DATA SHEET

"RTA" SMART DEFLECTOR

NEWSON NV

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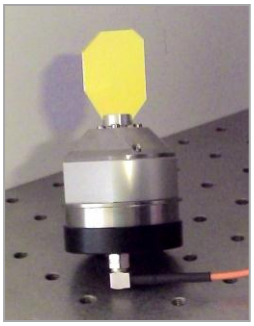
1 Smart Deflector™

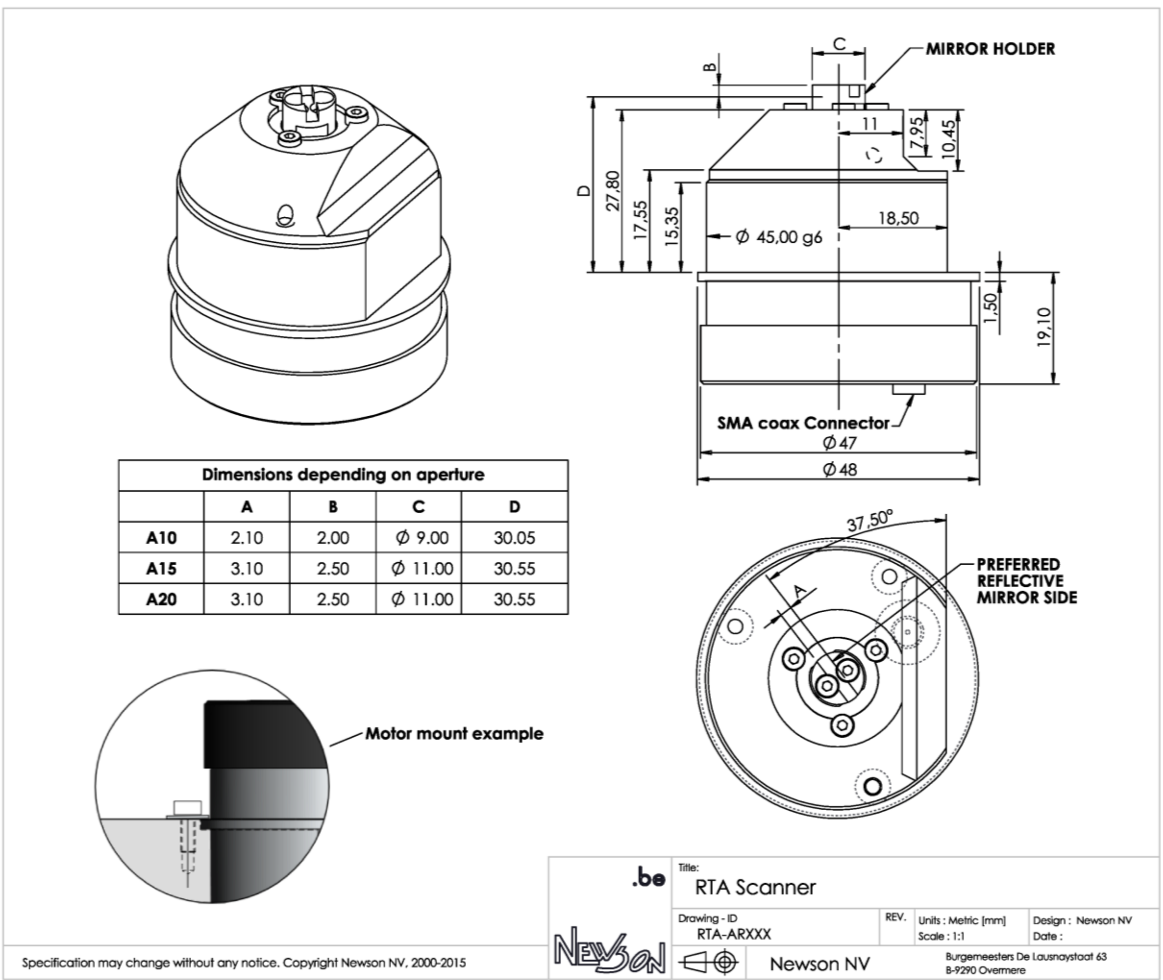
1.1. General Description



The Smart Deflector™ is a complete closed loop servo system. Regulator and amplifier are integrated into the mechanical device to obtain a complete self-operating system. Energy efficiency is maximized to avoid thermal heating.

The result is a part that can be used in nearly any optical layout. To maximize its ease of use, the electrical connection to the Smart Deflector™ is done over a coaxial connector. Both power supply and data are provided through this connection.

1.2. Dimensions



Dimensions depending on aperture				
	A	B	C	D
A10	2.10	2.00	Ø 9.00	30.05
A15	3.10	2.50	Ø 11.00	30.55
A20	3.10	2.50	Ø 11.00	30.55

2 GENERAL DATA

Smart Deflector™ with integrated regulator and amplifier

Principle:	moving coil
Coil inductance	4 µH
Coil resistance	300 mOhm
Regulator:	digital 18 bit
Amplifier:	class D
Position Sensor	optical

Mechanical Data

Rotor inertia:	2.6 g.cm²
Maximum load:	10 g.cm²

Positioning (optical angles)

Motor Type:	RTA-AR800	RTA-AR640	RTA-AR180
Rated angular excursion:	800mrad (45.8°)	640mrad (36.7°)	180mrad (10.3°)
Resolution:	65536 steps	65536 steps	65536 steps
Drift measured over 8 hours:	< 24µrad	< 20µrad	< 6µrad
Repeatability	< 12µrad	< 10µrad	< 3µrad

Electrical Data

Connection:	single SMA coax connection for both power and data
Data modulation:	AC modulated on the power supply
Data protocol:	9 bit UART
Data baud rate:	10 Mbit/sec

The coax connection is used for both data and power supply to the deflector. De data is modulated onto the power supply by the control unit. Power supply current of the deflector depends on its movements.

Description	Name	Min	Typ	Max	Units
Power supply	DC+12V	9	12	13	V
Power RMS current	I_{DC+12V}		0.2	0.6	A
Power Peak current			3		A (*)

(*) Peak current level and frequency depends on deflector movements. Peak current duration approx. 200µsec. The applied input DC voltage to the deflector should be 12V DC. However during current spikes, the power supply input voltage is allowed to drop to 9V.

WARNING:

The smart deflector is not protected against reverse polarity.

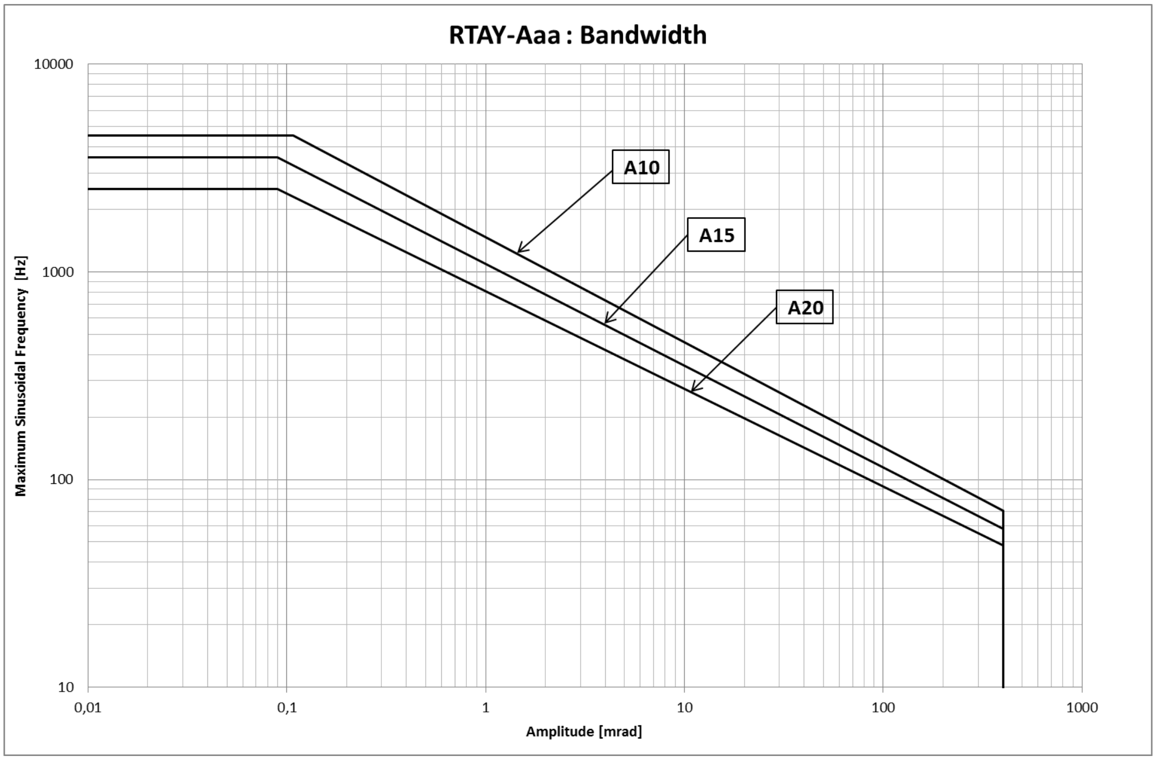
Reverse polarisation of the applied power supply will damage the system.

Temperature characteristics

Operating ambient temperature:	-10 to +50°C
Storage temperature:	-10 to +60°C

3 Typical Characteristics

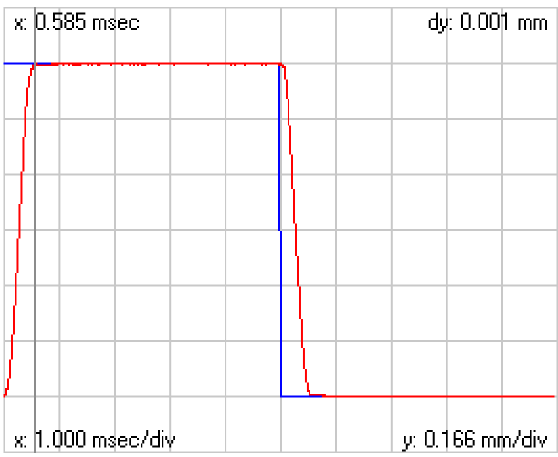
3.1 Bandwidth



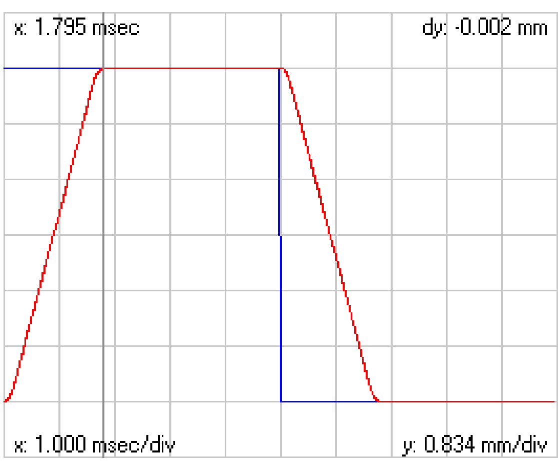
3.2 TYPICAL STEP RESPONSES

Aperture 15mm, Y-mirror, SiC

Fieldsize 46mm, JumpSpeed 3m/sec



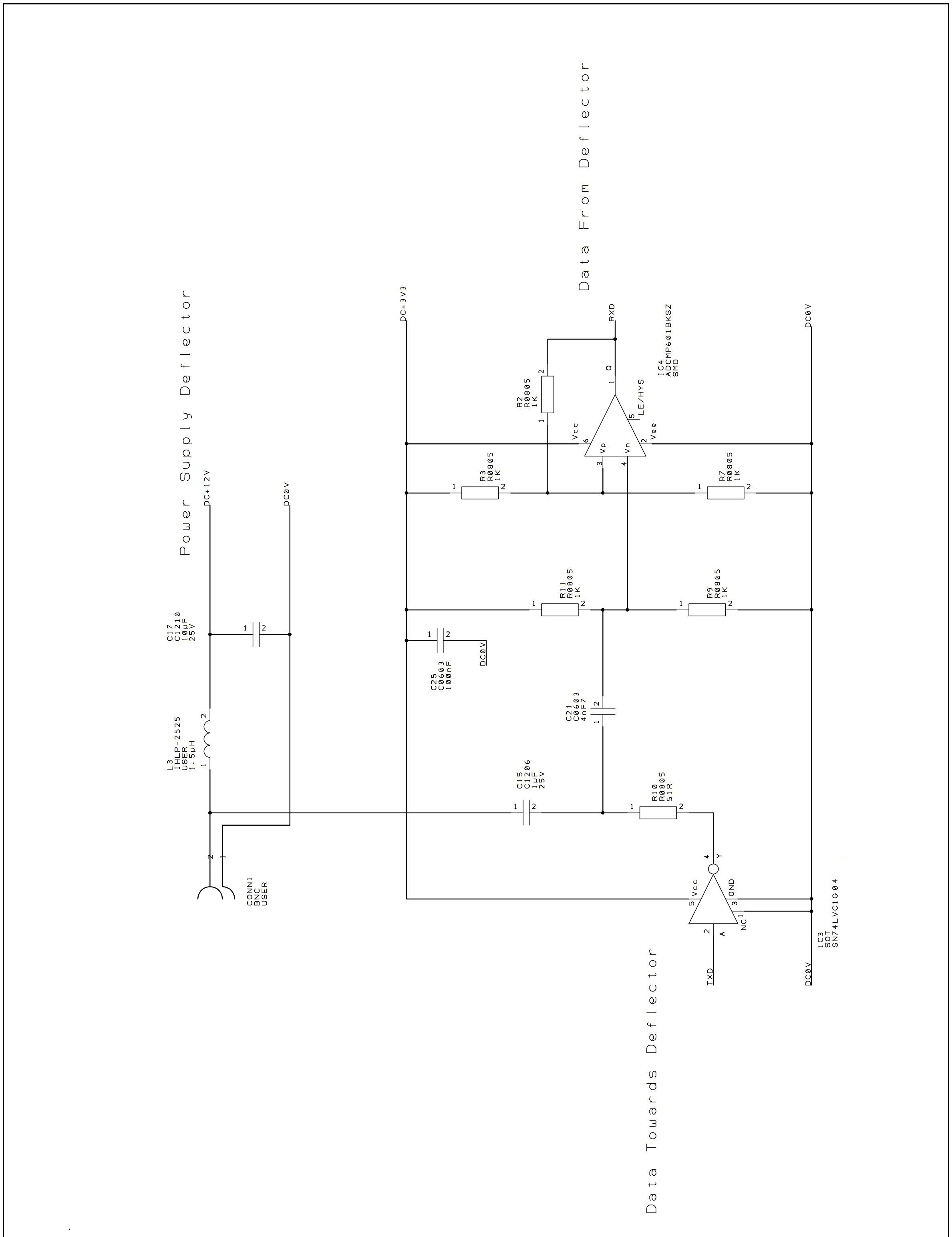
Fieldsize 46mm, JumpSpeed 3m/sec



Fieldsize 46mm, JumpSpeed 3m/sec

4 COMMUNICATION WITH THE SMART DEFLECTOR™

The communication with the Smart Deflector™ is done via the Coaxial Shared Data Power (SDP) Connection Protocol. The data send to the Smart Deflector™ needs to be modulated on the power supply. Following schematic shows how this should be done.



4.1 COMMUNICATION PROTOCOL

protocol:	UART
serial data:	START, B0, B1, B2, B3, B4, B5, B6, B7, DIR, STOP
baudrate:	10 Mbit/sec
START:	low
B0..B7:	command
DIR:	direction
STOP:	high

Bit START:

As every UART system, the Smart Deflector™ uses this start bit to synchronize its internal sample clock.
After sampling 10 bits the Smart Deflector™ will process the received command. When DIR bit is low, the received data will be ignored.

Bit DIR:

The coax connection supports half duplex serial operation.
The Smart Deflector™ only responds to received data wherein DIR bit is high.
When the Smart Deflector™ replies, the DIR bit will be low.

Bit 0..7: 8bit Data

Communication with the Smart Deflector™ is mainly for controlling its set point. The set point is the desired position of the mirror or lens. For bandwidth and safety reasons, the set point can't be set directly. The communication link to the Smart Deflector™ only allows relative settings of the set point. When the Smart Deflector™ receives a byte, its content is added to his current set point. The Smart Deflector™ thereby performs a µstep. The valid size of a µstep is limited to the range -111 to 111. All values outside this range are interpreted by the deflector as system commands, not as µstep commands.

System commands

-128...-112:	reserved (1)
-111...111:	µstep (delta set point) replies delta actual or delta set point, adds delta set point to set point
112:	read actual position replies actual position B15..B8 preloads BYTE2 with actual position B7..B0
113:	read BYTE2 replies BYTE2
114:	reserved (1)
115:	read set point position replies set point B15..B8, preloads BYTE2 with set point B7..B0
116:	reserved (1)
117:	switch off Smart Deflector™ replies 0
118:	read software version replies software version
119:	replies 0
120..124:	reserved (1)
125:	switch on deflector in mode 1 (2)

	replies 125 when succesfull
126:	switch on deflector in mode 2 (2)
	replies 126 when succesfull
127:	reserved (1)

(1) reserved functions are used by the rhothor™ tuning and configuration software. DO NOT CALL THESE FUNCTIONS.

(2) When turned on, the Smart Deflector™ can operate in 2 modes.

mode 1:	the Smart Deflector™ replies a µstep command with delta actual position
mode 2:	the Smart Deflector™ replies a µstep command with delta set point (echo mode).

In mode 1, it is possible to keep a live track of the actual position. Mode 2 allows error control on the communication link with the Smart Deflector™.

Bit STOP:

As every UART system, the Smart Deflector™ needs a stop bit to terminate the message.

4.2 Smart Deflector™ command processing

After reception of a valid command, the Smart Deflector™ will process it and start his reply within 500 nsec. To avoid overloading the command processor inside the Smart Deflector™, the time between different commands must be at least 5 µsec.

The maximal speed whereby the set point can be changed, equals:

max speed	=	max size µstep * max command frequency
	=	111 bit * 200 KHz
	=	22.2 Mbit/sec

eg. if fieldsize equals 100 mm for 65536 bits, the max steering speed equals 100*22.2M/65536 or 33.9 m/sec.

4.3 Smart Deflector™ Power up cycle

When the deflector is powered, its regulator is booted and 1 msec later the amplifier is switched on. After the boot cycle, the Smart Deflector™ transmits value 204. This is done to preset the schmitt triggers in the modulation electronics. To avoid communication collision, the controlling electronics should wait until this byte is received. The amplifier of the Smart Deflector™ is switched on 1 msec later making the Smart Deflector™ ready to be used.

4.4 Reference the Smart Deflector™

After the power-up cycle, the Smart Deflector™ needs to be referenced. To reference the Smart Deflector™ it's necessary to obtain the value of the currently stored setpoint within the Smart Deflector™.

Use the following command sequence to fetch the current setpoint.

step 1:	send 125/126 to Smart Deflector™ (mode 1/2)
step 2:	verify reply Smart Deflector™,
	if reply is not 125/126, go back to step1
step 3:	send 115 to Smart Deflector™,
	the Smart Deflector™ replies with high byte setpoint b15..b8

step 4: send 113 to deflector,
the Smart Deflector™ replies with low byte setpoint b7..b0

At this point you have a full 16 bit copy of the setpoint that is currently stored in the regulator of the deflector.
Calculate the displacement between the current and the desired setpoint. Divide this displacement vector into µsteps and send them to the deflector. The division into µsteps depends on the desired speed of the move. In any case the µstep must lie within -111 and 111 otherwise they will be interpreted by the deflector as commands.

4.5 Using the Smart Deflector™ with live actual position tracking

step 1:	send 125 to Smart Deflector™ (mode 1)
step 2:	verify reply Smart Deflector™ if reply isn't 125, go back to step1
step 3:	send 115 to Smart Deflector™ the Smart Deflector™ replies with set point b15..b8
step 4:	send 113 to Smart Deflector™ the Smart Deflector™ replies with low byte setpoint b7..b0
step 5:	send 112 to Smart Deflector™, the Smart Deflector™ replies with actual position b15..b8
step 6:	send 113 to deflector the Smart Deflector™ replies with low byte actual position b7..b0

At this point you have a full 16 bit copy of the setpoint and the actual position of the Smart Deflector™.

Changing the setpoint of the Smart Deflector™ is done by sending µstep commands to the Smart Deflector™. Keeping track of the Smart Deflector™'s actual position is done by adding the replies to your copy of the actual position.

4.6 Using the Smart Deflector™ with error control on the data link

step 1:	send 126 to Smart Deflector™ (mode 2)
step 2:	verify reply Smart Deflector™, if reply isn't 126 go back to step1
step 3:	send 115 to Smart Deflector™, the Smart Deflector™ replies with set point b15..b8
step 4:	send 113 to Smart Deflector™, the Smart Deflector™ replies with low byte setpoint b7..b0
step 5:	send 115 to Smart Deflector™, the Smart Deflector™ replies with set point b15..b8
step 6:	send 113 to Smart Deflector™, the Smart Deflector™ replies with low byte setpoint b7..b0

Step 5 and 6 are optional. However they give the advantage of a double read of the setpoint. The reply of step 3/4 and step 5/6 should be the same. If not you can fetch the setpoint again.

Changing the set point is done by sending µstep commands to the Smart Deflector™. The Smart Deflector™ replies by echoing those deltas. By keeping track of those echo's the integrity of the command flow to the Smart Deflector™ can be verified. If an echo is different from its command, the set point should be fetched again from the Smart Deflector™.

4.7 SET POINT RANGE

After referencing the deflector, it's setpoint can be set by sending offset vectors to the deflector. The setpoint can be controlled over the entire 16 bit range. The control board should always keep track of the deflectors setpoint using a local integrator. If the setpoint inside the deflector overflows, the deflector is switched off as a protection mechanism.