ELECTRONICS WORKSHOP PRACTICE

PROJECT REPORT: METAL DETECTOR

BY:

Contents

Acknowledgement

We are sincerely grateful to and for their valuable guidance and assistance in every stage of the project.

Abstract

Metal detectors are fascination machines. Many of the people who use them are just as enthusiastic about extolling the virtues of their favorite metal detector as they are about setting off in search of buried treasure. This is the primary means by which we determine how well we are doing our jobs, and what sort of things we need to do better. Sometimes though, communication is difficult. The most commonly used metal detection technology is very low frequency (VLF), also known as induction balance. In this type of metal detector, there are two rings: an outer coil called the transmitter coil and an inner coil called the receiver coil. The transmitter coil has an electric current running through it, which creates an electromagnetic field. This magnetic pulse interacts with any conductive object it passes over, causing that object to create a weaker magnetic field of its own; it is this magnetic pulse from the object that the receiver coil senses. The receiver coil is shielded from the transmitter coil's magnetic field, but can pick up magnetic pulses sent by other objects. The receiver coil amplifies these frequencies and sends them to the control box for analysis.

Introduction

A metal detector is a device which responds to metal that may not be readily apparent.
The simplest form of a metal detector consists of an oscillator producing an alternating current that passes through a coil producing an alternating magnetic field. If a piece of electrically conductive metal is close to the coil, eddy currents will be induced in the metal, and this produces an alternating magnetic field of its own. If another coil is used to measure the magnetic field (acting as a magnetometer), the change in the magnetic field due to the metallic object can be detected.
The first industrial metal detectors were developed in the 1960s and were used extensively for mining and other industrial applications. Uses include de-mining (the detection of land mines), the detection of weapons such as knives and guns, especially in airport security, geophysical prospecting, archaeology and treasure hunting. Metal detectors are also used to detect foreign bodies in food, and in the construction industry to detect steel reinforcing bars in concrete and pipes and wires buried in walls and floors.

Concept

Metal detectors work by transmitting an electromagnetic field from the search coil into the ground. Any metal objects (targets) within the electromagnetic field will become energized and retransmit an electromagnetic field of their own. The detector's search coil receives the retransmitted field and alerts the user by producing a target response. Special metal detectors are capable of discriminating between different target types and can be set to ignore unwanted targets.

Battery: The battery provides power to the detector.

Control Box: The control box contains the detector's electronics. This is where the transmit signal is generated and the receive signal is processed and converted into a target response.

Search Coil: The detector's search coil transmits the electromagnetic field into the ground and receives the return electromagnetic field from a target.

Transmit Electromagnetic Field: The transmit electromagnetic field energises targets to enable them to be detected.

Target: A target is any metal object that can be detected by a metal detector. In this example, the detected target is treasure, which is a good (accepted) target.

Unwanted Target: Unwanted targets are generally ferrous (attracted to a magnet), such as nails, but can also be non-ferrous, such as bottle tops. If the metal detector is set to reject unwanted targets then a target response will not be produced for those targets.

Receive Electromagnetic Field: The receive electromagnetic field is generated from energised targets and is received by the search coil.

Target Response: When a good (accepted) target is detected the metal detector will produce an audible response, such as a beep or change in tone. Many Minelab detectors also provide a visual display of target information.

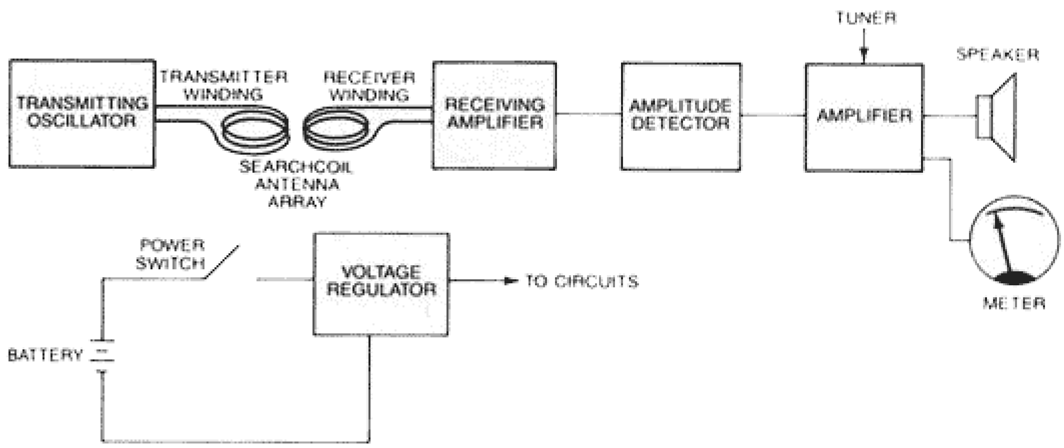
WORKING

Radio Transmission and Reception

Half of a metal detector is the common radio. Metal Detection is achieved, basically, by the transmission and “reception” of a radio wave signal. The block diagram on the facing page illustrates the basic components of a typical metal detector. The battery is the power supply. The transmitter electronic oscillator at the extreme left of the diagram generates a signal. The transmitter signal current travels from the transmitter oscillator through a wire (search coil cable), to the search coil’s transmitter winding (antenna), and the transmitter antenna is a few turns of electrical wire, generally wound in a circular fashion.

Electromagnetic Field Generation

As the current circulates in the transmitter antenna, an invisible electromagnetic field is generated that flows out into the air (or other surrounding medium, i.e.: air, wood, rock, earth materials, water, etc.) in all directions. If this electromagnetic field were visible, it would appear to be in the shape of a gigantic, three dimensional doughnut, with the transmitter antenna embedded in its center. Electromagnetic field theory states that field lines cannot cross one another. Consequently, they crowd together as they pass through the circular antenna, but they are not crowded on the outside. It is fortunate this crowding takes place, because the intensity (density) of the field lines is the very phenomenon that enables metal detection in the area adjacent to the search coil to take place. In the drawing at the bottom of the next page note the area indicated as the two dimensional detection patterns. This is the site of maximum field crowding; it is here that metal detection occurs as a result of two major phenomena…eddy current generation and electromagnetic field distortion. (Note theMirror-image detection pattern above the search coil.)

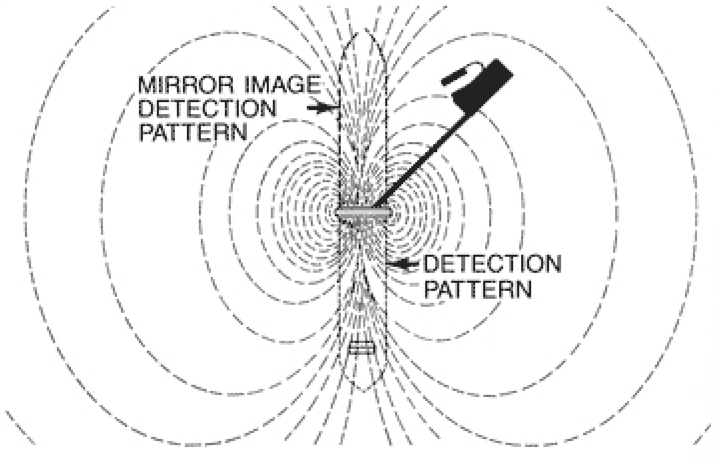


This electronic block diagram of a transmitter-receiver metal detector illustrates the basic components of a metal detector as they are pointed out in the description at left.

Eddy Currents

Secondary Electromagnetic Field Generation

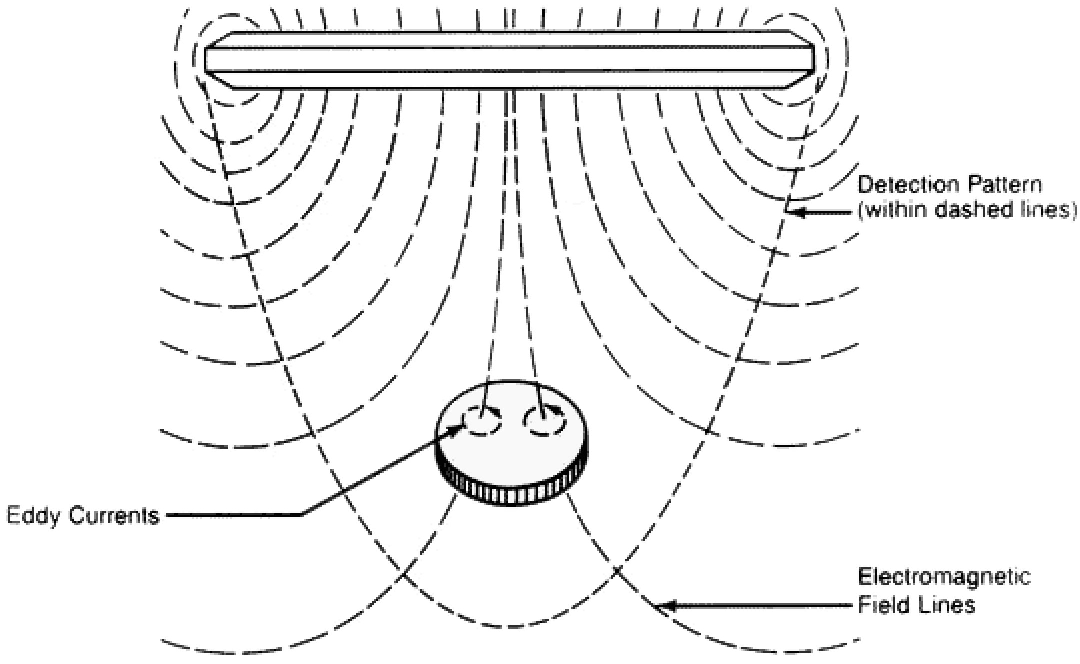
Whenever metal comes within the detection pattern, electromagnetic field lines penetrate the metal's surface. Tiny circulating currents called "eddy currents" are caused to flow on the metal surface as illustrated in the figure on the facing page. The power or motivating force that causes eddy currents to flow comes from the electromagnetic field itself. Resulting power loss by this field (the power used up in generating the eddy currents) is sensed by the detector's circuits. Also, eddy currents generate a secondary electromagnetic field that, in some cases, flows out into the surrounding medium. The portion of the secondary field that intersects the receiver winding, causes a detection signal to occur in that winding. Thus, the detector alerts the operator that metal has been detected.



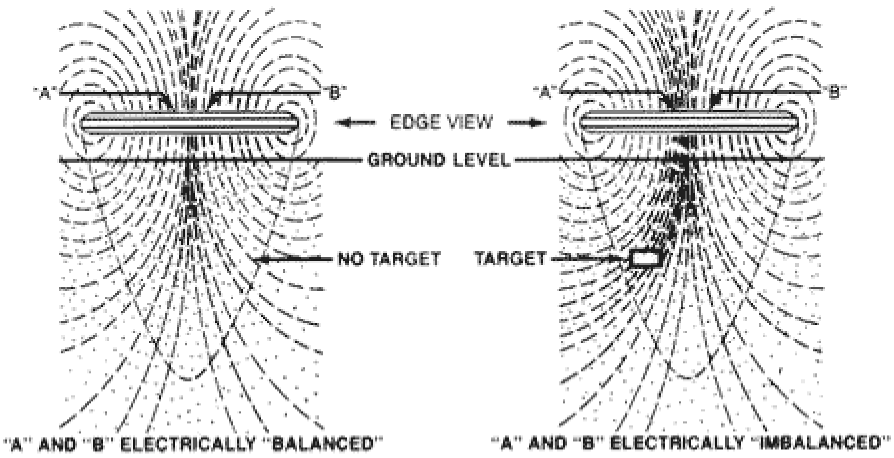
As transmitter current from the antenna generates the electromagnetic field, detection patter (dotted lines) is the area within which Metal detection occurs. Mirror-image pattern atop coil is not used.

Electromagnetic Field Distortion

The detection of non-conductive iron (ferrous) minerals takes place in a different manner. When iron mineral comes near and within the detection pattern, the electromagnetic field lines are redistributed, as shown in the figure on the following page. This redistribution upsets the "balance" of the transmitter and receiver windings in the search coil, resulting in power being induced into the receiver winding. When this induced power is sensed by the detector circuits, the detector alerts its operator to the presence of the iron mineral. Iron mineral detection is a major problem for both manufacturers and users of metal detectors. Of course, the detector of iron mineral is welcomed by a gold hunter who is looking for black magnetic sand which can often signal the presence of placer metal. On the other hand, the treasure hunter, who is looking for coins, jewelry, relics, gold nuggets, etc., usually finds iron mineral detection a nuisance.



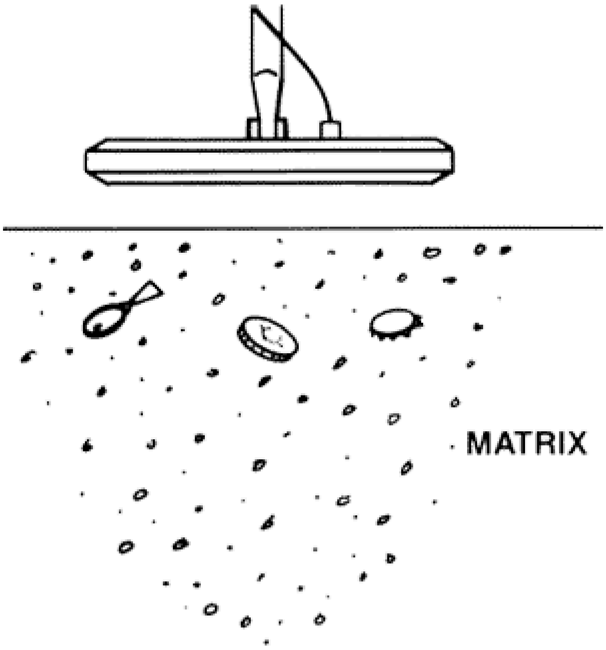
When any metal comes within the detection pattern of a search coil, *eddy currents* flow over its surface, resulting in a loss of power in the electromagnetic field, which the detector's circuits can sense.



When a target comes within the detection pattern, search coils windings become imbalanced at Point A and B, and electromagnetic field lines are redistributed as shown in this drawing.

Search Matrix

Any substance penetrated by the electromagnetic field is "illuminated." Many elements and different combinations of minerals are within the soil, including moisture, iron and other minerals, some detectable an some not. Of course, it is hoped that the targets being sought are also present. A detector's response at any given moment is caused by conductive metals and minerals and ferrous non-conductive minerals illuminated by its electromagnetic field as shown in the drawing below. One detector design criterion requires the elimination of responses from undesirable elements, permitting signals only from desirable objects. How this discrimination is accomplished depends on the type of detector.



This typical matrix beneath a metal detector's search coil illustrates how the electromagnetic field generated by the antenna in that search coil illuminates every metal target in the area it reaches.

Electromagnetic Field Coupling

"Coupling" describes the penetration of the electromagnetic field into any object near the transmitter antenna. There is perfect coupling into some objects such as wood, fresh water, air, glass, and certain non-mineralized earth materials as shown in the drawing below. Coupling is inhibited, however, when the electromagnetic field attempts to penetrate iron mineralization, wetted salt, and other substances. This inhibiting of the electromagnetic field, as shown in the drawing on the facing page decreases the detection capability of the metal detector. Even though modern instruments can eliminate the effects of iron minerals, the electromagnetic field is still inhibited (distorted), which results in reduced detection capability and performance.

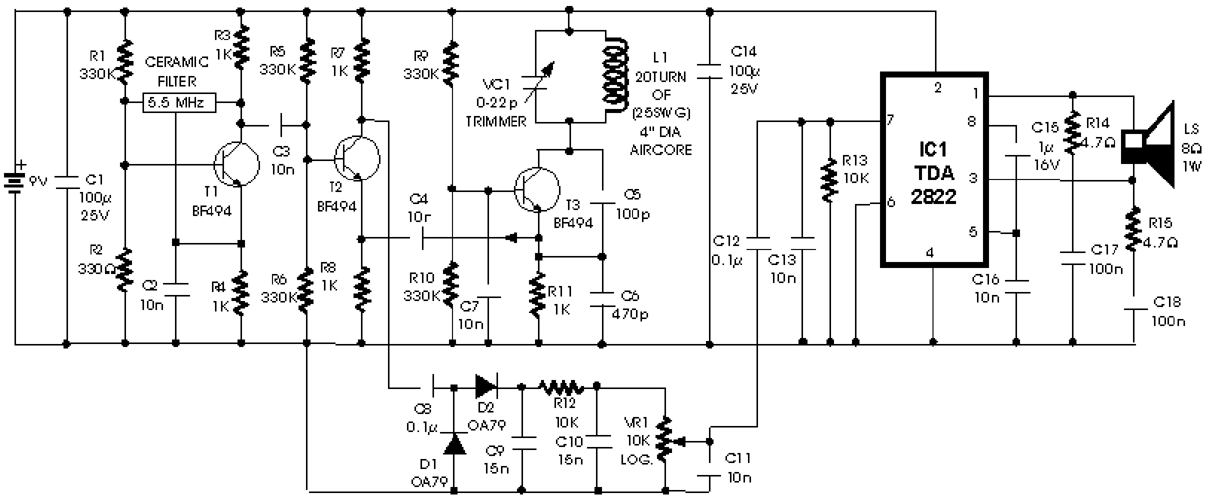
Component list:

	Component name	Specifications	No. of units
1	Ceramic filter	5.5 MHz	1
2	TDA 2822 Stereo Amplifier	1 Watt	1
3	Resistors	1 kΩ	5
		330 kΩ	6
		10 kΩ	3
		4.7 kΩ	2
4	Transistor	BF 494	3
5	Capacitor	10 nF	7
		100 nF	2
		100 μF	2
		100 pF	1
		1 μF	1
		0.1 μF	2
		470 pF	1
		15 nF	2
6	Diode	0A79	2
7	Variable Capacitance Trimmer	VC 1 0-22 pF	1
8	Variable Resistance	10 kΩ (Log)	1
9	Inductor	20 turns of (25 swg) 4” diameter aircore	1
10	Loud Speaker	8Ω, 1 Watt	1
11	Dry Cell	9 Volts	1

Component description

1. Ceramic filter: The filter is actually a bandpass filter with sharp filter characteristic.. At the input there is a signal generator and at the output a RF voltmeter. The signal generator will sweep the frequency from 400kHz to 500kHz
2. Stereo amplifier: A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. The current through a resistor is in direct proportion to the voltage across the resistor's terminals
3. Transistor: A transistor is a semiconductor device used to amplify and switch electronic signals and power. It is composed of a semiconductor material with at least three terminals for connection to an external circuit. A voltage or current applied to one pair of the transistor's terminals changes the current flowing through another pair of terminals. Because the controlled (output) power can be higher than the controlling (input) power, a transistor can amplify a signal
4. Capacitor: A capacitor (originally known as condenser) is a passive two-terminal electrical component used to store energy in an electric field. The forms of practical capacitors vary widely, but all contain at least two electrical conductors separated by a dielectric (insulator); for example, one common construction consists of metal foils separated by a thin layer of insulating film
5. Variable capacitance (trimmer): A variable capacitor (also known as a "variable air condenser") is a capacitor whose capacitance may be intentionally and repeatedly changed mechanically or electronically. Variable capacitors are often used in L/C circuits to set the resonance frequency
6. Inductor: An inductor (also choke, coil or reactor) is a passive two-terminal electrical component that stores energy in its magnetic field. For comparison, a capacitor stores energy in an electric field, and a resistor does not store energy but rather dissipates energy as heat.
7. Potentiometer: A potentiometer informally, a pot, in electronics technology is a component, a three-terminal resistor with a sliding contact that forms an adjustable voltage divider.[1] If only two terminals are used, one end and the wiper, it acts as a variable resistor or rheostat.
8. Loudspeaker: A loudspeaker (or "speaker") is an electroacoustic transducer that produces sound in response to an electrical audio signal input. Non-electrical loudspeakers were developed as accessories to telephone systems, but electronic amplification by vacuum tube made loudspeakers more generally useful.
9. TDA2822 is a low power stereo Op Amp used in Walkman players and Hearing aids. It can give 250 milli watts output. TDA2822 is an ideal Op amp for low output applications. It is a good choice as a preamplifier in stereo high power amplifier circuits.

Circuit diagram



Applications

1. **Archaeology**

Many historic artifacts from post Paleolithic age are metallic. These valuable items which generally include pots, vessels, weapons like spears, swords, tools like hammers, chisels etc can be easily detected with metal detectors of appropriate calibration. Their excavation and preservation is greatly facilitated due to metal detectors.

2. **Hobbies**

- Coin shooting is looking for coins after an event involving many people, like a baseball game, or simply looking for any old coins. Serious coin shooters will spend hours, days and months doing historical research to locate long lost sites that have the potential to give up historical and collectible coins.
- Prospecting is looking for valuable metals like gold and silver in their natural forms, such as nuggets or flakes.
- Metal detecting is very similar to coin shooting except that the metal detectorist is after any type of historical artifact. Metal detectorists may be dedicated to preserving historical artifacts, and often have considerable expertise. Coins, bullets, buttons, axe heads, and buckles are just a few of the items that are commonly found by relic hunters; in general the potential is far greater in Europe and Asia than many other parts of the world.
- Beach combing is hunting for lost coins or jewelry on a beach. Beach hunting can be as simple or as complicated as one wishes to make it. Many dedicated beach hunters also familiarize themselves with tide movements and beach erosion. There are two main techniques for beach hunting. The first one is called "gridding", which is when you search in a pattern. For example, you start from the beach line, and work your way down to the shoreline, move to the side a little, and repeat the process. The next technique is called "Random searching". Random searching is when you walk around the beach in no particular pattern.

3. **Security screening**

In common with the developments in other uses of metal detectors both alternating current and pulse systems are used, and the design of the coils and the electronics has moved forward to improve the discrimination of these systems. In 1995 systems such as the Metor 200 appeared with the ability to indicate the approximate height of the metal object above the ground, enabling security personnel to more rapidly locate the source of the signal. Smaller hand held metal detectors are also used to locate a metal object on a person more precisely.

4. **Industrial metal detectors**

Industrial metal detectors are used in the pharmaceutical, food, beverage, textile, garment, plastics, chemicals, lumber, and packaging industries. Contamination of food by metal shards from broken processing machinery during the manufacturing process is a major safety issue in the food industry. Metal detectors for this purpose are widely used and integrated into the production line. Current practice at garment or apparel industry plants is to apply metal detecting after the garments are completely sewn and before garments are packed to check whether there is any metal contamination (needle, broken needle, etc.) in the garments. This needs to be done for safety reasons.

Conclusion

After designing, simulating, assembling, soldering and testing the circuit, we came to the conclusion that our circuit of the metal detector is working satisfactorily and has negligible amount of unexpected functioning.

Data sheets

1. Ceramic filter

OSCILENT Corporation

telephone
949 252 0522

BACK

Data Sheet

Product Category: Filters

Series Number	Package	Description	Last Modified
760	Ceramic Filter	10.7 MHz	Jan. 01 2007

Filter FEATURES
- Ceramic Filter for FM Receiver
- Low Loss
- Wide / Narrow Bandwidths
- RoHS Compliant

TECHNICAL CHARACTERISTICS / PART NUMBER GUIDE

Ceramic Filter for FM Receiver

Part Number	3 dB Bandwidth	20 dB Bandwidth	Insertion Loss	Spurious Attenuation (9 ~ 12 KHz)	In/Out Impedance
	KHz min.	KHz max.	dB max.	dB min.	ohm
760-0107-A5	280 ±50	650	6	30	330
760-0107-S2	230 ±50	600	6	40	330
760-0107-S3	180 ±50	520	7	40	330

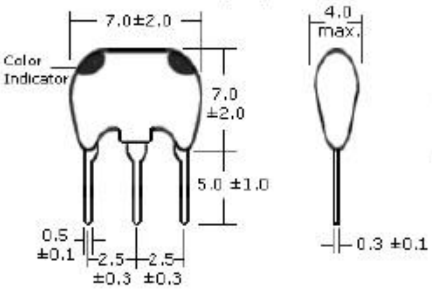
Low-Loss Type Ceramic Filter

Part Number	3 dB Bandwidth	20 dB Bandwidth	Insertion Loss	Spurious Attenuation (9 ~ 12 KHz)	In/Out Impedance
	KHz min.	KHz max.	dB max.	dB min.	ohm
760-0107-A5A10	280 ±50	590	2.5 ±2.0	30	330
760-0107-S2A10	230 ±50	520	3.0 ±2.0	35	330
760-0107-S3A10	180 ±50	470	3.5 ±1.5	35	330
760-0107-JA10	150 ±50	360	4.5 ±2.0	35	330

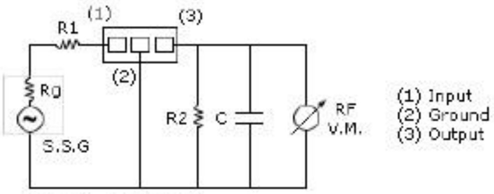
Wide/Narrow Bandwidth Ceramic Filter

Part Number	3 dB Bandwidth	20 dB Bandwidth	Insertion Loss	Spurious Attenuation (9 ~ 12 KHz)	In/Out Impedance
	KHz min.	KHz max.	dB max.	dB min.	ohm
760-0107-A19	350	950	3.0 ±2.0	20	470
760-0107-A20	330 ±50	680	4.0 ±2.0	30	330
760-0107-HY	110 ±30	350	7.0 ±2.0	30	330
760-0107-FP	20	95	6.0	24(10.7 ±1.0MHz)	600

PACKAGE DIMENSIONS (mm)



Test Circuit



Rg + R1 = R2 = 330Ω
C = 10pF
(Including stray capacitance and input capacitance of RF voltmeter)

Freq	Color Indicator
10.64 MHz ±30kHz	Black
10.67 MHz ±30kHz	Blue
10.70 MHz ±30kHz	Red
10.73 MHz ±30kHz	Orange
10.76 MHz ±30kHz	White
** Contact Oscilent for Test Circuits	

Oscilent Corporation - CALL **949.252.0522**
18195 East McDurmott Street . Building D . Irvine . CA 92614 . USA
Fax: 949.252.0599 . E-Mail: Sales@Oscilent.com

Series No.: 760

2. TDA 2822 Stereo Amplifier

SGS-THOMSON MICROELECTRONICS

TDA2822M

DUAL LOW-VOLTAGE POWER AMPLIFIER

- SUPPLY VOLTAGE DOWN TO 1.8V
- LOW CROSSOVER DISTORSION
- LOW QUIESCENT CURRENT
- BRIDGE OR STEREO CONFIGURATION

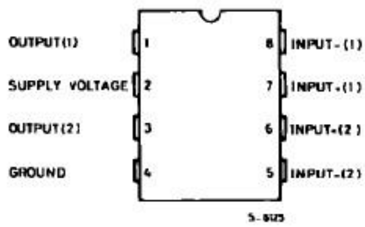
MINIDIP

ORDERING NUMBER : TDA2822M

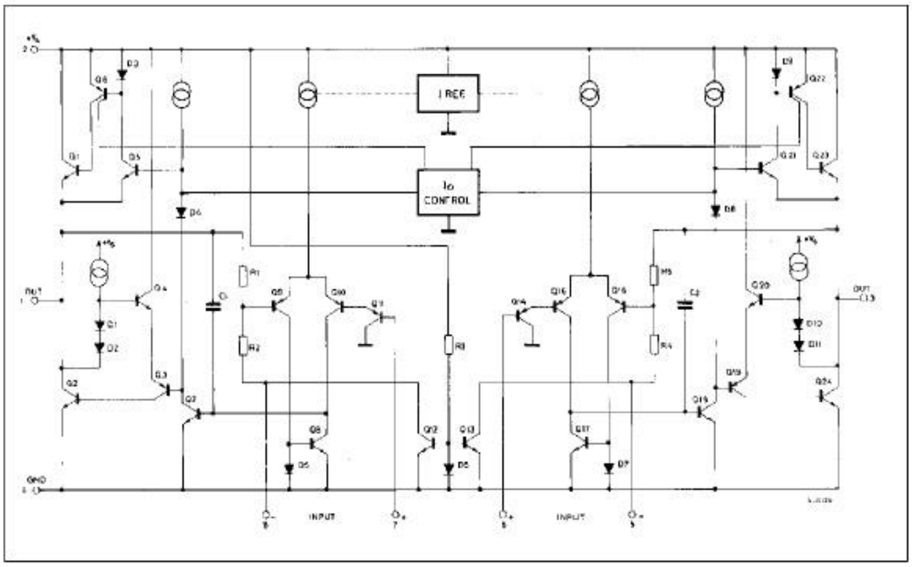
DESCRIPTION

The TDA2822M is a monolithic integrated circuit in 8 lead Minidip package. It is intended for use as dual audio power amplifier in portable cassette players and radios.

PIN CONNECTION (Top view)



SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_s	Supply Voltage	15	V
I_o	Peak Output Current	1	A
P_{tot}	Total Power Dissipation at T_{amb} = 50 °C at T_{case} = 50 °C	1 1.4	W W
T_{stg}, T_j	Storage and Junction Temperature	– 40, + 150	°C

THERMAL DATA

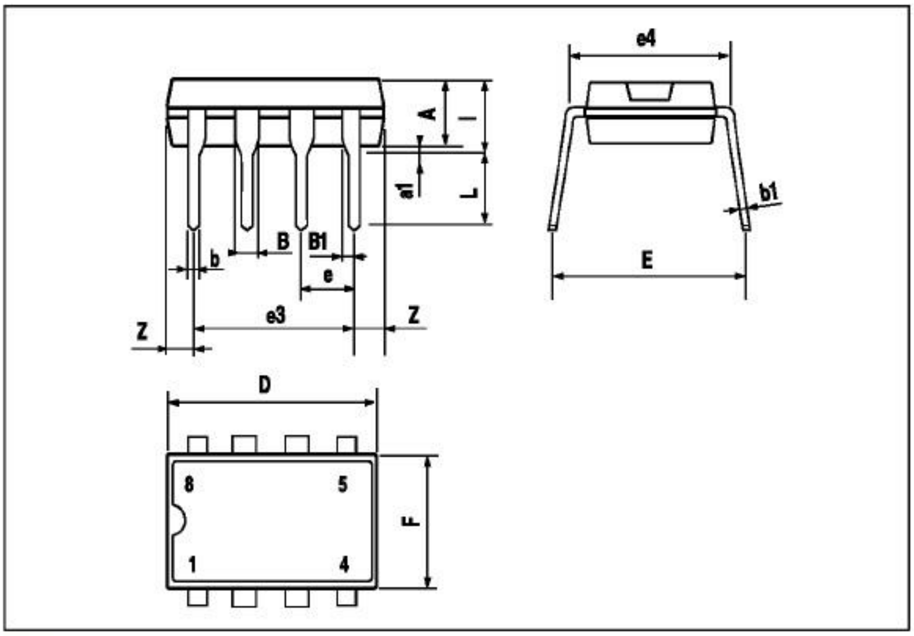
Symbol	Parameter		Value	Unit
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max.	100	°C/W
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-pin (4)	Max.	70	°C/W

ELECTRICAL CHARACTERISTICS (V_S = 6V, T_{amb} = 25°C, unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
STEREO (test circuit of Figure 1)						
V_s	Supply Voltage		1.8		15	V
V_o	Quiescent Output Voltage	 V_s = 3V		2.7 1.2		V V
I_d	Quiescent Drain Current			6	9	mA
I_b	Input Bias Current			100		nA
P_o	Output Power (each channel) (f = 1kHz, d = 10%)	R_L = 32Ω V_S = 9V V_S = 6V V_S = 4.5V V_S = 3V V_S = 2V R_L = 16Ω V_S = 6V R_L = 8Ω V_S = 9V V_S = 6V R_L = 4Ω V_S = 6V V_S = 4.5V V_S = 3V	 90 15 170 300 450 	300 120 60 20 5 220 1000 380 650 320 110		mW
d	Distortion (f = 1kHz)	R_L = 32Ω P_o = 40mW R_L = 16Ω P_o = 75mW R_L = 8Ω P_o = 150mW		0.2 0.2 0.2		% % %
G_v	Closed Loop Voltage Gain	f = 1kHz	36	39	41	dB
ΔG_v	Channel Balance				± 1	dB
R_i	Input Resistance	f = 1kHz	100			kΩ
e_N	Total Input Noise	R_s = 10kΩ B = Curve A B = 22Hz to 22kHz		2 2.5		µV µV
SVR	Supply Voltage Rejection	f = 100Hz, C1 = C2 = 100µF	24	30		dB
C_s	Channel Separation	f = 1kHz		50		dB
BRIDGE (test circuit of Figure 2)						
V_s	Supply Voltage		1.8		15	V
I_d	Quiescent Drain Current	R_L = ∞		6	9	mA
V_{os}	Output Offset Voltage (between the outputs)	R_L = 8Ω			± 50	mV
I_b	Input Bias Current			100		nA
P_o	Output Power (f = 1kHz, d = 10%)	R_L = 32Ω V_S = 9V V_S = 6V V_S = 4.5V V_S = 3V V_S = 2V R_L = 16Ω V_S = 9V V_S = 6V V_S = 3V R_L = 8Ω V_S = 6V V_S = 4.5V V_S = 3V R_L = 4Ω V_S = 4.5V V_S = 3V V_S = 2V	 320 50 900 200 	1000 400 200 65 8 2000 800 120 1350 700 220 1000 350 80		mW
d	Distortion	P_o = 0.5W, R_L = 8Ω, f = 1kHz		0.2		%
G_v	Closed Loop Voltage Gain	f = 1kHz		39		dB
R_i	Input Resistance	f = 1kHz	100			kΩ
e_N	Total Input Noise	R_s = 10kΩ B = Curve A B = 22Hz to 22kHz		2.5 3		µV µV
SVR	Supply Voltage Rejection	f = 100Hz		40		dB
B	Power Bandwidth (–3dB)	R_L = 8Ω, P_o = 1W		120		kHz

MINIDIP PACKAGE MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A		3.32			0.131	
a1	0.51			0.020		
B	1.15		1.65	0.045		0.065
b	0.356		0.55	0.014		0.022
b1	0.204		0.304	0.008		0.012
D			10.92			0.430
E	7.95		9.75	0.313		0.384
e		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			6.6			0.260
I			5.08			0.200
L	3.18		3.81	0.125		0.150
Z			1.52			0.060



3. BF 494 transistor

NPN medium frequency transistors BF494; BF495

FEATURES

- Low current (max. 30 mA)
- Low voltage (max. 20 V).

APPLICATIONS

- HF applications in radio and television receivers
- FM tuners
- Low noise AM mixer-oscillators
- IF amplifiers in AM/FM receivers.

DESCRIPTION

NPN medium frequency transistor in a TO-92; SOT54 plastic package.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

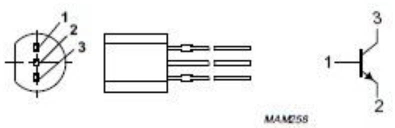


Fig. 1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	20	V
I_{CM}	peak collector current		–	30	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	300	mW
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 10$ V			
	BF494		67	220	
	BF495		35	125	
f_T	transition frequency	$I_C = 1$ mA; $V_{CE} = 10$ V; f = 100 MHz	120	–	MHz

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	20	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	30	mA
I_{CM}	peak collector current		–	30	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	300	mW
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		−65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	420	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

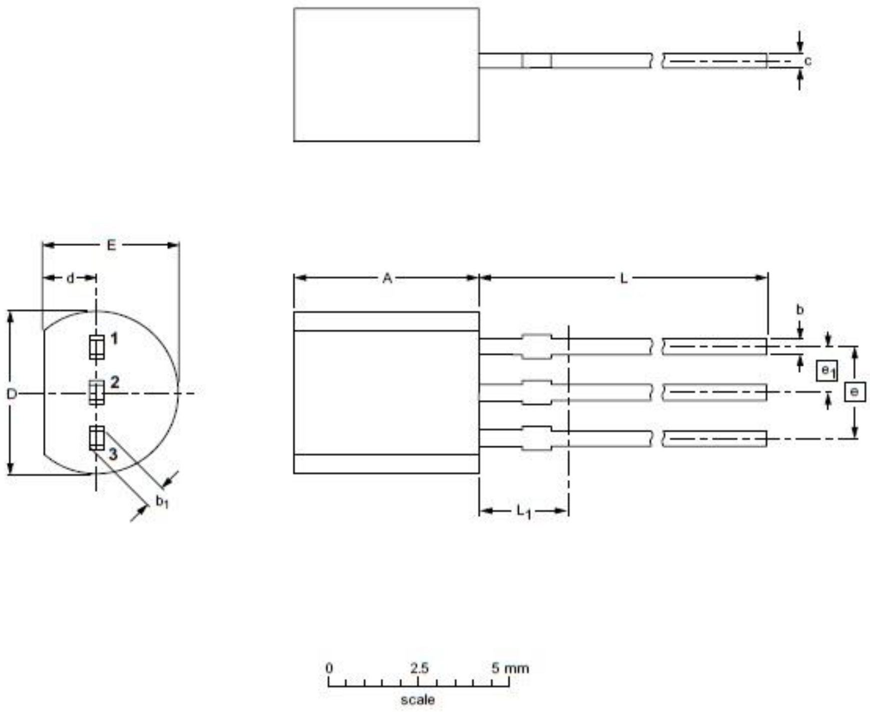
CHARACTERISTICS

$T_{amb} = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	100	nA
		$I_E = 0$; $V_{CB} = 20$ V; $T_{amb} = 150$ °C	–	4	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	100	nA
h_{FE}	DC current gain	$I_C = 1$ mA; $V_{CE} = 10$ V			
	BF494		67	220	
	BF494B		100	220	
	BF495		35	125	
	BF495B		100	125	
V_{BE}	base-emitter voltage	$I_C = 1$ mA; $V_{CE} = 10$ V	650	740	mV
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	1	pF
f_T	transition frequency	$I_C = 1$ mA; $V_{CE} = 10$ V; f = 100 MHz	120	–	MHz

PACKAGE OUTLINE

Plastic single-ended leaded (through hole) package; 3 leads **SOT54**



DIMENSIONS (mm are the original dimensions)

UNIT	A	b	b_1	c	D	d	E	e	e_1	L	$L_1^{(1)}$
mm	5.2 5.0	0.48 0.40	0.66 0.56	0.45 0.40	4.8 4.4	1.7 1.4	4.2 3.6	2.54	1.27	14.5 12.7	2.5

Note

1. Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT54		TO-92	SC-43			97-02-28

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