

Overview Integrated Drive**Document history**

Doc. Rev.	Date	Author(s)	Change(s)	Status
1.0	2007-03-30	O. Lehmann	Initial document	released
1.1	2010-06-25	A. Renggli	Various additions	released
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Overview of Service Bulletins for Integrated Drives (ID)

SB-60 Overview of Integrated Drives

- General product description
- Drive unit product lines and related capacitor series
- Function levels and configurations
- Description of module components
- Technical specifications
- Overview of the product range
- Type designation

SB-61 Drive Unit

- Drive unit product lines and related capacitor series
- Description of the drive unit components

SB-62 Introduction to Stepping Motors

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- Control system of the drive unit

SB-63 Electrical Installation ID-400

- Stepping driver control signals and connections for EXPERT ID

SB-64 Electrical Installation ID-1200

- Stepping driver control signals and connections for EXPERT ID

SB-65 Electrical Installation ID-2800

- Stepping driver control signals and connections for EXPERT ID

SB-66 Electrical Installation ID-5400

- Stepping driver control signals and connections for EXPERT ID

SB-67 Step/Direction; Clockwise / Counter clockwise (CW/CCW) Interface

- Stepping driver signals
- Stepping driver timing diagram

SB-68 Software Protocol Interface RS-232

- Specification of the interface
- Frame structure
- Communication protocol between the ID and the host system

SB-72 Safety Aspects of Integrated Drives

- Capacitor
- Electrical Insulation between ID and Capacitor

DATA SHEETS are available for each Integrated Drive

1 General Product Description

The Integrated Drive is available for a number of a COMET capacitor series (e.g. Maxi-Con, Hexa-Con, Power-Con, and Uni-Con) for Semiconductor and Flat-Panel applications but also for broadcast applications.

All Integrated Drive modules consist of two units, a variable capacitor and a drive unit. The drive unit consists again of the following components:

- Stepping Motor
- Coupler between Variable Vacuum Capacitor and Stepping Motor
- Mounting Tube
- Capacitor Mounting Flange
- Bulkhead Mounting Flange (Ground)

Besides that, some products include additional hardware, namely Stepping Motor Driver and Microcontroller.

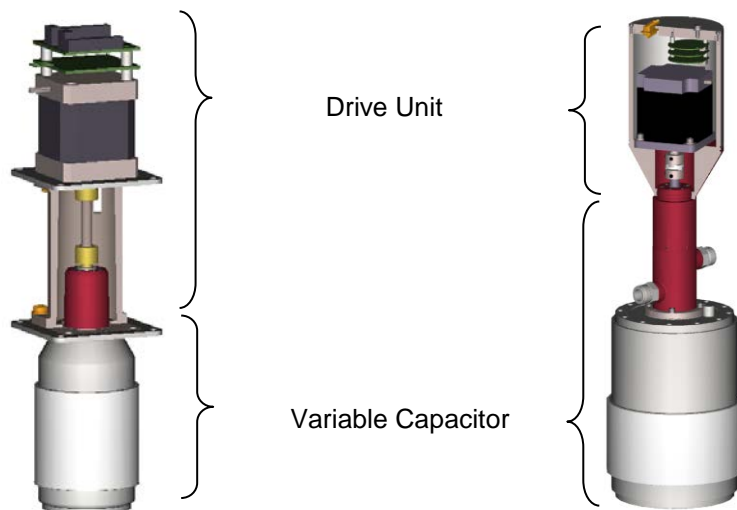


Figure 1: Picture of two different Integrated Drives

The Integrated Drive dramatically reduces procurement and assembly lead times and replaces tedious and error-prone manual assembly with a standardized, easy-to-install subsystem. It has the following technical benefits:

- Accurate alignment of variable capacitor, stepping-motor and coupler for high-precision operations
- A durable, backlash-free coupling connects the capacitor to the drive system
- No side load nor axial lead screw results in a longer lifetime of the lead screw
- Integrated reference index for easy calibration and recalibration
- Highly accurate repeatability of capacitance positions
- Optional downloadable C-Curve and specific module information on memory chip
- On request, an integrated stepping-motor drive as well as a microcontroller which allows high-level commands
- Easy to replace the module without further calibration

2 Integrated Drive unit product lines and related capacitor series

Integrated drive units are split up into four product lines named ID - 400, ID - 1200, ID - 2800 and ID - 5400. The number of each product line is based on the holding torque of the stepper motor.

The typical use of the ID – 400 and ID – 1200 is for Semiconductor and Flat-Panel application versus the ID – 2800 and ID – 5400 is for broadcast applications.

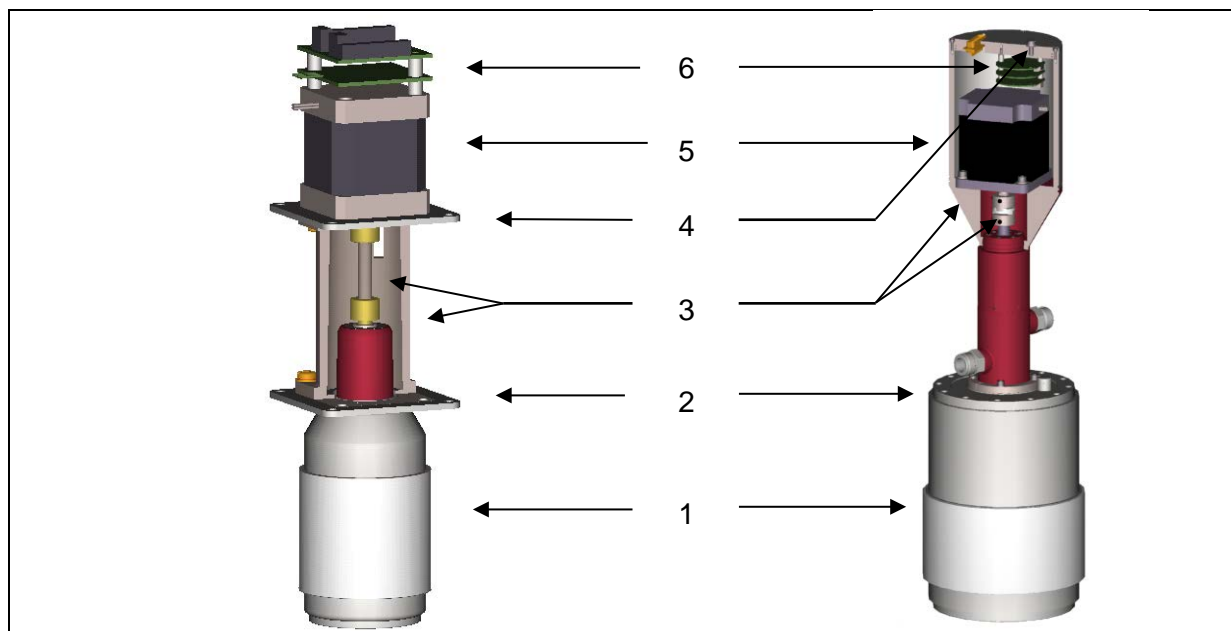
			
ID - 400	ID - 1200	ID - 2800	ID - 5400
Typical application area: Semicon and Flat-Panel		Typical application area: Broadcast	
Uni-Con	Power-Con	SAMi-Con	MAMi-Con
Uni-Select	Power-Solar	Hiper-Con	LAMi-Con
Smart-Con	Hexa-Con	NAMi-Con	HAMi-Con
	Maxi-Con	Supra-Con	

Table 1: Integrated Drive product lines and related capacitor series

3 Description of Module Components

The mechanical integration of the variable capacitor, the mounting tube and coupler, and the stepping motor is done in a way that perfectly aligns the capacitor's lead screw and the stepping motor shaft. In this way, the side load on the capacitor and its drive system is minimized, resulting in optimal long-life capability of these critical mechanical parts.

Mechanical end stops at both the lowest capacitance value (C_{min}) and highest capacitance value (C_{max}) are available. The end stop at C_{min} is very precise and mechanically stable and can be used for referencing the capacitor and synchronizing the capacitance values with those stored on the module. This referencing cycle will be used after a power interruption. The mechanical end stop will withstand 5000 Cycles. The stop at C_{max} , however, only prevents the lead screw from being moved out of the capacitor and eliminates the risk of damaging the motor or even the complete module. It is only a safety stop and must not be used for referencing nor should the capacitor be used beyond this point.



Principle components of the Integrated Drive and the ID – 400, ID - 1200		Principle components of the Integrated Drive and the ID – 2800, ID - 5400	
1.	<p>Variable capacitor</p> <p>Depending on required capacitance and voltage levels COMET provides a number of different capacitors series as an Integrated Drive.</p>		
2.	<p>Mounting flange</p> <p>Each Integrated Drive module includes two mounting flanges: one between the stepping motor and the mounting tube and another between the mounting tube and the variable capacitor. The former</p>	2.	<p>Mounting flange</p> <p>This flange is used for mounting the integrated drive to a ground plane. The hole pattern is similar to the respective capacitor which is used at the Integrated Drive. COMET has designed standard flanges.</p>

	<p>intended use is to attach the module to a ground plane (4), e. g. the bulkhead in a matching network. The latter (2) is used to provide a good RF connection to the variable electrode of the capacitor.</p> <p>For both flanges, COMET has designed standard parts. Customized flanges will be provided at a higher price.</p>	<p>However customized flanges will be provided at a higher price.</p>
<p>3.</p>	<p>Coupler and mounting tube</p> <p>The IFLEX™ coupler insulates the lead screw of the variable capacitor and the stepping motor shaft. In addition, it transfers the rotation of the stepping motor to the variable capacitor and thus allows changing the capacitor's value. The two ends of the IFLEX™ coupler are formed so that any residual misalignment between the capacitor and stepping motor axes is compensated for. This results in an improved overall lifetime of the tuning mechanism of the variable vacuum capacitor.</p> <p>Applying the torque that is required to turn the lead-screw of the vacuum capacitor to the IFLEX™ coupler causes a twisting of the coupler, resulting in a backlash with respect to the accurate positioning of the capacitor's electrode. This backlash is in the range of 2 full steps of the stepping motor and is comparable to other coupler systems that are frequently used in applications in the Semiconductor and Flat Panel industries.</p> <p>The mounting tube is mechanically strong enough to serve as the single mounting feature for the Integrated Drive module in the matching network.</p>	<p>Coupler and mounting tube</p> <p>The Oldham coupler transfers the rotation of the stepping motor to the variable capacitor thus changing the capacitor's value. The two ends of the Oldham coupler are formed so that any residual misalignment between the capacitor and stepping motor axes is compensated for. This result in an improved overall lifetime of the tuning mechanism of the variable vacuum capacitor. The backlash is in the range of 2 full steps of the stepping motor.</p> <p>The mounting tube connects the drive system with the capacitor.</p>
<p>4.</p>	<p>See point 2.</p>	<p>GND connection</p> <p>This screw has to be connected to GND.</p>
<p>5.</p>	<p>Stepping motor</p> <p>Stepping motors used in the Integrated Drive are two-phase types with a resolution of 200 full steps per revolution of the motor shaft. The driving mode is bipolar half coil.</p>	

6.	<p>Motor driver and controller</p> <p>The driver and microcontroller PCB includes stepping motor drivers and a microcontroller for various functions. Please note: the motor driver and controller are not included at the function level ENTRY.</p>
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Table 2: Description of module components

3.1 Classification of different Insulations

This chapter describes the different available insulations.

Type of Insulation	Description	
Full Voltage	The motor and driver block is insulated from the variable flange of the capacitor by at least the peak working voltage U_{pw} . U_{pw} is specified for each capacitor in its corresponding datasheet. The insulation distance is determined according to EN50178.	
	ID 400 ($U_{pw,max} = 9 \text{ kV}$)	Max. insulation distance: 23 mm
	ID1200 ($U_{pw,max} = 15 \text{ kV}$)	Max. insulation distance: 40 mm
GND insulation	The motor and driver block has a electrical connection with the variable flange of the capacitor	

Table 3: Classification of Insulations

4 Technical specifications

	ID - 400	ID - 1200	ID - 2800	ID - 5400
Power supply	24 V	24 V	24 V	24 V
Holding torque	0.4 Nm	1.2 Nm	2.8 Nm	5.4 Nm
Torque at 1000 Steps/sec.	0.37Nm	0.75Nm	2.0 Nm	3.2 Nm
Motor dimension	42mm	Ø 56mm	88 mm	87mm

Table 4: Technical specifications

4.1 Thermal characteristics

All modules have over-temperature protection, to give reliable operation and a long life time. If the temperature of the drive unit exceeds 105°C (+/- 10°C), the setting at that time is reduced to 80%. Normal motor current is restored below 95°C. While this is only a small current reduction, it reduces power dissipation to about 65%. However, if a temperature of 120°C is exceeded, the motor drivers are completely switched off.

5 Overview of the product range

ID	Function-level	Configurations- level	Electrical interface
ID-400 Uni-Con Uni-Select Smart-Con	ENTRY	ENTRY-1	Stepping Motor
	EXPERT	EXPERT-1	RS-232
		EXPERT-2	RS-485
		EXPERT-3	STEP/DIR; Clockwise / Counterclockwise
ID-1200 Maxi-Con Hexa-Con Power-Con	ENTRY	ENTRY-1	Stepping Motor
	EXPERT	EXPERT-1	RS-232
		EXPERT-2	RS-485
		EXPERT-3	STEP/DIR; Clockwise / Counterclockwise
ID-2800 Hiper-Con NAMi-Con SAMi-Con	EXPERT Shielded	EXPERT-S1	RS-232
		EXPERT-S2	RS-485
		EXPERT-S3	STEP/DIR; Clockwise / Counterclockwise
ID-5400 MAMi-Con LAMi-Con HAMi-Con	EXPERT Shielded	EXPERT-S1	RS-232
		EXPERT-S2	RS-485
		EXPERT-S3	STEP/DIR; Clockwise / Counterclockwise

Table 5: Overview of the product range

6 Type designation

C M U N – 500 A C/8 – X S 1 – F 1

CM

Motorized Capacitor

UN

Capacitor Series Name

UN = Uni-Con

HE = Hexa-Con

PO = Power-Con

SA = SAMi-Con

MA = MAMi-Con

LA = LAMi-Con

500

Maximum nominal Capacitance Cmax [pF]

A

Capacitor Block

C

Cooling System

8

Maximum voltage – Peak Test U_{pt} [kV]

X

Function Level

E = Entry

X = Expert

S

Shielded Version (no letter when not shielded)

S = Shielded Version

1

Configuration / Interface Letter (only for Expert Integrated Drives)

1 = RS-232

2 = RS-485

3 = Step/Direction; Clockwise / Counterclockwise

4 = SPI

5 = I2C

*No number for Entry Integrated Drive

F

Isolation* Letter

F = Full Voltage Version

R = Reduced Voltage Version

G = Ground Version

*Isolation between the motor flange and the capacitor variable end flange

1

Product configuration

No number = COMET standard version of motorized capacitor

Single digit = Customer specific version

(correlated to the ERP variant / no left-hand zeros)

Seven digits = ID still in project status