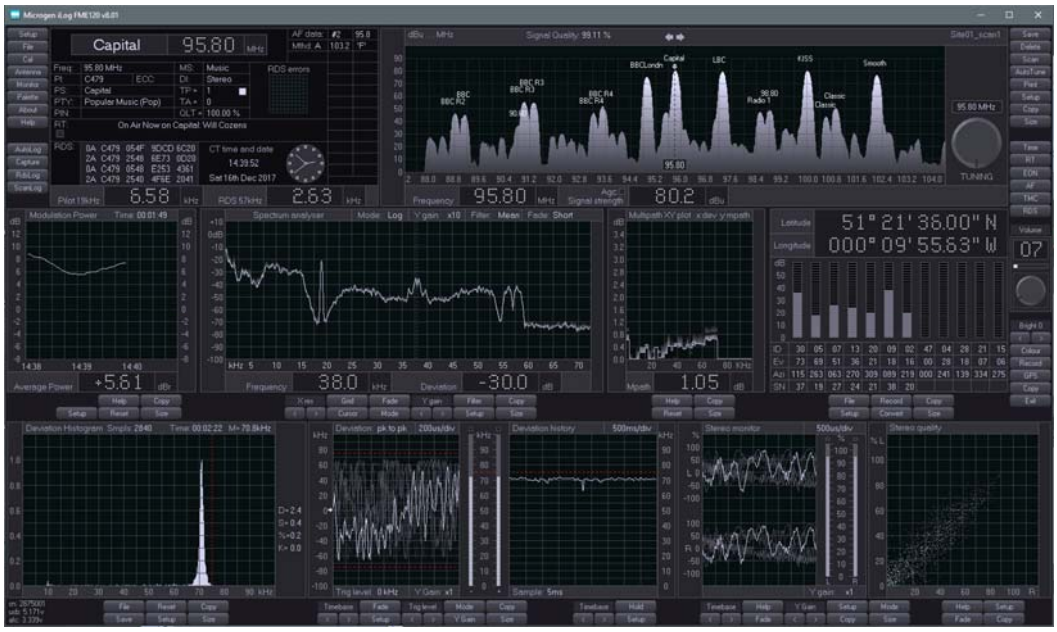
FME120

FM Modulation Analyser + AF Spectrum Analyser

FME120G + GPS receiver



2018 Technical specification Issue 1.1

microGen electronics ™

FME120

The FME120 FM Modulation and AF Spectrum Analyser, has been designed for precision monitoring of FM Radio Broadcasts. Connected to a standard Windows PC, via the USB port, the user friendly interface displays comprehensive modulation data, for live 'off-air' analysis.

FM Quadrature demodulator with DSP

A new quadrature detector, utilising Digital Signal Processing, to correct distortion has been specifically developed for this instrument. The positive and negative halves of the baseband signal are split, individually analysed and subsequently corrected for non-linearity. All measurements of deviation, modulation power, pilot level and RDS sub-carrier are referenced to this demodulator, as are any other baseband measurements made with the analyser.

FFT Spectrum Analyser

Unique to this class of product is a FFT Spectrum Analyser for precise FM baseband analysis. Covering 10Hz to 100kHz , it samples at 16 bit resolution, achieving a 100dB dynamic range. This can be extended to greater than 110dB with waveform averaging, allowing signals below noise to be observed and measured.

Dual A/D converters

Two precision A/D convertors are employed to digitise the incoming signal. A 16bit A/D is employed for the FM multiplex data and a 12bit A/D for digitising the signal strength.

Dual bandwidth IF filters Two IF filter bandwidths are provided on the FME120 model, providing wide and narrow bandwidths, to suit receiving conditions. The wideband filter response, promises low distortion with minimum overshoot. This filter allows for precise 'off-air' measurements, The narrow band filter consists of a three stage, individually selected, 4 pole ceramic filter networks, utilising low noise IF amplifier buffers. This offers the best balance between low distortion and selectivity.

Audio live monitoring The FM broadcast stereo audio is digitally routed to the host PC or laptop sound system. Allowing for high quality headphone or loudspeaker monitoring,

Software DSP stereo decoder with excellent phase matching between channels, with lower distortion and noise than traditional analogue types.

Stereo monitor with left and right channels shown on a time domain display. An additional 2D vector stereo quality display gives a visible guide to left and right channel behaviour.

Stereo blend of left and right channels can be set for automatic noise control for poor signals.

Multipath detection employs the high speed 12bit A/D convertor, allowing digital DSP filtering to extract the multipath distortion.

GPS logged data

The iLog software includes GPS decoding to the NMEA global standard. It will automatically scan the PC for any connected GPS NMEA compliant devices. GoogleEarth KML files are generated for GPS tagged field measurement.

Data logging

Extensive automatic logging of broadcast data with, remote control possible with simple text file commands allowing the unit to be controlled from 3rd party software.

Multiplex data recording and playback with full stereo audio monitoring using PC sound system. This feature records the raw USB data from the FME120 directly to hard disk. This can then be replayed at any time, giving a live 'off-air' monitor. A recording can be made from any frequency on the channel list and is only limited by the hard-disk size.

RDS decoding

Full RDS decoding is available, with live 'off-air' data recording.

10.7MHz IF input provides IF monitoring with the RF front-end shut down.

Antenna attenuator provides 10 and 20 dB attenuation. The attenuator can be individually assigned to each frequency on the channel list.

Broadcast monitoring

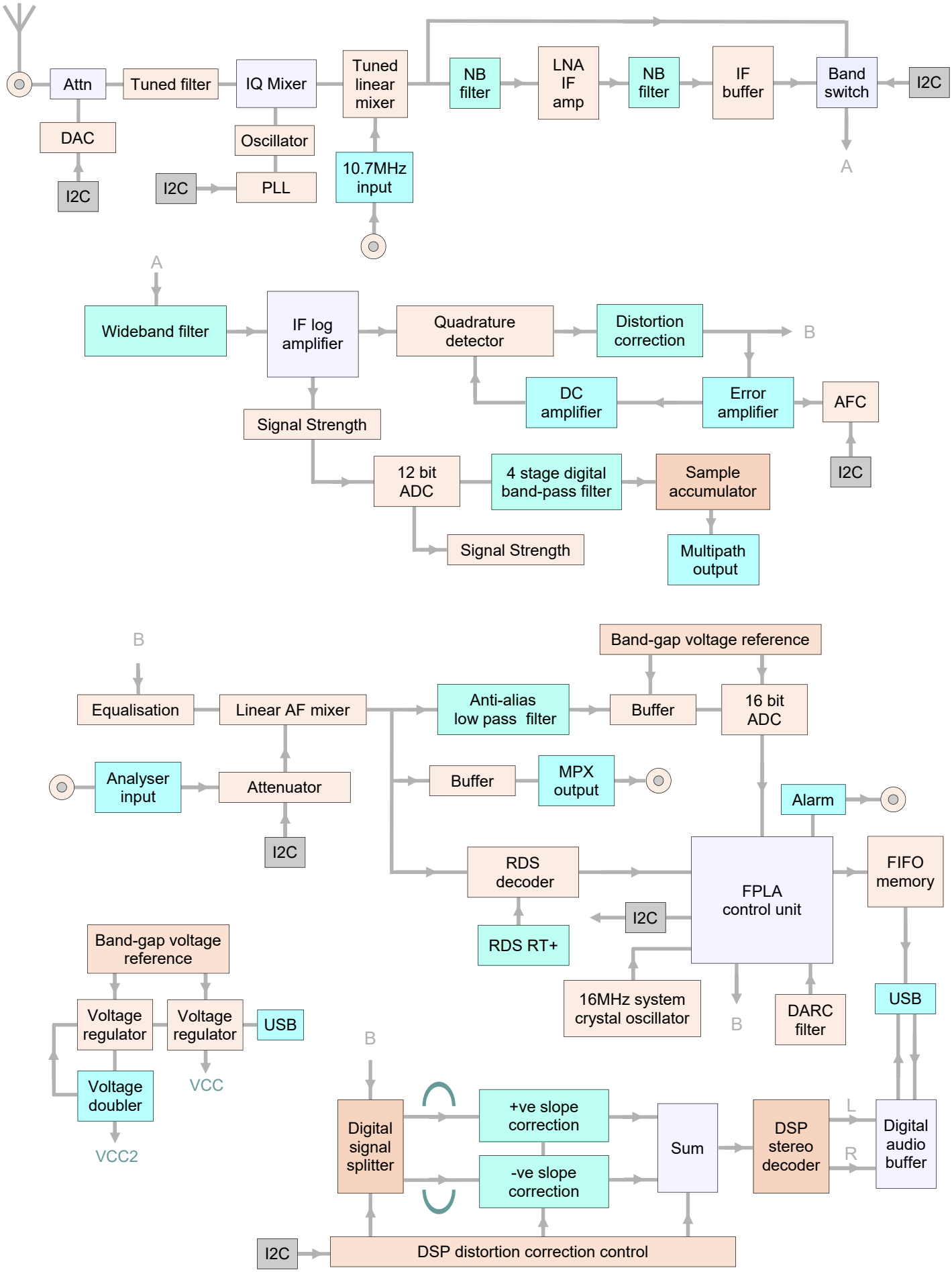
Housed in light weight aluminium, the double screened enclosure, which separates the RF analogue circuitry from the digital sampling and USB interface. This provides broadcast engineers, whether working on-site or as a mobile unit, with a high performance, reference class instrument.

USB powered no other power source is required. Running from a Laptop computer, provides for mobile monitoring and logging of radio broadcasts.

Windows iLog software is supplied with the unit, providing complete control and display of all measurements. This will run on a standard desktop or laptop PC. The iLog software is compatible Windows 7, Windows 8.0/8.1 and Windows10.


ANALYSER
MPX OUT
MICROGEN ELECTRONICS
FME120
0dBm
50ohm
FM MODULATION
SPECTRUM ANALYSER
ALARM

FME120 system diagram



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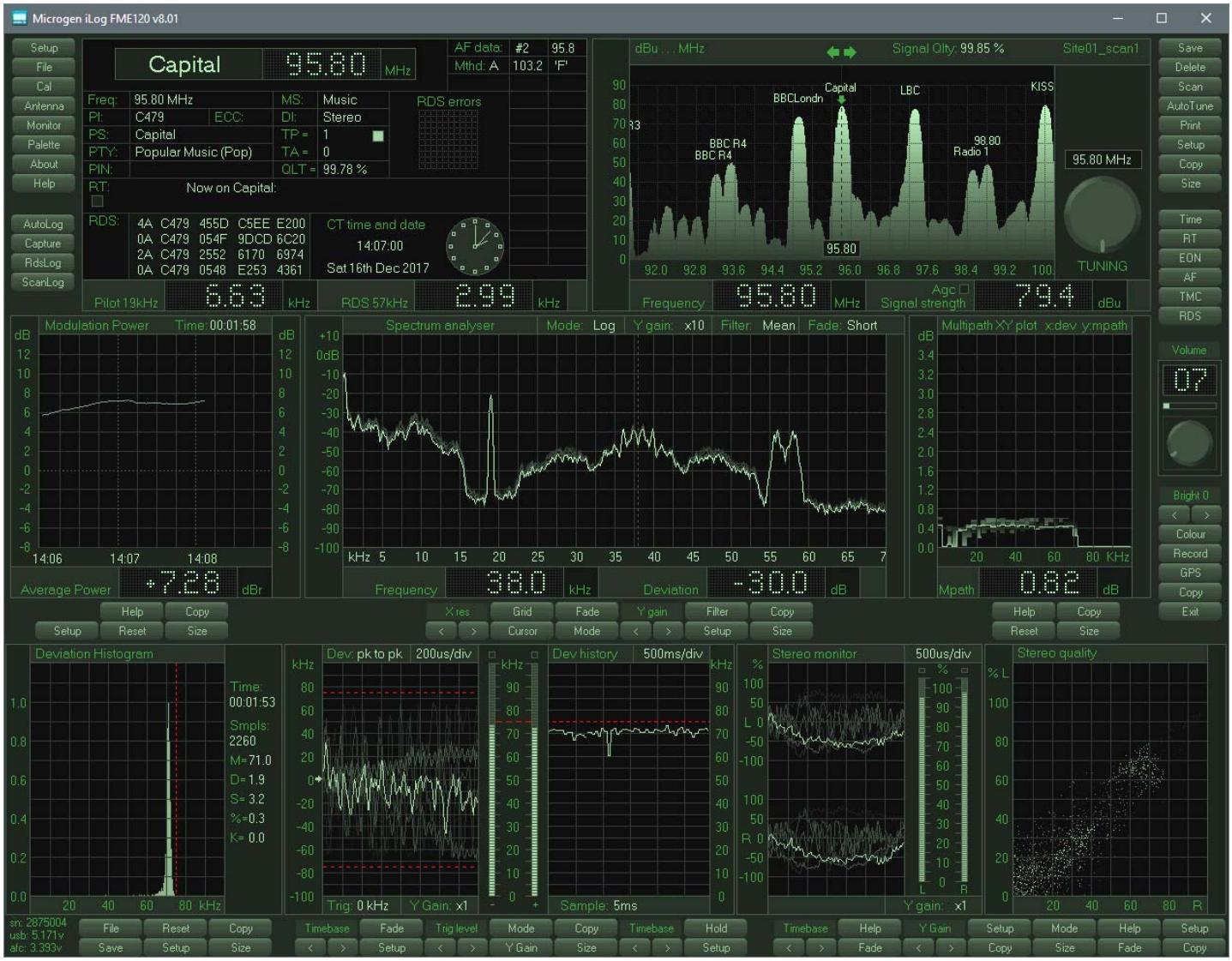
FME120
IF IN
ANTENNA
USB
MICROGEN
ELECTRONICS
50ohm
50ohm

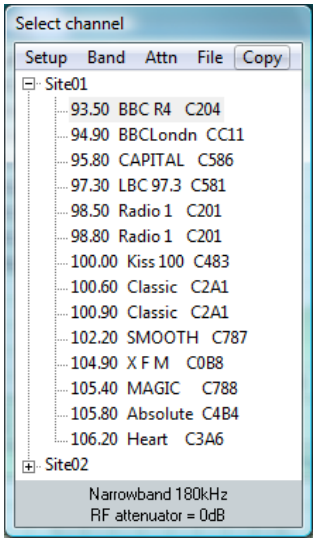
iLog Windows software

iLog application iLogV8 . . . screen dump at 1280 x 1024 screen resolution



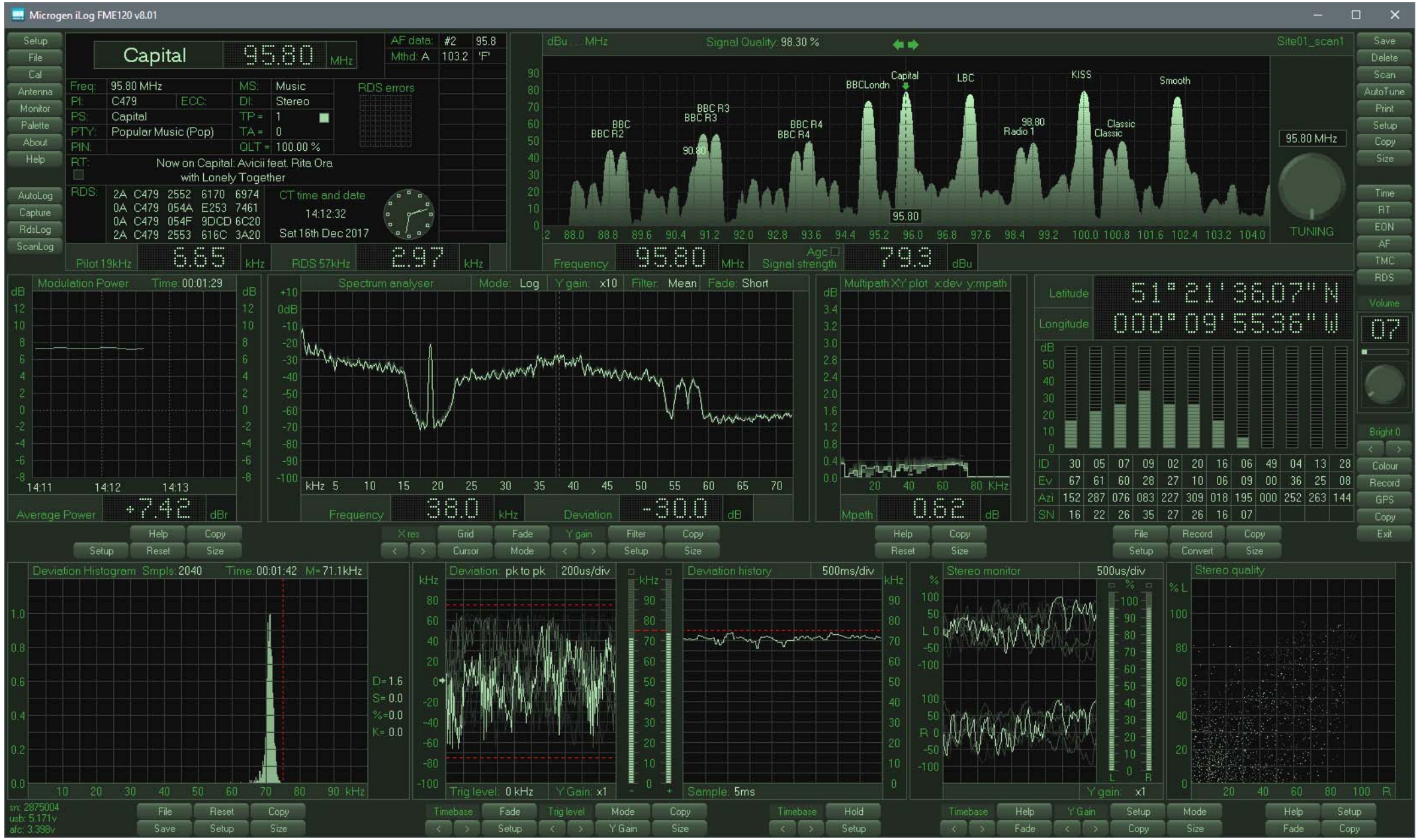
FM Modulation analyser features:

- High performance FM receiver and Modulation Analyser
- Signal strength 85dB range with frequency scanning
- FM deviation 0 to 100kHz with histogram
- Modulation Power calculated with 32bit floating-point precision
- Multipath XY plot
- Pilot 19kHz amplitude
- RDS 57kHz and DARC 76kHz sub-carrier amplitude
- Left and right channel decoding, with stereo quality vector readout
- Automatic logging of signal strength, pilot and RDS carrier
- Software remote control with simple text file commands
- I2C hardware remote control
- Stereo blend, user selectable for automatic noise reduction



RDS/RBDS decoder features:

- Full RDS/RBDS decoding, with signal quality readout.
- Decoded groups PI,PTY,PS,RT,CT,PIN,AF,TA,TP,DI,MS,EON
- RT messages saved to file
- RT+ decoding with Title and Artist automatically saved to file



iLog application iLogV8 . . . screen dump at 1680 x 1050 WSXGA screen resolution which includes GPS data

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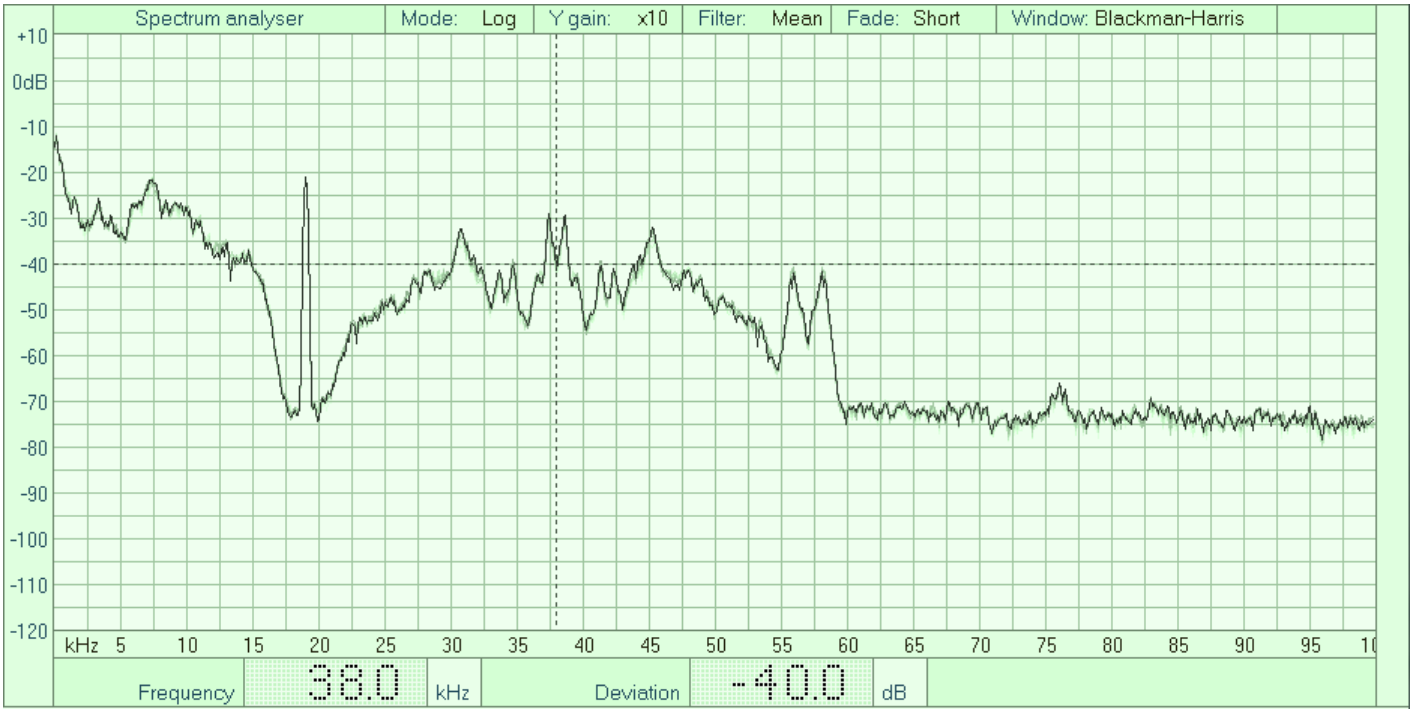
FFT Spectrum Analyser

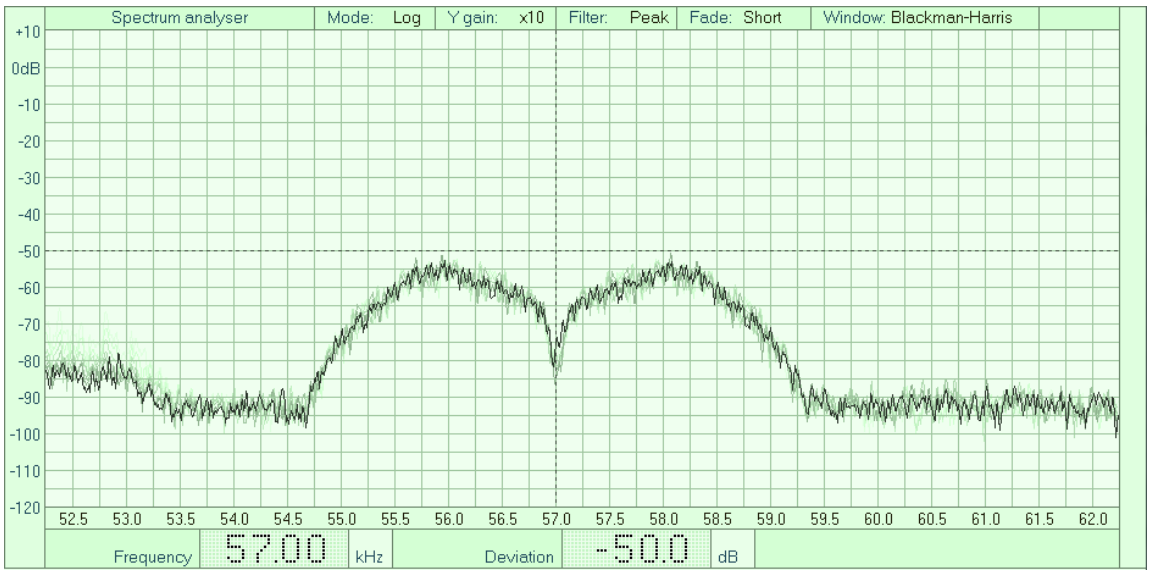
The FFT Spectrum Analyser, utilises the 16 bit data from a high quality SAR A/D convertor. Using 32bit calculations, and advanced signal processing, it is able to extract frequency detail well into the noise of the signal.

The A/D convertor is fed by a National Semiconductor LM49721 ultra low distortion buffer, via a computer optimised LC anti-alias filter. A software controlled passive input attenuator network, allows for scaling of the signal under measurement for greater flexibility. Any measurements taken can be cut and pasted into other applications. This high quality analyser can also be used as a general purpose AF spectrum analyser, over a bandwidth of 100kHz.

- Precision base-band FFT Spectrum Analyser covering 10Hz to 100kHz
- 16 bit sampling
- Maximum 16,000 point resolution
- Dynamic range of 100dB with a resolution of 20Hz
- Linear or logarithmic scale with full cursor measurement of frequency and amplitude
- Multiplex signal analysis
- External BNC multiplex analyser
- External BNC audio analyser



The FFT spectrum analyser, provides a valuable tool for examining the FM multiplex signal. The A/D converter has a very low spurious output, coupled with low distortion and noise. With signal averaging it is possible to detect signals below noise. This will extend range to greater than 110dB. Various sample windows can be applied, Hanning, Hamming, Blackman-Harris etc, providing versatile measurement.



The spectrum, shown left, details just the FM broadcast 57KHz RDS sub-carrier.

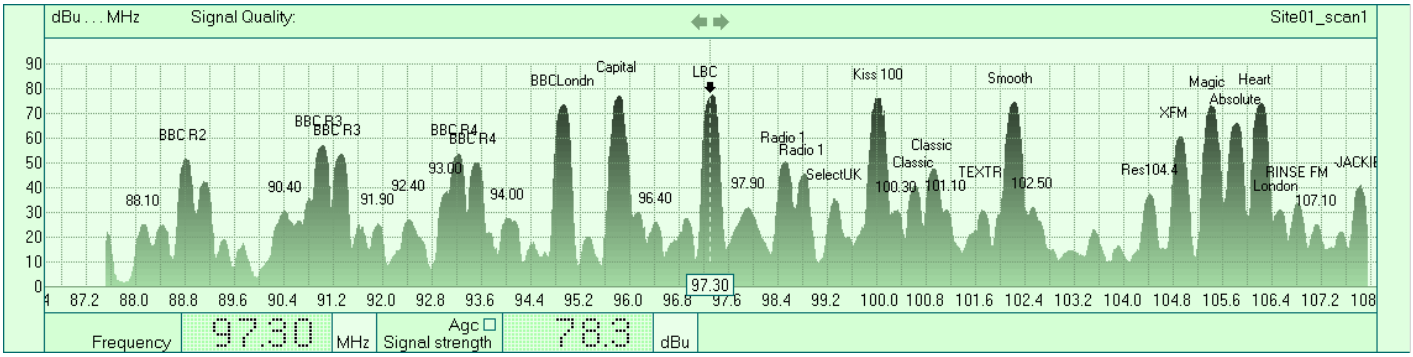
It details the sideband modulation at a resolution of 250Hz per division.

FM BROADCAST RF SPECTRUM

The FM Broadcast frequency band can be continually scanned with a 10kHz resolution. This window can be re-sized to view any particular frequency. If the channel is transmitting its PS name then this will be automatically displayed, otherwise its frequency will just be shown.

The AutoTune feature provides a completely automatic channel search and save function. The Windows **iLog** software provides extensive logging, manual or automatic, with an alarm on error.

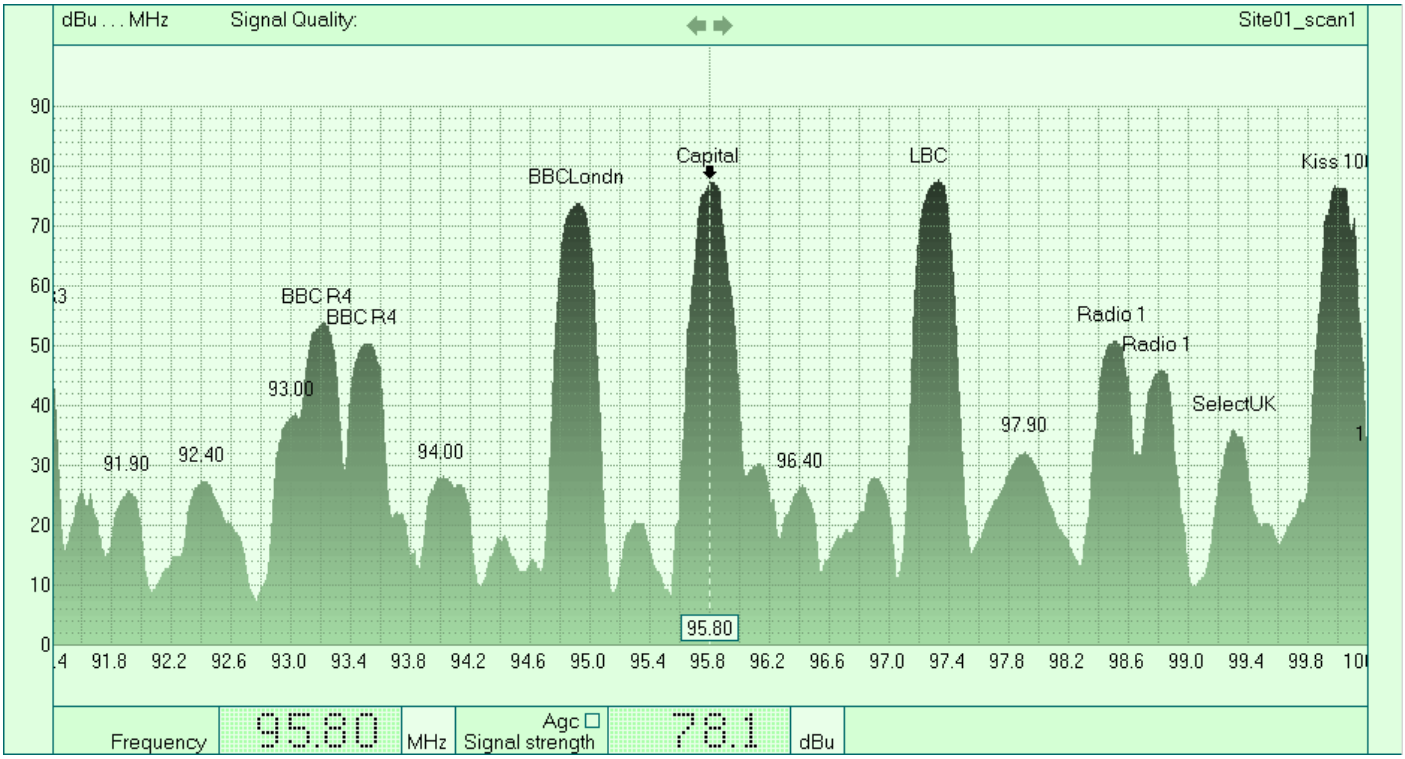
FM band amplitude spectrum



Narrowband 160kHz IF filter

The above shows a complete frequency band scan. The digital readout gives the frequency and signal strength of the channel tuned. This spectrum can be printed out as a hard copy for future reference.

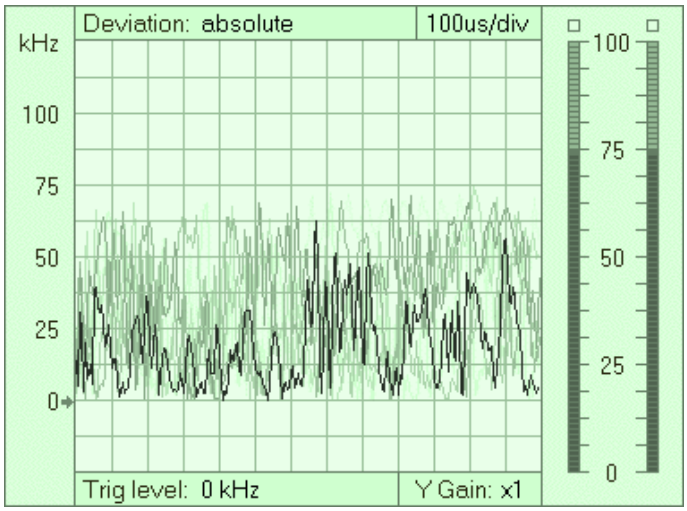
RF Broadcast spectrum at 95.8MHz



The graph above, scanned with the NB IF filter, details a smaller frequency range at 10kHz resolution. The vertical scale has doubled the resolution with 2dB increments. This frequency scan can be dragged with the computer mouse to show any frequency of interest. For strong signal areas, a user settable RF attenuator can be selected. This has setting of -20dB. These graphical windows can be copied and pasted for recording field measurements.

FREQUENCY DEVIATION

Time domain oscilloscope: The FM multiplex signal can be viewed in the time domain, with a standard view XY oscilloscope display.



Oscilloscope:

The FM multiplex signal can be viewed in the time domain, with a standard type oscilloscope display.

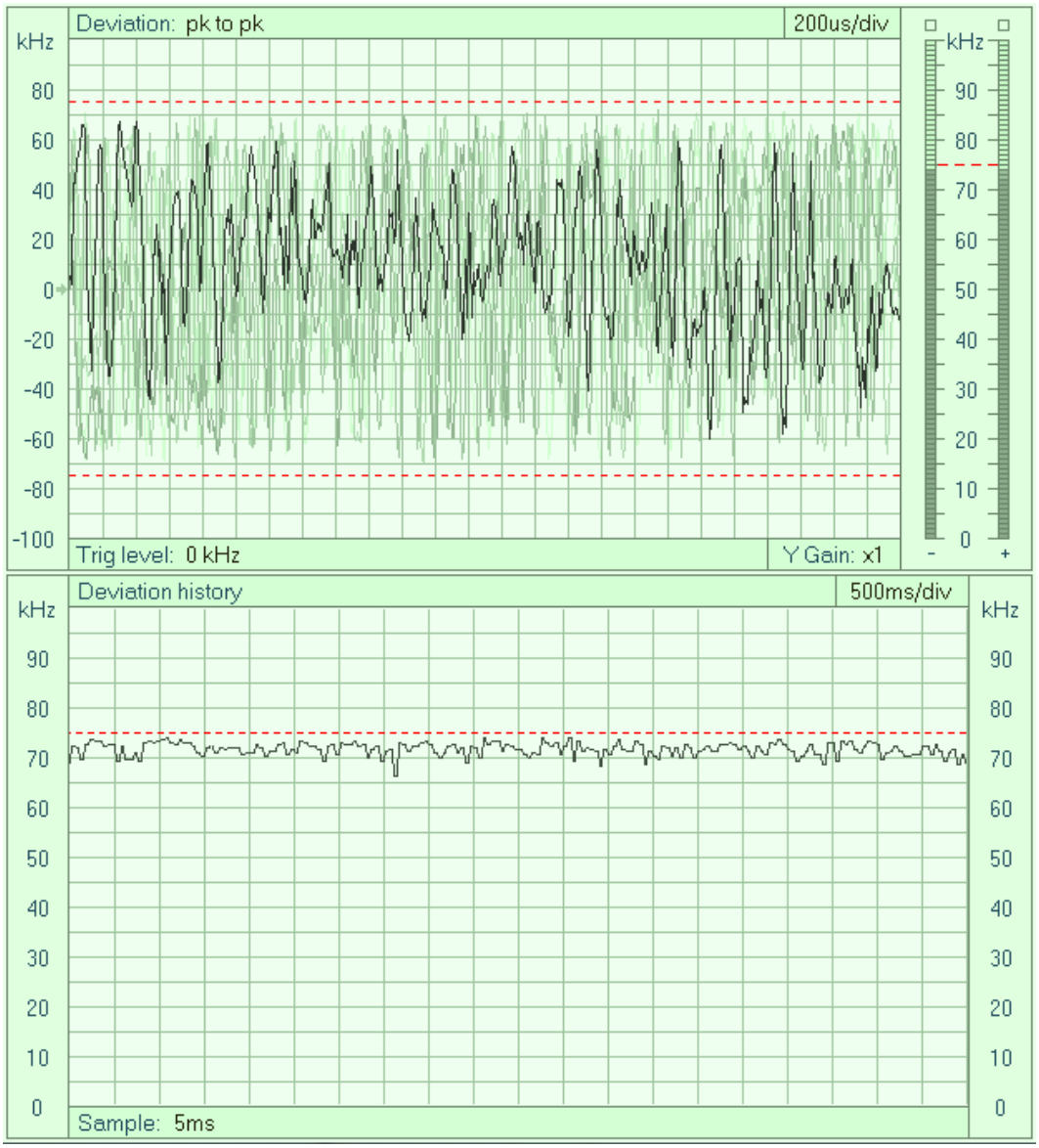
The Y-axis has been calibrated for frequency deviation measurement, with a user selectable x10 function. The X-axis time-base can be set from 10ms/div to 10us/div.

The waveform trigger point is automatic or user settable.

The deviation window, shown here, is a typical broadcast trace set for absolute signal readings. Alternately the display can be set positive and negative deviation.

A bar graph is also provided for a convenient peak style reading for absolute or positive or negative deviation.

FREQUENCY DEVIATION HISTORY



Deviation history:

With the introduction of iLog V6.00 a new frequency deviation history window has been added.

This graph has a much slower time-base, with a sample accumulator.

The sample algorithm takes the highest value of deviation within the sample period. This ensures no modulation peaks are missed.

The time-base can set from 100ms/div to 10sec/div, displaying absolute frequency deviation.

This history feature allows the operator to assess frequency deviation over a very long period of time. This makes it very easy to spot over modulation peaks.

The display can be set for a normal left to right update or can be configured to automatically scroll continuously.

FREQUENCY DEVIATION HISTOGRAM AND ACCUMULATED DISTRIBUTION

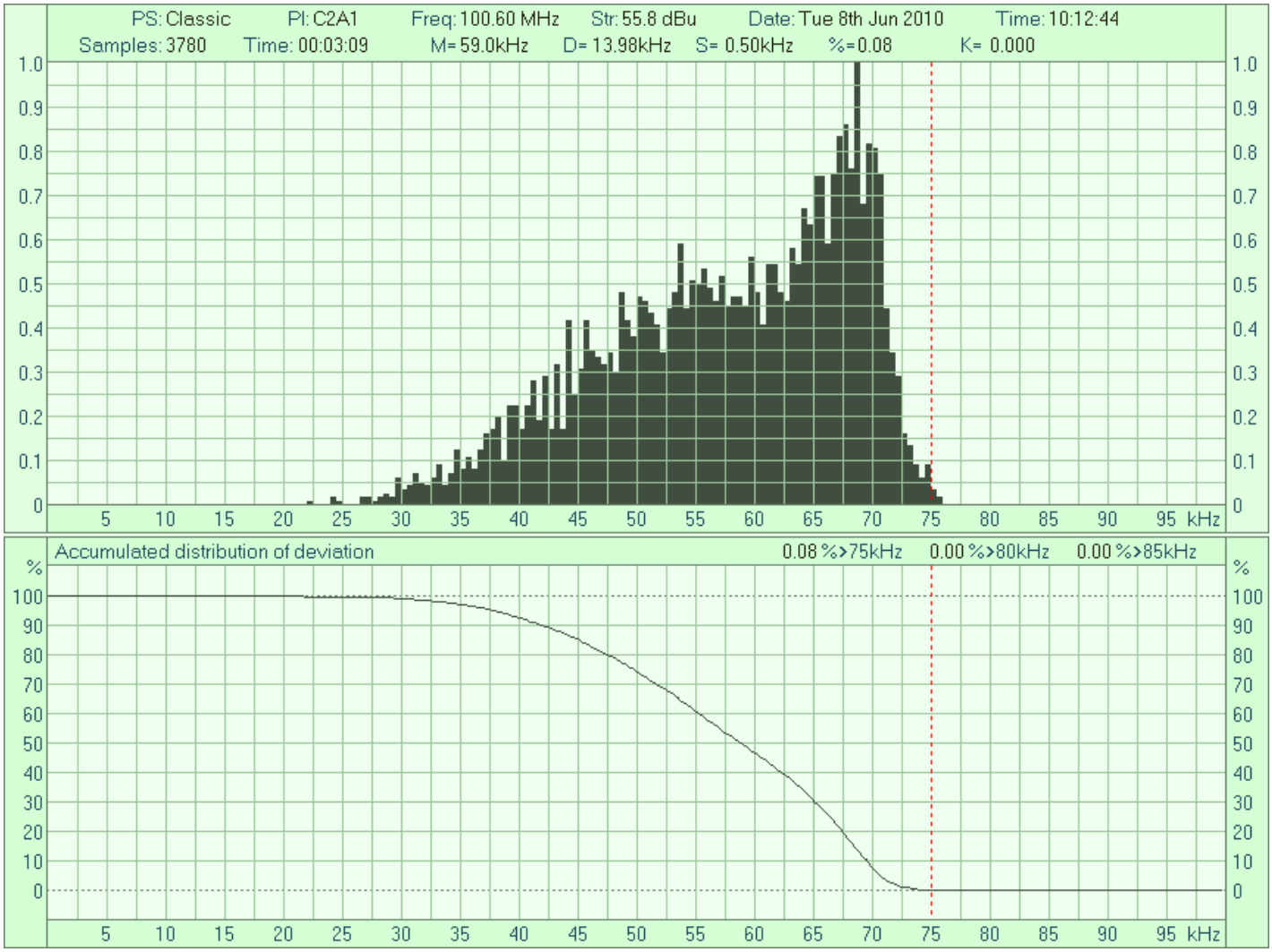
Frequency deviation histogram: The frequency deviation histogram method provides an accurate way to asses the frequency deviation level over a set period of time.

The multiplex signal is sampled with a peak hold system, to the recommended standard size 50ms bins. These samples are normalised and then separated into frequency bins over a range of 100kHz.

The histogram resolution can be set for 0.25kHz, 0.5kHz and 1kHz bins. The graph shown below, was sampled with 0.5kHz bins.

The histogram window is updated in real time, with the following deviation variables calculated once per second, from the accumulated data.

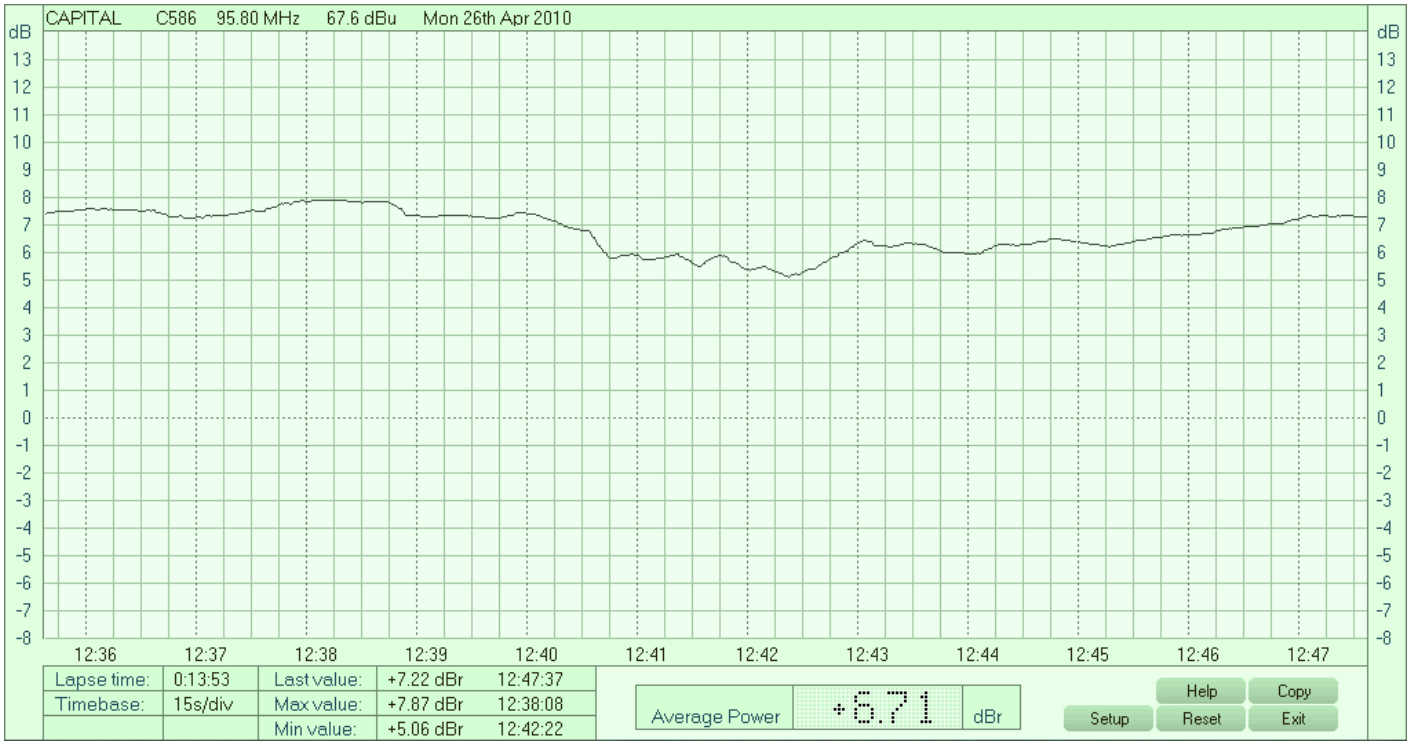
- T Lapse time measured in minutes and seconds
- The number of samples taken
- M The mean value of deviation
- D The quadratic mean value of deviation
- S The mean of samples above 75KHz
- % The percentage of samples above 75KHz
- K Equals S*(%/100)



Accumulated distribution of deviation:
The accumulated distribution of deviation, is calculated by summing all bins in ascending order. These are normalised to the total number of samples taken and shown graphically over a range of 100kHz. The percentage of samples over 75kHz, 80kHz and 85kHz are calculated every second.

MODULATION POWER

Modulation Power is calculated with 32bit floating-point precision from the 16bit digitally sampled multiplex signal. This provides the most accurate way of calculating modulation power compared to the more traditional analogue method with it's inherent problem of dynamic range and temperature drift.

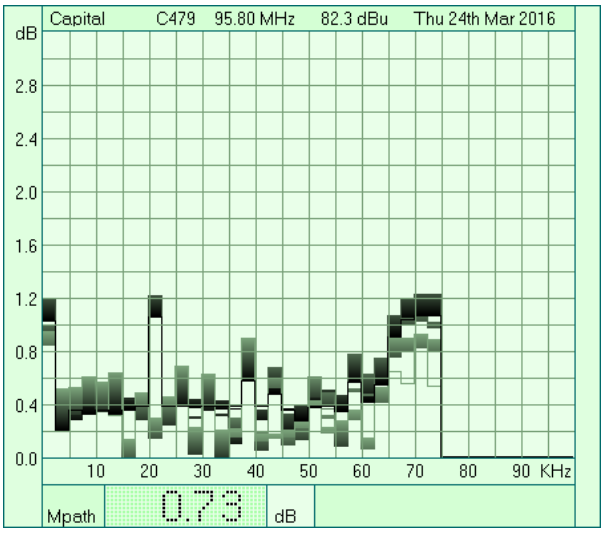


- The full scale measurement range is from –8dB to +12dB. The average power is calculated with reference to the EBU standard 0dBr.
- The time-base can be set to run from 15sec/div to 10min/div and automatically resets on channel frequency change, or can be user reset at any time. There are lapse time or real time x-axis options.
- The graph continuously scrolls over any period of time and can be printed as required. Every minute the minimum and maximum values are recorded, with the last value shown for the previous recorded minute.
- The Lapse time gives the recorded time from frequency change or user reset. By simply clicking the Copy button the graph can be copied, via the clip-board, and pasted to any other application.

MULTIPATH DISTORTION

Multipath detection employs a high speed 12bit A/D convertor, allowing digital DSP filtering to extract the multipath distortion.

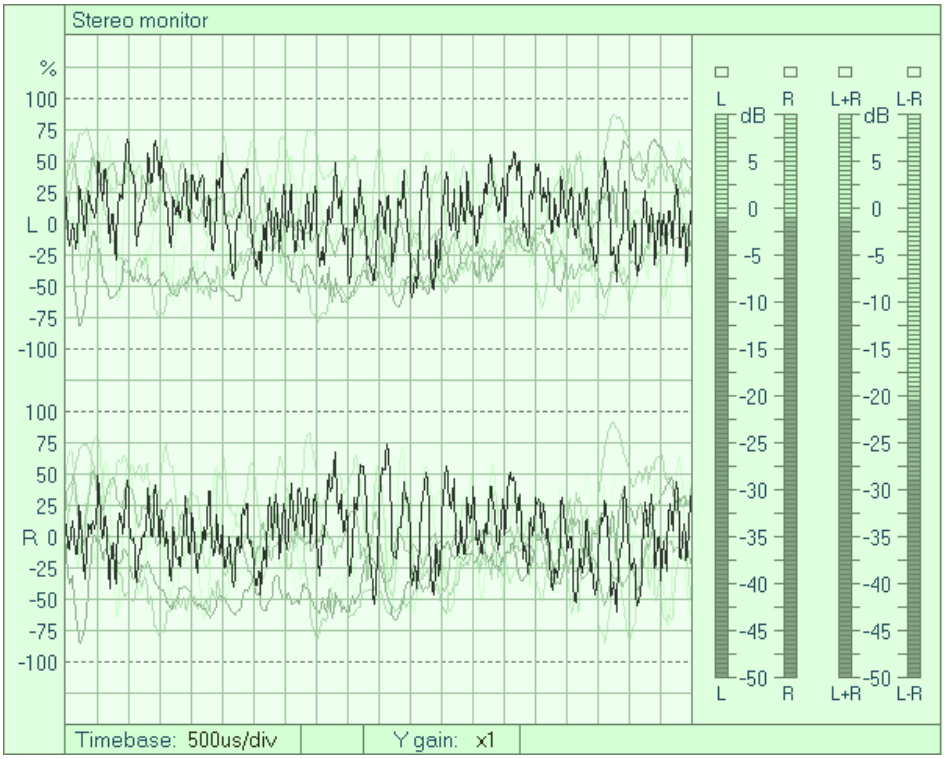
- Instantaneous values are displayed graphically and mean values are calculated and displayed digitally.
- A built in analogue phosphor type fade helps to assess peak levels of multipath interference.



STEREO MONITOR

Unique to the FME120 analyser, is that the stereo multiplex audio is decoded by a software algorithm. The 19kHz pilot is detected and phased locked to a narrowband filter. The left and right channels are then extracted with a synchronous detector. This new method of decoding gives excellent phase matching between channels. De-emphasis is finally applied with a further digital filter. Since all this processing is achieved using DSP techniques, no hardware close tolerance components are required or any alignment necessary. The extracted 16 bit left and right audio signals are then passed, via Windows, to the Sound Card for audio monitor-

The stereo monitor software also provides for digital recording of the USB data. This allows the complete monitoring of a Radio Channel, i.e. it's multiplex data is decoded for deviation, RDS data, and it's stereo audio signal. This gives an engineer the opportunity to take a snap-shot of a radio channel, save it to file, and later play it as a live 'off-air' broadcast.



Stereo Monitor display

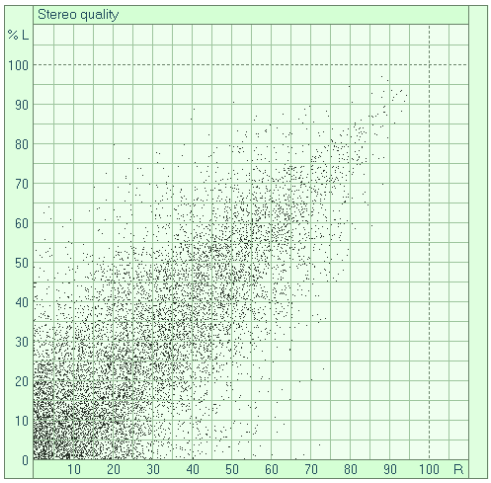
Shown here is a typical 'off-air' music broadcast of the left and right channels.

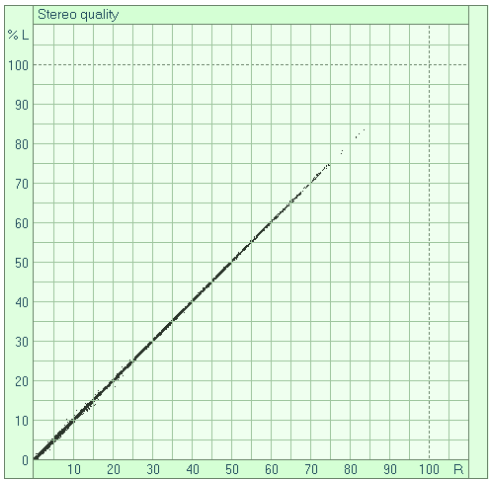
The time-base can set as required and the vertical gain can be set to x1 or x10, for detailed inspection.

Left and right channel PPM style bar-graphs show program content. These are calibrated to automatically compensate for stereo pilot and RDS sub-carrier injection levels.

Additional bar-graphs show L+R and L-R channels.

Stereo quality display on vectored axis





To visualise the stereo quality, the left channel is set to the vertical axis and the right channel to the horizontal axis. The resultant 2D vector display gives an instant assessment of the stereo content from the channel being monitored. The graph on the left displays a typical stereo broadcast and on the right, a good quality mono broadcast. In this case it was for speech. If either the left or right channels are missing then the display will not show symmetrically.

RDS DECODER

The RDS decoder, will decode groups PI,PTY,PS,RT,CT,PIN,AF,TA,TP,DI,MS,EON. This data can be viewed on-screen as it arrives and it can be stored directly to hard-disk.

RDS group rates			
0A	37.5%	0B	
1A	9.5%	1B	
2A	18.6%	2B	
3A	0.2%	3B	
4A		4B	
5A		5B	
6A	1.6%	6B	
7A		7B	
8A		8B	
9A		9B	
10A		10B	
11A		11B	
12A		12B	
13A		13B	
14A	26.7%	14B	5.9%
15A		15B	

Received Blocks	2100
Block errors	0
Block error ratio	-
RDS quality %	100.0000

0A	C203	01D9	2C2D	4320
2A	C203	21DB	2020	2020
14A	C203	E1D2	0053	C712
0A	C203	01DA	2B20	5233
2A	C203	21DC	2020	2020
0A	C203	01DF	2A21	2020
1A	C203	11C0	80E1	B380
14A	C203	E1D3	0066	C712
0A	C203	01DC	242E	4242
14A	C203	E1DD	4800	C712
6A	C203	61DE	0000	8255
2A	C203	21DD	2020	2020

Group data

- Un-decoded continuous RDS data is displayed in this window.
- Group repetition rates are calculated over a sixty second period.
- RDS quality is given to four decimal places.

Group: 14A	Network: 2	TA: 0	PI: C201	PS: Radio 1
PTY: Pop Music		LINK: 8001	PIN: B340 22nd at 13:00	

AF		Map 1		Map 2		Map 3		Map 4		AM	
ON	ON	TN	ON	TN	ON	TN	ON	TN	ON	TN	ON
		93.5	98.8	94.4	99.6						
		93.2	98.5	94.2	97.7						
		92.5	97.7								
		94.4	99.5								
		94.5	99.7								
		94.6	99.2								
		93.1	98.3								
		94.1	99.3								
		94.2	99.4								
		92.8	98.0								
		92.9	98.2								
		93.9	99.1								
		93.0	98.2								
		93.3	98.5								
		94.3	99.5								
		92.7	97.9								

Group: 14B	PI: C814	TP: 1
		TA: 0

EON data

- A continuous update of EON data is available for all networks received.
- When all data has been captured, it can be stepped through for in-spection, or printed out for hard copy.

Classic 100.90 MHz	Radio Text	Text flag: ☐ 00:00:12	Tue 22nd Jan 2013
14:36:30	Classic FM on the Internet at www.classicfm.com.....		
14:36:45	Classic FM on FM, DAB and online at www.classicfm.com.....		
14:36:00	For information about our programmes visit www.classicfm.com....		
14:37:15	Classic FM - Playing a relaxing mix of popular classical music..		
14:37:30	Classic FM on the Internet at www.classicfm.com.....		
14:37:45	Classic FM on FM, DAB and online at www.classicfm.com.....		
14:38:15	Classic FM - Playing a relaxing mix of popular classical music..		
14:38:45	Classic FM on FM, DAB and online at www.classicfm.com.....		
14:38:00	For information about our programmes visit www.classicfm.com....		
14:39:15	Classic FM - Playing a relaxing mix of popular classical music..		
14:39:30	Classic FM on the Internet at www.classicfm.com.....		
14:39:45	Classic FM on FM, DAB and online at www.classicfm.com.....		
14:39:00	For information about our programmes visit www.classicfm.com....		
14:41:30	Classic FM on FM, DAB and online at www.classicfm.com.....		
14:41:45	For information about our programmes visit www.classicfm.com....		
14:41:59	Classic FM - Playing a relaxing mix of popular classical mus		

RT history

- Sixteen RT messages are captured and displayed in the RT window.
- These messages can be logged directly to hard disk.
- Any number of messages to capture can be set and they will be stored as AS-CII text.
- These can be cut and pasted into any text file. Any repeat messages can be ignored.

RDS DECODER RT+ Radiotext plus

The FME120 has additional RDS decoding for the RT+ 11A group.
Along with the standard RT text, the music Title and Artist, are decoded and displayed in this window.

Kiss 100 100.00 MHz	Mon 14th Jan 2013	Text flag: ☐ 00:01:38	RT+ AGT code: 11A			
			Item toggle bit:			1
Content type:	Radio Text		Item running bit:			1
14:36:34	Monday afternoon and this is Kiss 100					
Item.Title	Blow Me One Last Kiss		SM1	13	LM1	20
Item.Artist	Pink		SM2	37	LM2	3
14:36:54	You're listening to Kiss 100					
Item.Title	Blow Me One Last Kiss		SM1	13	LM1	20
Item.Artist	Pink		SM2	37	LM2	3
14:37:18	For the best Dance, Hip-Hop and R&B, this is Kiss					
Item.Title			SM1		LM1	
Item.Artist			SM2		LM2	
14:37:34	Kiss 100 - It's 2:37 pm					
			SM1		LM1	
			SM2		LM2	
14:37:58	Kiss 100 - for the best Dance, Hip-Hop and R&B					
			SM1		LM1	
			SM2		LM2	
14:38:18	Monday afternoon and this is Kiss 100					
			SM1		LM1	
			SM2		LM2	
14:38:37	You're listening to Kiss 100					
			SM1		LM1	
			SM2		LM2	
14:38:54	Now Playing: Troublemaker by Olly Murs / Flo Rida					
Item.Title	Troublemaker		SM1	13	LM1	11
Item.Artist	y Olly Murs / Flo Rid		SM2	27	LM2	19

Up to eight Titles and Artists can be displayed at any time, as they arrive. The window automatically scrolls when more than eight entries are received. This continuous data stream can be logged directly to hard disk, by means of a RT+ text file. The Titles and Artists can then be extracted from this file.

File name: RTdata
Recorded: Mon 14th Jan 2013
PS name: Kiss 100
Frequency: 100.0MHz

15:40:14 Kiss 100 - for the best Dance, Hip-Hop and R&B
15:40:33 Monday afternoon and this is Kiss 100
15:40:52 Now Playing: Payphone by Maroon 5
15:43:28 For the best Dance, Hip-Hop and R&B, this is Kiss
15:43:45 Kiss 100 - It's 3:43 pm
16:06:11 Now Playing: Beauty And A Beat by Justin Bieber / Nicki Minaj
16:09:25 Now Playing: Don't You Worry by Swedish House Mafia
16:12:56 Monday afternoon and this is Kiss 100
16:13:16 You're listening to Kiss 100
16:22:31 Now Playing: Troublemaker by Olly Murs / Flo Rida
16:25:12 Kiss 100 - It's 4:25 pm
16:27:31 Now Playing: Starships by Nicki Minaj
16:29:55 Kiss 100 - for the best Dance, Hip-Hop and R&B
16:30:13 Monday afternoon and this is Kiss 100

GPS log

The iLog software includes GPS decoding to the NMEA global standard. It will automatically scan the PC for any connected GPS NMEA compliant devices. Google Earth .kml files are generated for GPS tagged field measurement. The FME120G units are supplied with their own USB GPS receiver module.

The GPS software decodes the following standard NMEA messages:

- GPGSV
- GPGGA
- GPGSA
- GPRMC

These will provide latitude, longitude and altitude along with comprehensive satellite information:

The bar graph displays the active satellites with their relative signal strengths.

ID: Unique satellite ID
Ev: Satellite elevation in degrees
Azi: Satellite azimuth in degrees
SN: Signal noise ratio in dBHz

The scrolling data displays all the GPS groups transmitted by the GPS antenna/ decoder

Fix Mode: 2D or 3D

Altitude: This displays altitude of the GPS antenna.

Speed: Gives speed over ground

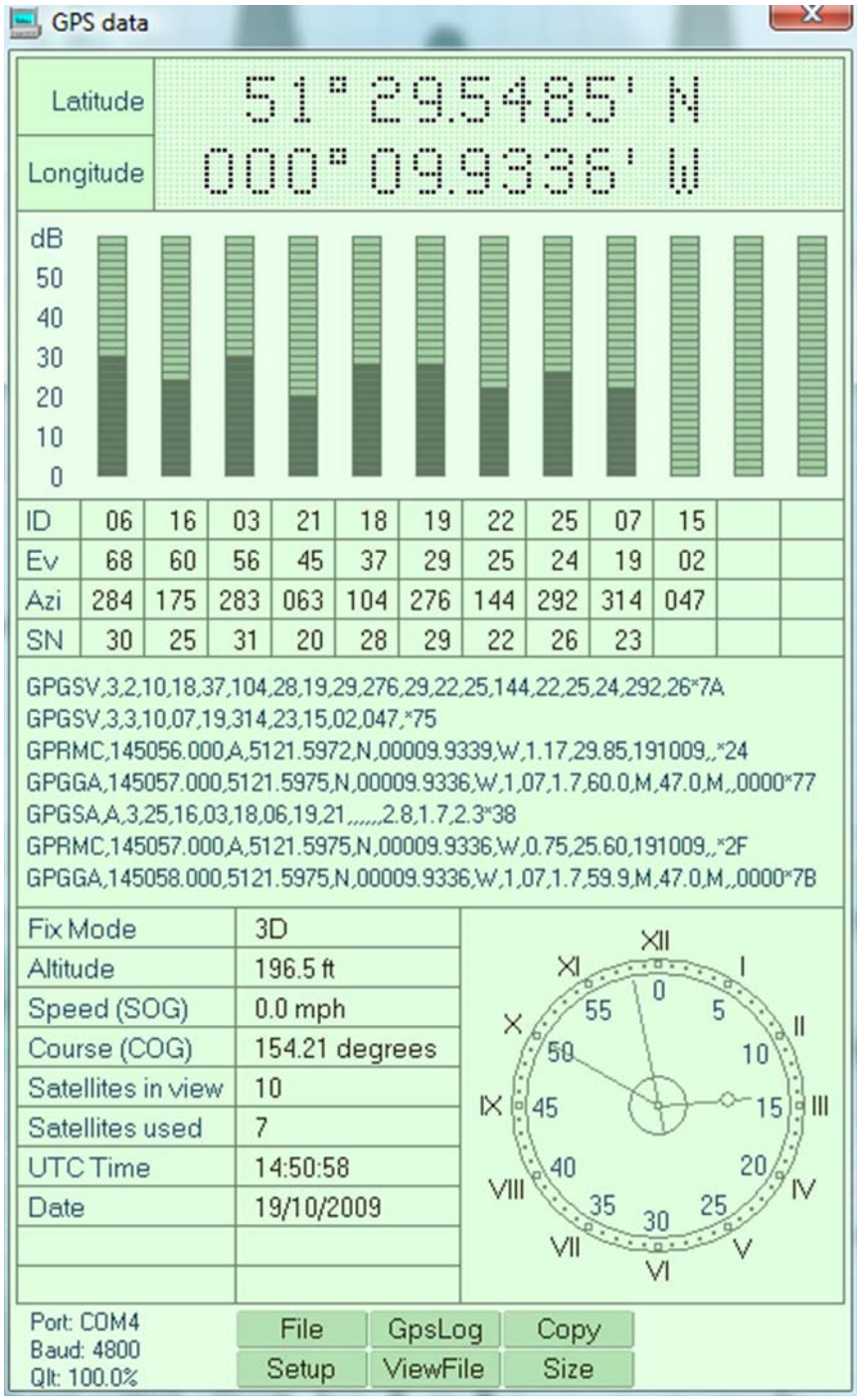
Course: Course over ground

Satellites in view: Number of satellites being received

Satellites used: Number of satellites actually being used for calculating position

UTC Time: Universal time code. This is not local time

Date: The current date



GPS Google Earth

The iLog software will generate standard Google Earth mapping .kml files. These will contain signal strength measurement at each sample point, say every 100 metres, and can be tagged with channel frequency, PS name and PI code.

These files can be displayed at any time during the logging process, or they can automatically displayed at each sample point. This gives a real-time update of signal parameters, whilst logging a particular geographic area.

With it's auto incrementing file name feature, a large area can be mapped with ease, with all results saved to hard disk.

GPS Google Earth Mapping

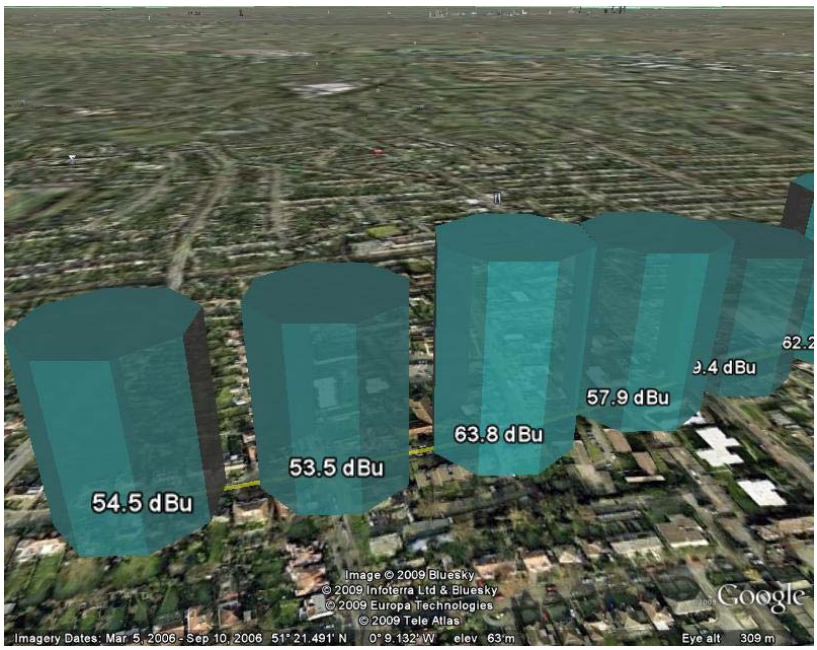
The iLog GPS mapping software, records FM measurements to a standard ACII text file. These files can then be converted to Google Earth compatible .kml files. Various user options can be selected in how to display the recorded data on the Google map.

3D mapping view

2D mapping view

GPS receiver

The FME120G units are supplied with their own SiRFstarIII USB GPS magnetic receivers.



iLog Remote Control

We have had many requests to control our earlier analysers, the TS9000, TS9050, TS9085 etc, with remote software. This had been possible in the past by providing the USB software protocol for the hardware. However, as the control commands grew, the complexity of the returned data posed considerable problems for would-be software developers. To solve this, a new and extremely simple shared text file system was introduced into the iLog software. This has now been extended to the FME120 analyser.

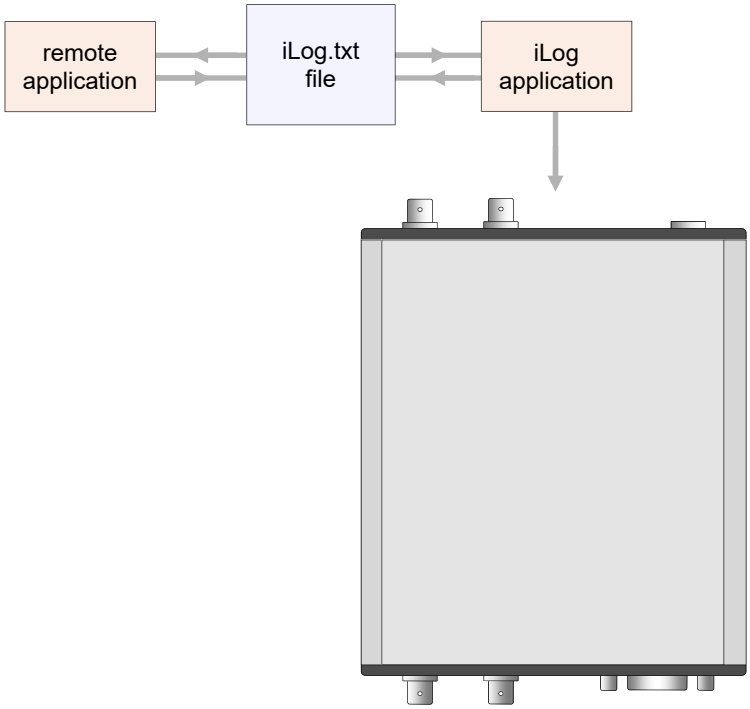
Basic operation:

1. When the iLog application is running it automatically generates a simple text file called iLog.txt

2. An application can now control the FME120 by writing a single line of text to this file.

3. The iLog application automatically reads this line of text every 1 to 100ms, executes its commands and returns an acknowledge by overwriting this control text with an 'action complete code'.

4. If the application has requested data, the iLog application will write this data back as a single line of text.



To control the FME120:

Tx=Control code, frequency, attenuator, volume, screen size, clear histogram, clear modulation power
Control code: 2
Frequency: frequency x100
Attenuator: 0=0dB 1=-10dB 2=-20dB 3=-30dB
Volume: 0 to 63
Screen size: 0: normal large screen 1: collapsed small window
Clear histogram: 0: clear histogram data 1: normal operation
Clear modulation power: 0: clear modulation power data 1: normal operation

Example:
Tx=2,9580,2,40,1,0,0
This will set frequency to 95.8MHz, attenuator -20dB, volume 40, small screen, and clears histogram and power

To receive data from the FME120:

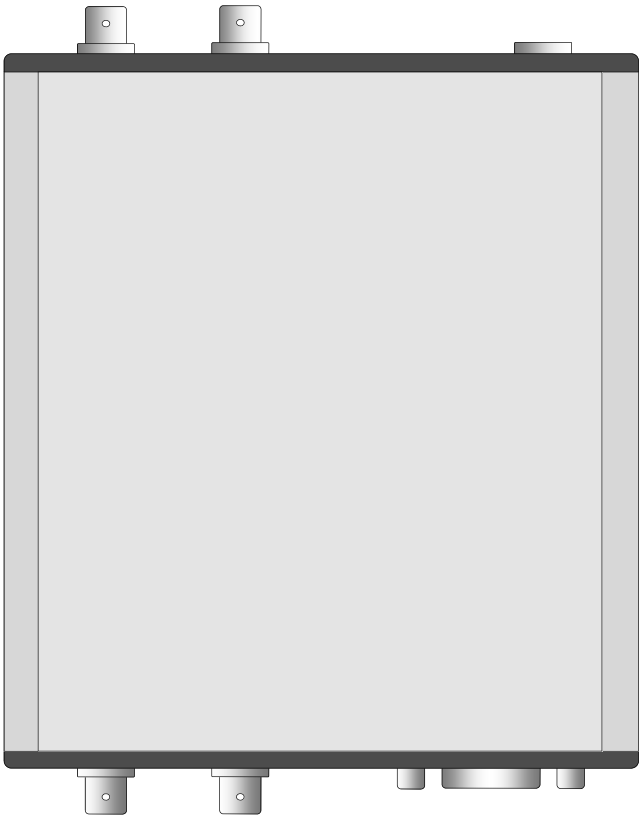
Tx=3 This will request to receive information, in the format:

Info: frequency, PS, PI, signal strength, pilot level, rds carrier, multipath level, average modulation power, time, date,TA

Example:
Info: 95.80 MHz,CAPITAL,C586,72.6 dBu,6.45 kHz,2.47 kHz,1.2 dBu,3.86 dBr,20:33:54,Tue 17th Mar 2009,0

FME120 I/O connections

* BNC 50 ohm unbalanced antenna input.
* BNC external IF 50 ohm 10.7MHz input
* USB connector. This is compatible with USB1.1 and USB2.0 standards. All control and data signals are fed to and from this port. The unit is powered from this connector.



* BNC analyser input, for external multiplex signal or any AF signal for evaluation with the internal Spectrum Analyser.
* BNC multiplex signal unbalanced output.
* D-type 9 pin alarm output. This will sink 10mA.
* USB power blue LED indicator window

FME120 TECHNICAL SPECIFICATION

System Measurements:	
Deviation:	+100kHz to -100kHz
Modulation Power:	-8dBr to +12dBr (0dBr ref 19kHz)
Pilot 19KHZ:	dB or %
RDS carrier 57KHz:	dB or %
Signal Strength:	85dBu full scale range
Multipath:	10dBu full scale range
Stereo:	0 to 100% modulation

Multiplex signal:	Bandwidth
Wideband Narrowband	80kHz < 0.1dB, 100KHz < 0.6dB 80kHz < 0.4dB, 100KHz < 3.5dB
IF filter bandwidth	WB: 250kHz NB: 160kHz
Deviation accuracy:	+/-0.5%
Sub-carrier accuracy:	WB: +/-2.0% NB: +/-3.5%

Multiplex distortion:	Typical	Units
THD Wideband Narrowband	0.02 % 0.12 %	75 kHz deviation 400 Hz modulation

System parameters	Min	Typical	Max	Units
RF Bandwidth	87.5	-	107.95	MHz
Input impedance		50		ohms
Image rejection		85		dB
Sensitivity		2.8		uV
RSSI resolution		0.1		dB
RSSI accuracy		+/-2.0		dB
Multipath resolution		0.1		dB
Pilot 19KHz range	18.95		19.05	kHz
RDS 57kHz range	55.5		58.5	kHz
Stereo cross-talk		42		dB

Signal I/O connections:
Front connections:
BNC 50 ohm IF input at 10.7MHz
BNC MPX multiplex. Output 50ohms 0dBm at 75KHz
D-TYPE 9pin 10mA alarm output
Rear connections:
BNC Analyser input ~10Kohms 0dBm (FM multiplex or audio spectrum analyser)
BNC Antenna input 50ohms
USB 1.1 and 2 compatible (Not suitable for non-powered hubs)

Spectrum Analyser:	
Resolution	16 bits
Points	2,000 to 16,000
Input impedance	9.0k, 12.0k ,14.4k
Input attenuator	0dB,-6dB,-12dB
Dynamic range	>100dB
Dynamic range averaged	>110dB
Bandwidth	100kHz
Resolution:	20Hz

Screen resolutions:	
XGA	1024 x 768
WXGA	1280 x 800
SXGA	1280 x 1024
WXGA+	1440 x 900
SXGA+	1400 x 1050
UXGA	1600 x 1200
WSXGA	1680 x 1050
WUXGA	1920 x 1200

System requirements:
FME120 iLog software runs under:
Windows 7, Windows 8.0/ 8.1 and 10.
Minimum usable system: Windows 7 running on a
1.8 GHz Intel Celeron or equivalent.
Recommended system: Windows10 running on
3.0+ GHz Intel i5/i7 processor
Requires a minimum of 64MBytes of RAM.
Temperature: Operating: 5degC to 40degC Storage: -10degC to 50degC

Dimensions: FME120
160mm x 125mm x 30.5mm
6.3 in x 4.9 in x 1.2 in
Weight: 540 gm

SiRFstarIV GPS receiver USB specification

Electrical characteristics	
GPS chipset	SiRFstarIV GSD4e
Frequency	L1, 1575.42MHz
C/A Code	1.023 MHz chip rate
Channels	48
Sensitivity	-163dBm
Accuracy	
Position horizontal	<2.5m 2D RMS SBAS Enable
Velocity	0.1m/sec 95% (SA off)
Time	1us synchronised to GPS time
WAAS	Enabled for North America Products
DATUM	
Datum	WGS_84
Acquisition rate	
Hot start	8 sec. Average (with ephemeris and almanac valid)
Warm start	38 sec. Average (with ephemeris but not almanac valid)
Reacquisition	0.1 sec. Average (interruption recovery time)
Protocol	
Default protocol	NMEA 0183 V3.0 Secondary: SirF Binary >>position, velocity, altitude, status and control
GPS output data	Supports commands: GGA,GSA,GSV,RMC,VTG,GLL
GPS transfer rate	Default: 4800,n,8,1 for NMEA compliance
Temperature	
Operating	-40 to 85 deg.C
Storage	-40 to 85 deg.C
Humidity	Up to 95% non-condensing
Dynamic condition	
Acceleration limit	< 4g
Alitude limit	18,000 meters max.
Velocity limit	515 meters/sec (1,000 knots) max
Jerk limit	20 m/sec
Low noise amplifier	
LNA amplifier gain	27 dB typical
Filtering	-25dB (+100MHz)
Output VSWR	2.0 max.
Power	
Voltage	5.0 +/-5% volts DC
Current	60mA typical
Physical characteristics	
Dimensions	59 mm x 47mm x 21mm
USB cable length	1.52 meter

GPS LED status	
Steady ON	No GPS fix with satellite signals
Flashing	GPS position if fixed (Signal received)