Universidad del País Vasco
Euskal Herriko Unibertsitatea

BILBOKO INGENIARITZA ESKOLA
ESCUELA DE INGENIERÍA DE BILBAO

INDUSTRIA INGENIARITZA TEKNIKOKO ATALA

SECCIÓN INGENIERÍA TÉCNICA INDUSTRIAL

INDUSTRIA ELEKTRONIKAREN ETA AUTOMATIKAREN INGENIERITZAKO GRADUA

GRADU AMAIERAKO LANA

2016 / 2017

ENTZUMEN URRITASUNA DUTEN PERTSONEI ZUZENDUTAKO SOINU--SEINALEEN SISTEMA ANTZEMALE/ ADIERAZLE BATEN DISEINU ETA INPLEMENTAZIOA

5. ERANSKINAK

IKASLEAREN DATUAK

IZENA: IGOR

ABIZENAK: LLONA AGIRRE

SIN.:

DATA: 2017/04/25

ZUZENDARIAREN DATUAK

IZENA: NEKANE

ABIZENAK: AZKONA ESTEFANIA

SAILA: TEKNOLOGIA ELEKTRONIKOA

SIN.:

DATA: 2017/04/25

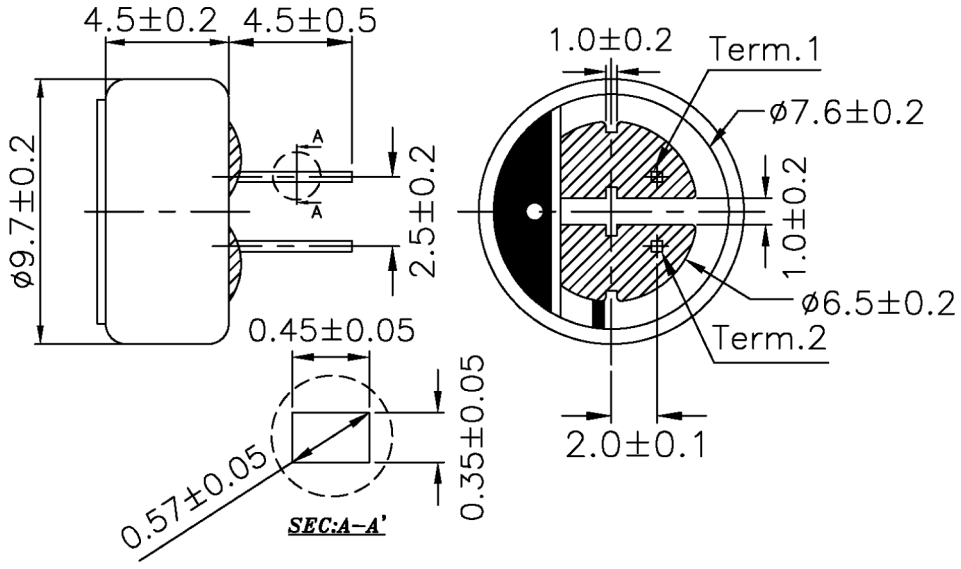
PART NUMBER: CMA-4544PF-W **DESCRIPTION:** electret condenser microphone

SPECIFICATIONS

directivity	omnidirectional	
sensitivity (S)	-44 ±2 dB	f = 1KHz, 1Pa 0dB = 1V/Pa
sensitivity reduction (ΔS-Vs)	-3 dB	f = 1KHz, 1Pa Vs = 3.0 ~ 2.0 V dc
operating voltage	3 V dc (standard), 10 V dc (max.)	
output impedance (Zout)	2.2 KΩ	f = 1KHz, 1Pa
operating frequency (f)	20 ~ 20,000 Hz	
current consumption (IDSS)	0.5 mA max.	Vs = 3.0 V dc RL = 2.2KΩ
signal to noise ratio (S/N)	60 dBA	f = 1KHz, 1Pa A-weighted
operating temperature	-20 ~ +70° C	
storage temperature	-20 ~ +70° C	
dimensions	ø9.7 x 4.5 mm	
weight	0.80 g max.	
material	Al	
terminal	pin type (hand soldering only)	
RoHS	yes	

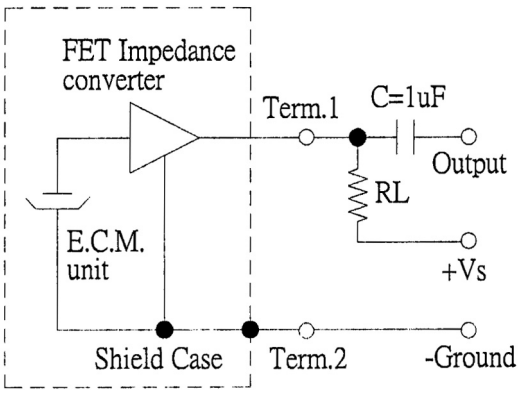
note: We use the “Pascal (Pa)” indication of sensitivity as per the recomendation of I.E.C. (International Electrotechnical Commission). The sensitivity of “Pa” will increase 20dB compared to the “ubar” indication. Example: -60dB (0dB = 1V/ubar) = -40dB (1V/Pa)

APPEARANCE DRAWING



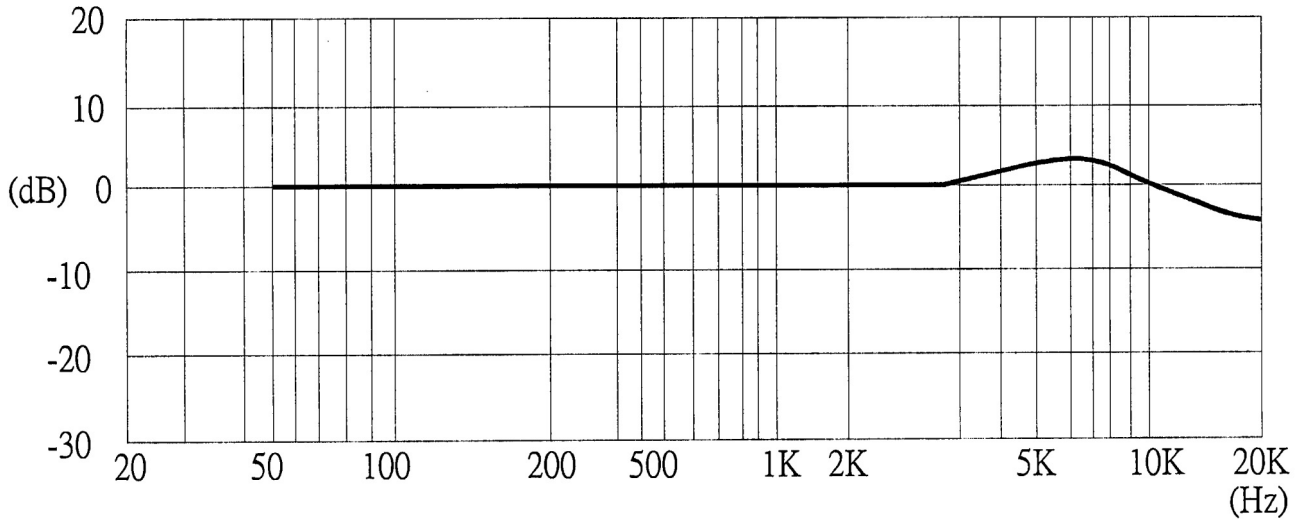
PART NUMBER: CMA-4544PF-W **DESCRIPTION:** electret condenser microphone

MEASUREMENT CIRCUIT



Schematic Diagram **RL=2.2KΩ**

FREQUENCY RESPONSE CURVE

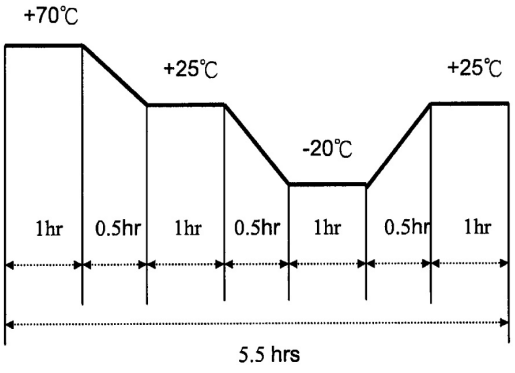


PART NUMBER: CMA-4544PF-W **DESCRIPTION:** electret condenser microphone

MECHANICAL CHARACTERISTICS

item	test condition	evaluation standard
soldering heat resistance	Lead terminals are immersed in solder bath of 270 ±5°C for 2 ±0.5 seconds.	No interference in operation.
PCB wire pull strength	The pull force will be applied to double lead wire: Horizontal 4.9N (0.5kg) for 30 seconds	No damage or cutting off.
vibration	The part will be measured after applying a vibration amplitude of 1.5 mm with 10 to 55 Hz band of vibration frequency to each of the 3 perpendicular directions for 2 hours.	After any tests, the sensitivity should be within ±3dB compared to the initial measurement.
drop test	The part will be dropped from a height of 1 m onto a 20 mm thick wooden board 3 times in 3 axes (X, Y, Z) for a total of 9 drops.	

ENVIRONMENT TEST

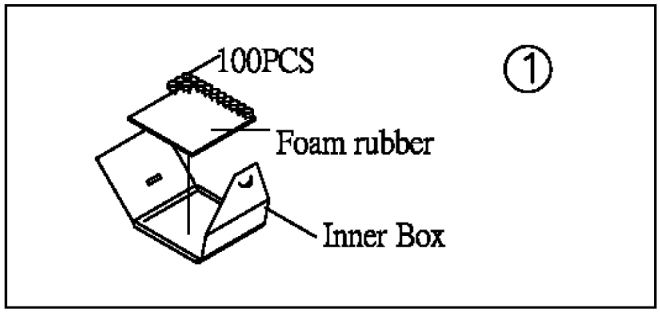
item	test condition	evaluation standard
high temp. test	After being placed in a chamber at +70°C for 72 hours.	The part will be measured after being placed at +25°C for 6 hours. After any tests, the sensitivity should be within ±3dB compared to the initial measurement.
low temp. test	After being placed in a chamber at -20°C for 72 hours.	
humidity test	After being placed in a chamber at +40°C and 90±5% relative humidity for 240 hours.	
temp. cycle test	The part shall be subjected to 10 cycles. One cycle will consist of:  	

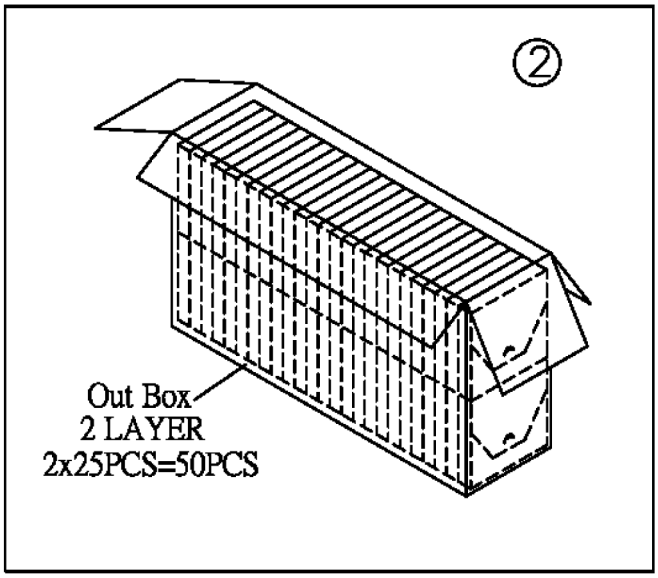
TEST CONDITIONS

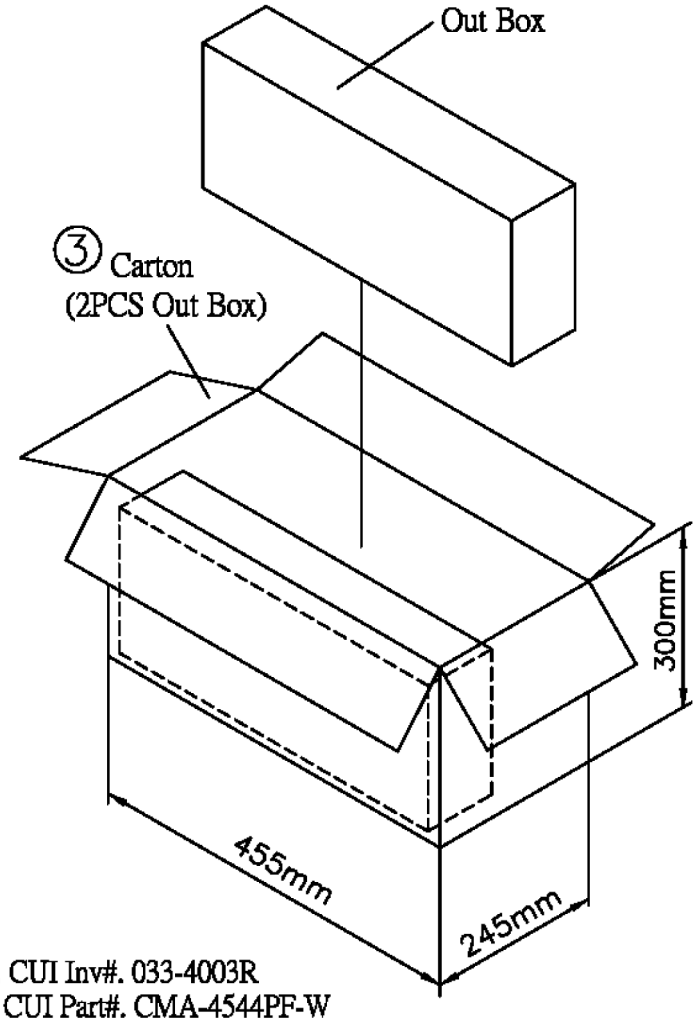
standard test condition	a) temperature: +5 ~ +35°C	b) humidity: 45 - 85%	c) pressure: 860-1060 mbar
judgement test condition	a) temperature: +25 ±2°C	b) humidity: 60 - 70%	c) pressure: 860-1060 mbar

PART NUMBER: CMA-4544PF-W **DESCRIPTION:** electret condenser microphone

PACKAGING







1. CUI Inv#. 033-4003R
   CUI Part#. CMA-4544PF-W
2. RoHS Compliant

Inner Box	100mmx100mmx15mm	100PCSx1=100PCS
Out Box	435mmx120mmx280mm	100PCSx50=5,000PCS
Carton Box	455mmx245mmx300mm	5,000PCSx2=10,000PCS

19-1950; Rev 1; 4/01

MAXIM

Low-Cost, Micropower, SC70/SOT23-8, Microphone Preamplifiers with Complete Shutdown

General Description

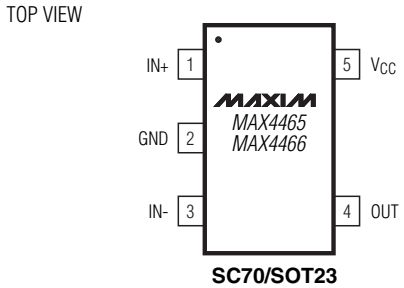
The MAX4465–MAX4469 are micropower op amps optimized for use as microphone preamplifiers. They provide the ideal combination of an optimized gain bandwidth product vs. supply current, and low voltage operation in ultra-small packages. The MAX4465/MAX4467/MAX4469 are unity-gain stable and deliver a 200kHz gain bandwidth from only 24µA of supply current. The MAX4466/MAX4468 are decompensated for a minimum stable gain of +5V/V and provide a 600kHz gain bandwidth product. In addition, these amplifiers feature Rail-to-Rail® outputs, high A_{VOL}, plus excellent power-supply rejection and common-mode rejection ratios for operation in noisy environments.

The MAX4467/MAX4468 include a complete shutdown mode. In shutdown, the amplifiers' supply current is reduced to 5nA and the bias current to the external microphone is cut off for ultimate power savings. The single MAX4465/MAX4466 are offered in the ultra-small 5-pin SC70 package, while the single with shutdown MAX4467/MAX4468 and dual MAX4469 are available in the space-saving 8-pin SOT23 package.

Applications

Microphone Preamplifiers
Hearing Aids
Cellular Phones
Voice-Recognition Systems
Digital Dictation Devices
Headsets
Portable Computing

Pin Configurations



SC70/SOT23

Pin Configurations continued at end of data sheet.

Rail-to-Rail is a registered trademark of Nippon Motorola, Ltd.

Features

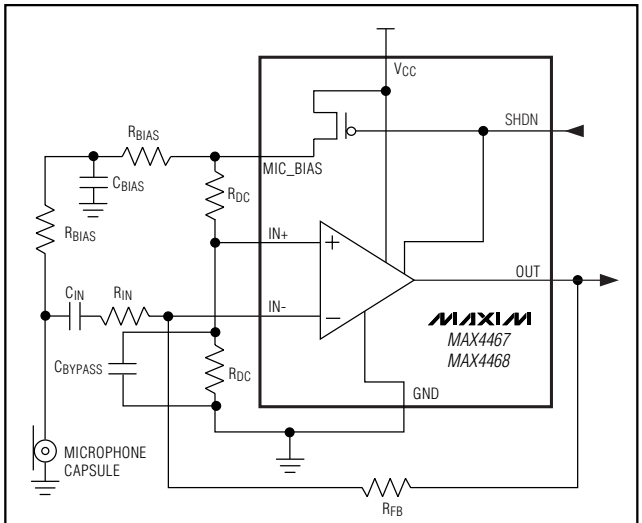
- **+2.4V to +5.5V Supply Voltage Operation**
- **Versions with 5nA Complete Shutdown Available (MAX4467/MAX4468)**
- **Excellent Power-Supply Rejection Ratio: 112dB**
- **Excellent Common-Mode Rejection Ratio: 126dB**
- **High A_{VOL}: 125dB (R_L = 100kΩ)**
- **Rail-to-Rail Outputs**
- **Low 24µA Quiescent Supply Current**
- **Gain Bandwidth Product:**
  200kHz (MAX4465/MAX4467/MAX4469)
  600kHz $A_V \geq 5$ (MAX4466/MAX4468)
- **Available in Space-Saving Packages**
  5-Pin SC70 (MAX4465/MAX4466)
  8-Pin SOT23 (MAX4467/MAX4468/MAX4469)

Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE
MAX4465EXK-T	-40°C to +85°C	5 SC70-5
MAX4465EUK-T	-40°C to +85°C	5 SOT23-5
MAX4466EXK-T	-40°C to +85°C	5 SC70-5
MAX4466EUK-T	-40°C to +85°C	5 SOT23-5

Ordering Information continued at end of data sheet.

Typical Operating Circuit



MAX4467/MAX4468 TYPICAL OPERATING CIRCUIT WITH COMPLETE SHUTDOWN

Low-Cost, Micropower, SC70/SOT23-8, Microphone Preamplifiers with Complete Shutdown

ABSOLUTE MAXIMUM RATINGS

Supply Voltage (V_{CC} to GND).....+6V
All Other Pins to GND.....-0.3V to (V_{CC} + 0.3V)
Output Short-Circuit Duration
OUT Shorted to GND or V_{CC}.....Continuous
Continuous Power Dissipation (T_A = +70°C)
5-Pin SC70 (derate 2.5mW/°C above +70°C).....200mW
5-Pin SOT23 (derate 7.1mW/°C above +70°C).....571mW
8-Pin SOT23 (derate 5.3mW/°C above +70°C).....421mW
8-Pin SO (derate 5.88mW/°C above +70°C).....471mW
Operating Temperature Range .....-40°C to +85°C
Storage Temperature Range .....-65°C to +150°C
Junction Temperature.....+150°C
Lead Temperature (soldering, 10s) .....+300°C

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

(V_{CC} = +5V, V_{CM} = 0, V_{OUT} = V_{CC}/2, R_L = ∞ to V_{CC}/2, SHDN = GND (MAX4467/MAX4468 only). T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values specified at T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Supply Voltage Range	V_{CC}	Inferred from PSRR test		2.4		5.5	V
Supply Current (Per Amplifier)	I_{CC}	T_A = +25°C			24	48	µA
		T_A = T_{MIN} to T_{MAX}				60	
Supply Current in Shutdown	I_{SHDN}	SHDN = V_{CC} (Note 2)			5	50	nA
Input Offset Voltage	V_{OS}				±1	±5	mV
Input Bias Current	I_B	V_{CM} = -0.1V			±2.5	±100	nA
Input Offset Current Range	I_{OS}	V_{CM} = -0.1V			±1	±15	nA
Input Common-Mode Range	V_{CM}	Inferred from CMRR test		-0.1		V_{CC} - 0.1	V
Common-Mode Rejection Ratio	CMRR	-0.1V ≤ V_{CM} ≤ V_{CC} - 1V		80	126		dB
Power-Supply Rejection Ratio	PSRR	2.4V ≤ V_{CC} ≤ 5.5V		80	112		dB
		MAX4465/MAX4467/MAX4469, f = 3.4kHz			75		
		MAX4466/MAX4468, f = 3.4kHz			80		
Open-Loop Gain	A_{VOL}	R_L = 100kΩ to V_{CC}/2, 0.05V ≤ V_{OUT} ≤ V_{CC} - 0.05V			125		dB
		R_L = 10kΩ to V_{CC}/2, 0.1V ≤ V_{OUT} ≤ V_{CC} - 0.1V		80	95		
Output Voltage Swing High	V_{OH}	$\lvert V_{CC} - V_{OH} \rvert$	R_L = 100kΩ		10		mV
			R_L = 10kΩ		16	50	
Output Voltage Swing Low	V_{OL}		R_L = 100kΩ		10		mV
			R_L = 10kΩ		14	50	
Output Short-Circuit Current		To either supply rail			15		mA
Output Leakage Current in Shutdown		SHDN = V_{CC}, 0 ≤ V_{OUT} ≤ V_{CC}; (Notes 2, 3)			±0.5	±100	nA
SHDN Logic Low	V_{IL}	(Note 2)				V_{CC} × 0.3	V
SHDN Logic High	V_{IH}	(Note 2)		V_{CC} × 0.7			V
SHDN Input Current		(Note 2)			2	25	nA
Gain Bandwidth Product	GBWP	MAX4465/MAX4467/MAX4469			200		kHz
		MAX4466/MAX4468			600		

ELECTRICAL CHARACTERISTICS (continued)

(V_{CC} = +5V, V_{CM} = 0, V_{OUT} = V_{CC}/2, R_L = ∞ to V_{CC}/2, SHDN = GND (MAX4467/MAX4468 only), T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values specified at T_A = +25°C.) (Note 1)

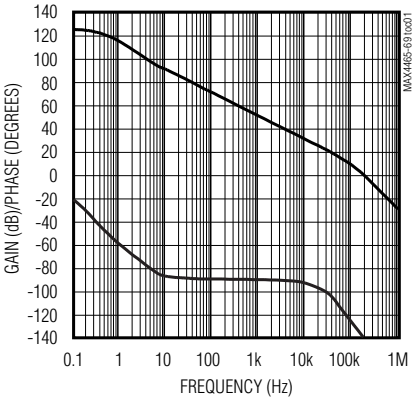
PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Channel-to-Channel Isolation		MAX4469 only, f = 1kHz			85		dB
Phase Margin	$Ø_M$	R_L = 100kΩ			70		degrees
Gain Margin		R_L = 100kΩ			20		dB
Slew Rate	SR	Output step = 4V	MAX4465/MAX4467/MAX4469, A_V = +1		45		mV/µs
			MAX4466/MAX4468, A_V = +5		300		
Input Noise Voltage Density	e_n	f = 1kHz			80		nV/√Hz
Total Harmonic Distortion	THD	f = 1kHz, R_L = 10kΩ, V_{OUT} = 2Vp-p	MAX4465/MAX4467/MAX4469		0.02		%
			MAX4466/MAX4468		0.03		
Capacitive Load Stability	C_{LOAD}	MAX4465/MAX4467/MAX4469, A_V = +1			100		pF
		MAX4466/MAX4468, A_V = +5			100		
SHDN Delay Time	t_{SHDN}	(Note 2)			1		µs
Enable Delay Time	t_{EN}	(Note 2)			50		µs
Power-On Time	t_{ON}	(Note 2)			40		µs
Bias Switch On-Resistance	R_S	I_S = 5mA (Note 2)			20	500	Ω

Note 1: All specifications are 100% production tested at T_A = +25°C. All temperature limits are guaranteed by design.
Note 2: Shutdown mode is available only on the MAX4467/MAX4468.
Note 3: External feedback networks not considered.

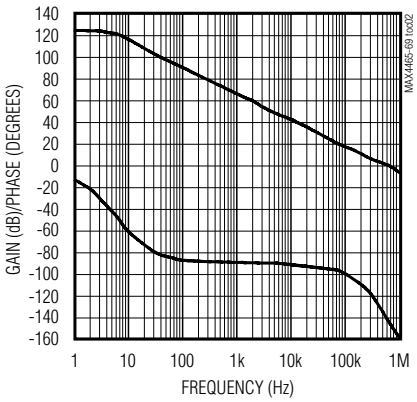
Typical Operating Characteristics

(V_{CC} = +5V, V_{CM} = 0, V_{OUT} = V_{CC}/2, R_L= 100kΩ to V_{CC}/2, SHDN = GND (MAX4467/MAX4468 only), T_A = +25°C, unless otherwise noted.)

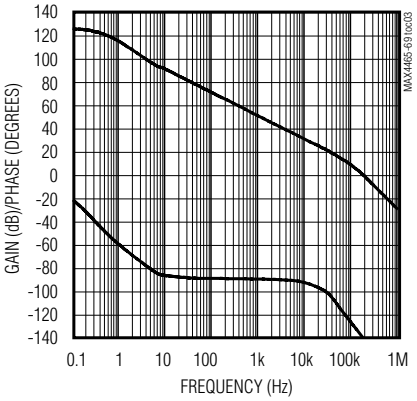
MAX4465/MAX4467/MAX4469 GAIN AND PHASE vs. FREQUENCY (NO LOAD)



MAX4466/MAX4468 GAIN AND PHASE vs. FREQUENCY (NO LOAD)



MAX4465/MAX4467/MAX4469 GAIN AND PHASE vs. FREQUENCY (C_L = 100pF)

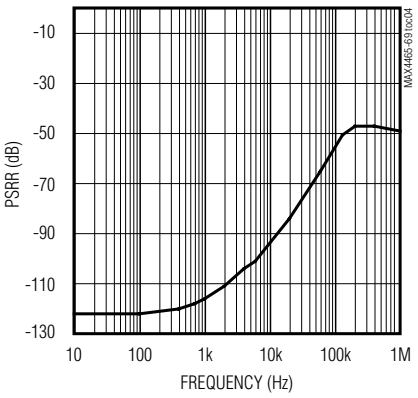


Low-Cost, Micropower, SC70/SOT23-8, Microphone Preamplifiers with Complete Shutdown

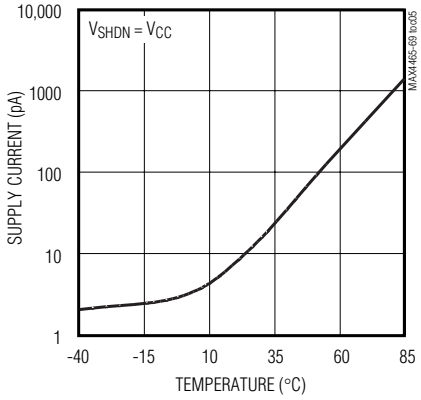
Typical Operating Characteristics (continued)

(V_{CC} = +5V, V_{CM} = 0, V_{OUT} = V_{CC}/2, R_L= 100kΩ to V_{CC}/2, SHDN = GND (MAX4467/MAX4468 only), T_A = +25°C, unless otherwise noted.)

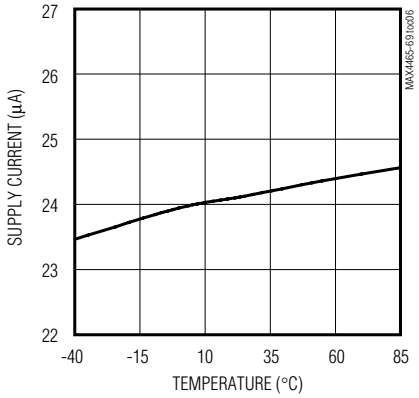
POWER-SUPPLY REJECTION RATIO vs. FREQUENCY



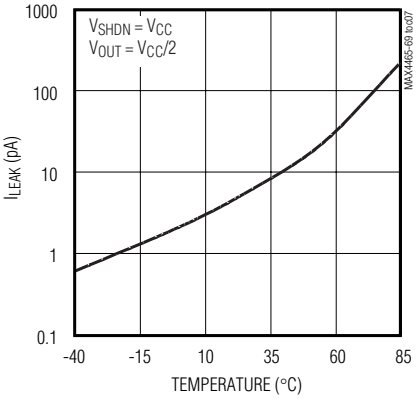
SHUTDOWN SUPPLY CURRENT vs. TEMPERATURE



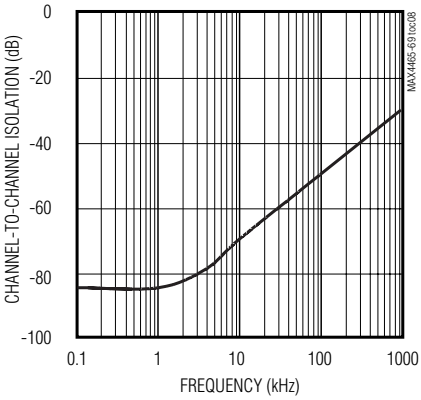
SUPPLY CURRENT vs. TEMPERATURE



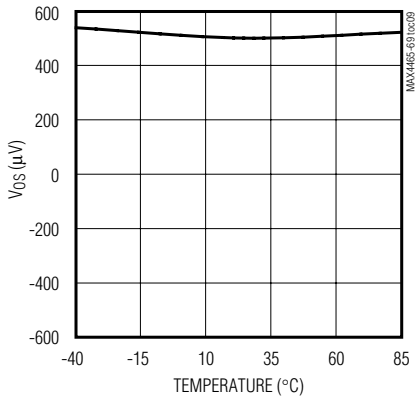
OUTPUT LEAKAGE CURRENT vs. TEMPERATURE



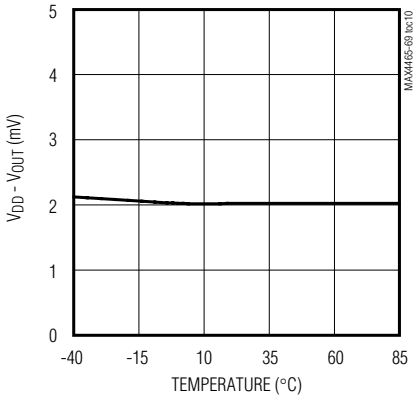
CHANNEL-TO-CHANNEL ISOLATION vs. FREQUENCY



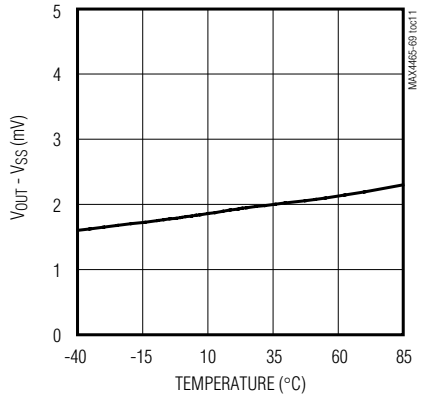
INPUT OFFSET VOLTAGE vs. TEMPERATURE



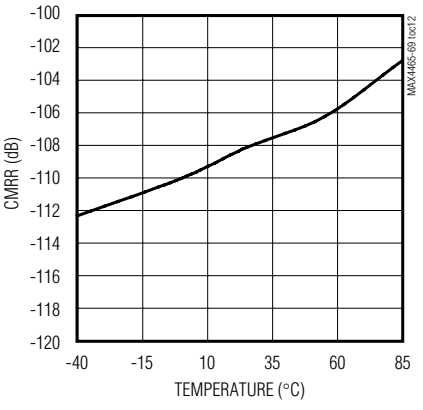
OUTPUT VOLTAGE SWING HIGH vs. TEMPERATURE



OUTPUT VOLTAGE SWING LOW vs. TEMPERATURE



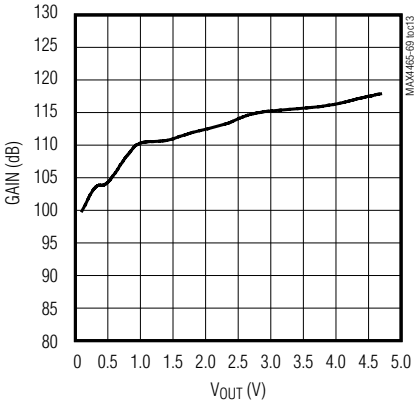
COMMON-MODE REJECTION RATIO vs. TEMPERATURE



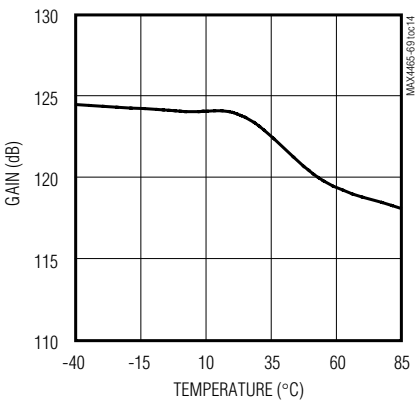
Typical Operating Characteristics (continued)

(V_{CC} = +5V, V_{CM} = 0, V_{OUT} = V_{CC}/2, R_L= 100kΩ to V_{CC}/2, SHDN = GND (MAX4467/MAX4468 only), T_A = +25°C, unless otherwise noted.)

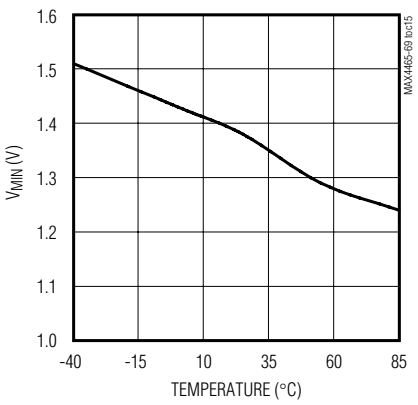
LARGE-SIGNAL GAIN vs. OUTPUT VOLTAGE



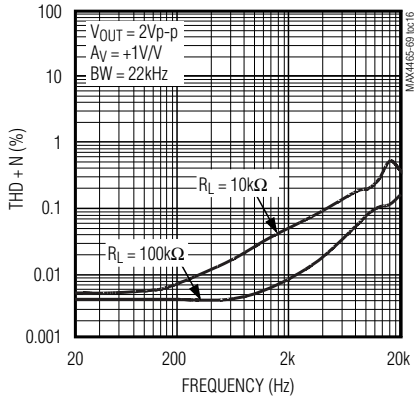
LARGE-SIGNAL GAIN vs. TEMPERATURE



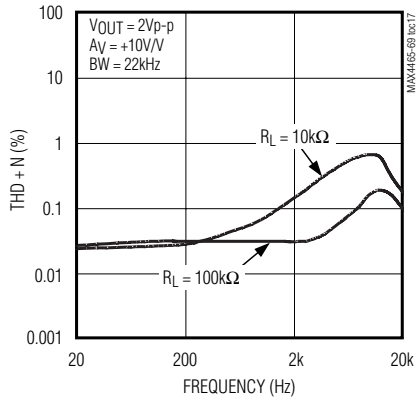
MINIMUM OPERATING VOLTAGE vs. TEMPERATURE



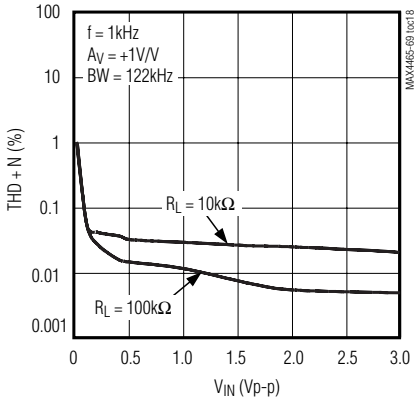
MAX4465/MAX4467/MAX4469 TOTAL HARMONIC DISTORTION PLUS NOISE vs. FREQUENCY



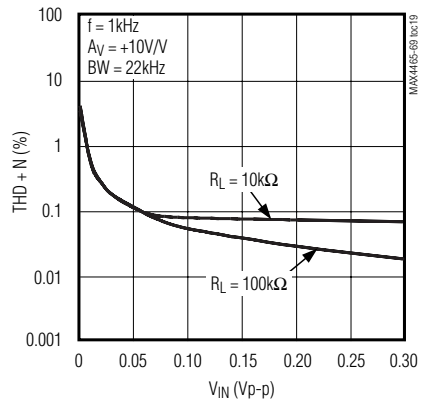
MAX4466/MAX4468 TOTAL HARMONIC DISTORTION vs. FREQUENCY



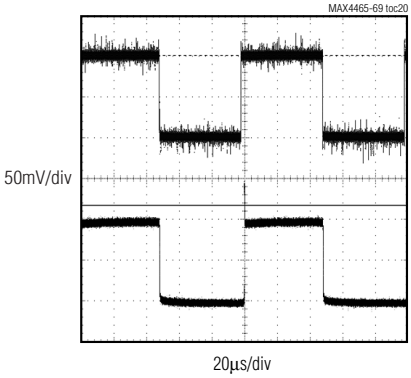
MAX4465/MAX4467/MAX4469 TOTAL HARMONIC DISTORTION PLUS NOISE vs. INPUT AMPLITUDE



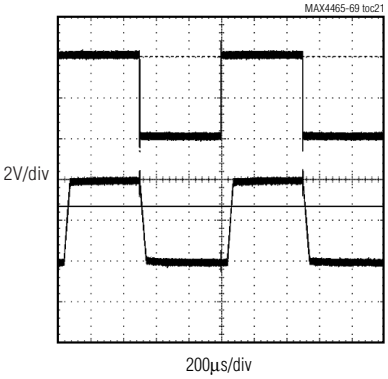
MAX4466/MAX4468 TOTAL HARMONIC DISTORTION PLUS NOISE vs. INPUT AMPLITUDE



NONINVERTING SMALL-SIGNAL TRANSIENT RESPONSE



NONINVERTING LARGE-SIGNAL TRANSIENT RESPONSE

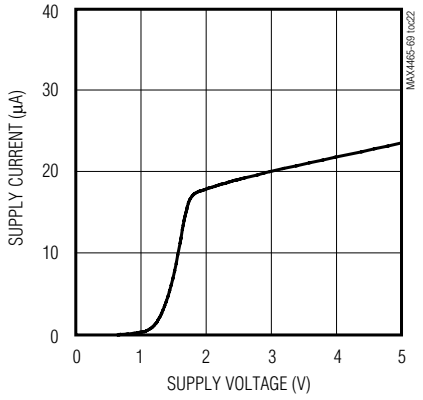


Low-Cost, Micropower, SC70/SOT23-8, Microphone Preamplifiers with Complete Shutdown

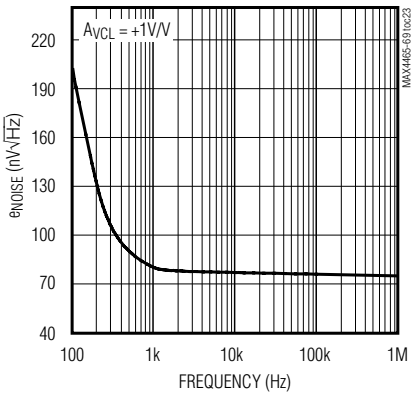
Typical Operating Characteristics (continued)

(V_{CC} = +5V, V_{CM} = 0, V_{OUT} = V_{CC}/2, R_L= 100kΩ to V_{CC}/2, SHDN = GND (MAX4467/MAX4468 only), T_A = +25°C, unless otherwise noted.)

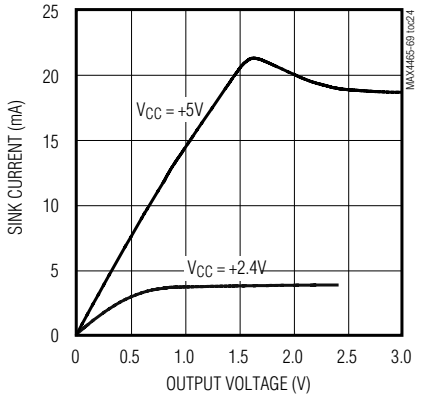
SUPPLY CURRENT vs. SUPPLY VOLTAGE



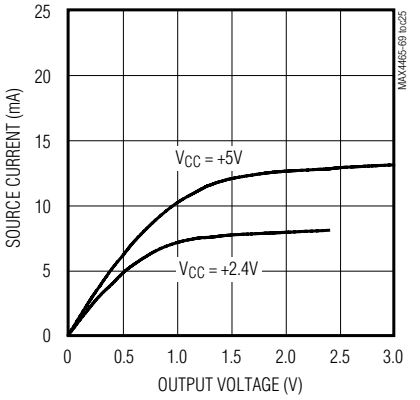
eNOISE vs. FREQUENCY



SINK CURRENT vs. OUTPUT VOLTAGE



SOURCE CURRENT vs. OUTPUT VOLTAGE



Pin Description

PIN			NAME	FUNCTION
MAX4465 MAX4466	MAX4467 MAX4468	MAX4469		
4	6 (8)	—	OUT	Amplifier Output
—	—	1	OUTA	Amplifier Output A
—	1 (4)	—	MIC_BIAS	External Microphone Bias Network Switch Output
3	2 (3)	—	IN-	Inverting Amplifier Input
1	3 (2)	—	IN+	Noninverting Amplifier Input
2	4 (1)	4	GND	Ground

( ) denotes S0T23 package of the MAX4467/MAX4468

Pin Description (continued)

PIN			NAME	FUNCTION
MAX4465 MAX4466	MAX4467 MAX4468	MAX4469		
5	7 (7)	8	V_{CC}	Positive Supply. Bypass with a 0.1µF capacitor to GND.
—	—	2	INA-	Inverting Amplifier Input A
—	—	3	INA+	Noninverting Amplifier Input A
—	—	6	INB-	Inverting Amplifier Input B
—	—	5	INB+	Noninverting Amplifier Input B
—	—	7	OUTB	Amplifier Output B
—	8 (6)	—	SHDN	Active-High Shutdown Input. Connect to GND for normal operation. Connect to V_{CC} for shutdown. Do not leave floating.
—	5 (5)	—	N.C.	No Connection. Not internally connected.

( ) denotes SOT23 package of the MAX4467/MAX4468.

Detailed Description

The MAX4465–MAX4469 are low-power, micropower op amps designed to be used as microphone preamplifiers. These preamplifiers are an excellent choice for noisy environments because of their high common-mode rejection and excellent power-supply rejection ratios. They operate from a single +2.4V to +5.5V supply.

The MAX4465/MAX4467/MAX4469 are unity-gain stable and deliver a 200kHz gain bandwidth from only 24µA of supply current. The MAX4466/MAX4468 have a minimum stable gain of +5V/V while providing a 600kHz gain bandwidth product.

The MAX4467/MAX4468 feature a complete shutdown, which is active-high, and a shutdown-controlled output providing bias to the microphone. The MAX4465/MAX4467/MAX4469 feature a slew rate suited to voice channel applications. The MAX4466/MAX4468 can be used for full-range audio, e.g., PC99 inputs.

Rail-to-Rail Output Stage

The MAX4465–MAX4469 can drive a 10kΩ load and still typically swing within 16mV of the supply rails. Figure 1 shows the output voltage swing of the MAX4465 configured with A_V = +10.

Switched Bias Supply

When used as a microphone amplifier for an electret microphone, some form of DC bias for the microphone is necessary. The MAX4467/MAX4468 have the ability to turn off the bias to the microphone when the device is in shutdown. This can save several hundred microamps of supply current, which can be significant in low power applications. The MIC_BIAS pin provides a switched version of V_{CC} to the bias components. Figure 3 shows some typical values.

Driving Capacitive Loads

Driving a capacitive load can cause instability in many op amps, especially those with low quiescent current. The MAX4465/MAX4467/MAX4469 are unity-gain stable for a range of capacitive loads up to 100pF. Figure 4 shows the response of the MAX4465 with an excessive capacitive load.

Applications Information

Shutdown Mode

The MAX4467 and MAX4468 feature a low-power, complete shutdown mode. When SHDN goes high, the supply current drops to 5nA, the output enters a high impedance state and the bias current to the microphone is switched off. Pull SHDN low to enable the amplifier. Do not leave SHDN floating. Figure 5 shows the shutdown waveform.

Common-Mode Rejection Ratio

A microphone preamplifier ideally only amplifies the signal present on its input and converts it to a voltage appearing at the output. When used in noninverting mode, there is a small output voltage fluctuation when both inputs experience the same voltage change in the

Low-Cost, Micropower, SC70/SOT23-8, Microphone Preamplifiers with Complete Shutdown

common mode. The ratio of these voltages is called the common-mode gain. The common-mode rejection ratio is the ratio of differential-mode gain to common-mode gain. The high CMRR properties of the MAX4465–MAX4469 provide outstanding performances when configured as a noninverting microphone preamplifier.

Power-Up

The MAX4465–MAX4469 outputs typically settle within 1µs after power-up. Figure 6 shows the output voltage on power-up.

Power Supplies and Layout

The MAX4465–MAX4469 operate from a single +2.4V to +5.5V power supply. Bypass the power supply with a 0.1µF capacitor to ground. Good layout techniques are necessary for the MAX4465–MAX4469 family. To decrease stray capacitance, minimize trace lengths by placing external components close to the op amp's pins. Surface-mount components are recommended. In systems where analog and digital grounds are available, the MAX4465–MAX4469 should be connected to the analog ground.

Test Circuits/Timing Diagrams

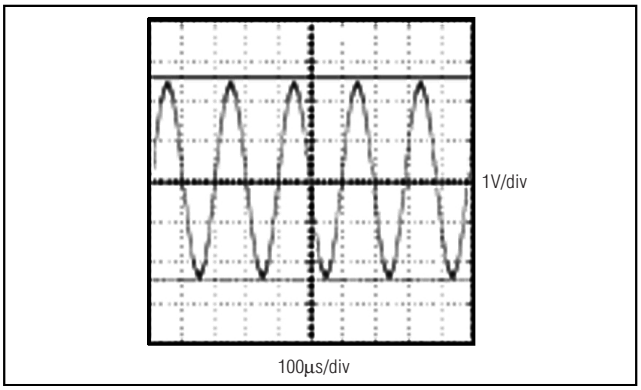


Figure 1. Rail-to-Rail Output Operation

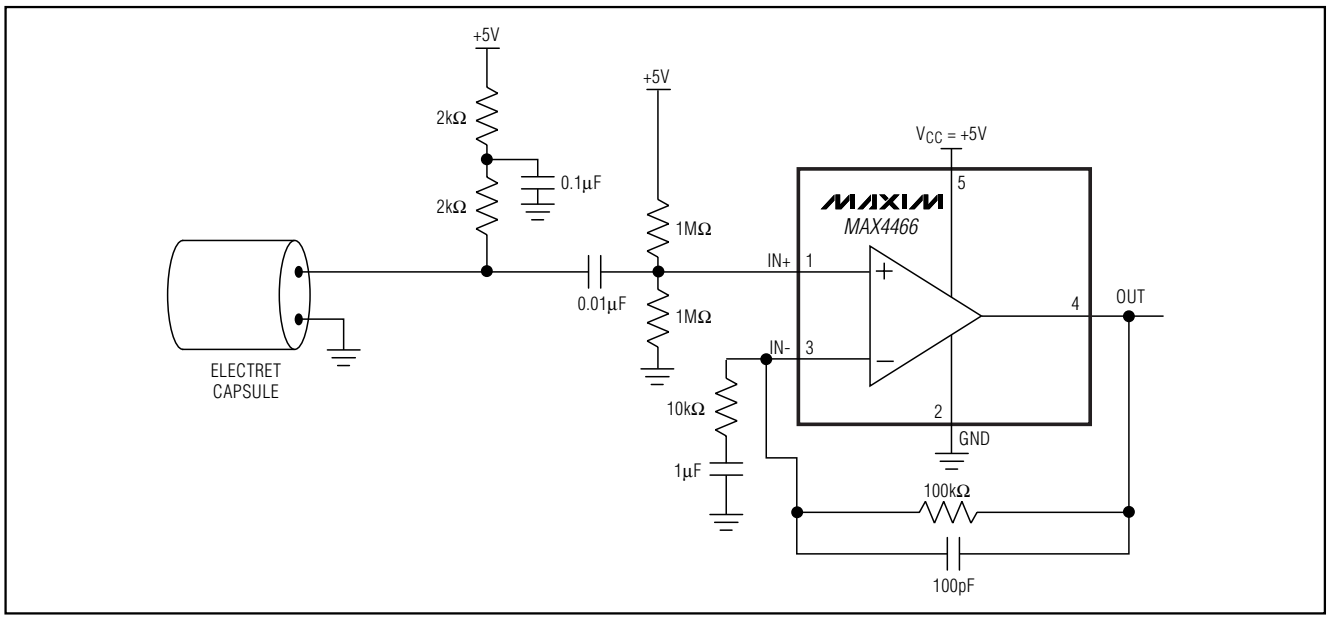


Figure 2. MAX4466 Typical Application Circuit

Test Circuits/Timing Diagrams (continued)

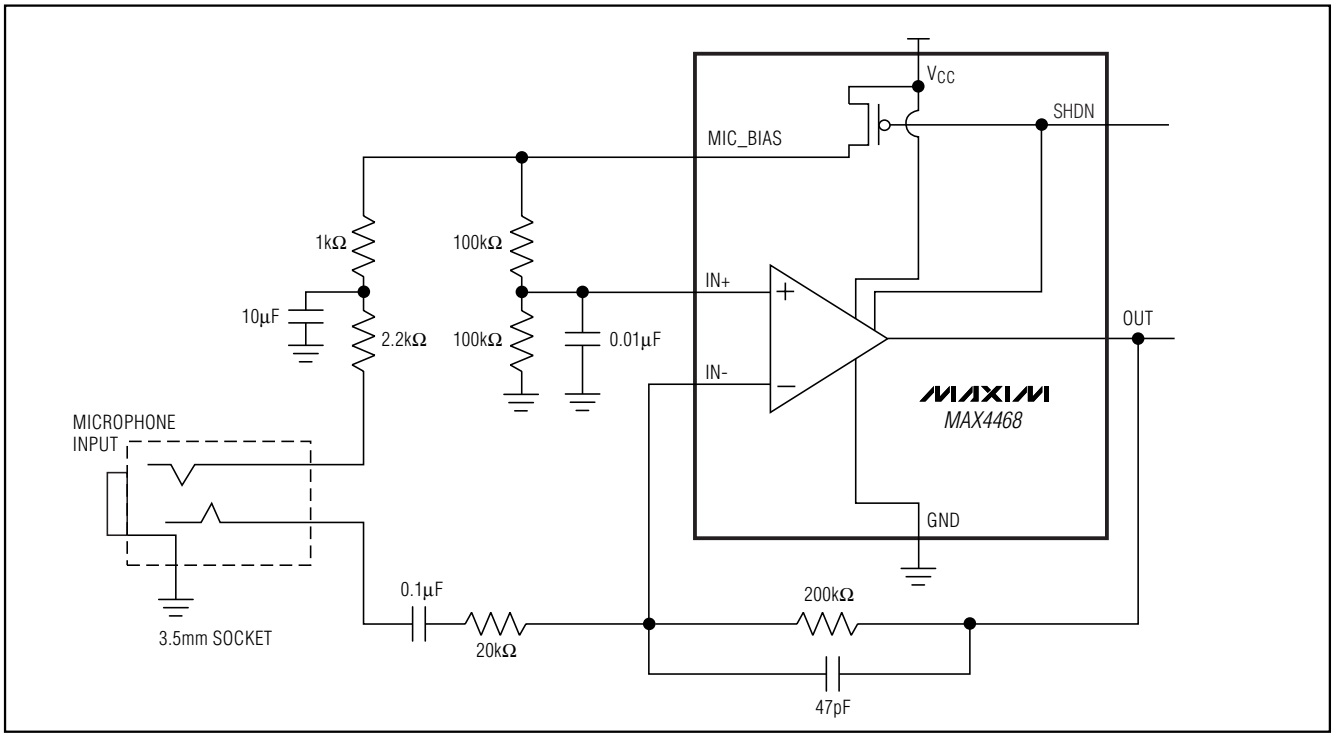


Figure 3. Bias Network Circuit

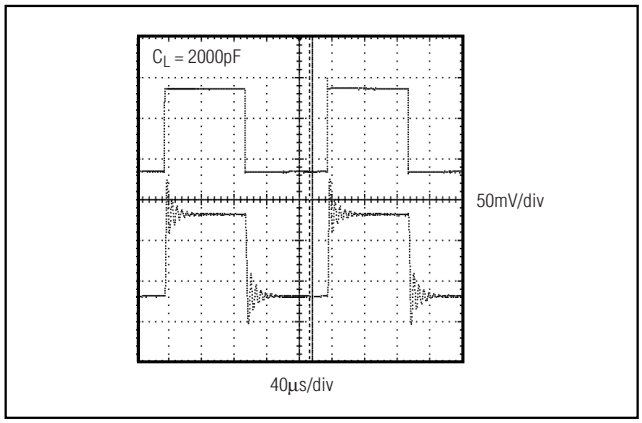


Figure 4. Small-Signal Transient Response with Excessive Capacitive Load

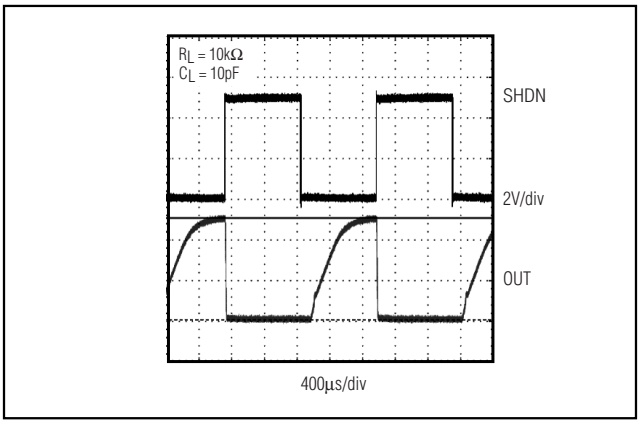


Figure 5. MAX4467/MAX4468 Shutdown Waveform

Low-Cost, Micropower, SC70/SOT23-8, Microphone Preamplifiers with Complete Shutdown

Test Circuits/Timing Diagrams (continued)

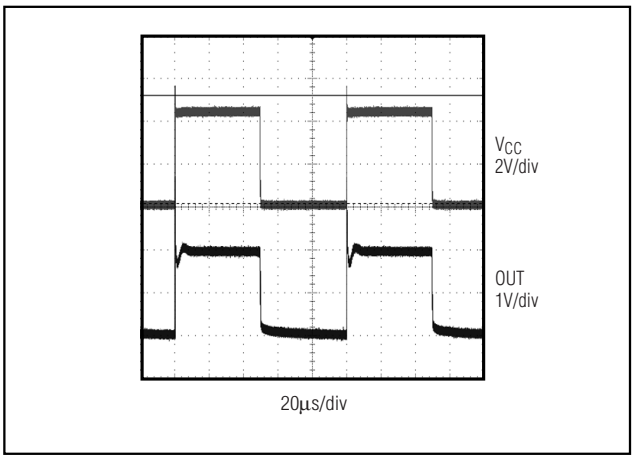


Figure 6. Power-Up/Power-Down Waveform

Chip Information

MAX4465/MAX4466 TRANSISTOR COUNT: 62

MAX4467/MAX4468 TRANSISTOR COUNT: 72

MAX4469 TRANSISTOR COUNT: 113

PROCESS: BiCMOS

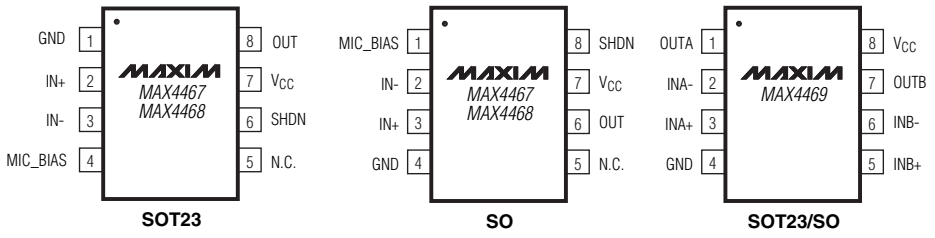
Ordering Information (continued)

PART	TEMP. RANGE	PIN-PACKAGE
MAX4467EKA-T	-40°C to +85°C	8 SOT23-8
MAX4467ESA	-40°C to +85°C	8 SO
MAX4468EKA-T	-40°C to +85°C	8 SOT23-8
MAX4468ESA	-40°C to +85°C	8 SO
MAX4469EKA-T	-40°C to +85°C	8 SOT23-8
MAX4469ESA	-40°C to +85°C	8 SO

Selector Guide

PART	MINIMUM STABLE GAIN	EXTERNAL MICROPHONE SHDN	GBWP (kHz)	PIN-PACKAGE
MAX4465	+1	No	200	5 SC70/5 SOT23
MAX4466	+5	No	600	5 SC70/5 SOT23
MAX4467	+1	Yes	200	8 SOT23/8 SO
MAX4468	+5	Yes	600	8 SOT23/8 SO
MAX4469	+1	No	200	8 SOT23/8 SO

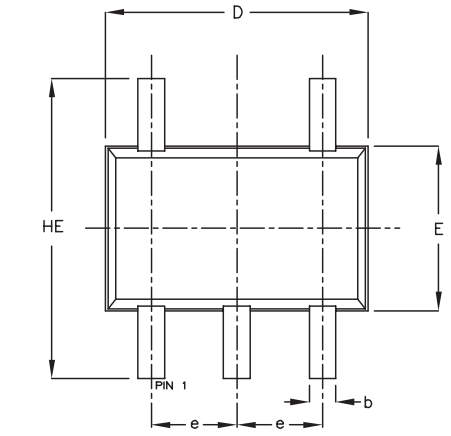
Pin Configurations (continued)

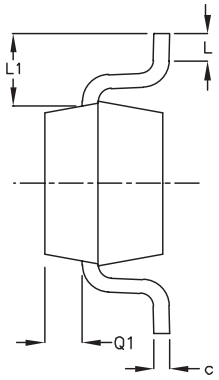


Low-Cost, Micropower, SC70/SOT23-8, Microphone Preamplifiers with Complete Shutdown

Package Information

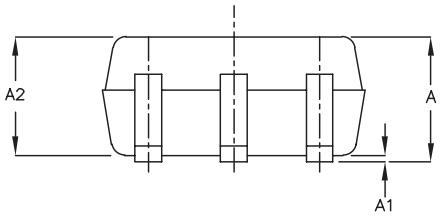
SC70, 5L.EPS





SYMBOL	MIN	MAX
e	0.65 BSC	
D	1.80	2.20
b	0.15	0.30
E	1.15	1.35
HE	1.80	2.40
Q1	0.10	0.40
A2	0.80	1.00
A1	0.00	0.10
A	0.80	1.10
c	0.10	0.18
L	0.10	0.30
L1	0.425 TYP.	

NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETERS
2. DIMENSIONS ARE INCLUSIVE OF PLATING
3. DIMENSIONS ARE EXCLUSIVE OF MOLD FLASH & METAL BURR
4. ALL SPECIFICATIONS COMPLY TO EIAJ SC70
5. COPLANARITY 4 MILS. MAX.



MAXIM
PROPRIETARY INFORMATION

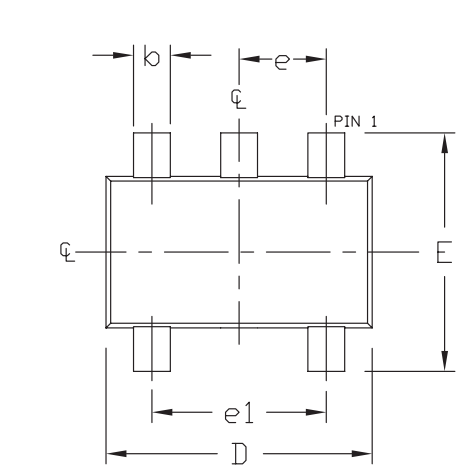
TITLE:
PACKAGE OUTLINE, SC70, 5L

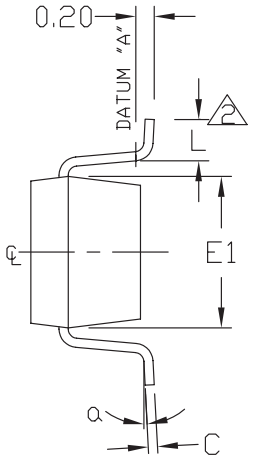
APPROVAL	DOCUMENT CONTROL NO.	REV	
	21-0076	B	1/1

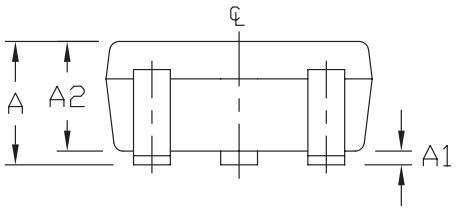
Low-Cost, Micropower, SC70/SOT23-8, Microphone Preamplifiers with Complete Shutdown

Package Information (continued)

SOT5L.EPS







SYMBOL	MIN	MAX
A	0.90	1.45
A1	0.00	0.15
A2	0.90	1.30
b	0.35	0.50
C	0.08	0.20
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.75
L	0.35	0.55
e	0.95 REF	
e1	1.90 REF	
a	0°	10°

NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. FOOT LENGTH MEASURED AT INTERCEPT POINT BETWEEN DATUM A & LEAD SURFACE.
3. PACKAGE OUTLINE EXCLUSIVE OF MOLD FLASH & METAL BURR.
4. PACKAGE OUTLINE INCLUSIVE OF SOLDER PLATING.
5. MEETS JEDEC MO178.

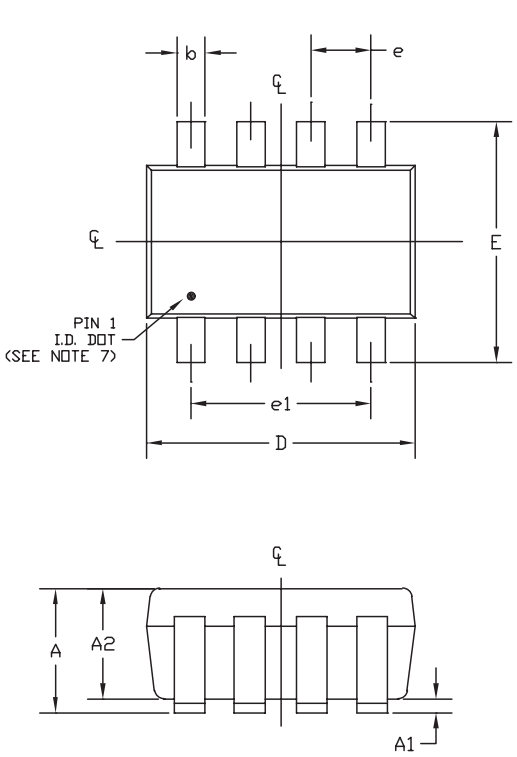
MAXIM
PROPRIETARY INFORMATION
TITLE: PACKAGE OUTLINE, SOT-23, 5L

APPROVAL	DOCUMENT CONTROL NO.	REV	
	21-0057	C	1/1

Low-Cost, Micropower, SC70/SOT23-8, Microphone Preamplifiers with Complete Shutdown

Package Information (continued)

SOT23, 8L.EPS



SYMBOL	MIN	MAX
A	0.90	1.45
A1	0.00	0.15
A2	0.90	1.30
b	0.28	0.45
C	0.09	0.20
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.75
L	0.10	0.60
e	0.65 ref	
e1	1.95 ref	
α	0°	10°

NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. FOOT LENGTH MEASURED REFERENCE TO FLAT FOOT SURFACE PARALLEL TO DATUM "A".
3. PACKAGE OUTLINE EXCLUSIVE OF MOLD FLASH & METAL BURR.
4. PACKAGE OUTLINE INCLUSIVE OF SOLDER PLATING.
5. EIAJ REF. NUMBER" SC-74 (6 LEAD VERSION)
6. COPLANARITY 4 MILS. MAX.
7. PIN 1 I.D. DOT IS 0.3 MM ø MIN. LOCATED ABOVE PIN 1.

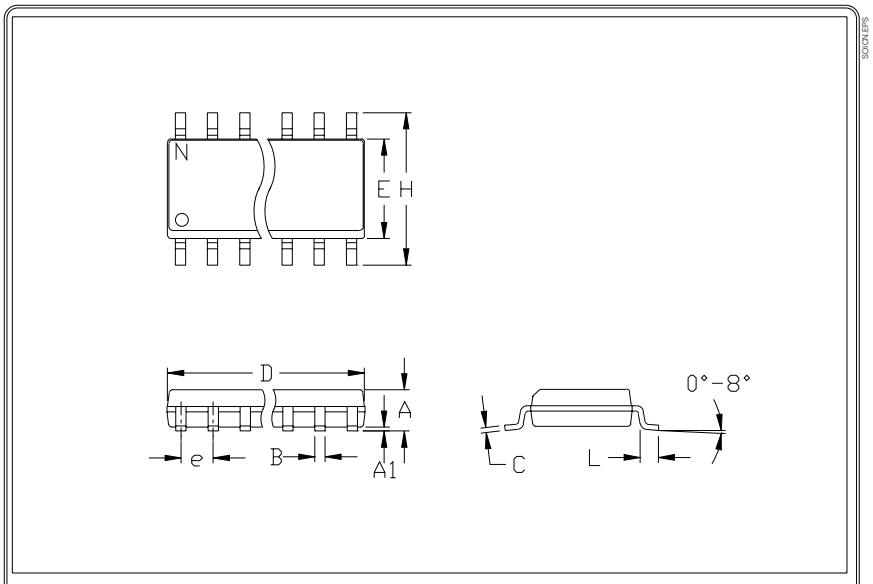
MAXIM
PROPRIETARY INFORMATION

TITLE:
PACKAGE OUTLINE, SOT 23, 8L

APPROVAL	DOCUMENT CONTROL NO.	REV	
	21-0078	B	1/1

Low-Cost, Micropower, SC70/SOT23-8, Microphone Preamplifiers with Complete Shutdown

Package Information (continued)



	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.053	0.069	1.35	1.75
A1	0.004	0.010	0.10	0.25
B	0.014	0.019	0.35	0.49
C	0.007	0.010	0.19	0.25
e	0.050		1.27	
E	0.150	0.157	3.80	4.00
H	0.228	0.244	5.80	6.20
h	0.010	0.020	0.25	0.50
L	0.016	0.050	0.40	1.27

	INCHES		MILLIMETERS			
	MIN	MAX	MIN	MAX	N	MS012
D	0.189	0.197	4.80	5.00	8	A
D	0.337	0.344	8.55	8.75	14	B
D	0.386	0.394	9.80	10.00	16	C

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .15mm (.006")
3. LEADS TO BE COPLANAR WITHIN .102mm (.004")
4. CONTROLLING DIMENSION: MILLIMETER
5. MEETS JEDEC MS012-XX AS SHOWN IN ABOVE TABLE
6. N = NUMBER OF PINS

MAXIM 120 SAN GABRIEL DR SUNNYVALE CA 94086 FAX (408) 737 7194 PROPRIETARY INFORMATION | PACKAGE FAMILY OUTLINE: SOIC .150" TITLE | 1/1 | 21-0041 A DOCUMENT CONTROL NUMBER REV

VirtualWire

Mike McCauley

Documentation for the VirtualWire 1.3 communications library for Arduino.

1.0 Introduction

Arduino is a low cost microcontroller with Open Source hardware, see http://www.arduino.cc. VirtualWire is a communications library for Arduino that allows multiple Arduino's to communicate using low-cost RF transmitters and receivers.

The document describes the VirtualWire library and how to install and use it.

2.0 Overview

VirtualWire is an Arduino library that provides features to send short messages, without addressing, retransmit or acknowledgment, a bit like UDP over wireless, using ASK (amplitude shift keying). Supports a number of inexpensive radio transmitters and receivers. All that is required is transmit data, receive data and (for transmitters, optionally) a PTT transmitter enable.

It is intended to be compatible with the RF Monolithics (www.rfm.com) Virtual Wire protocol, but this has not been tested.

Does not use the Arduino UART. Messages are sent with a training preamble, message length and checksum. Messages are sent with 4-to-6 bit encoding for good DC balance, and a CRC checksum for message integrity.

Why not just use the Arduino UART connected directly to the transmitter/receiver? As discussed in the RFM documentation, ASK receivers require a burst of training pulses to synchronize the transmitter and receiver, and also requires good balance between 0s and 1s in the message stream in order to maintain the DC balance of the message.

UARTs do not provide these. They work a bit with ASK wireless, but not as well as this code.

2.1 Supported hardware.

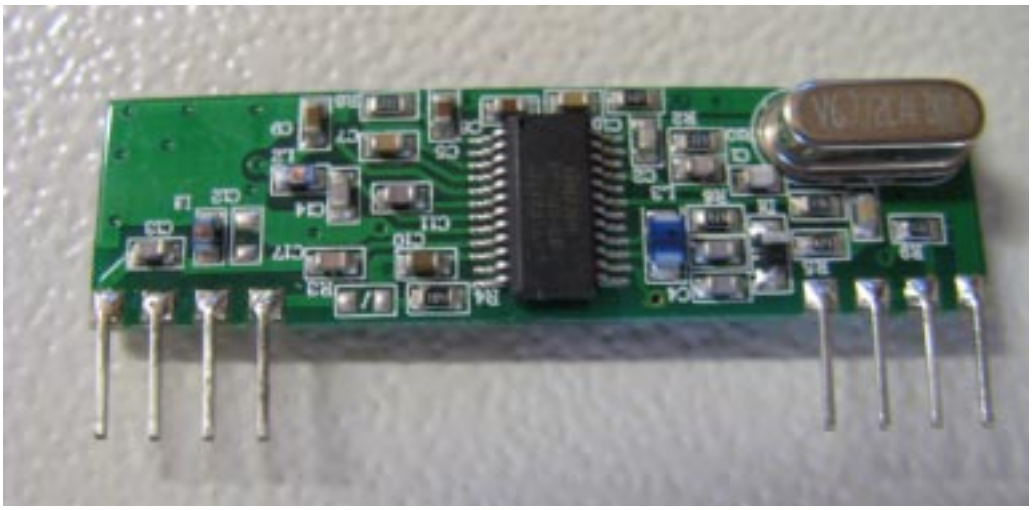
A range of communications hardware is supported. The ones listed blow are available in common retail outlets in Australian and other countries for under $10 per unit. Many other modules may also work with this software.

Runs on ATmega8/168 (Arduino Diecimila etc) and ATmega328 and possibly others.

2.2 Receivers

- RX-B1 (433.92MHz) (also known as ST-RX04-ASK)

FIGURE 1. RX-B1

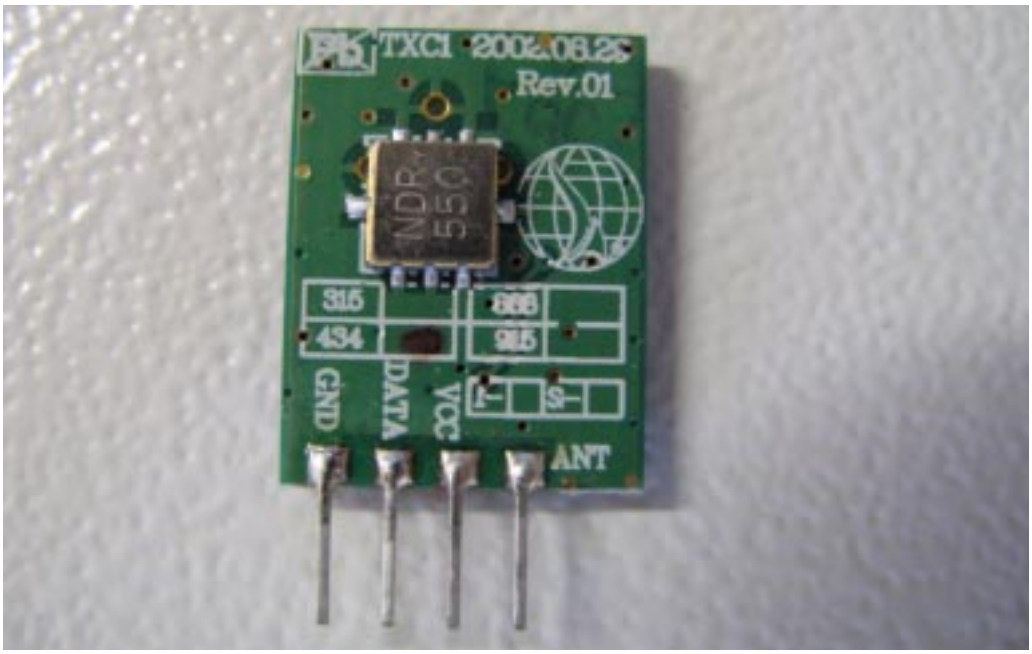


Details at http://www.summitek.com.tw/ST_SPEC/ST-RX04-ASK.pdf

2.3 Transmitters:

- TX-C1 (433.92MHz)

FIGURE 2. TX-C1



Details at http://www.tato.ind.br/files/TX-C1.pdf

2.4 Transceivers:

- DR3100 (433.92MHz)

FIGURE 3. DR3100

Details at http://www.rfmonolithics.com/products/data/dr3100.pdf

3.0 Downloading and installation

The latest version of this document is available from

```
http://www.open.com.au/mikem/arduino/VirtualWire.pdf
```

Download the VirtualWire distribution from

```
http://www.open.com.au/mikem/arduino/VirtualWire-1.3.zip
```

To install, unzip the library to a sub-directory of the `hardware/libraries` sub-directory of your Arduino application directory. Then launch the Arduino environment; you should see the library in the Sketch->Import Library menu, and example code in File->Sketchbook->Examples->Library-VirtualWire menu.

4.0 Function calls

To use the VirtualWire library, you must have

```
#include <VirtualWire.h>
```

At the top of your sketch.

4.1 vw_set_tx_pin

```
extern void vw_set_tx_pin(uint8_t pin);
```

Set the digital IO pin to use for transmit data. Defaults to 12.

4.2 vw_set_rx_pin

```
extern void vw_set_rx_pin(uint8_t pin);
```

Set the digital IO pin to use for receive data. Defaults to 11.

4.3 vw_set_ptt_pin

```
extern void vw_set_ptt_pin(uint8_t pin);
```

Set the digital IO pin to use to enable the transmitter (press to talk). Defaults to 10. Not all transmitters require PTT. The DR3100 does, but the TX-B1 does not.

4.4 vw_set_ptt_inverted

```
extern void vw_set_ptt_inverted(uint8_t inverted);
```

By default the PTT pin goes high when the transmitter is enabled. This flag forces it low when the transmitter is enabled. Required for the DR3100.

4.5 vw_setup

```
extern void vw_setup(uint16_t speed);
```

Initialise the VirtualWire software, to operate at *speed* bits per second. Call this once in your setup() after any vw_set_* calls. You must call vw_rx_start() after this before you will get any messages.

4.6 vw_rx_start

```
extern void vw_rx_start();
```

Start the receiver. You must do this before you can receive any messages. When a message is available (good checksum or not), vw_have_message() will return true.

4.7 vw_rx_stop

```
extern void vw_rx_stop();
```

Stop the receiver. No messages will be received until vw_rx_start() is called again. Saves interrupt processing cycles when you know there will be no messages.

4.8 vw_wait_tx

```
extern void vw_wait_tx();
```

Block and wait until the transmitter is idle

4.9 vw_wait_rx

```
xtern void vw_wait_rx();
```

Block and wait until a message is available from the receiver.

4.10 vw_wait_rx_max

```
extern uint8_t vw_wait_rx_max(unsigned long milliseconds);
```

Wait at most *milliseconds* ms for a message to be received. Return true if a message is available.

4.11 vw_send

```
extern uint8_t vw_send(uint8_t* buf, uint8_t len);
```

Send a message with the given length. Returns almost immediately, and the message will be sent at the right timing by interrupts. Returns true if the message was accepted for transmission. Returns false if the message is too long (>VW_MAX_PAYLOAD).

4.12 vw_have_message

```
extern uint8_t vw_have_message();
```

Returns true if an unread message is available from the receiver.

4.13 vw_get_message

```
extern uint8_t vw_get_message(uint8_t* buf, uint8_t* len);
```

If a message is available (good checksum or not), copies up to *len octets to buf. Returns true if there was a message *and* the checksum was good.

5.0 Sample code

The following samples are available as examples in the VirtualWire distribution.

5.1 transmitter

A simplex (one-way) transmitter. Sends a short message every 400 ms. Test this with the receiver below.

```
#include <VirtualWire.h>
void setup()
{
    vw_setup(2000); // Bits per sec
}
```

```
void loop()
{
    const char *msg = "hello";
    vw_send((uint8_t *)msg, strlen(msg));
    delay(400);
}
```

5.2 receiver

A simplex (one-way) receiver. Waits for a message and dumps it contents. Test this with transmitter above.

```
#include <VirtualWire.h>
void setup()
{
    Serial.begin(9600);
    Serial.println("setup");
    vw_setup(2000); // Bits per sec
    vw_rx_start();    // Start the receiver PLL running
}
void loop()
{
    uint8_t buf[VW_MAX_MESSAGE_LEN];
    uint8_t buflen = VW_MAX_MESSAGE_LEN;
    if (vw_get_message(buf, &buflen)) // Non-blocking
    {
          int i;
          // Message with a good checksum received, dump HEX
          Serial.print("Got: ")
          for (i = 0; i < buflen; i++)
          {
              Serial.print(buf[i], HEX);
              Serial.print(" ");
          }
          Serial.println("");
   }
}
```

5.3 client

Implements a simple wireless client for DR3100. Sends a message to another Arduino running the server code below and waits for a reply.

```
#include <VirtualWire.h>
void setup()
{
    Serial.begin(9600);// Debugging only
    Serial.println("setup");
    vw_set_ptt_inverted(true); // Required for DR3100
    vw_setup(2000); // Bits per sec
    vw_rx_start();       // Start the receiver PLL running
}
void loop()
{
```

```
    const char *msg = "hello";
    uint8_t buf[VW_MAX_MESSAGE_LEN];
    uint8_t buflen = VW_MAX_MESSAGE_LEN;
    vw_send((uint8_t *)msg, strlen(msg));
    vw_wait_tx(); // Wait until the whole message is gone
    Serial.println("Sent");
   // Wait at most 400ms for a reply
   if (vw_wait_rx_max(400))
   {
          if (vw_get_message(buf, &buflen)) // Non-blocking
          {
              int i;
              // Message with a good checksum received, dump it.
              Serial.print("Got reply: ");
              for (i = 0; i < buflen; i++)
              {
                 Serial.print(buf[i], HEX);
                 Serial.print(" ");
              }
              Serial.println("");
          }
    }
    else
          Serial.println("Timout");
}
```

5.4 server

Implements a simple wireless server for DR3100. Waits for a message from another Arduino running the client code above and sends a reply.

```
#include <VirtualWire.h>
void setup()
{
    Serial.begin(9600);// Debugging only
    Serial.println("setup");
    vw_set_ptt_inverted(true); // Required for DR3100
    vw_setup(2000); // Bits per sec
    vw_rx_start();       // Start the receiver PLL running
}
void loop()
{
    const char *msg = "hello";
    uint8_t buf[VW_MAX_MESSAGE_LEN];
    uint8_t buflen = VW_MAX_MESSAGE_LEN;

    // Wait for a message
    vw_wait_rx();
    if (vw_get_message(buf, &buflen)) // Non-blocking
    {
          int i;
          const char *msg = "goodbye";
          // Message with a good checksum received, dump it.
          Serial.print("Got: ");
```

```
            for (i = 0; i < buflen; i++)
            {
                Serial.print(buf[i], HEX);
                Serial.print(" ");
            }
            Serial.println("");
            // Send a reply
            vw_send((uint8_t *)msg, strlen(msg));
        }
    }
```

6.0 Implementation Details

Messages of up to VW_MAX_PAYLOAD (27) bytes can be sent

Each message is transmitted as:

- 36 bit training preamble consisting of 0-1 bit pairs
- 12 bit start symbol 0xb38
- 1 byte of message length byte count (4 to 30), count includes byte count and FCS bytes
- n message bytes
- 2 bytes FCS, sent low byte-hi byte

Everything after the start symbol is encoded 4 to 6 bits, Therefore a byte in the message is encoded as 2x6 bit symbols, sent hi nybble, low nybble. Each symbol is sent LSBit first.

The Arduino Diecimila clock rate is 16MHz => 62.5ns/cycle.

For an RF bit rate of 2000 bps, need 500microsec bit period.

The ramp requires 8 samples per bit period, so need 62.5microsec per sample => interrupt tick is 62.5microsec.

The maximum message length consists of

(6 + 1 + VW_MAX_MESSAGE_LEN) * 6 = 222 bits = 0.11 secs (at 2000 bps).

The code consists of an ISR interrupt handler. Most of the work is done in the interrupt handler for both transmit and receive, but some is done from the user level. Expensive functions like CRC computations are always done in the user level.

7.0 Performance

Unit tests show that the receiver PLL can stand up to 1 sample in 11 being inverted by noise without ill effect.

Testing with TX-C1, RX-B1, 5 byte message, 17cm antenna, no ground plane, 1m above ground, free space

At 10000 bps the transmitter does not operate correctly (ISR running too frequently at 80000/sec?)

At 9000 bps, asymmetries in the receiver prevent reliable communications at any distance

At 7000bps, Range about 90m

At 5000bps, Range about 100m

At 2000bps, Range over 150m

At 1000bps, Range over 150m

As suggested by RFM documentation, near the limits of range, reception is strongly influenced by the presence of a human body in the signal line, and by module orientation.

Throughout the range there are nulls and strong points due to multipath reflection. So... your mileage may vary.

Similar performance figures were found for DR3100. 9000bps worked.

Arduino and TX-C1 transmitter draws 27mA at 9V.

Arduino and RX-B1 receiver draws 31mA at 9V.

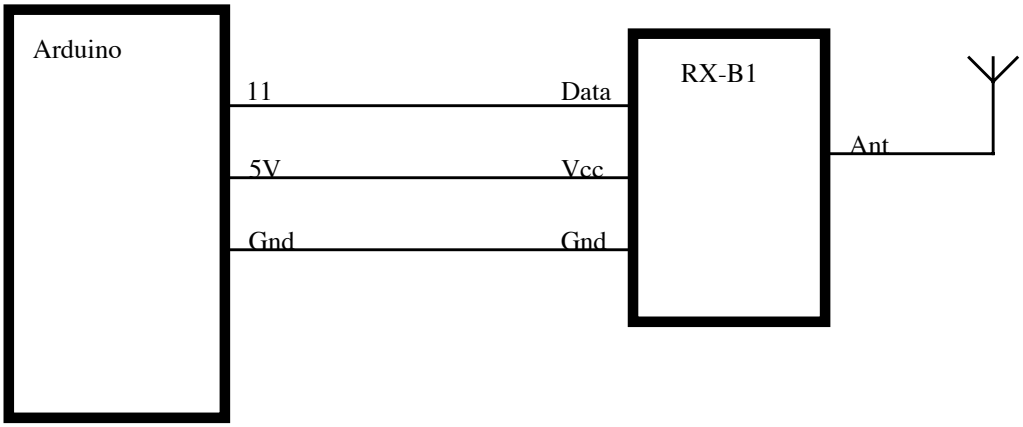
Arduino and DR3100 receiver draws 28mA at 9V.

8.0 Connections

Note that the IO pins can be changed from their defaults (as shown here) to any suitable IO pins using the vw_set_*_pin() calls.

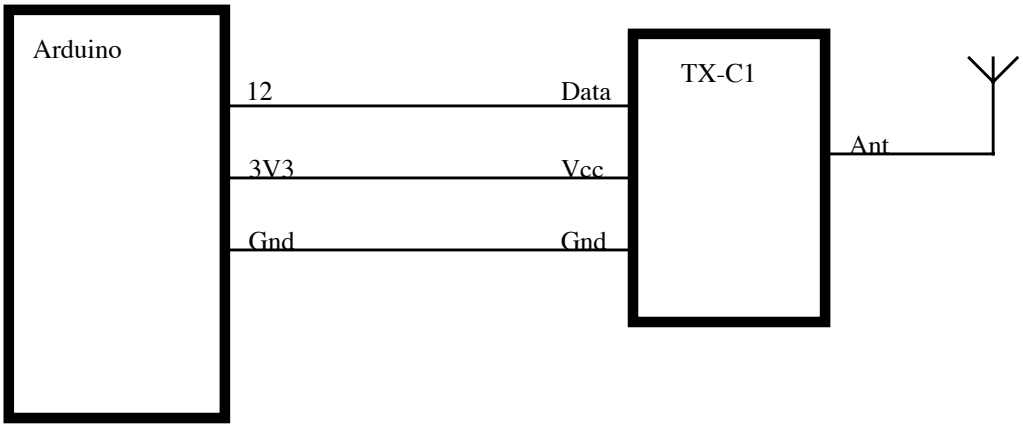
8.1 RX-B1 receiver

FIGURE 4. Wiring for RX-B1 receiver



8.2 TX-C1 transmitter

FIGURE 5. Wiring for TX-C1 transmitter



8.3 DR3100 transceiver

FIGURE 6. Wiring for DR3100

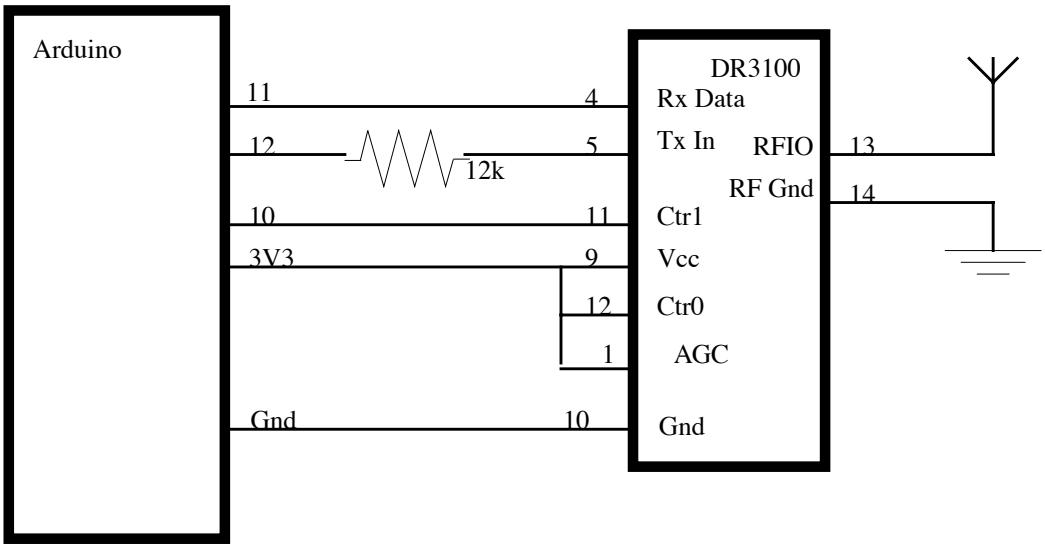
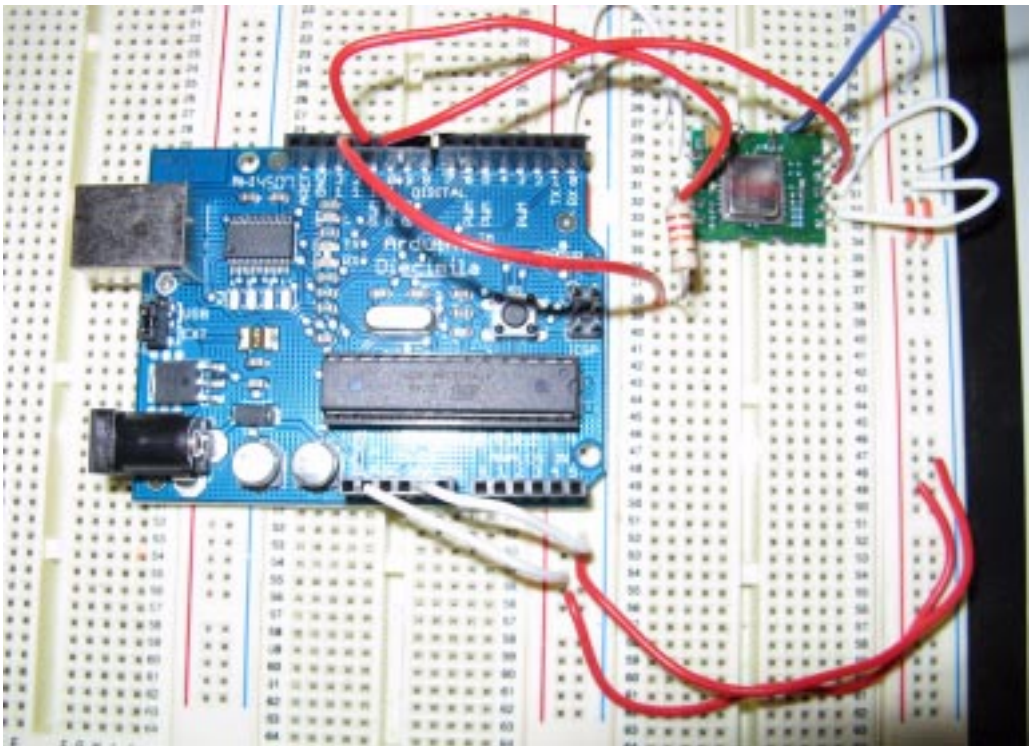


FIGURE 7. DR3100 connections on breadboard



Connections shown for no AGC, 1mW power out, 2400bps. Note the 12k resistor in series with Tx In to control the power output If you want to use higher data rates, need a resistor from pin 8 of the DR3100 to ground (see RFM documentation for more details).

If you want to use AGC, need a capacitor from pin 1 of the DR3100 to ground (see RFM documentation for more details).

The DR3100 module is supplied without any connection pins, only surface mount style pads. You will need to solder pins onto the module if you wish to use it in a breadboard.

9.0 Copyright and License

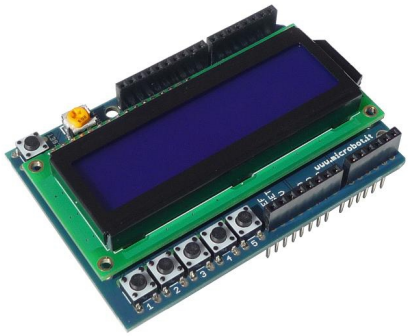
9.1 Open Source Licensing GPL V2

This is the appropriate option if you want to share the source code of your application with everyone you distribute it to, and you also want to give them the right to share who uses it. If you wish to use this software under Open Source Licensing, you must contribute all your source code to the open source community in accordance with the GPL Version 2 when your application is distributed. See http://www.gnu.org/copyleft/gpl.html

9.2 Commercial Licensing

This is the appropriate option if you are creating proprietary applications and you are not prepared to distribute and share the source code of your application. Contact info@open.com.au for details.

Name: **LCD Shield for Arduino**
Code: **MR007-005.1**



The *LCD Shield for Arduino* allows an Arduino board to visualize informations on an attractive LCD display with white text on blue backlight.

5 push buttons make possible the implementation of projects where menus are visualized on the LCD display and selections are made by the pressure of the buttons, each of them numbered from 1 to 5.

The board equipment is integrated with a trimmer used to regulate the display contrast and there is also a RESET button used to reset the Arduino board below.

Formal Arduino shield connectors are mounted on the board, this allows to access all spare, not jet utilized, Arduino signals.

The control of the LCD display is done by the Arduino board through the connections showed in Tab.1 and it is possible to use the libraries already available in the Arduino programming software. The LCD display uses the SPLC780D controller.

CONNECTIONS

Arduino pin	***Display function***
7	RS - Register select
6	E - Enable
5	D4 - High 4-bit data
4	D5 - High 4-bit data
3	D6 - High 4-bit data
2	D7 - High 4-bit data
A0	Analog Input for buttons readings

Tab.1 – Connections

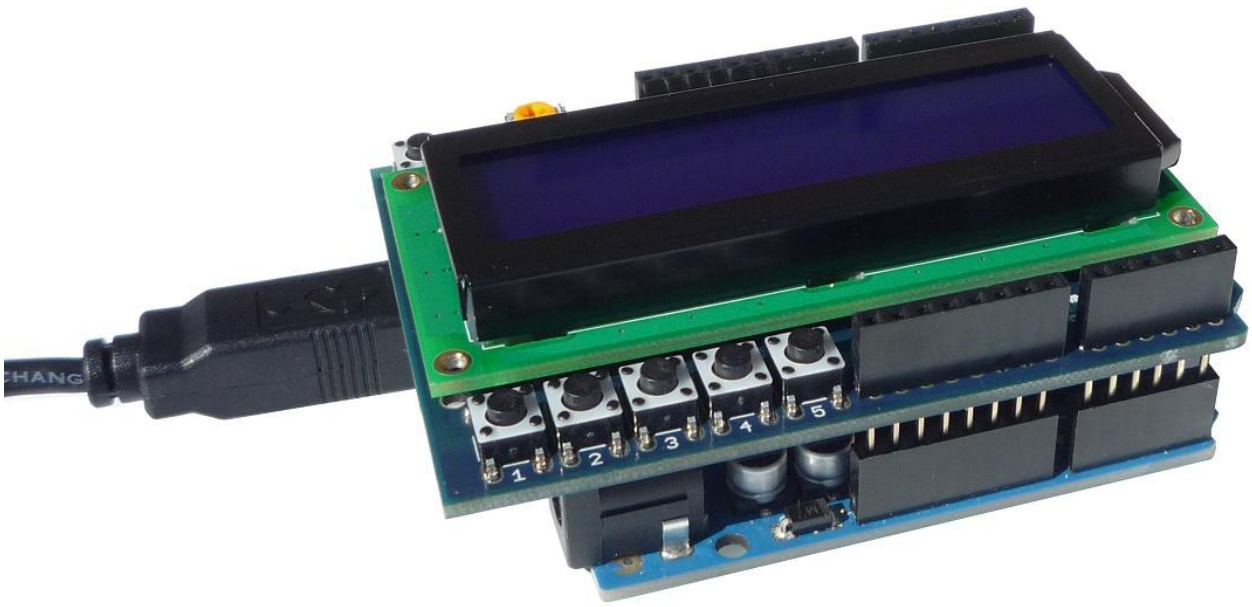
MICROBOT di Prosseda Mirko – Strada Chiesuola 117, 04010 Borgo Carso (LT), Italy
web: http://www.microbot.it email: info@microbot.it tel: +39-347-2159275

The pressure of one of the five buttons produces on the Arduino A0 pin an analog voltage which value is related to the button that has been pressed. The relation between the button pressed and the analog voltage produced on the A0 pin is reported in Tab.2. It is very important to notice that the analog voltage value produced could differ in the measure of a 10% from nominal value reported in the table below. For this reason it is recommended to keep in mind this variability during the creation of the Arduino sketch.

PUSH BUTTONS

Push Button	Voltage on the A0 pin
1	0V ±10%
2	1V ±10%
3	2V ±10%
4	3V ±10%
5	4V ±10%
none	5V ±10%

Tab.2 – Relation between push buttons and voltage on the A0 pin



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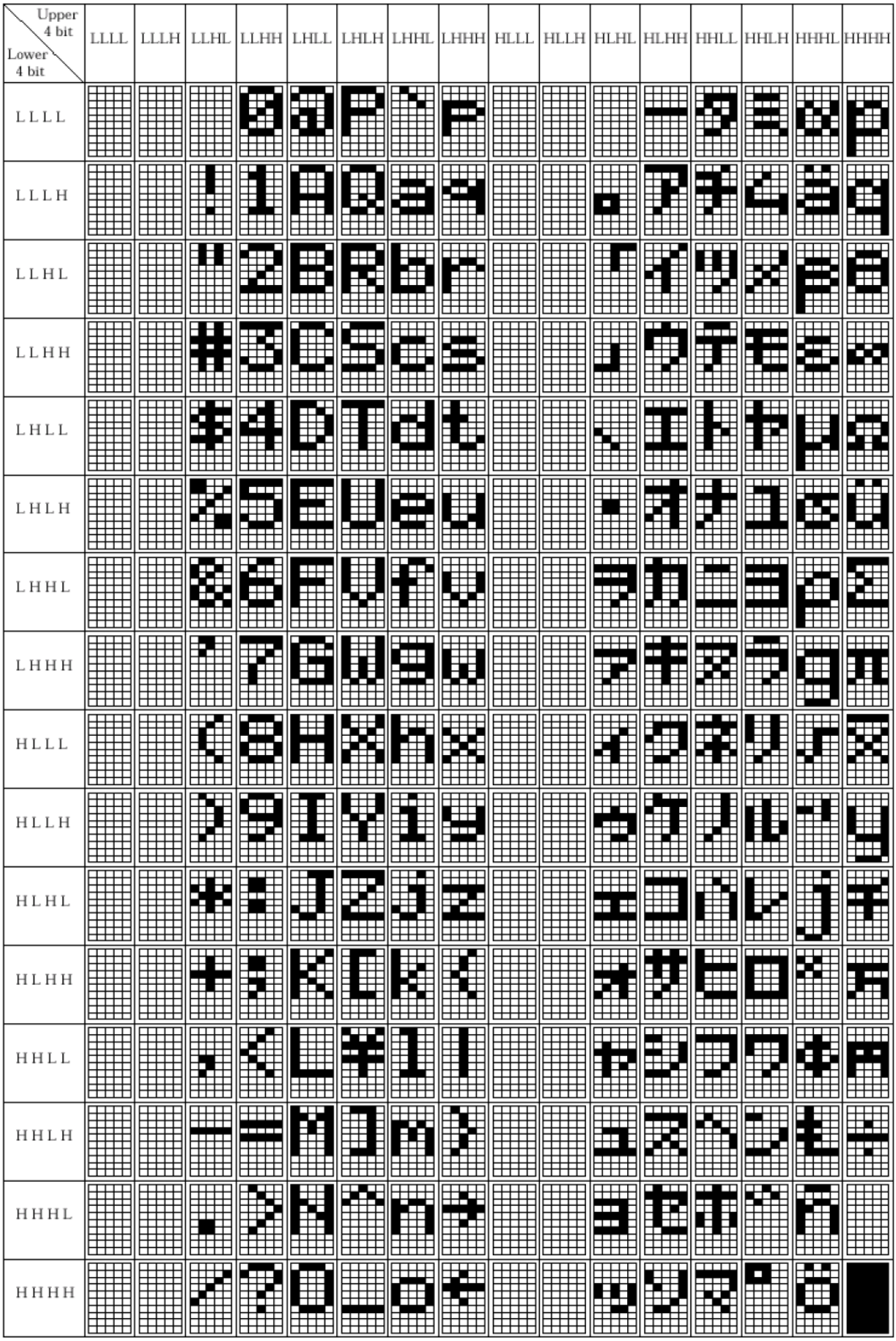
web: http://www.microbot.it email: info@microbot.it tel: +39-347-2159275

英日韩+常用符号字库表


Upper 4 bit
Lower 4 bit
LLLL
LLLH
LLHL
LLHH
LHLL
LHLH
LHHL
LHHH
HLLL
HLLH
HLHL
HLHH
HHLL
HHLH
HHHL
HHHH
L L L L
L L L H
L L H L
L L H H
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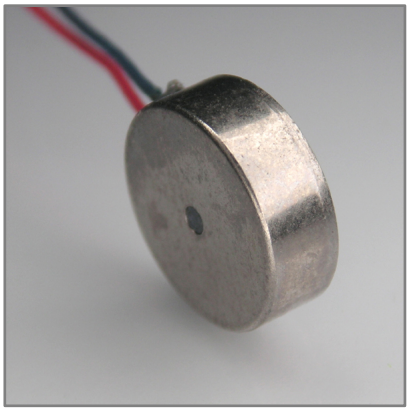
310-101

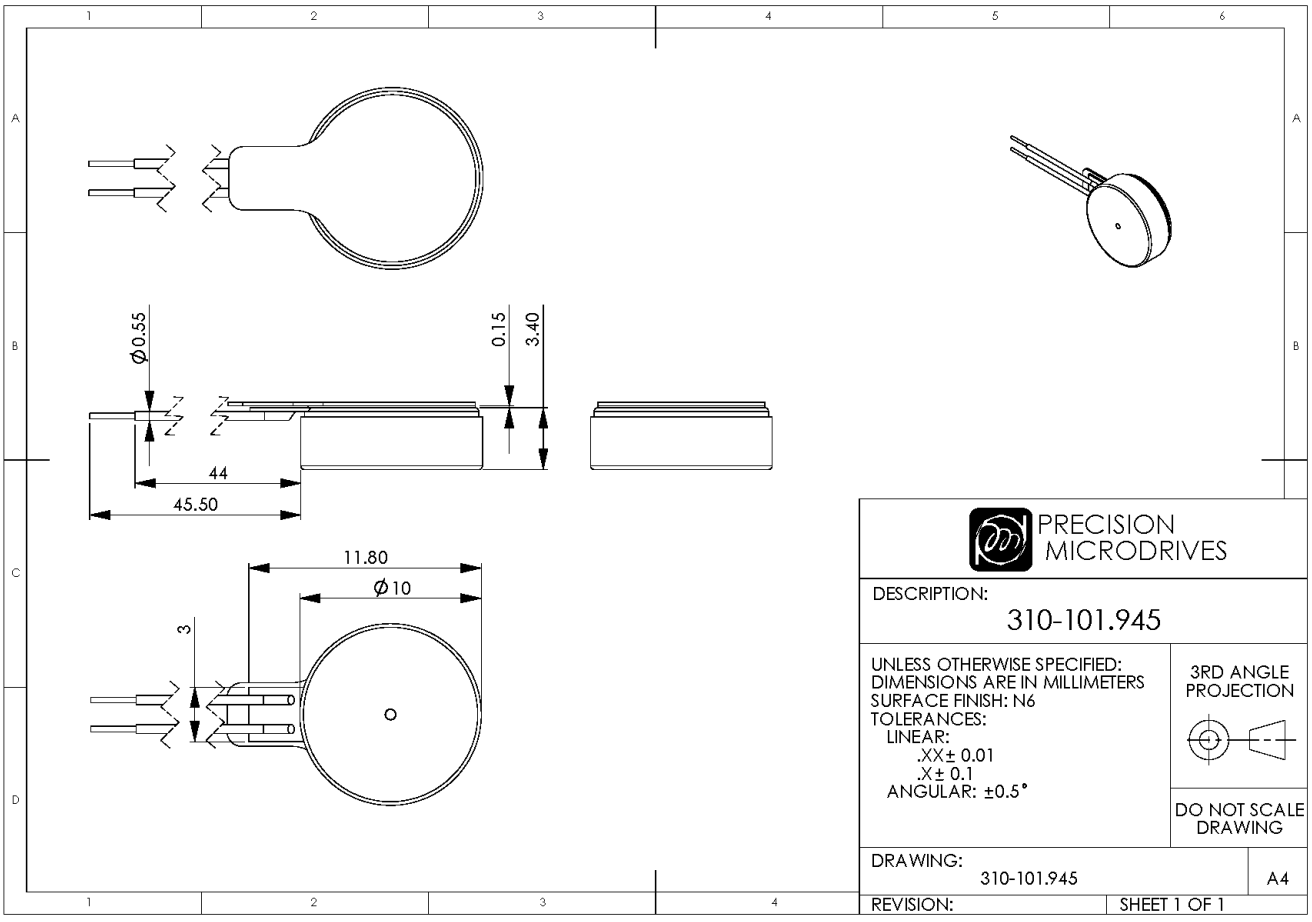
10mm Shaftless Vibration Motor
3.4mm Button Type

Specification	Value
Voltage [V]	3
Frame Diameter [mm]	10
Body Length [mm]	3.4
Weight [g]	1.2
Voltage Range [V]	2.5~3.8
Rated Speed [rpm]	12000
Rated Current [mA]	75
Start Voltage [V]	2.3
Start Current [mA]	85
Terminal Resistance [Ohm]	75
Vibration Amplitude [G]	0.8



www.precisionmicrodrives.com

Tel: +44 (0) 1932 252482
Fax: +44 (0) 1932 325353
Email: sales@precisionmicrodrives.com



浙江乐穗电子股份有限公司

ZHEJIANG YUESUI ELECTRON STOCK CO.,LTD.

产　品　规　格　书

PRODUCT　SPECIFICATION

客 户 承 认 栏

产品名称： 扁平式振动马达

NAME： COIN TYPE VIBRATION MOTOR

产品型号 Model： B1034.FL45-00-015

日　期 Date： 2016-1-12

拟　制 DRAWN	王成美	校　对 CHECK	徐祥富	批　准 APPROVE	吴积忠

ISSUE / 版本	REASON FOR CHANGE/ 更改原因	DR./ 拟制	APPR./ 审核	DATE/ 日期
1	RELEASE FOR DESIGN/产品设计	黄良芬	徐祥富	2005.5.28
2	ENRICH CONTENTS /完善内容	黄良芬	徐祥富	2006.6.10

TABLE OF CONTENTS/目录

1. OPERATING SCOPE/适用范围

THIS SPECIFICATIONS APPLY TO Φ10X3.4T STANDARD COIN TYPE VIBRATION MOTOR

该产品说明书适用于Φ10X3.4T 标准扁平马达。

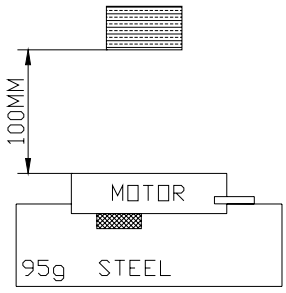
2. CONSTRUCTION-FORM /结构形式

NO	ITEMS/项目	CONTENTS/内容
2-1	MOTOR CONSTRUCTION/ 马达结构	Dia 10mm Coin Type Vibration Motor 直径为 10mm 的扁平永磁马达
2-2	NUMBER OF PHASES/ 相数	SINGLE-PHASE (-CONNECTION)/ 单相
2-3	NUMBER OF MAGNET POLES/ 磁极极数	4-POLES 4 极
2-4	COIL CONSTRUCTION/ 线圈结构	FLAT CORELESS COIL/ 扁平型线圈
2-5	RECTIFYING METHOD/ 换向方式	COMMUTATOR/ 单平面扇形

3. PERFORMANCE AND CHARACTERISTICS/性能和特性

NO.	ITEMS/项目	SPECIFICATIONS/规定
3-1	RATED VOLTAGE / 额定电压	3.0V DC

3-2	OPERATING VOLTAGE / 电压使用范围	2.3～3.6V DC
3-3	STARTING VOLTAGE / 启动电压	2.0V DC
3-4	RATED CURRENT/ 额定电流	60mA (max)
3-5	RATED SPEED / 额定转速	13000±3000rpm /min
3-6	DIRECT CURRENT RESISTANCE/ 直流阻抗	33/65±20%Ω
3-7	OPERATING ENVIRONMENT/ 使用环境	-30～60℃ 10～90%(RELATIVE HUMIDITY/相对湿度)
3-8	STORAGE ENVIRONMENT/ 贮存环境	-40～85℃ 5～95%(RELATIVE HUMIDITY/相对湿度) (NO CONDENSATION OF MOISTURE/不凝露)
3-9	INSULATION RESISTANCE/ 绝缘强度	100V DC 10MΩ MIN.FROM HOUSING CASE TO TERMINAL CONTACTS, THE LEAKAGE CURRENT SHALL NOT EXCEED 1mA PEAK./从机身到端点在 100V 直流电时,最小为 10MΩ, 电流泄漏最多不超过 1mA。

3-10	MECHANICAL NOISE/ 机械噪音	50dB（A）(MAX）/AT RATED VOLTAGE AND RATED LOAD BACK GROUND NOISE：30dB（A） (MAX) 最大为 50dB（A）/额定电压及负荷下测试，背景噪音不超过 30 dB（A） 

4. MEASURING CONDITIONS/测试条件

NO	ITEMS/项目	SPECIFICATIONS/规格
4-1	TEMPERATURE/温度	25±2℃
4-2	RELATIVE HUMIDITY/相对湿度	45～85%
ALL DATA ARE BASED ON THE MEASURING CONDITIONS: TEMPERATURE, 20℃; HUMIDITY, 65%RH. IF ANY DISAGREEMENT OCCURS, SUCH TEST CONDITIONS ARE AVAILABLE: TEMPERATURE, 5～35℃; HUMIDITY, 45～85%RH. 所有数据的测试条件为：温度 20℃，相对湿度 65%RH。如果有任何不一致出现，在以下条件中测试也是可以的：温度 5～35℃，湿度(45～85%)RH。		

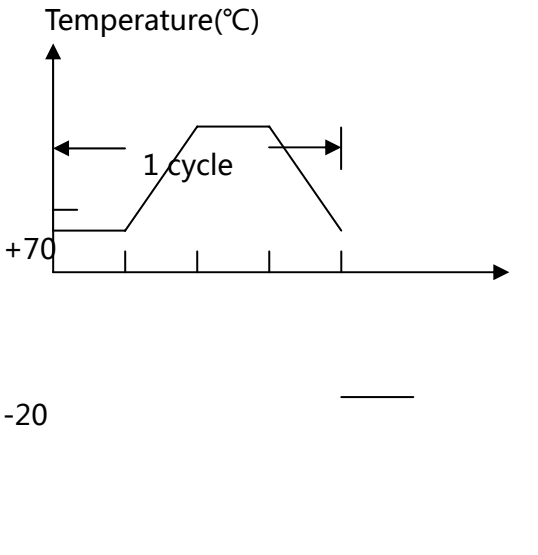
5. APPEARANCE SPECIFICATION/外观性能要求

NO.	ITEMS/项目	SPECIFICATIONS/规定	CONDITION REMARK/条件、备注
5-1	CONFIGURATION/	AS SPECIFIED IN OUTLINE DRAWING/	

	外观尺寸	按外形图规定	
5-2	APPEARANCE/ 外观	THERE SHALL BE NO EVIDENCE OF MECHANICAL DAMAGE,AND SHALL NOT HAVE INADEQUATE CORROSION AND SO ON./没有机械的损害痕迹，并且也没有腐蚀痕迹，等.	VISUAL EXAMINATION : (ALLOWABLE EXTENT IN BASED ON BOUNDARY SAMPLE)./目视检查(允许范围和限度见样品)。
5-3	WEIGHT/重量	0.9g(APPROX)	

6. RELIABILITY TEST /可靠性试验

NO	ITEMS/项目	SPECIFICATIONS/规定	REQUIREMENTS/判定特性
6-1	LIFE TEST/寿命试验	VOLTAGE/电压：3.0V DC TEMPERATURE/温度：25℃±2℃ HUMIDUTY/湿度：65±5%RH TEST MODE/试验形式：2 SECS.ON (C.W)、2 SECS. OFF TEST TIME/试验时间：20000 cycles	MEASUREMENT UNDER THE TEMPERATURE OF 25℃。AFTER THE TEST ,MOTOR SHALL BE APPROVED AS SPECIFIED IN ITEM7-1. 测试温度在 25℃。试验后，应满足 7-1 项。
6-2	SHOCK TEST/ 振动试验	MOTOR WITHSTANDS DURATION OF 50M/S^2 WAVE FROM VELOCITY CHANGE OF 10 M/S^2 SHOCK FROM EACH OF X.Y.AXIS. 从 X，Y 轴输出的振动，马达可承受从 10 M/S^2 到 50M/S^2 震级的转变。	AFTER THE TEST MOTORS SHALL BE APPROVED AS SPECIFIED IN ITEM 7-1. 试验后，应满足 7-1 项要求.
6-3	LOW TEMP EXPOSURE TEST/低温存放试验	TEMPERATURE /温度：-40℃±5℃ TIME /时间：96 HOURS	ALL DATA ARE BASED ON THE MEASURING CONDITIONS: TEMPERATURE,25℃;HUMIDITY, 65%RH.AFTER 2HOURS EXPOSURE IN ORDINARY TEMPERATURE AND HUMIDITY，MOTORS SHALL BE APPROVED AS SPECIFIED IN ITEM 7-1.
6-4	HIGH TEMP EXPOSURE TEST/高温存放试验	TEMPERATURE /温度：70℃±5℃ TIME/时间：96 HOURS	

6-5	HUMIDITY EXPOSURE TEST/湿度存放试验	TEMPERATURE /温度：60±2℃ HUMIDITY /湿度： 90±5%RH TIME /时间：96 HOURS	所有测试在 25℃、相对湿度 65%中进行。在常温常湿中放置 2 小时后，测试应满足 7-1 项要求。
6-6	HEAT CYCLE TEST/温度冲击试验	 Test cycle/试验循环周期数：15 cycles	MEASUREMENT UNDER THE TEMPERATURE OF 25℃, AFTER 4 HOURS EXPOSURE IN ORDINARY TEMPERATURE AND HUMIDITY , MOTORS SHALL BE APPROVED AS SPECIFIED IN ITEM 7-1. 测试温度在 25℃。常温常湿中放置 4 小时后，测试应满足 7-1 项要求。

6-7	DROP TEST/ 跌落试验	SET THE MOTOR TO THE APPROXIMATELY 100g(INCLUDING THE MOTOR)WEIGHT OF BLOCK DROP THE MOTOR ON THE CONCRETE FLOOR. 电机放在大约 100g(包括电机)重的物体上自由落下到水泥地板上. HEIGHT/高度：1.5 m DIRECTION/方向：±X，±Y，±Z NUMBER OF TIMES/次数：EACH 3 TIMES	AFTER THE TEST MOTORS SHALL BE APPROVED AS SPECIFIED IN ITEM 7-1. 试验后，应满足 7-1 项要求.

7. REQUIREMENTS/判断特性

NO	ITEMS/项目	REQUIREMENTS/判定特性
7-1	TABLE A	1. RATED SPEED /额定转速：INITIAL DATA /初始值±30%（MAX） 2. RATED CURRENT /额定电流：INITIAL DATA /初始值±30%（MAX） 3. STARTING VOLTAGE /启动电压：2.0V DC（MAX） 4. SHOULD NOT FAIL IN STARTING /正常启动 5. SHOULD NOT BE UNUSUAL MECHANICAL NOISE /无异常噪音

8. PACKAGE REQUIREMENTS/包装要求（建议包装方式，厂家可根据本公司自己的包装方式进行）

CONTENT AND PROCESS/工作内容和程序

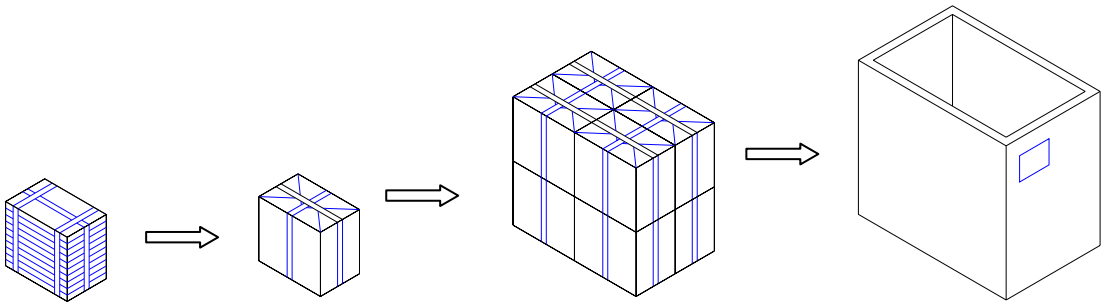
1.100 VIBRATORS IN EACH PLASTIC CAPSULE./每个泡沫盒里放 100 个马达。

2. EVERY 10 CAPSULES AS A GROUP, PUT A PLASTIC COVER ON THE GROUP AND WRAP IT IN TAPE./每 10 个泡沫盒上盖一个泡沫盖板，用胶带捆做一捆。

3.PUT THE WRAPPED GROUP INTO A PLASTIC BAG AND WRAP THE BAG./捆好后装入塑料袋内用胶带绑好。

4.EVERY 8 BAGS ARE PUT INTO AN OUTER CASE WITH A SIZE OF 495×315×445 BY THE WAYS STIPULATED AS THE DRAWING./每 8 袋泡沫盒按图中的叠放方式放入一个外包装箱（495×315×445）。

5.QUANTITY AND BATCH NUMBER ARE WRITTEN ON THE SURFACE OF THE OUTER CASE./数量、生产批号均写在外包装箱上。



9. MATTERS TO BE PAID ATTENTION TO WHEN USING NOTOR/使用时注意事项

1、PLEASE LAY THE NOTORS CAREFULLY IN TRANSPORTATION TO AVOID ANY SERIOUS DANAGE TO THE MOTOR BODY OR ITS ELECTRIC FUNCTION BECAUSE OF COLLISION./电机在运输过程中应小心轻放，避免严重碰撞敲击引起的电机机身和性能受损。

2、PLEASE USE THE MOTOR ACCORDING TO THE INSTRUCTION OF THIS PRODUCT SPECIFICATION, OR ELSE, IT WILL BE BAD FOR MOTOR’S LIFE./必须按照规格书的标准使用，否则会影响电机寿命。

3、MAKE ARRANGEMENT TO LIMIT THE STORAGE PERIOD TO 6 MONTHS OR LESS. PLEASE FO NOT STORE MOTOR IN HIGH TEMPERATURE, LOW TEMPERATUEE. HIGH HUMIDITY ENVIRONMENT. CONDENSATION OF ATMOSPHERE MUST BE AVOIDED IN MOTER USAGE OR OPENING THE PACKAGING OF THE MOTOR./请在 6 个月内使用，请不要在高温、低温、高湿环境下存储。在使用和打开马达外包装时请避免

水气凝结。

4、FOR PROPER OPERATION, STORAGE AND OPERATING ENVIRONMENT MUST NOT CONTAIN CORROSIVE GASES. FOR EXAMPLE H2S. SO2. NO2. CL2. ETC. IN ADDITION STORAGE ENVIRONMENT MUST NOT HAVE MATERIALS THAT EMIT CORROSIVE GASES ESPECIALLY FROM SILICON, CYANIC. FORMALIN AND PHENOL GROUP. IN THE MECHANISM OR THE SET. EXISTENCE OF CORROSIVE GASES MAY CAUSE NO ROTATION IN MOTOR./马达应适当的操作、储存和运转环境中均不可存在腐蚀性气体。例如：H2S、SO2、NO2、CL2 等。另外存储环境中不可有诸如硅、氰、甲醛水和苯酚等能放射出腐蚀性气体的物质，在电机的机械构造或装置中，如果存在腐蚀性气体，那么这会引起马达不运转。

5、DUE ATTENTION MUST BE PAID TO THE HANDLING AND WORKING ENVIRONMENTS BECAUSE SUCH OBJECTS AS IRON POWDER IF ATTRACTED BY THE MOTOR MAGNENT,WILL CAUSE NOISE,CHARACTERISTIC DETERIORATION THUS REDUCING THE TELIABILITY./ 注意处理马达的工作环境，避免含铁质等物体被马达吸住，否则马达将会产生噪声，性能会降低，从而减少产品可靠性。

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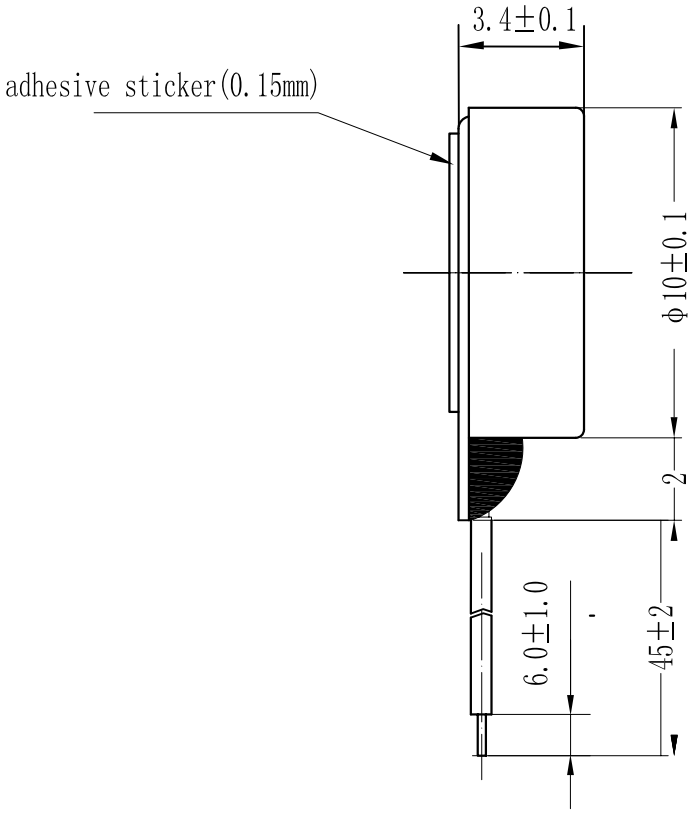

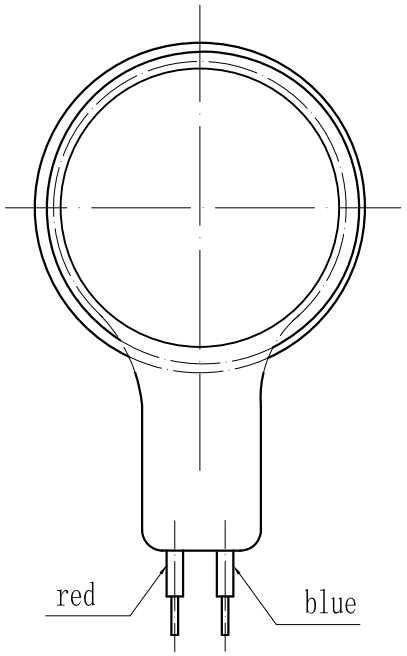

Technical requirement
1.Rated Voltage: 3.0V
2.Rated Current: 60mA Max
3.Rated Speed: 13000± 3000rpm
4.Direct Current Resistance:
33/65Ω(±20%)
5.Starting Voltage: 2.0V Max
6.Wire Spec: AWG32 UL1571

					COIN TYPE VIBRATION MOTOR	Zhejiang Yuesui Electron Stock Co.,L
						Specification
Mark	Revise	Reversion	Signature	Date		
Design		Standardize			Pattern Mark	Weight / Proportion
Check		Approve				B1034.FL45-00-015
Approve						
Technology		Date			Total pages / Page	