MH88615

Standard SLIC with Ringing Amplification

Preliminary Information

ISSUE 6 June 1997

Features

- 2W to 4W conversion
- Battery Feed to line
- Off-Hook and dial pulse detection
- Power Denial
- Integral Ringing Amplifier
- Programmable Loop Current
- Wide Battery Voltage Operating Range
- Variants
- - 1 Germany/Spain/South Africa/Australia
- - 2 600Ω
- - 3 UK
- - 4 900Ω
- - 7 North America

Applications

Line Interface for:

- PABX
- Pair Gain Systems
- Satellite Communication Systems
- Key Telephone Systems
- Terminal Adapters
- Cordless Local Loop

Ordering Information

MH88615-1/-3/-7	20 Pin SIL Package
MH88615AV-2	20 Pin SIL Package
MH88615AT-1/-3/-7	20 Pin 90° Package
MH88615AT-2	20 Pin 90° Package
MH88615AS-4	40 Pin SM Package

0°C to 70°C

Description

The Mitel MH88615 SLIC provides an interface between a switching system and a subscriber loop. The functions provided by the MH88615 include battery feed, ringing amplification, 2W to 4W conversion, current feed, off-hook detection and dial pulse detection. The device is fabricated as a thick film hybrid.

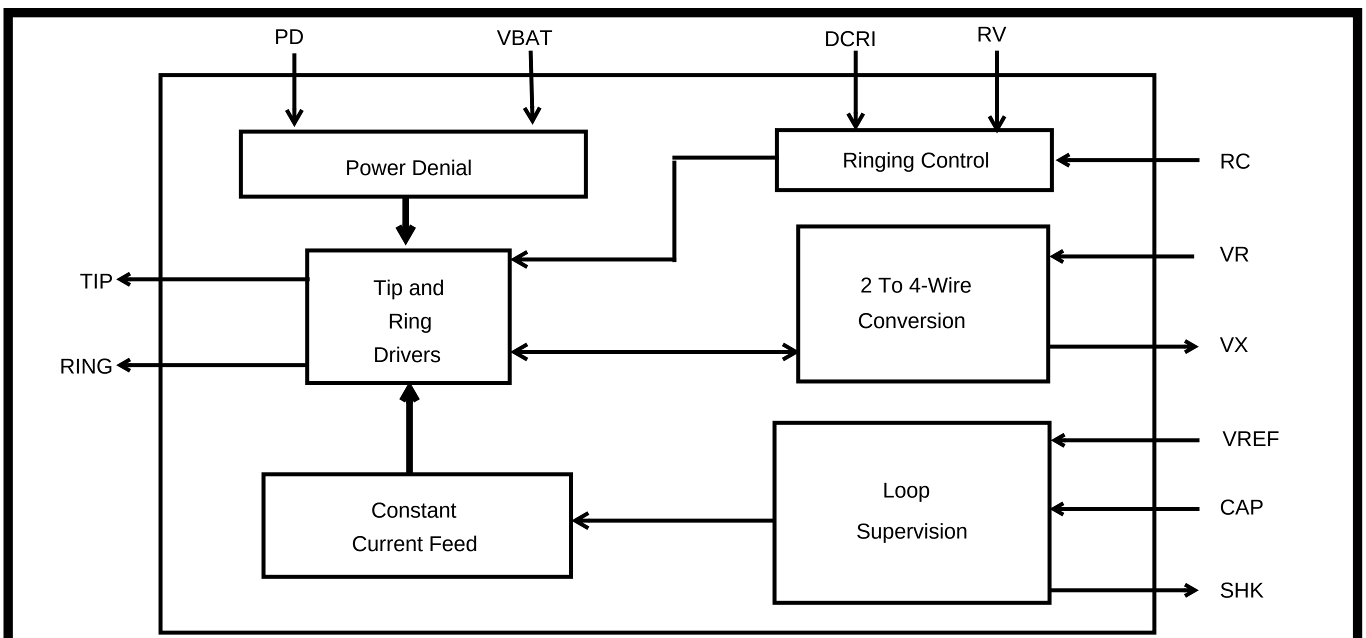


Figure 1 - Block Diagram

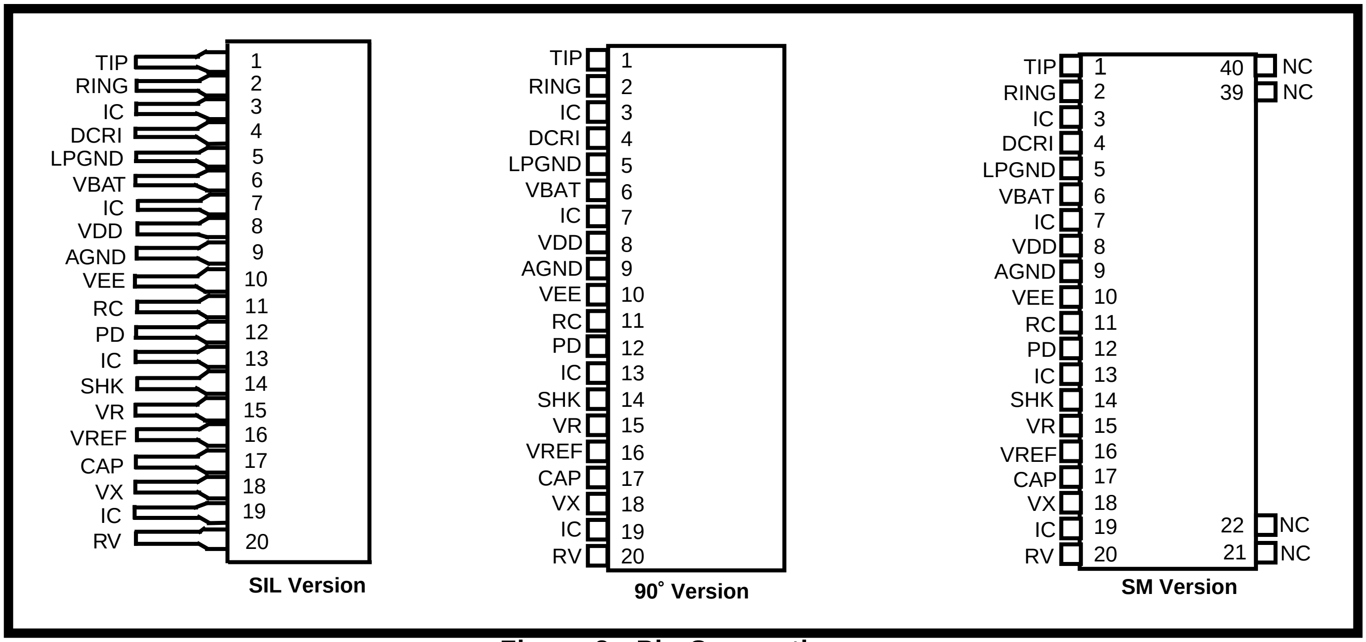


Figure 2 - Pin Connections

Pin Description

Pin#	Name	Description
1	TIP	**Tip Lead.** Connects to the "Tip" or "A" lead of subscriber line.
2	RING	**Ring Lead**. Connects to the "Ring" or "B" lead of subscriber line.
3	IC	**Internal Connection.** This pin is internally connected and must be left open circuit.
4	DCRI	**DC Ringing Voltage Input.** A continuous DC voltage is applied to this pin. This voltage is the positive supply rail for the internal ringing amplifier.
5	LPGND	**Battery Ground.** V_{BAT} return path for subscriber line. Connects to the system energy dumping ground. LPGND and AGND must be connected together within the system.
6	VBAT	**Battery Voltage.** Battery supply feed for subscriber line. Typically -48V DC is applied to this pin.
7	IC	**Internal Connection.** This pin is internally connected and must be left open circuit.
8	VDD	**Positive Supply Voltage.** +5V DC supply rail. VDD must not be applied before VEE is applied.
9	AGND	**Analogue Ground.** V_{DD} and V_{EE} return path. AGND and LPGND must be connected together within the system.
10	VEE	**Negative Supply Voltage.** -5V DC supply rail. VDD must not be applied before VEE is applied.
11	RC	**Ringing Control.** A logic 1 enables a balanced ringing voltage to be applied to the subscriber line when the correct Ringing Voltage input is applied.
12	PD	**Power Denial.** A logic 1 will isolate the battery voltage from Tip and Ring.
13	IC	**Internal Connection.** This pin is internally connected and must be left open circuit.
14	SHK	**Switch Hook Detect.** A logic 1 indicates when the subscriber line has gone off-hook.
15	VR	**Receive Signal (input).** This is the analogue signal to the subscriber's set.
16	VREF	**Reference Voltage.** A DC reference voltage is applied to this pin to set the constant current feed to subscriber line. This pin may also be grounded for normal 25mA loop current when V_{BAT} = -48V.

Pin Description

Pin#	Name	Description
17	CAP	**Ring Trip Filter Capacitor**. A capacitor should be connected from this pin to ground whilst ringing is applied. This filters out low frequency ringing signals preventing false off-hook conditions.
18	VX	**Transmit Signal (output).** This is the analogue signal from the subscriber's set.
19	IC	**Internal Connection.** This pin is internally connected and must be left open circuit.
20	RV	Ringing Voltage. A low level AC sinusoid is applied as the ringing signal at this pin. This signal is amplified and applied to the subscriber line. A source with less than 10Ω output impedance should be used to supply this signal.
21, 22, 39, 40	NC	**No Connection.** These pins are provided for mechanical mounting only on the surface mount versions.
23 - 38		**Not Fitted.** No pins are fitted in these positions.

Functional Description

The Mitel MH88615 standard SLIC provides an interface between a switching system and a subscriber loop. The functions provided by the MH88615 include battery feed, integral ringing amplifier, 2W to 4W conversion, constant current feed, off-hook detection and dial pulse detection. The device is fabricated as a thick film hybrid in a 20 pin package format for SIL and 90° versions while surface mountable packages are 40 pin versions.

The MH88615 is intended for applications where low cost and a basic functionality are important. The MH88615 features an integral ringing amplifier which enables a system designer to provide ringing without having to generate a high voltage, high current AC signal.

The SLIC implements a 2-4 wire converter which is usually connected to a CODEC. This provides an interface from the 2 wire subscriber loop to a TDM (time division multiplex), PCM (pulse code modulation) digital link.

Powering of the subscriber line is provided through precision battery feed resistors on the circuit. The thick film hybrid circuit also contains control, signalling and status circuits which combine to provide a comprehensive line interface solution. A power denial facility is provided which isolates the battery feed from the Tip and Ring leads. This can remove a line from service which will reduce power consumption.

An Application Note MSAN-151 is available to provide technical assistance to the customer in their use of the MH88615 product. The customer can obtain a copy of the Applications Note from their local Mitel Sales Office, Distributor or Representative.

DC Current Limit

Under normal Ring ground or Tip ground conditions the current is limited to 45mA. Both leads should not be simultaneously grounded.

Ringing and Ring Trip Detection

The MH88615 incorporates an integral ringing amplifier. When a logic 1 is applied to the Ringing Control (RC) pin a balanced ringing signal equal to 60x the AC sine wave applied to the RV pin is placed on the unloaded Tip and Ring leads. See Recommended Operating Conditions for details of the AC ringing generator voltages.

The internal off-hook detection circuit monitors changing DC levels on Tip and Ring and indicates an off-hook condition by taking SHK pin to logic 1. Whilst ringing is being applied there is a large AC component present on the line which must be filtered at the input to the detection circuit for it to operate properly. The Application Circuit (Figure 3) shows how this is achieved. Since C1 will remove dial pulse signals from the line it must be isolated during pulse dialing and resistor R1 is switched in using a sense drive output (SD3) on a Mitel MT896x CODEC. Applications which solely use DTMF signalling can have C1 permanently connected to ground. More details, including an entirely hardware solution for Ringing Voltage Filtering, are available in MSAN-151.

When a subscriber set goes off-hook during ringing (RC is logic 1) the SHK pin will go to a logic 1 within 200ms. Ringing is not automatically removed from the line. Systems should be designed such that the RC pin of the hybrid is taken to logic 0 within 200ms of SHK going to logic 1. The system must also ensure that the RC pin will not go to logic 1 again within 400ms of SHK going to logic 1. These two functions can be realized using a software or a hardware solution. A suitable circuit to perform both of these functions is given in MSAN-151.

Power Denial

A logic 1 applied to the power denial input removes the battery voltage from the loop driver circuitry. The resulting loop current is negligible and power consumption is minimized. The power denial function is useful for disabling a loop which may have a fault. Note that the SHK is invalid during power denial.

Constant Current Feed

The loop current is programmed by the DC reference voltage applied to $V_{REF.}$ The loop current is given by the formula:

$$Iloop = -(0.52V_{BAT} + 4.24V_{REF})mA$$

Switch Hook Detection

When the DC current exceeds an internal threshold level which represents a loop current level of typically 10mA, the switch hook output (SHK) will switch to a logic 1. If the loop resistance is so high that V_{BAT} can no longer supply the required loop current, the output SHK will switch to logic 0.

Transmit Gain

Transmit gain (Tip-Ring to VX) is fixed at 0dB. For correct gain, the SLIC input impedance must match the line impedance.

Receive Gain

Receive Gain (VR to Tip-Ring) is fixed at 0dB. For correct gain, the SLIC input impedance must match the line impedance.

Input and Network Balance Impedances

Variants are available to meet different country line impedances, they are as follows:

MH88615-1 Germany, Spain, South
MH88615T-1 Africa, Australia

Zin = 220Ω+(820Ω//115nF)
Znet = 220Ω+(820Ω//115nF)

MH88615AV-2 - 600Ω
MH88615AS-2

Zin = 600Ω
Znet = 600Ω

MH88615-3 UK
MH88615T-3

Zin = 300Ω+(1000Ω//220nF)
Znet = 370Ω+(620Ω//310nF)

MH88615AS-4

Zin = 900Ω
Znet =900Ω

MH88615-7 North America
MH88615T-7

Zin = 600Ω
Znet = 350Ω+(1kΩ//210nF)

Absolute Maximum Ratings * - Voltages are with respect to AGND

	Characteristics	Sym.	Min.	Max.	Units	Comments
9	Supply Voltages	V_{BAT} V_{DD} V_{EE} V_{DCRI}	0.3 -0.3 0.3 -0.3	-65 6 -6 150	V V V V	With respect to LPGND With respect to LPGND
10	Storage Temperature	T_S	-55	125	°C	

* Exceeding these values may cause permanent damage. Functional operation under these conditions is not implied.

Recommended Operating Conditions

	Characteristics	Sym.	Min.	Typ.	Max.	Units	Test Comments	Test Circuit
1	Supply Voltages	V_{BAT} V_{DD} V_{EE} V_{DCRI}	-20 4.75 -4.75 0	-48 5.0 -5.0 90	-60 5.25 -5.25 100	V V V V	V_{DD} must not be applied before V_{EE} is applied.	
2	Operating Temperature	T_{OP}	0	25	70	°C	300Hz - 3.4kHz	Figure 7
3	AC Ring Amplifier Gain Voltage Frequency	 V_R F_R	 56.4 17	 60 60 	 63.6 90 68	 V/V V_{rms} Hz	V_{BAT} = -48V V_{DCRI} = 100V Sine wave input Open circuit output	Figure 4 SW1= 3

* Typical figures are at 25°C with ± 5V supplies and are for design aid only

DC Electrical Characteristics

	Characteristics	Sym.	Min.	Typ.	Max.	Units	Test Comments	Test Circuit
1	Supply Current	I_{DD} I_{EE} I_{BAT} I_{DCRI}		10 4 1 	12 5 2.5 1	mA mA mA mA	 PD on RC off	Figure 4 Figure 4 Figure 4
2	Power Consumption	PC			150 1700	mW mW	Standby Active	
3	Constant Current Line Feed	I_{LOOP}	23	25	27	mA	V_{REF} = AGND V_{BAT} =-48V	Figure 4 SW1= 2
4	Adjustable Loop Current Range	I_{LOOP}	18		30	mA	See 'Constant Current Feed' on page 5	Figure 4 SW1= 2
5	Maximum Operating Loop Resistance	R_{LOOP}	1800			Ω	V_{BAT}=-48V @ I_{LOOP}=18mA R_{LOOP} includes telephone set	
6	Ground Over-Current				45	mA	Connecting Tip and Ring to Ground at the same time may cause damage	Figure 4 SW1= 1 Ring lead OR Tip lead grounded
7	Off-Hook Detect Output Low Voltage Output High Voltage	 V_{OL} V_{OH}	 2.7		 0.4 	 V V	Active High Logic	

DC Electrical Characteristics (continued)

	Characteristics	Sym.	Min.	Typ.	Max.	Units	Test Comments	Test Circuit
8	Off-Hook Detect Output Low Current Output High Current	I_{OL} I_{OH}			4 -400	mA μA		
9	RC, PD Control Input Input Low Voltage Input High Voltage	V_{IL} V_{IH}	2.0		0.7	V V	Active High Logic	
10	RC, PD Control Input Input Low Current Input High Current	I_{IL} I_{IH}			-500 500	μA μA		

* Typical figures are at 25°C with ± 5 supplies and -48V battery voltage. They are for design aid only.
Note: Operating I_{BAT} and I_{DCRI} are dependant on application. Transient values can be up to 250mA during off-hook or Ringing Cadence conditions.

AC Electrical Characteristics*

	Characteristics	Sym.	Min.	Typ.	Max.	Units	Test Comments	Test Circuit
1	Ringing Voltage	V_R F_R	17	60	90 68	Vrms Hz	V_{BAT} = -48V V_{DCRI} =+100V	
2	Ring Trip Detect Time				200	ms	C1 = 1μF in ring trip filter circuit (see Figure 6)	Figure 4 SW1 switched from 3
3	Input Impedance at VR		90	100	110	kΩ		
4	Output Impedance at VX			10		Ω		
5	Voltage Gain 2-wire to $\overline{VX}$		-0.25	0	0.25	dB		Figure 5
6	Frequency Response 2-wire to VX		-0.25	0	0.25	dB	Relative to 1kHz 300Hz to 3.4 kHz	Figure 5
7	Voltage Gain VR to 2-wire		-0.25	0	0.25	dB		Figure 6 Z= Zin
8	Frequency Response VR to 2-wire		-0.25	0	0.25	dB	Relative to 1kHz 300Hz to 3.4 kHz	Figure 6 Z= Zin
9	Total Harmonic Distortion at Tip-Ring and VX	THD		0.2 5	1	% %	@ 0dBm @ +3dBm	Figure 5 & Figure 6 Z= Zin
10	Common Mode Rejection Ratio	CMRR	48	55		dB	@1kHz	Figure 9-
11	Power Supply Rejection Ratio at 2-Wire or VX	PSRR	25	40		dB	Ripple 0.1V 1kHz @ VDD	Figure 6 Z= Zin

* Typical figures are at 25°C and are for design aid only.
Notes: All of the above test conditions use a test source impedance which matches the device's impedance (Zin - see page 5).
THD is measured with "A Weight" filter.

AC Electrical Characteristics* - MH88615-1, MH88615T-1

	Characteristics	Sym.	Min.	Typ.	Max	Units	Test Comments	Test Circuit
1	Ringer Equivalence	REN	5				1 REN = 8000Ω @25Hz	
2	Return Loss	RL	20	33		dB	300Hz-3.4kHz	Figure 7
3	Transhybrid Loss	THL	24	32		dB	300Hz -3.4kHz	Figure 6 Z=Znet
4	Longitudinal to Metallic Balance		32 54	 58		dB dB	50Hz - 300Hz 300Hz - 4kHz	Figure 8
5	VX Idle Channel Noise Tip/Ring Idle Channel Noise	Nc Nc		11 11	17 15	dBrnc dBrnc	Iloop = 25mA	Figure 6 Z=Zin

Notes: Return Loss reference impedances are defined by variant type.
Transhybrid Loss is measured when terminated with network impedance (Zin - see page 5).

AC Electrical Characteristics* - MH88615-3, MH88615T-3

	Characteristics	Sym.	Min.	Typ.	Max	Units	Test Comments	Test Circuit
1	Ringer Equivalence	REN	4				1 REN = 7000Ω @25Hz	
2	Return Loss	RL	20	33		dB	300Hz -3.4kHz	Figure 7
3	Transhybrid Loss	THL	20	32		dB	300Hz -3.4kHz	Figure 6 Z=Znet
4	Longitudinal to Metallic Balance		50 52	53 57		dB dB	300Hz 1kHz to 3.4kHz	Figure 8
5	VX Idle Channel Noise Tip/Ring Idle Channel Noise	Nc Nc		11 11	17 15	dBrnc dBrnc	Iloop = 25mA	Figure 6 Z=Zin

Notes: Return Loss reference impedances are defined by variant type.
Transhybrid Loss is measured when terminated with network impedance (Zin - see page 5).

AC Electrical Characteristics* - MH88615-7, MH88615T-7, MH88615AV-2/AT-2

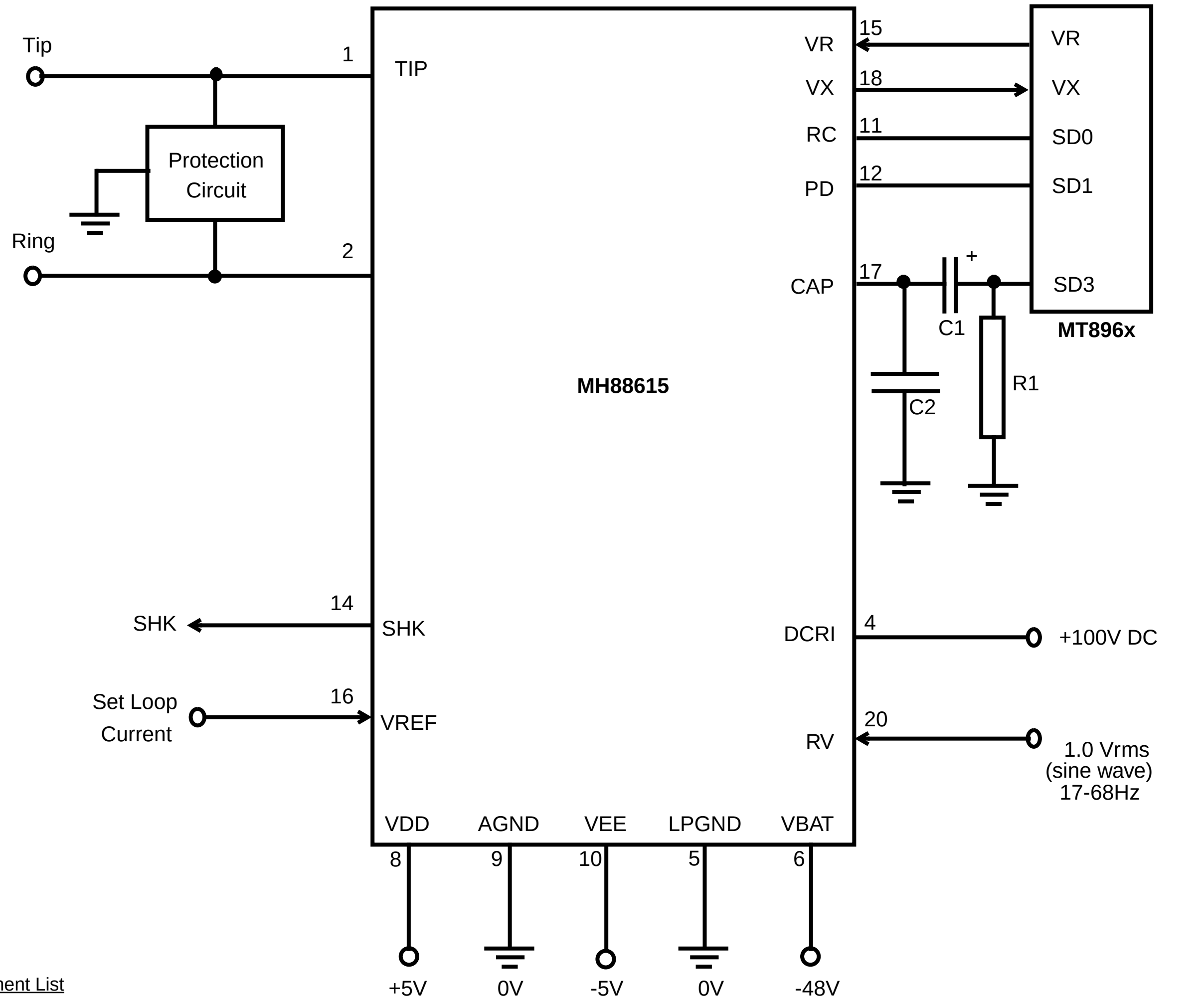
	Characteristics	Sym.	Min.	Typ.	Max	Units	Test Comments	Test Circuit
1	Ringer Equivalence	REN	5				1 REN = 7000Ω @20Hz	
2	Return Loss	RL	24	37		dB	300Hz -3.4kHz	Figure 7
3	Transhybrid Loss	THL	20	30		dB	300Hz -3.4kHz	Figure 6 Z=Znet
4	Longitudinal to Metallic Balance		52	58		dB	300Hz - 3.4kHz	Figure 8
5	VX Idle Channel Noise Tip/Ring Idle Channel Noise	Nc Nc		11 11	17 15	dBrnc dBrnc	Iloop = 25mA	Figure 6 Z=Zin

Notes: Return Loss reference impedances are defined by variant type.
Transhybrid Loss is measured when terminated with network impedance (Zin - see page 5).

AC Electrical Characteristics* - MH88615AS-4

	Characteristics	Sym.	Min.	Typ.	Max	Units	Test Comments	Test Circuit
1	Ringer Equivalence	REN	5				1 REN = 7000Ω @20Hz	
2	Return Loss	RL	24	37		dB	300Hz -3.4kHz	Figure 7
3	Transhybrid Loss	THL	20	30		dB	300Hz -3.4kHz	Figure 6 Z=Znet
4	Longitudinal to Metallic Balance		52	58		dB	300Hz - 3.4kHz	Figure 8
5	VX Idle Channel Noise Tip/Ring Idle Channel Noise	Nc Nc		11 11	17 15	dBrnc dBrnc	Iloop = 25mA	Figure 6 Z=Zin

Notes: Return Loss reference impedances are defined by variant type.
Transhybrid Loss is measured when terminated with network impedance (Zin - see page 5).



Component List

C1 = 1mF 20% 16V

C2 = 10nF 20% 16V

R1 = 470kW 10%

Details of a recommended Protection Circuit and full implementation details are included in the Applications Note (MSAN-151).

Figure 3 - Typical Application Circuit

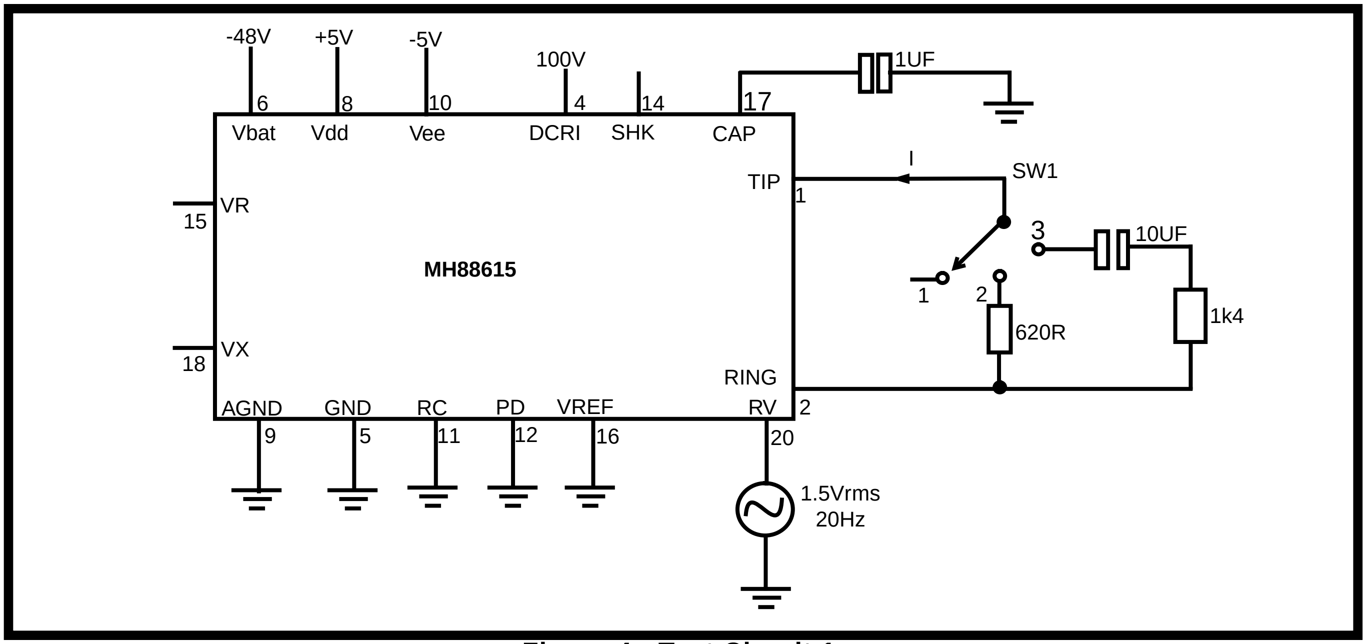


Figure 4 - Test Circuit 1

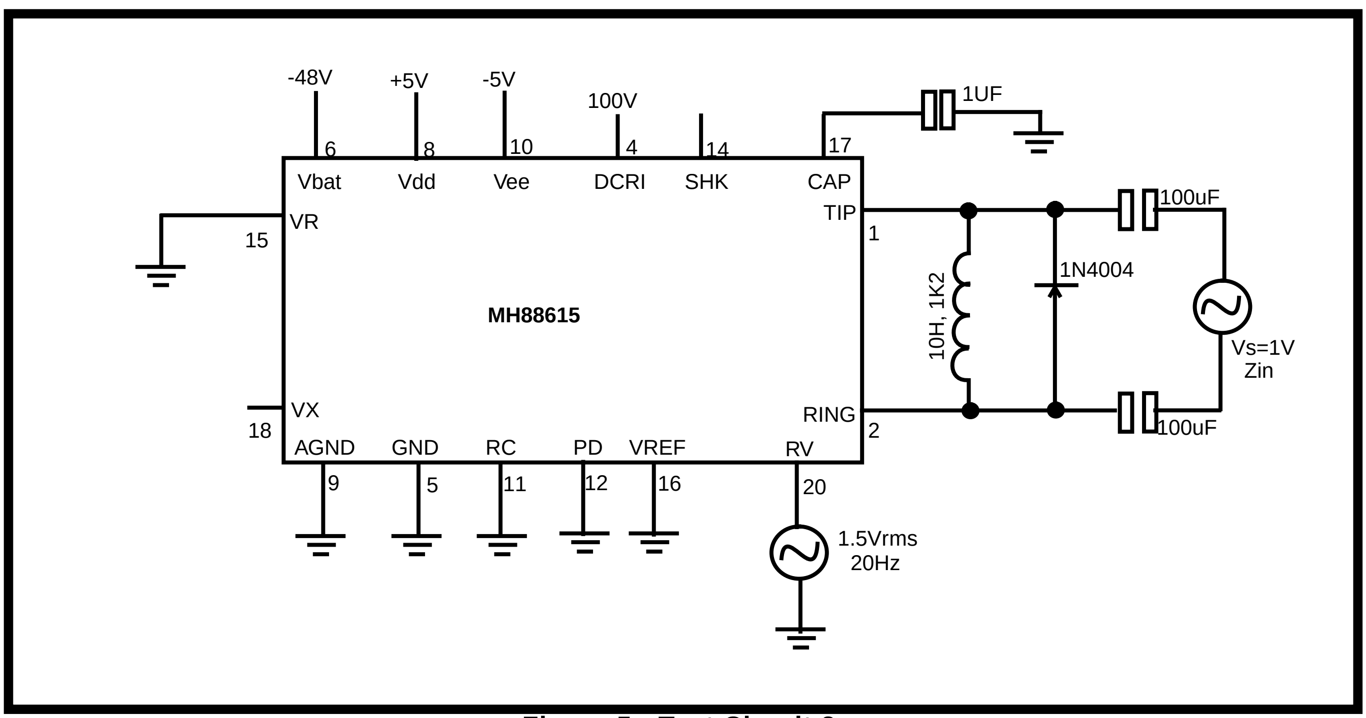


Figure 5 - Test Circuit 2

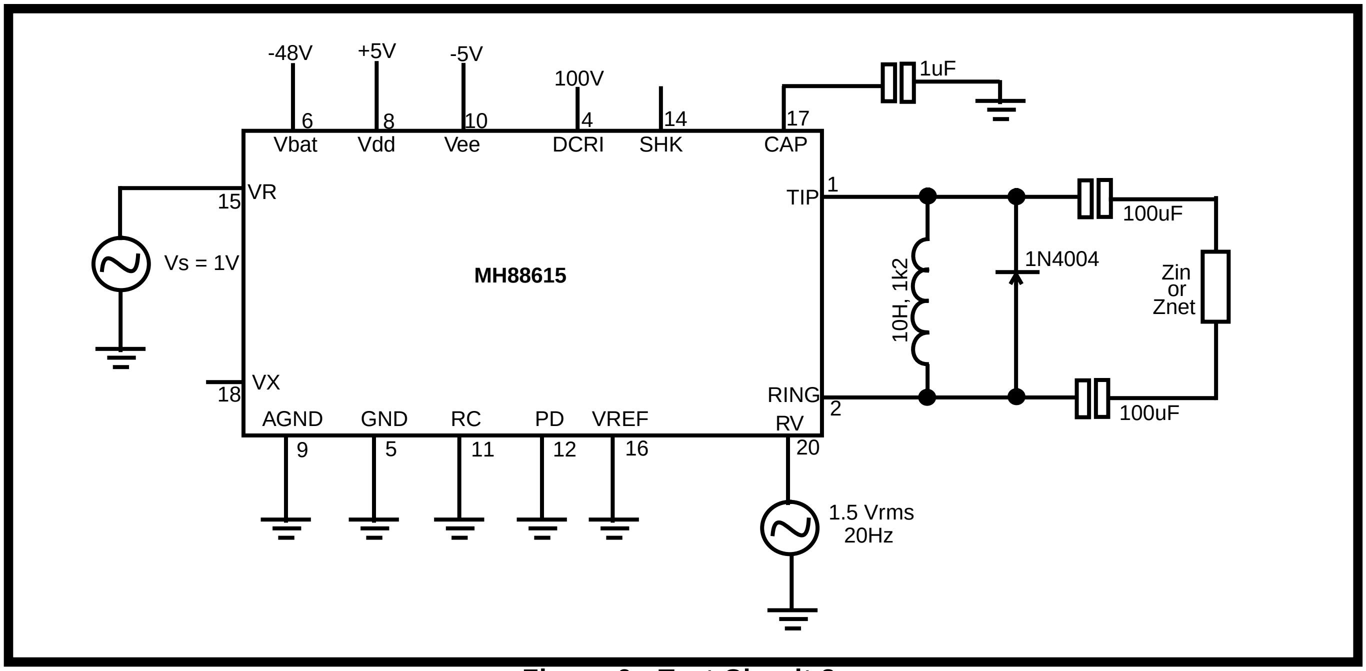


Figure 6 - Test Circuit 3

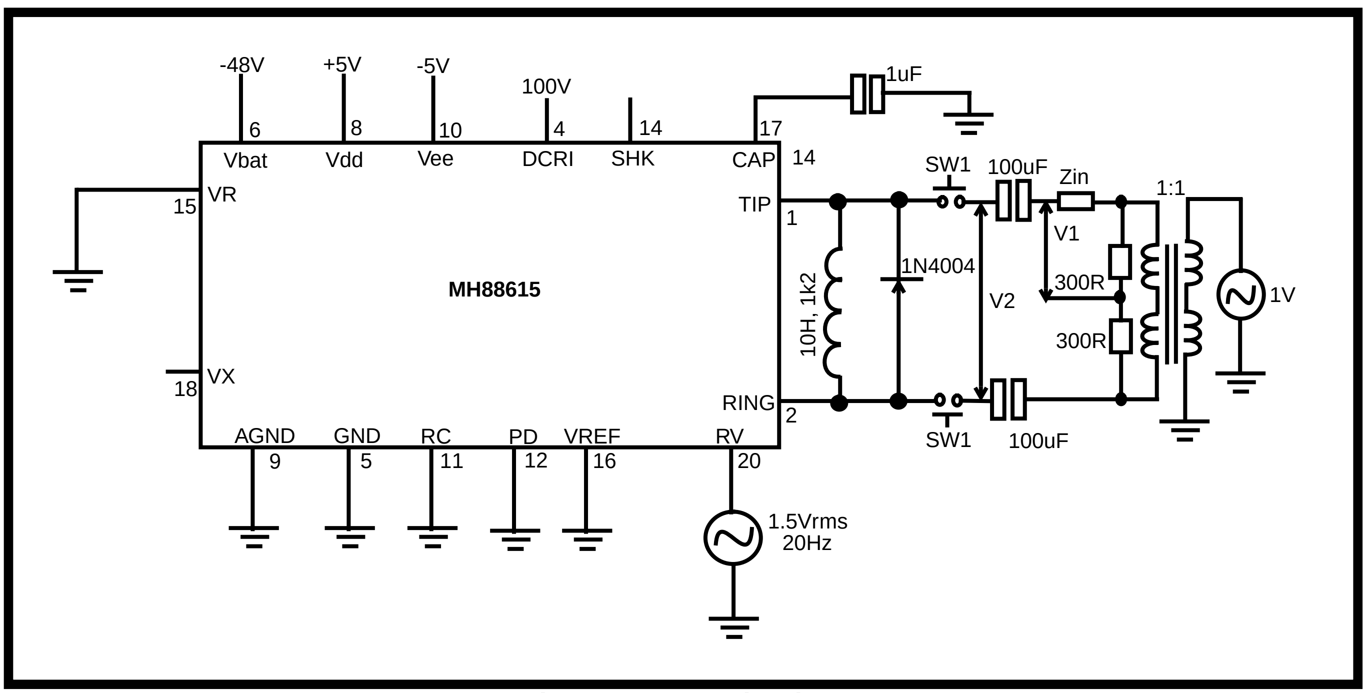


Figure 7 - Test Circuit 4

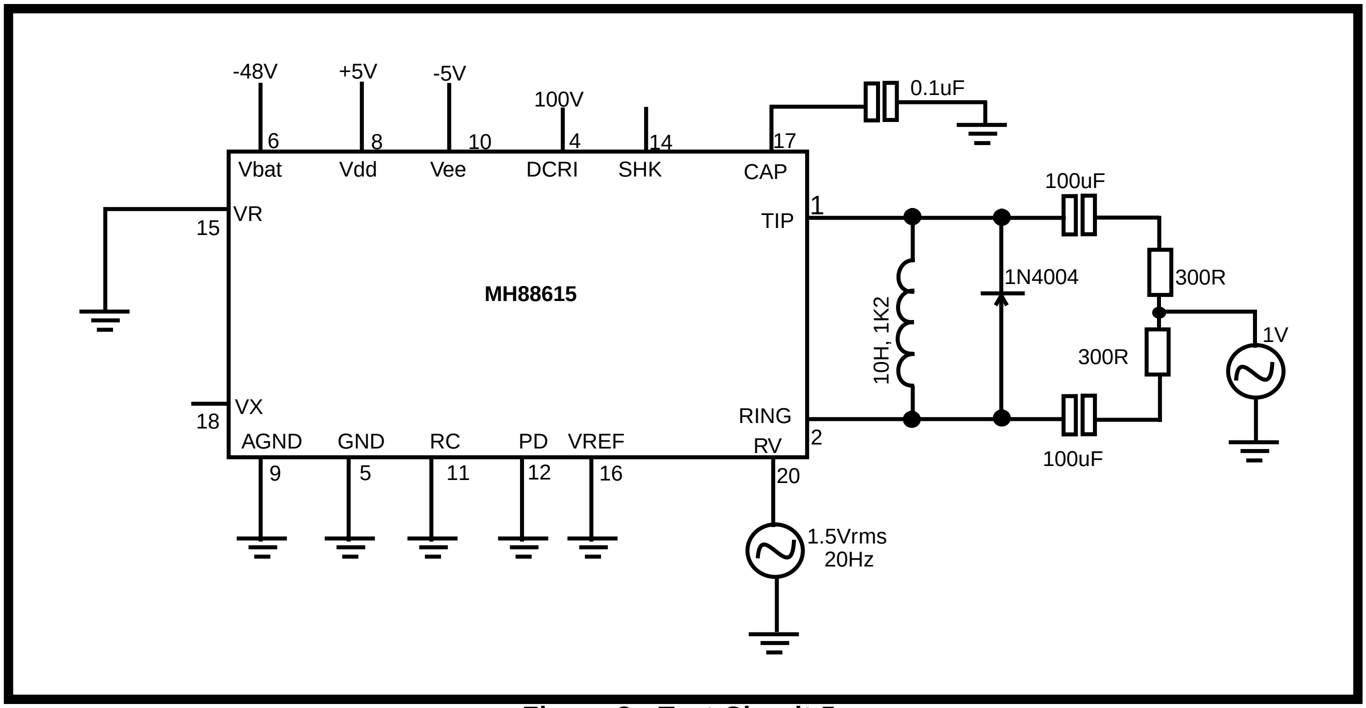


Figure 8 - Test Circuit 5

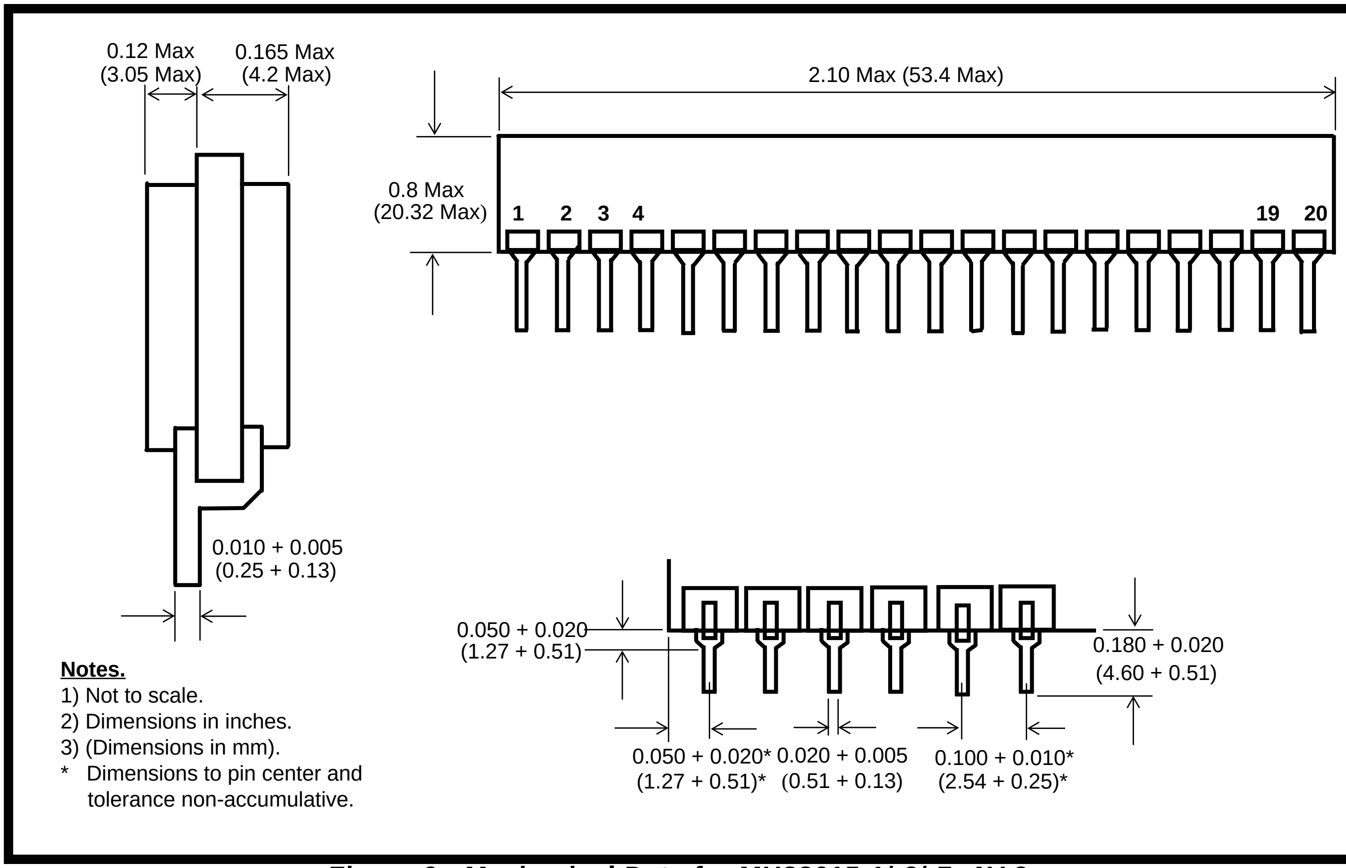


Figure 9 - Mechanical Data for MH88615-1/-3/-7, AV-2

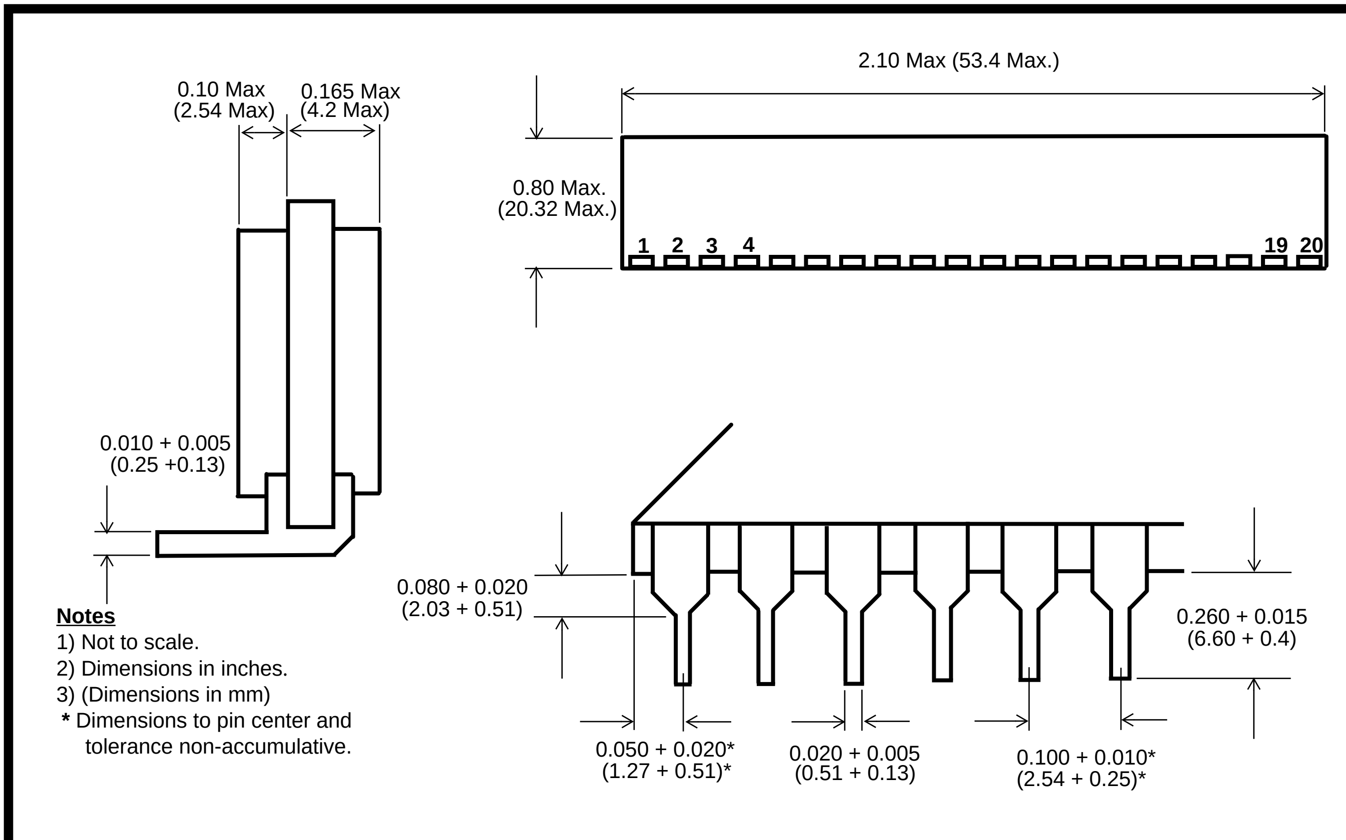


Figure 10 - Mechanical Data for MH88615T-1/-3/-7, AT-2

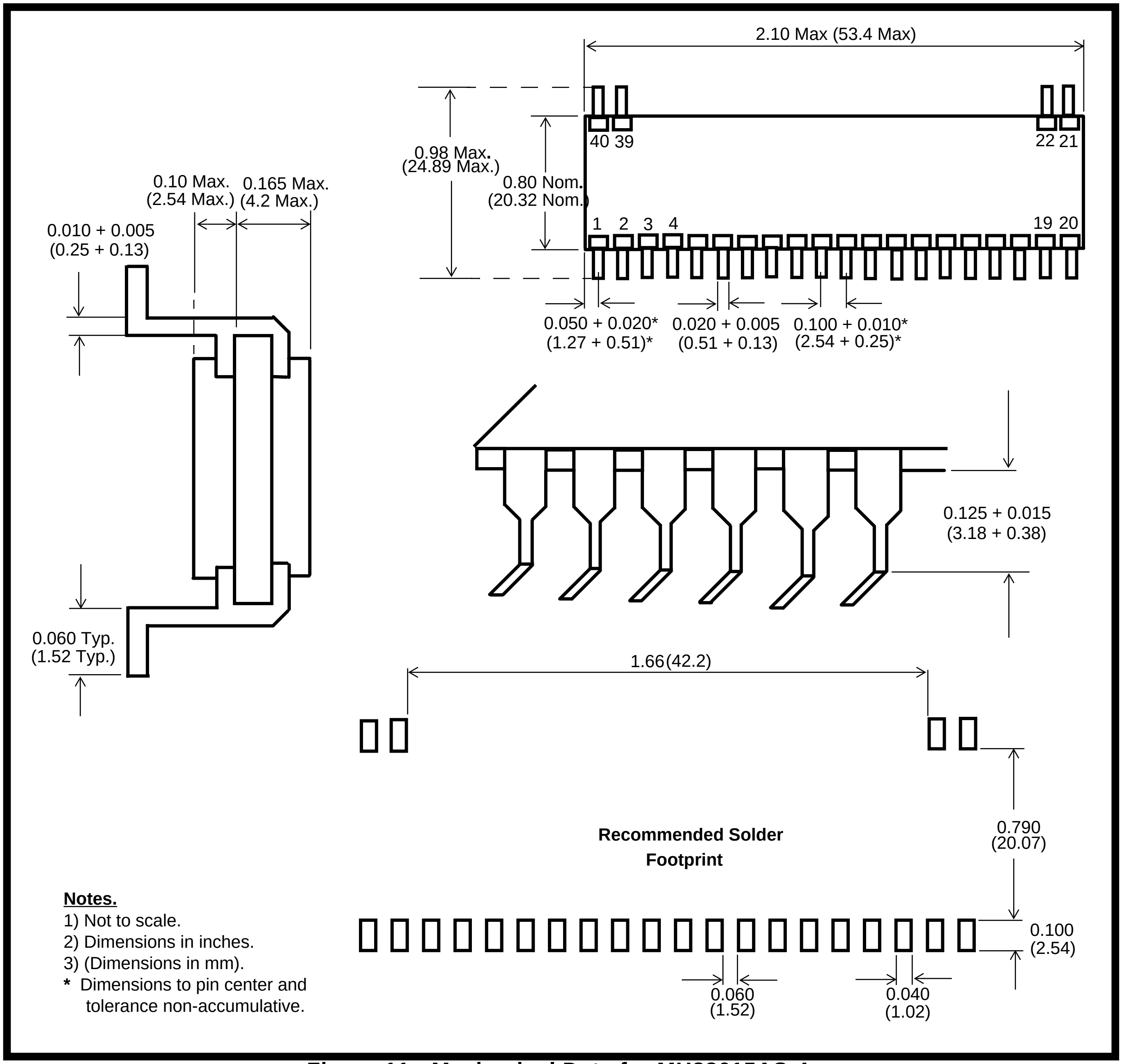


Figure 11 - Mechanical Data for MH88615AS-4