2 frequency ref1 | PID | Default setup of PID control uses PID |
| 30.14 | Maximum frequency | 60.0 Hz | If operating above 60.0 Hz for the application increase this value. |
| 40.07 | Process PID operation mode | On when drive running | Default setup of IPC |
| 40.08 | Set 1 feedback 1 source | P.1.6 (output frequency) | Use "other" setting option to point to the output frequency reference parameter 01.06 if using scalar mode. If running in vector mode point to 01.02. |
| 40.16 | Set 1 setpoint 1 source | AI1 scaled | This is specific setting for speed/frequency follower mode |
| 40.31 | Set 1 deviation inversion | Not Inverted (Ref - Fbk) | This is specific setting for speed/frequency follower mode |
| 40.32 | Set 1 gain | 2 | A gain value is required. If this value is set too large, some oscillation may be observed in motor speed regulation. Adjust as necessary. Accel and decel ramp times still impact on how fast the motor changes speed. |
| 40.33 | Set 1 integration time | 5 | An integration time is required. If this value set too short, some oscillation may be observed in motor speed regulation. Adjust as necessary. Accel and decel ramp times still impact on how fast motor changes speed. |

| Parameter number | Parameter name | Setting | Description |
|---|---|---|---|
| 40.79 | Set 1 units | User text | With parameter 40.79 = User text [0], then in Primary Settings → Pump features → Multipump control → Sharred settings → PID control → Custom text, units of “Hz” or “RPM” to be manually entered |
| 58.01 | Protocol enabled | None / IPC communication | IPC default setting enabling drive-to-drive link |
| 76.21 | Multipump configuration | IPC | Default for IPC |
| 76.22 | Multipump node number | 1 – 8 | Must be different number for each drive in system |
| 76.25 | Number of motors | 2 - 8 | Total number of motors in each system |
| 76.26 | Min number of motors allowed | 1 - 7 | Parameters 76.26 and 76.27 must be set to the same value. These two parameters will be set to a value of at least one less than total number of motors in system Par. 76.25. |
| 76.27 | Max number of motors allowed | 1 - 7 | |
| 76.70 | PFC autochange | Even Wear | Default which allows for simplest balancing of wear between motors and loads |
| 76.71 | PFC autochange interval | Time value in hours | Adjust this setting as desired for number of hours between motor rotations. |
| 76.73 | Autochange level | 100.0% | Leave at 100.0% to allow an automatic backup drive to come online |
| 76.101 | IPC parameter synchronization | Enable | Recommended to use this feature to make drive programming easier |
| 76.102 | PIC synchronization settings | Bit 0, 1, and 2 = 1 | Recommended to allow synchronization for analog input, PID, and IPC parameters |

Two additional features that can be implemented with this IPC speed follower are signal loss and damper/valve control. It could be desirable to have the drives revert to a fixed speed incase the reference speed signal is lost. Table 2 provides an example set of programming to allow the drive to operate at a fixed speed incase the analog 2 – 10 VDC signal is lost.

**Table 2 Signal loss**

| Parameter number | Parameter name | Setting | Description |
|---|---|---|---|
| 32.05 | Supervision 1 function | Low | |
| 32.06 | Supervision 1 action | Warning | |
| 32.07 | Supervision 1 signal | P12.11 AI1 actual value | Use the “Other” option to select the actual value in group 12 |
| 32.09 | Supervision 1 low | 2.00 | |
| 28.22 | Constant frequency sel1 | Supervision1 | |
| 28.26 | Constant frequency 1 | Desired frequency or speed | Site specific choice on what the fixed operating frequency shall be. |

Another situation is wanting to open a damper or valve before the motor runs. In this scenario, regardless of moving water or air, the advanced damper logic in the drive can be used to accomplish this function. Table 3 provides an example parameter set to accomplish this feature.

**Table 3 Damper control**

| Parameter number | Parameter name | Setting | Description |
|---|---|---|---|
| 84.01 | Advanced damper configuration | DA damper, no pre-pressure | |
| 84.03 | DA damper open input | DI2 | Feedback end switch that must close before the drive can run |

**Conclusion**

For multidrive applications where the function of automatic redundancy or automatic system rotation is not supported by a building controller or PLC, the use of the IPC feature in the ACH580 and ACQ580 can accomplish this functionality. The IPC drive-to-drive link allows the drives in the system to communicate with one another and if one drive goes offline, a standby drive will automatically come online keeping a system running.