EQUIPMENT DESCRIPTION

PCS 1900 BOOSTER

SINGLE FEED - SINGLE ANTENNA

SYSTEM PRODUCT SPECIFICATION

Airtech

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HISTORY

DATE	ISSUE	AUTHOR	ISSUE NOTE	NOTES
03/02/98	Issue A	R S Manku	5000-211	Original
16/03/98	Issue 1	R S Manku / E. Yearby	5000-260	Changed Title. Technical Specification changed to apply to SF-SA type only.
19Jan99	Issue 2	R S Manku / E.Yearby	5000-492	Deleted 40 Watt Option. Updated section 2.5
10Mar99	Issue 3	R S Manku / E.Yearby	MI-0115?	Added Transmit and Receive Path Output IP3
13Apr99	Issue 4	R S Manku / E.Yearby	MI-0179	Called Product Specification. Updated Sections 2.5, 2.9, 3.4,3.6 3.7. Re-introduced HPA bypass as an option. Interface drawings added.

CONTENTS

1. TECHNICAL SUMMARY

This document defines the system requirements for a Single Feed Single Antenna PCS 1900 Booster. The system consists of a high power amplifier and a bandpass filter in the transmit path and bandpass / lowpass filters and a Low Noise Amplifier in the receive path. The system shall be designed to deliver single carrier Tx nominal gain of 12 dB with a maximum output of +43 dBm (20 W). The nominal gain of Rx shall be 22 dB. The system shall be housed in a compact low volume, lightweight IP68 enclosure. This product is designed to extend coverage, increase traffic and improve the quality of the signal within a network cell. The unit shall be convection cooled.

Figure 1 shows a block diagram of a Single Feed Single Antenna (SF-SA) PCS 1900 Booster.

This system is connected to the BTS via a common cable for receive and transmit signals, and to a common transmit / receive antenna.

As an option, the Booster shall provide a by-pass of the HPA in the transmit section as shown on figure 2, which shall be enabled if the HPA fails. By-pass of the LNA in the receive section shall be a standard configuration, which shall be enabled if the LNA fails

The Booster shall be designed to operate over the entire PCS band, but the filters optimized to pass only a 15 MHz band (e.g. A, B, C band). The unit shall be designed to mount on a mast (pole) or a wall and integrated with a customer provided sector antenna. A Solar Shield shall be included to provide protection against direct Sun Radiation.

A low pass filter and a variable attenuator at the output of the Low Noise Amplifier shall form an integral part of the LNA tile. The functional status of the LNA shall be monitored, e.g. current drawn by the LNA, and a low loss bypass switch shall be incorporated to provide failure mode operation.

An isolator, a VSWR monitoring circuit at the output and a variable attenuator at the input shall form an integral part of the HPA tile. Couplers at the input and the output of the HPA shall be used to monitor the input signal level and the level of the reflected signal at the output port. The Booster shall be designed to ensure good thermal stability.

The Booster unit shall also include voltage regulators to provide the required voltage to the amplifiers and to account for any voltage drop across the feeder cables which transmit DC power from the Power Distribution Unit (PDU) at the BTS to the Booster unit. The DC power shall be transmitted via the RF feeder cable using Bias Tees to couple the DC power onto the RF cables. The Bias Tees shall also provide protection against a lightning strike.

A serial data interface shall be used to monitor the status of the amplifiers, and display on the PDU at the base. The data interface system may also be used to transmit commands from the BTS to adjust the variable attenuators within the Booster Unit. The serial data signals shall be coupled onto the RF feeder cable via the Bias Tees used for coupling the DC power.

The Booster unit shall have 7/16 RF connectors for the antenna and the RF feeder cable connections. An earth stud shall be provided to connect earth strap between the unit and the mast (ground).

2. ELECTRICAL REQUIREMENTS

2.1. Definitions

BTS	Base Transceiver Station
ANT	Antenna
Tx	Transmit
Rx	Receive
LNA	Low Noise Amplifier
HPA	High Power Amplifier
VSWR	Voltage Standing Wave Ratio
BTS Port	Base Station Connector on the Booster
ANT Port	Antenna Connector on the Booster
LPF	Low Pass Filter
PDU	Power Distribution Unit

2.2. Frequency Range

Transmit Band	1930 - 1990 MHz
Receive Band	1850 - 1910 MHz

2.3. Operating Bandwidth

Transmit Band	15 MHz
Receive Band	15 MHz

2.4. Filter Isolation

Measured at ANT port:

Provided by Tx filter to Rx frequency band	> 85 dB
Provided by Rx filter to Tx frequency band	> 80 dB

Measured at BTS port:

Provided by Tx filter to Rx frequency band	> 45 dB
Provided by Rx filter to Tx frequency band	> 80 dB

2.5. Spurious Output from High Power Amplifier Measured at ANT port

Spurious Emissions at the Antenna port with Booster operated at full rated power shall not exceed the following levels (ETSI 11.21) measured in the stated resolution bandwidth.

Frequency Band	Level	Offset	Resolution BW
Up to 1000 MHz	-36 dBm		100 kHz
880 – 960 MHz	-98 dBm		100 kHz
925 – 960 MHz	-57 dBm		100 kHz
1850 –1910 MHz	-120 dBm		100 kHz
1930 - 1990 MHz	-36 dBm	>1.8 – 6.0 MHz from carrier	100 kHz
1000 MHz – 12.75 GHz (outside Tx band)	-30 dBm	(from TX band edge) ≥2 MHz ≥5 MHz ≥10 MHz ≥20 MHz ≥30 MHz	 30 kHz 100 kHz 300 kHz 1 MHz 3 MHz
Broadband Noise	-70 dBc or –36 dBm which ever is the higher	>6 MHz to Tx band edge	100 kHz

2.6. Out of band Gain Reduction

Measured from ANT port to BTS port.

100 kHz - 1825 MHz	> 15 dBc
1935 MHz - 12.75 GHz	> 15 dBc

2.7. Bypass Condition Insertion Loss

Rx band	<2.4 dB
Tx band	<2.3 dB

2.8. Noise Figure

Rx Band over temperature range -40 to +55 °C	2.0 dB (at maximum gain setting)
Typical Value at +25 °C	1.8 dB (at maximum gain setting)

2.9. Transmit Path Gain

BTS to ANT port, any 15 MHz band in range 1930 - 1990 MHz

Nominal Gain	12 dB ± 1 dB
Variation with temperature -40 to +55°C	± 1.5 dB (at maximum output power)

2.10. Receive Path Gain

ANT to BTS port, any 15 MHz band in range 1850 - 1910 MHz

Nominal Gain	22 dB ± 0.5 dB

Variation with temperature -40 to +55°C	± 1.5 dB

2.11. Variable Gain Adjustment

Transmit path	2 - 12 dB in 1±0.5 dB steps
Receive path	7 - 22 dB in 1±0.5 dB steps

2.12. Output 1 dB Compression Point

Transmit Output 1 dB Compression	≥ +44 dBm
Receive Output 1 dB Compression	≥ +10 dBm

2.13. Output IP3

Transmit Output IP3	≥ +54 dBm
Receive Output IP3	≥ +20 dBm

2.14. Tx Dynamic Range

Dynamic Range of HPA	≥ 35 dB

2.15. Stability Under Different Load Conditions

Both the Tx and Rx paths shall remain stable under the worst case match condition of 10:1

2.16. Maximum Input No Oscillation

The maximum signal that can be tolerated by the LNA in the Rx band at the ANT port without causing the LNA to oscillate shall be +10 dBm.

The maximum signal that can be tolerated by the HPA in the Tx band at the BTS port without causing the HPA to oscillate shall be +38 dBm.

2.17. Maximum Survivable Input

The maximum signal that can be tolerated by the LNA in the Rx band at the ANT port without causing damage to the LNA shall be +20 dBm.

The maximum signal that can be tolerated by the HPA in the Tx band at the BTS port without causing damage to the HPA shall be +42 dBm single carrier input .

2.18. Intermodulation Products at ANT Port

Two carriers in the band 1930 - 1990 MHz, the forward wanted signal at a maximum rated output power and the interfering signal at a power level 30 dB below the wanted signal output power into the ANT port. The frequency of the interfering signal to be chosen such that the 5^{th} order intermodulation product with the wanted forward signal falls in the 15 MHz receive band corresponding to the 15 MHz transmit band.

Intermodulation Band	Intermodulation Level	Measurement BW
15 MHz operating band in 1850 - 1910 MHz	-120 dBm	300 kHz

2.19. Intermodulation Products at BTS Port

Two Signals in the band 1850 - 1910 MHz at a power level of -49 dBm into ANT Port. The frequency of the interfering signal to be chosen such that the 3rd order intermodulation product with the main receive signal falls in the 15 MHz receive band.

Intermodulation Band	Intermodulation Level	Measurement BW
15 MHz operating band in 1850 - 1910 MHz	-120 dBm	300 kHz

2.20. Return Loss

ANT and BTS Ports	Return Loss*
Rx Operating Band	≥ 18 dB
Tx Operating Band	≥ 18 dB
Bypass mode Tx band (option) and Rx band	≥ 16 dB

- Reference to 50 Ω

3. DC POWER

3.1. Booster input supply voltage

+28V to 30.25 V DC

3.2. Power Consumption

182 watts max. made up of: 6 A @ 30.25VDC

3.3. Power Supply Interface

Coupled via Bias Tee

3.4. Booster Power Supply Distribution Unit (PDU)

The DC to the Booster shall be provided from Airtech Power Distribution Unit is enclosed in a weatherproofed enclosure. The PDU also monitors alarms and provides gain controls. The PDU is specified in the PDU Specification No. 98DS0004.

As an option the PDU can supply DC power to six Boosters.

3.5. Lightning Protection

The lightning protection is implemented on the Bias Tee circuit board at the BTS port and by direct tap on the filter at the Antenna port. It is based on IEC 801-5, embodied by BS EN6100-4-5.
The Booster is designed to withstand a lightning pulse of 20 kA, pulse shape 8/20 µs.

3.6. Alarms

Alarms from the Booster shall be provided on the PDU via a Bias Tee using serial data interface.

These alarms cover the following :

LNA current out of range (partial failure indicated)
LNA current out of range (bypass activated)
HPA temperature out of range – Transmit gain reduced and alarm raised
HPA current out of range - alarm raised and bypass activated (option)
Transmit path over-gain – Transmit gain reduced and alarm raised
Reverse power out of limit - alarm raised

Alarms on the PDU can be classified to provide ‘fatal / non-fatal’ signals at the BTS.

3.7. Alarm Limits

HPA heatsink temperature limit	as required for the HPA
Reverse power	> +36 dBm (±1dB)
Excess Gain in Tx path	Output power >+44 dBm (±0.5dB)

4. APPROVALS AND REGULATORY ISSUES

4.1. Electromagnetic Compatibility

The equipment is fully compliant with the following European Community requirements.

European EMC directives 89/336/EEC and 92/31/EEC for both spurious emissions and immunity.

European Telecommunications Standard ETS 300 342-2 (-3)

4.2. Environmental Specifications

The equipment is fully compliant with the following specifications of the European Telecommunications Standards.

Operational Conditions	Class 4.1, ETS 300 019-1-4
Transportation Conditions	Class 2.3, ETS 300 019-1-2
Storage Conditions	Class 1.2, ETS 300 019-1-1

5. ENVIRONMENTAL REQUIREMENTS

5.1. Operating Conditions

The Booster operates satisfactorily under the following external climatic conditions:

Environmental Condition	Value
Air Temperature	-40 °C to +55 °C
Relative Humidity	5 to 95 %
Absolute Humidity	1 to 29 g/m³
Rate of Change of temperature	0.5°C / min.
Air Pressure	70 to 106 KPa
Solar Radiation	1120 W/m²

5.2. Storage and Transportation Conditions

Environmental Condition	Value
Air Temperature	-40 °C to +70 °C
Relative Humidity	8 to 100 %
Absolute Humidity	0.03 to 60 g/m³
Rate of Change of temperature	0.5°C / min.
Air Pressure	70 to 106 KPa
Solar Radiation	1120 W/m²

5.3. Vibration

The Booster conforms to BS2011 part 2.1, sections Ea, Eb and Fc - Corresponding IEC publication.

5.3.1. Operational Conditions

Vibration Test:

Parameter	Frequency Range	Severity (3 Axes)		Duration
	(Hz)	(Disp) (mm)	(Accel) (m/s^2)	(ms)
Sinusoidal	5 - 9	3.5		3 x 5 sweep cycles
Sinusoidal	9 - 200		10	3 x 5 sweep cycles

Shock Test:

Parameter	Shock Spectrum	Severity		Duration
	(Hz)	(Accel) (m/s^2)	(No)	(ms)
Shock	Half Sine	100	500 (in each of 6 directions)	6

5.3.2. Transportation Conditions

Vibration Test:

Parameter	Frequency Range	Severity (3 Axes)		Duration
	(Hz)	(ASD) (m^2/s^3)	(Roll Off) (dB/oct)	
Random	5 - 20	0.96		3 x 10 mins
Sinusoidal	9 - 200		-3	3 x 10 mins

Shock Test:

Parameter	Shock Spectrum	Severity		Duration
	(Hz)	(Accel) (m/s^2)	(No)	(ms)
Shock ($m \leq 100$ Kg)	Half Sine	400 **OR:**	500 (in each of 6 directions) 1000 in normal attitude	6

Drop Test:

Parameter	Mass	Drop Height	No of Drops
	(Kg)	(m)	
Free Fall	50 - 100	0.3	1 on each face or 2 in normal attitude
Toppling	-	-	None

5.3.3. Enclosure Weatherproofing

The unit is weatherproofed (including connectors) to IP68 of the European Standard IEC 529.

6. RELIABILITY, MAINTAINABILITY

6.1. Reliability

The MTBF for the Booster, calculated using MIL HDBK 217F for Ground Benign Conditions at +25 °C, is 125,000 Hours. Reliability data from the manufactures was used for the power devices in the HPA and FETs in the LNA. The calculations took account of the fact that the electronics in the HPA section will operate at temperatures approximately 20°C higher than ambient.

6.2. Maintainability

The Mean Time To Replace (MTTR) the Booster is < 60 minutes.

7. MECHANICAL REQUIREMENTS

7.1. Volume

Parameter	Value
Output RF power	20 W
Volume	< 14.3 Liters

7.2 Dimensions (Including Heatsink)

Parameter	Value
Output RF power	20 W
Length	300 mm
Width	253 mm
Depth	190 mm

(**figures in brackets include fixings, brackets, handles etc)**

7.3. Weight

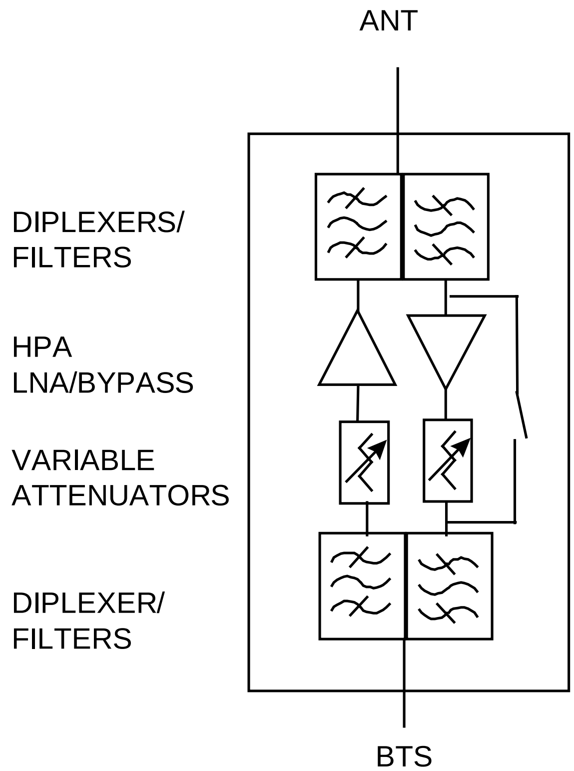
Parameter	Value
Output RF power	20 W
Weight	15 kg

8. INTERFACES

Connectors:

Parameter	Connector Type
RF Connectors ANT and BTS ports	7/16 Female

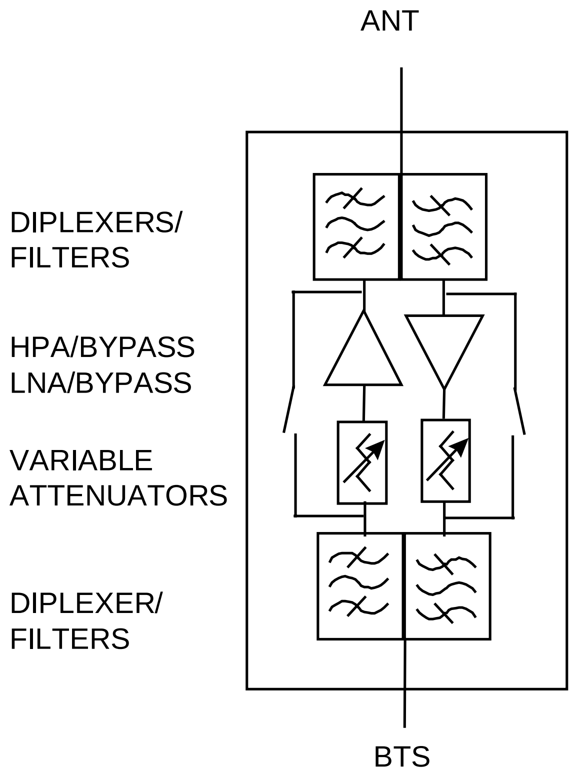
Figure 1 - FUNCTIONAL BLOCK DIAGRAM – WITHOUT Tx BYPASS



Single Feeds - Single Antenna

SF - SA

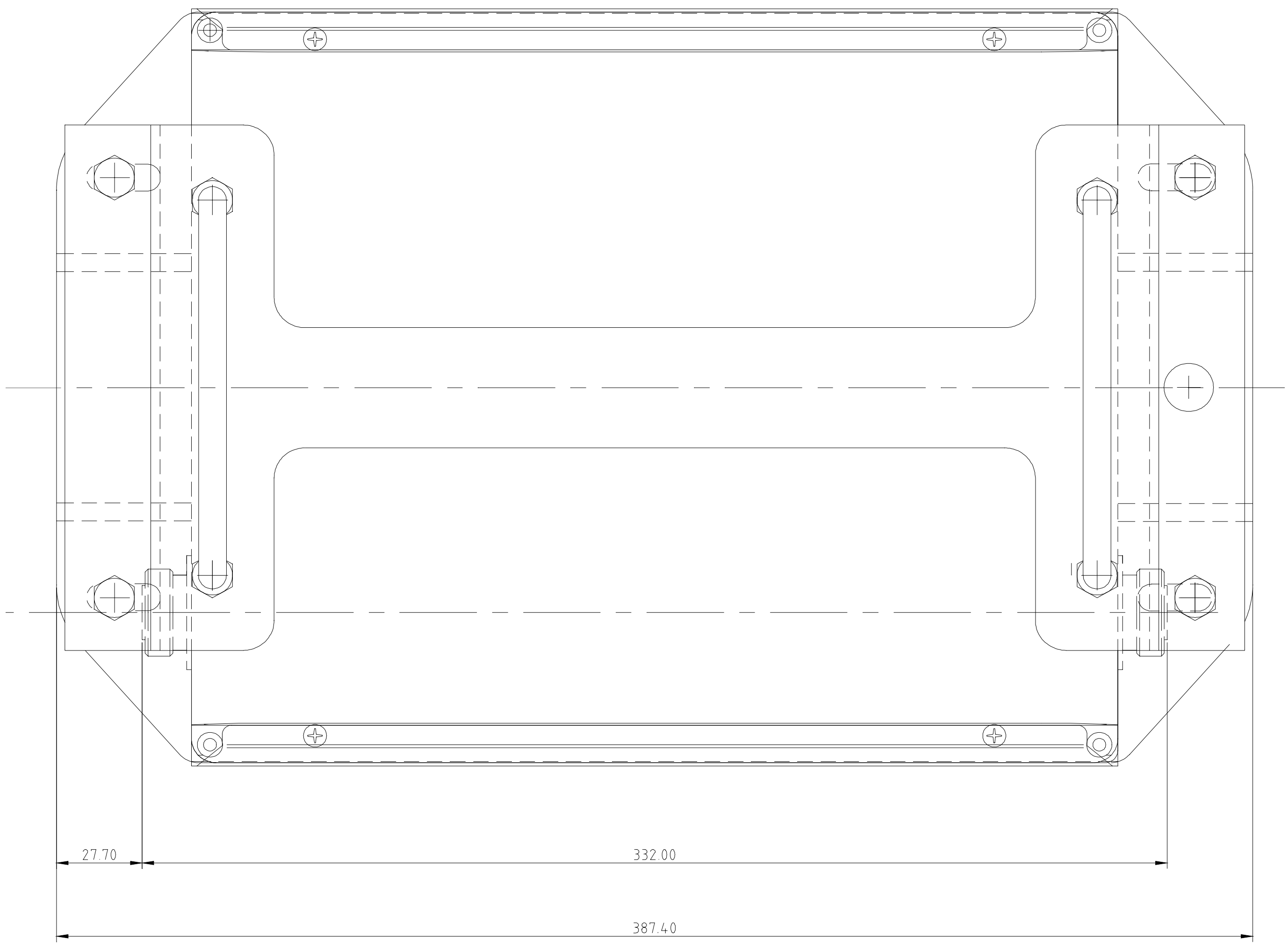
Figure 2 - FUNCTIONAL BLOCK DIAGRAM – WITH HPA BYPASS OPTION

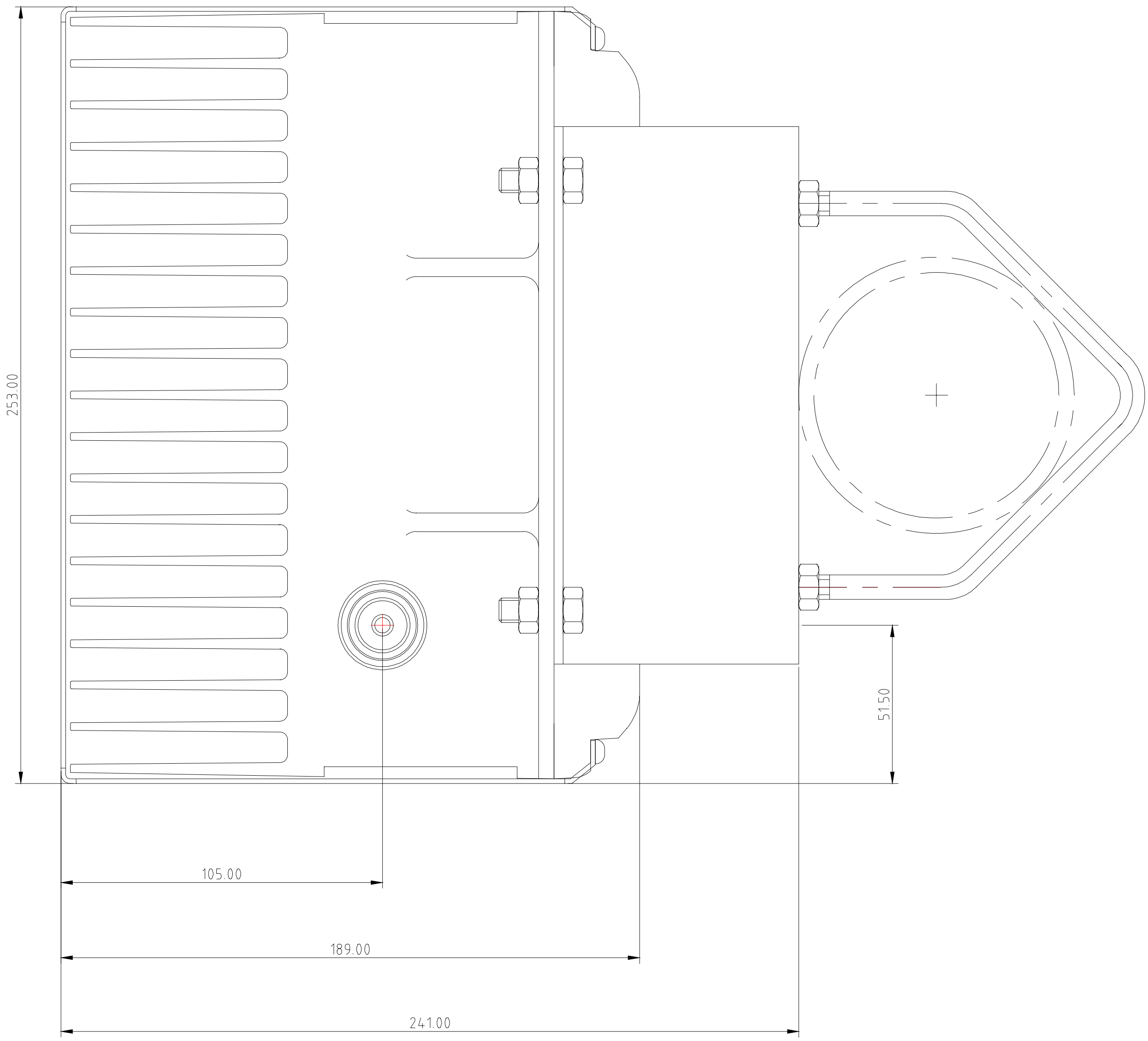


Single Feeds - Single Antenna

SF - SA

Figure 3 - INTERFACE CONTROL DRAWINGS

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