BALANCING AUDIO

On Campus

Objectives

- Signal flow
- Line level
- Mic level
- Decibels
- Gain staging
- Balancing input and output
- Calculating input gain

Signal Flow

- Starts with sound source
- Transducer
- Preamp stage
- Amplifies signal (mic or line)
- A/D conversion
- Processing
- Routing

Signal Flow

- D/A conversion
- To amps
- Speakers
- Listeners



Speakers



Signal Flow with Mixer



Mic Input Level

- The voltage of signal generated by a microphone is the lowest or weakest level
- Requires a preamplifier to bring it up to line level
- •-60 to -50 dBu (.001 to .002 V)

Line Input Level

- Line level signals are the highest level signal before amplification.
- •The type of signal that flows through the system after the preamp stage
- The two types of line levels are consumer and professional
- •+4 dBu or -10 dBV

Line Input Level

- 0 dBu = .775 volts
- •+4 dBu = 1.23 volts
- -10 dBV = .316 volts or 316 mV
- Mic -60 to -50 dBu (.001 to .002 V)

Instrument Input Level

- Instrument level falls between mic level and line level
- Output level of an instrument usually guitar or bass
- A preamp is required to bring the signal up to line level

Speaker Level

- Speaker level signals are post amplification
- Signal is much higher in voltage than line level, requires speaker cable

Example

 1,000 watts feeding an 8-ohm load would require an 89.4 volt level

Decibels

- Five flavors of Decibels
- •dB relative value
- dBu measured in volts
- •dBV measured in volts
- dBFS Full Scale digital
- dB-SPL Sound Pressure Level of output in the atmosphere

Decibels

- Decibel or dB
- Logarithmic ratio between two values
- Used in audio
- Dimensionless Value
- Relationship between two numbers
- Or comparing amplitude of two audio signals

Decibels

- Amplitude is the same 0 dB apart
- 6 dB increase is a doubling of amplitude
- Another 6 dB is a four times increase in amplitude
- •Turn up 60 dB is 1000 times increase

dBu and dBV

- dBu and dBV
- Measurable value
- Measured in voltage
- •0 dBu is our optimal output level

dBu and dBV

- $0 \, dB \upsilon = 0.775 \, V$
- •+4 dBu = 1.23 V
- 0 dBV = 1 V
- $-10 \, \text{dBV} = 0.316 \, \text{V} \, (316 \, \text{mV})$



dBFS

- dBFS decibel relative to full scale
- Full Scale, or max output level
- Used to measure digital audio signal levels
- Dimensionless value, can't be converted directly to a voltage.
- O dBFS clipping point in digital audio
- Varies depending on manufacturer

dB-SPL

• SPL – Signal Pressure Level

Sound pressure in the atmosphere

•SPL Meter

SPL Levels

- Quiet room = 38-40 dB-SPL
- Room with air handler = 45-50 dB-SPL
- Conversation = 66-70 dB-SPL, 1 meter
- Sound system preforms best at 30 dB above ambient noise

Sound source	dB SPL
Colt 45 pistol - 8 meters	140
Threshold of pain	130
Rock Concert	120
Night club music	110
Chainsaw / Jet ski	100
Lawnmower	90
Cabin of jet aircraft cruising	80
Car - 10 meters	70
Average conversation - 1 meter	60
Average suburban home (night)	50
Quiet auditorium	40
Quiet whisper - 1.5 meters	30
Extremely quiet recording studio	20
Anechoic Chamber	10
Threshold of hearing	0

Gain Staging

- Foundation of audio system
- Must be set right
- Looking for 30 dB-SPL above ambient noise
- •SPL Meter
- 0 dBu or .775 volts output

Mic Input Gain

- •Handheld Vocals = 35 dB minimum
- Handheld Presentation = 45 dB
- Gooseneck mic = 45 dB
- Boundary mic = 55 dB
- Farther away = 60 dB+

Input

- Normal conversation dB-SPL is around 65 to 70 dB-SPL
- Presenter is around 78 dB-SPL
- Most preamps provide 60 dB of gain
- Inverse square law

Reverse Square Law

- •1 meter (3 feet) talking 66 dB-SPL
- •.5 meter (18 inches) talking 72 dB-SPL
- •.25 meter (9 inches) talking 78 dB-SPL

Pascal

Unit of Pressure or stress

Mic Sensitivity • 1 Pa = 94 dB-SPL

Mixer Specifications

SPECIFICATIONS

Measurement Conditions (unless otherwise specified): Line voltage 120 Vac, 60 Hz (SCM268) or 230 Vac, 50 Hz (SCM268E); full gain; 1 kHz, one channel activated; source impedances: Mic 150 Ω , Aux Level 150 Ω ; terminations: Line 600 Ω , Mic 600 Ω , Aux Out 10 k Ω . 12 V phantom power off.

Frequency Response (Ref 1 kHz, controls centered)

Microphone Inputs: 150 Hz to 20 Khz + 2 dB (built-in 80 Hz low-cut) Auxiliary Inputs: 20 Hz to 20 kHz + 2 dB

Low-Cut Filter (Microphone inputs only)

3dB down at 80 Hz, 6 dB/octave

Gain (typical, controls full clockwise)

Input	Output		
	Mic	Line	Aux Out
Low-impedance mic (150 Ω)	38 dB	76 dB	65 dB
Aux Level	3 dB	40 dB	29 dB

Inputs

Input	Impedance		
	Designed for use with	Actual (typical)	Input Clipping Level
Mic	19-600 Ω	1.2 kΩ	–5 dBV
Aux Level	32 kΩ	21 kΩ	>28 dBV

Outputs

Output	Impedance		
	Designed for use with	Actual (typical)	Output Clipping Level
Mic	low-Z inputs	0.2 Ω	–21 dBV
Line	>600 Ω	72 Ω	+18 dBV
Aux Out	>2 kΩ	870 Ω	+7 dBV

Total Harmonic Distortion

<0.25% at +4 dBu output level (through 22 Hz–22 kHz filter; Input 1 and Master centered, all other controls full counter clockwise)

Hum and Noise (150 Ω source; through 22 Hz–22 kHz filter) Equivalent Input Hum and Noise: -124 dBV

Output Hum and Noise (through 22 Hz–22 kHz filter; channel controls full counterclockwise)

Master full counterclockwise: -92 dBV Master full clockwise: -70 dBV

Common Mode Rejection

>80 dB at 1 kHz

Polarity

All inputs to all outputs are non-inverting

Overload and Shorting Protection

Shorting outputs, even for prolonged periods, causes no damage. Microphone inputs are not damaged by signals up to +10 dBV; Auxiliary inputs by signals up to +36 dBV

Microphone Sensitivity

- •The standard reference SPL is a 1,000Hz tone at 94 dB-SPL at the mic capsule.
- •94 dB-SPL equals 1 Pascal
- Sensitivity is expressed as the mic's output voltage in at either 1 Pascal or 94 dB-SPL
- •The notation used may vary depending on microphone Manufacturer

SM58® Cardioid Dynamic Microphone

Overview

The legendary SM58® is an industry-standard, highly versatile cardioid dynamic vocal microphone that is consistently the first choice of vocal performers around the globe. Even in extreme conditions, the SM58 is tailored to target the main sound source while minimizing background noise, delivering warm and clear vocal reproduction.

Features

- Frequency response tailored for vocals, with brightened midrange and bass rolloff
- Uniform cardioid pickup pattern isolates the main sound source and minimizes background noise
- Pneumatic shock-mount system cuts down handling noise
- Effective, built-in spherical wind and pop filter
- Supplied with break-resistant stand adapter which rotates 180 degrees
- Legendary Shure quality, ruggedness and reliability
- Cardioid (unidirectional) dynamic
- Frequency response: 50 to 15,000 Hz

Available Models

SM58-LC	Includes Stand Adapter and Zippered Pouch
SM58-CN	Includes 7.6 m (25 ft) XLR-Male to XLR-Female Cable, Swivel Adapter and a Zippered Pouch
SM58S	Includes Integrated On/Off Switch, Swivel Adapter and a Zippered Pouch

Specifications

Туре	Dynamic	
Frequency Response	50 to 15,000 Hz	
Polar Pattern	Cardioid	
Sensitivity (at 1,000 Hz Open Circuit Voltage)	-54.5 dBV/Pa (1.85 mV) 1 Pa = 94 dB SPL	
Impedance	Rated impedance is 150Ω (300 Ω actual) for connection to microphone inputs rated low impedance	
Polarity	Positive pressure on diaphragm produces positive voltage on pin 2 with respect to pin 3.	
Case	Dark gray, enamel-painted, die cast metal; matte-finished, silver colored, spherical steel mesh grille	
Connector	Three-pin professional audio connector (male XLR type)	
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Net Weight	298 grams (10.5 oz)	
Dimensions	162 mm (6-3/8 in.) L x 51 mm (2 in.) W	



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Calculating Input Gain

- •Level at mic
- Mic reference level
- Mic sensitivity
- dBV to dBu conversion
- Output level = 0 dBu
- Preamp gain required

Calculating Input Gain

+

+

Level at mic Mic ref level Mic Sensitivity dBV to dBU Output level Gain required

78 dB-SPL

- 94 dB-SPL
 - dBV
- 2.2 conversation
- 0 dBu
 - dB gain

Mic Preamp Gain

Shure SM58

- Level at mic
- Mic ref level
- Mic Sensitivity
- dBV to dBU
- Output level
- Gain required

- 78 dB-SPL
- 94 dB-SPL
- + -54.5 dBV
- + 2.2
 - 0 dBu
 - -68.3 dB

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UNIDIRECTIONAL CONDENSER BOUNDARY MICROPHONE



- Designed for surface-mount applications such as high-quality sound reinforcement, professional recording, television, conferencing and other demanding sound pickup situations.
- UniGuard[™] RFI-shielding technology offers outstanding rejection of radio frequency interference(RFI).
- Superior off-axis rejection for maximum gain before feedback.
- Small-diameter UniPoint capsule near boundary eliminates phase distortion and delivers clear, high-output performance.
- Heavy die-cast case and non-silp silicon foam bottom pads minimize coupling of surface vibration to the microphone.
- Low-profile design with low-reflectance finish for minimum visibility.
- AT871UG has contained electronics eliminate need for external power module.

SPECIFICATIONS

ELEMENT	Fixed-charge back plate permanently polarized condenser
POLAR PATTERN	Half-cardioid (cardioid in hemisphere above mounting surface)
FREQUENCY RESPONSE	30-20,000 Hz
OPEN CIRCUIT SENSITIVITY	-33 dB (19.9 mV) re 1V at 1 Pa
IMPEDANCE	200 ohms
MAXIMUM INPUT SOUND LEVEL	130 dB SPL, 1 kHz at 1% T.H.D.
DYNAMIC RANGE (typical)	103 dB, 1 kHz at Max SPL
SIGNAL-TO-NOISE RATIO	67 dB, 1 kHz at 1Pa
PHANTOM POWER REQUIREMENTS	9-52V DC, 2 mA typical
WEIGHT (less cable)	415 g
DIMENSIONS	120.0 mm - maximum width, 145.0 mm - maximum length, 17 mm - height
OUTPUT CONNECTOR	TB3M-type
CABLE	7.6m long, 3.2mm diameter, 2-con- ductor shielded cable with TA3F-type connector and XLRM-type connectors.
OPTIONAL INTERCHANGEABLE ELEMENTS	AT853H-ELE hypercardioid (100°) AT853C-ELE cardioid (120°) AT853SC-ELE subcardioid (170°) AT853O-ELE omnidirectional (360°)
ACCESSORIES FURNISHED	Soft protective pouch

Mic Preamp Gain

Audio Technica AT871UG

- Level at mic
- Mic ref level
- Mic Sensitivity
- dBV to dBU
- Output level
- Gain required

- 78 dB-SPL
- 94 dB-SPL
- + -33 dBV
- + 2.2
 - 0 dBu
 - -46.8

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Avixa

Balancing Audio – Chuck Espinoza

Questions