

- Automatic frequency control module for Magnetron or Klystron-driven LINACs
- Forms two output signals AFCA and AFCB from forward and reflected RF signal
- Error signal AFC B – AFC A acts in proportion to the phase difference of the RF input signals
- Electronic phase shifter to adjust the phase relationship between the RF signals
- Compact design
- RoHS compliant

## Product Characteristics

### Characteristics

#### RF Signals

- |                                       |                        |
|---------------------------------------|------------------------|
| ■ Center Frequency $f_0$              | 2998 MHz               |
| ■ Bandwidth $\Delta f$                | $\pm 10$ MHz           |
| ■ Forward Peak Power (FWD and REF)    | +38 dBm max.           |
| ■ Forward Average Power (FWD and REF) | +20 dBm max.           |
| ■ Pulse Width                         | 4 to 5 $\mu$ s typical |
| ■ Suppression of Second Harmonic      | > 30 dB                |

#### Output signals

- |                                      |   |
|--------------------------------------|---|
| ■ AFC A and AFC B                    | +3.75 V $\pm$ 0.75 V *                        |
| ■ Matching of AFC A and AFC B within | 10% max.                                      |
| ■ Error Voltage AFC B – AFC A        | 6.5 V $\pm$ 1 V ** (peak-to-peak), see Fig. 2 |

#### Phase Control

- |                                    |   |
|------------------------------------|---|
| ■ Phase Shifting Range             | 400 deg min.                              |
| ■ Phase Control Voltage $V_{ctrl}$ | 0 V to 13 V (<1 mA), 15 V max.            |
| ■ Phase-Voltage Sensitivity        | approx. +35 deg/V, see Fig. 3 for details |

#### Bias Voltage

+24 VDC (50..60 mA typical)

#### Mechanical Data

- |                          |                              |
|--------------------------|------------------------------|
| ■ Dimensions             | 131 mm x 96 mm x 27 mm       |
| ■ Weight                 | 420 g $\pm$ 10%              |
| ■ Mounting holes/threads | 4x M4, see footprint drawing |

#### Ambient Temperature Range

- |             |                |
|-------------|----------------|
| ■ Operating | +15°C to +50°C |
| ■ Storage   | -40°C to +80°C |

### Interfaces

#### Signals

- |                          |                                   |
|--------------------------|-----------------------------------|
| ■ RF Forward Power (FWD) | SMA female connector, 50 $\Omega$ |
| ■ RF Reverse Power (REF) | SMA female connector, 50 $\Omega$ |
| ■ AFC A                  | SMA female connector              |
| ■ AFC B                  | SMA female connector              |

#### Bias and Control Voltage

- |                  |  |
|------------------|--|
| ■ Connector type | ODU MINI-SNAP Series L Size 6.5mm<br>3-pin, female, see Fig. 4 for pin assignment  |
| ■ Accessories    | 1x mating connector (male),<br>for cable assembly instructions see doc. P000191886 |

#### Footprint Drawing No.

**3-122607-FP**

**Conformity**

CE, RoHS

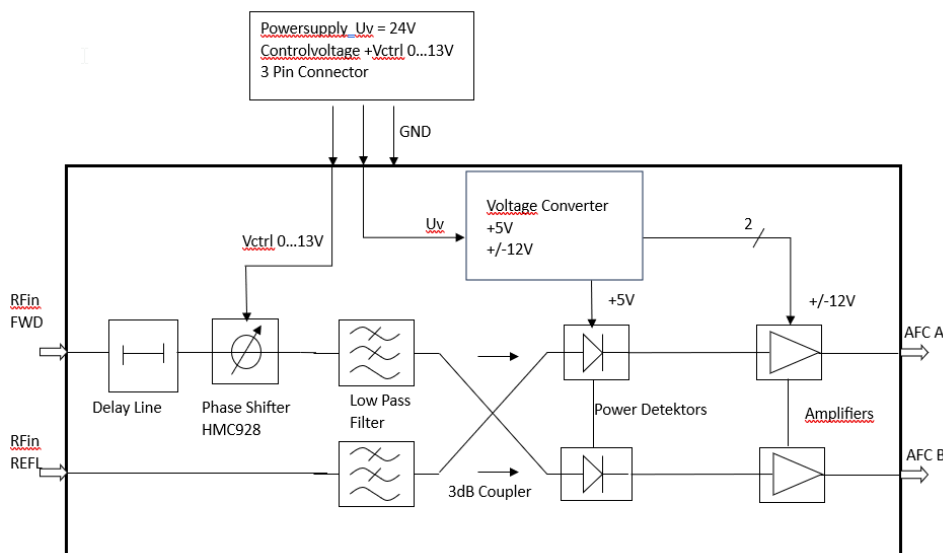
**Replacement for**

eAFC-2998-02

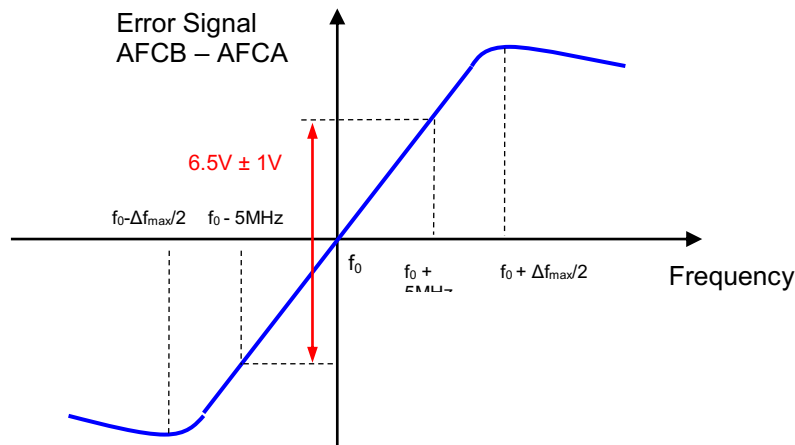
**Notes:**

- \* for  $P_{FWD} = 4W$  and  $P_{REF} = 0W$  or  $P_{FWD} = 0W$  and  $P_{REF} = 4W$ ,  
 $\Delta f = \pm 5$  MHz, both AFC A and AFC B terminated with 2 k $\Omega$  loads each
- \*\* for  $P_{FWD} = P_{REF} = 4W$ ,  $\Delta f = \pm 5$  MHz, both AFC A and AFC B terminated with 2 k $\Omega$  loads each

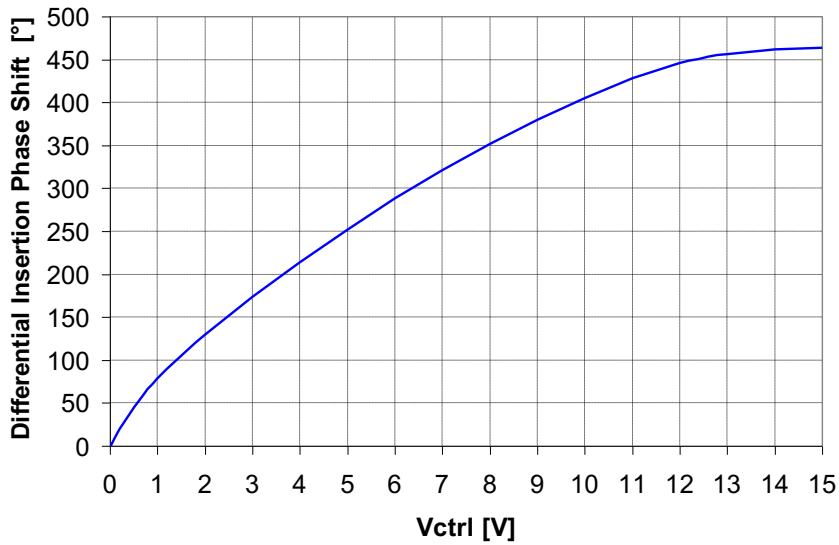
The AFC (Automatic Frequency Control) circuit module is a key component within a feedback control loop of linear accelerator (LINAC) systems. It provides a control signal for the frequency tuning of a magnetron at the resonant frequency of the accelerator cavity. A compact microwave integrated circuit processes the RF forward (FWD) and reflected (REF) signal picked up between magnetron and accelerator cavity. As illustrated in Fig. 1, the module generates two output signals AFC A and AFC B. The differential error signal AFC B – AFC A acts in proportion to the phase difference of the two RF input signals. It forms a reliable control variable, which is used for a frequency tuning of the magnetron at the resonant frequency of the accelerator. The AFC provides an electronically tunable RF phase shifter. The purpose of this phase shifter is to set the phase relationship between the FWD and REFL signal such that the AFC allows for equal frequency correction on both side of the resonance frequency.



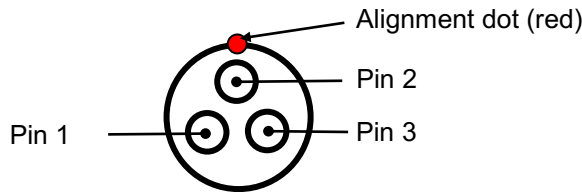
**Fig. 1: Block diagram of the AFC circuit**



**Fig. 2: Typical AFC error curve**



**Fig. 3:** Typical phase shift vs. control voltage Vctrl at room temperature



Pin	Description	Voltage Range
1	Bias	+24 VDC
2	GND	----
3	Vctrl	0 V to +13 V

**Fig. 4:** Pin assingment of the eAFC connector for bias and control voltage. The figure shows a frontal view of the female connector on the housing side.

**Handling & Operating Instructions**

- (1) This device contains ESD sensitive components such as an RF phase shifter, RF detector diodes and ICs. Handle the device with care in order to avoid any static discharge to all pins and connectors. The ESD rating of pins Vctrl and Bias is class 3 (up to 16kV) according to human body model ESD STM5.1-2007.
- (2) Do not exceed the max. allowed RF input power.
- (3) Do not exceed the rated bias supply voltages.
- (4) Faulty wiring of the connecting cable could cause damage to the device.



Rev.	Remark	Date	Name
00	Initial	09.07.2020	C. Weil
	Formal update	31.03.2022	C. Weil
	Update Block diagram	19.12.2023	J. Schwarzhorn