Who is Wurth Electronics Midcom?

Wurth Electronics Midcom is a world leader in the production of standard and custom magnetics for communication and low power applications. Our products are used in a variety of electronic equipment ranging from personal computers and modems to telephone switching equipment, to credit card swiping machines, to high tech medical equipment and industrial controls. WE Midcom ships analog modem, digital telecom, switchmode power, and LAN magnetic products throughout North America and Internationally.

Several factors contribute to our tremendous success. Innovative designs, outstanding quality, and exceptional performance lead WE Midcom to every corner of the globe. The customer's complete satisfaction is the goal of our organization. It is achieved by our team working closely with our customer's team. High ethical standards and fairness are an integral part of our total effort. Our pride in workmanship, ingenuity in design, and strong work ethic help accomplish our aggressive goals.

Analog Business Unit Mission Statement

The Analog business unit will be the industry leader in PC mountable magnetic devices by providing the most cost effective and highest quality products through innovative design,technical leadership, and world class manufacturing.

Contact Information

WE Midcom, Inc. USA

121 Airport Drive ~ PO Box 1330
Watertown, SD 57201
T: 605.886.4385 ~ F: 605.886.4486
www.midcom-inc.com
sales@midcom-inc.com

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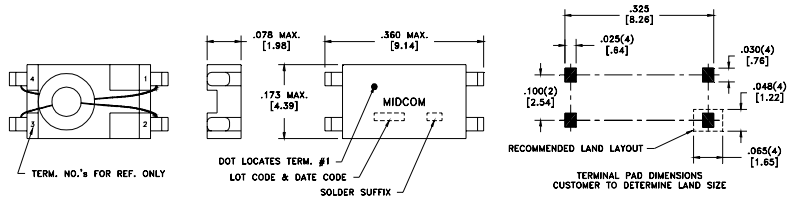
Wurth Electronics Midcom, Inc. USA
121 Airport Drive - PO Box 1330
Watertown, SD 57201
T: 605.886.4385 ~ F: 605.886.4486
www.we-online.com ~ email:sales@midcom-inc.com

SmartDAA™

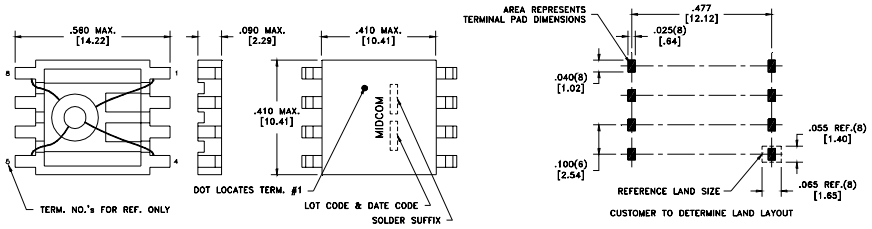
82144R
82149R
82146R
82154R



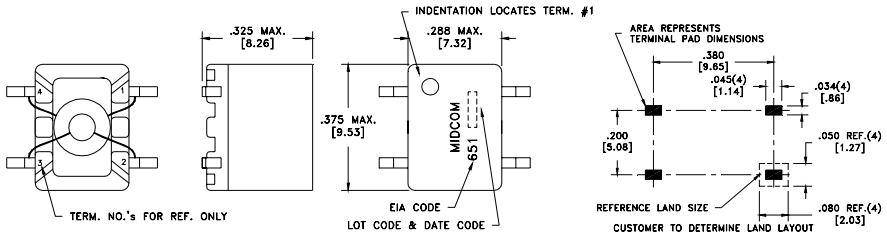
Features

- V.90 performance
- Approved by Conexant for their SmartDAA™ solution
- Cost effective Supplementary Insulation

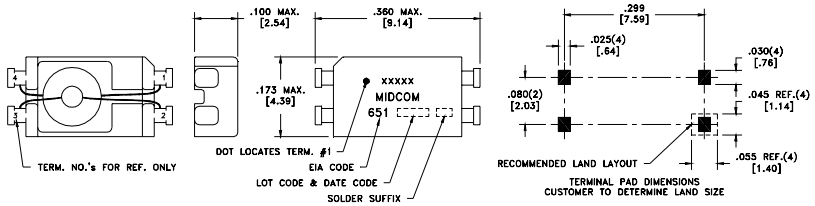
82127R
82128R



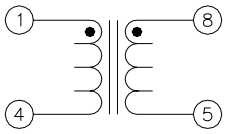
82102R
82126R



82157R



Part Number	Inductance (uH)	Dielectric (VAC)	Turns Ratio	Safety Agency	Mechanicals	Schematic
82144R	30	3750	1:2.0	IEC950	SMD	2
82146R	30	3750	1:1.5	IEC950	SMD	2
82149R	30	3750	1:2.4	IEC950	SMD	2
82154R	30	3750	1:1.67	IEC950	SMD	2
82127R	40	3750	1:2.4	IEC950	SMD	1
82128R	40	3750	1:2.0	IEC950	SMD	1
82102R	50	1875	1:2.4	IEC950	SMD	2
82126R	50	1875	1:2.0	IEC950	SMD	2
82157R	450	3750	1:1	IEC950	SMD	2



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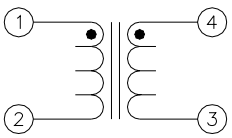

2

SmartDAA™ is a trademark of Conexant Systems, Inc.

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Watertown, SD 57201
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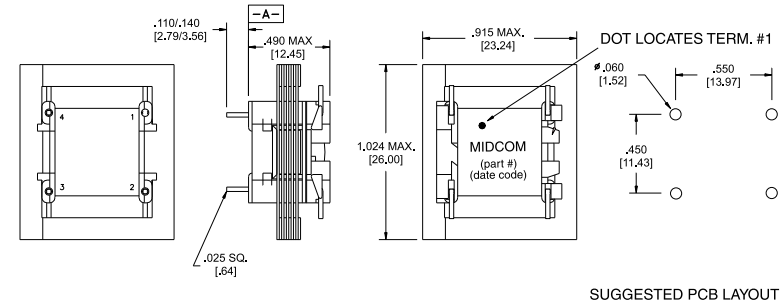
V.90-UL1950/IEC950 Through-hole

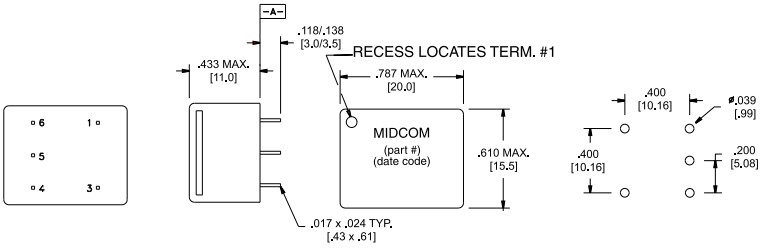
Features

- Supplementary Insulation
- Low Distortion
- Low Cost
- Flat frequency/Phase response
- Application drawings available

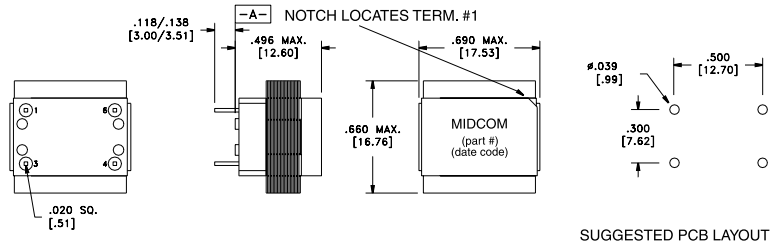
82096
82097
82098



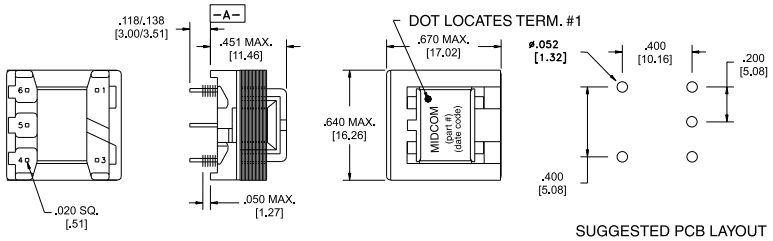
671-8248



671-8236-M
671-9690



82100



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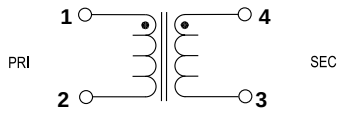
V.90-UL1950/IEC950 Through-hole (continued)

Part Number	THD(dB)	RL(dB)	IL(dB)	Mechanicals	Schematic
82096	-76	20	1	TH	1
82097	-82	18	2	TH	1
82098	-85	25	3	TH	1
671-8248	-82	14	1	TH	2
671-8236-M	-82	14	2	TH	2
671-9690	-82	14	3	TH	2
82100	-82	20	1	TH	2



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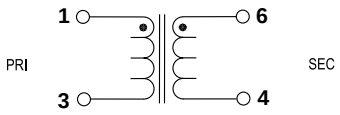

2

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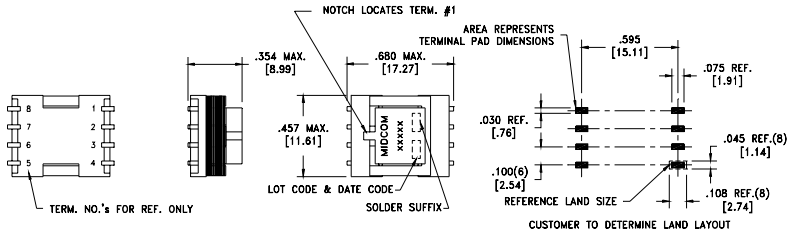
V.90-UL1950 Surface-mount and PCMCIA

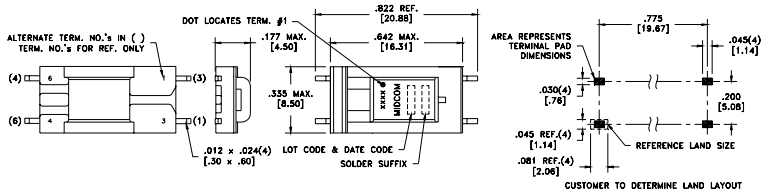
Features

- Low Distortion
- Flat frequency response
- Cost effective
- Supplementary Insulation
- Application drawings available

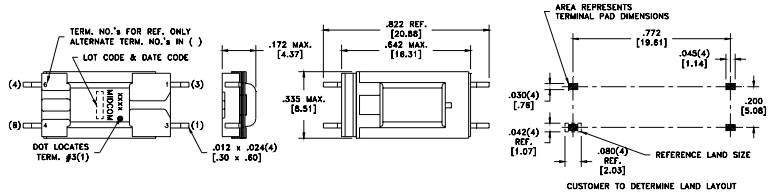
671-8335-MR
82188MR



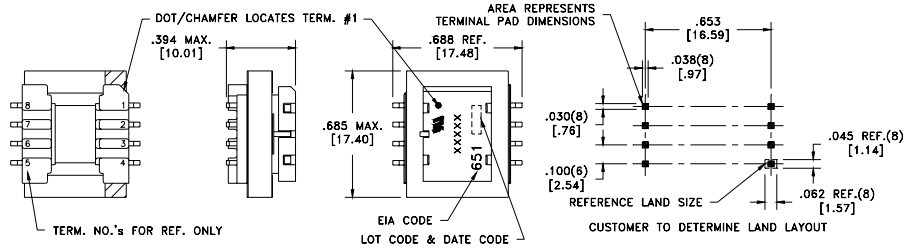
671-8489R



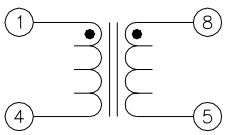
671-8481R
671-8488R



82179R
82180R



Part Number	THD (dB)	RL (dB)	IL (dB)	Safety Agency	Mechanicals	Pin Bend	Schematic
671-8335-MR	-82	14	3	R250	SMD	-	1
82188MR	-82	14	2.6	S250	SMD	-	1
671-8489R	-82	14	3	S250	SMD	-	2
671-8481R	-82	14	3	S250	PCMCIA	0.096"	2
671-8488R	-82	14	3	S250	PCMCIA	0.084"	2
82179R	-82	20	2.5	S250	SMD	-	1
82180R	-76	20	1	S250	SMD	-	1



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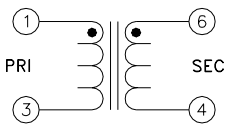

2

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Watertown, SD 57201
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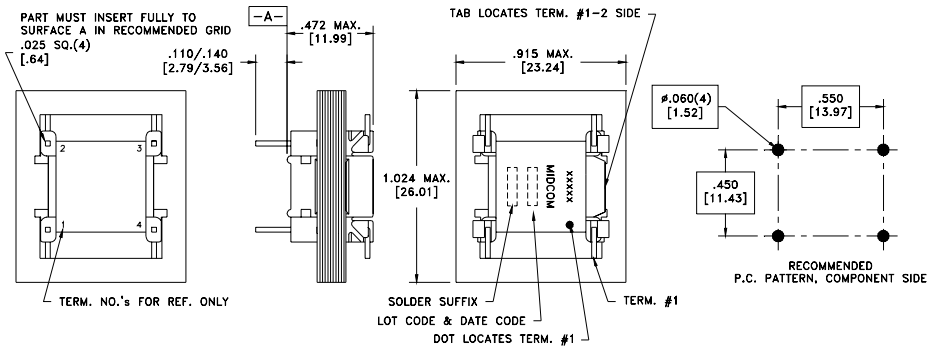
www.we-online.com ~ email:sales@midcom-inc.com

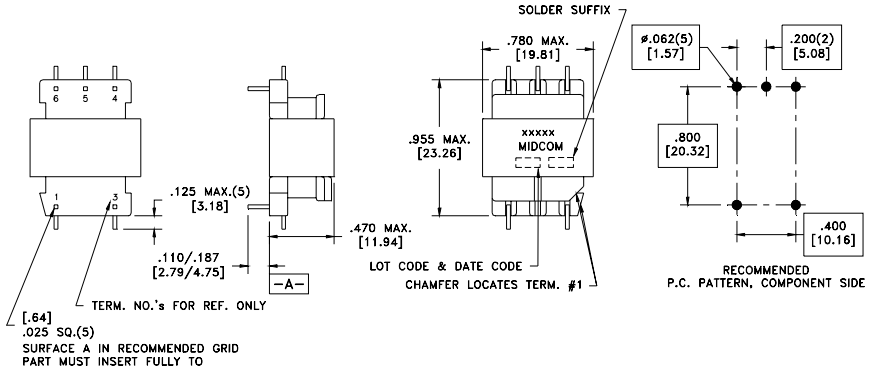
Mechanical 1



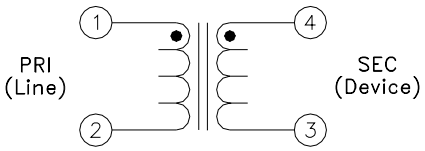
Features

- RoHS versions available
- Good total harmonic distortion characteristics
- Cost effective
- UL file number: E99406
  CSA file number: LR61218

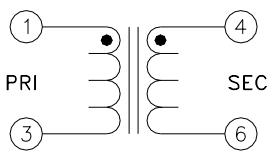
Mechanical 2



Part Number	THD(dB)	RL(dB)	IL(dB)	Mechanicals
671-9372	-76	25	1	1
671-8056	-82	20	2	1
671-8079	-86	25	3	1
671-8262	-82	15	3	2



Schematic 1



Schematic 2

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Midcom

WÜRTH ELEKTRONIK

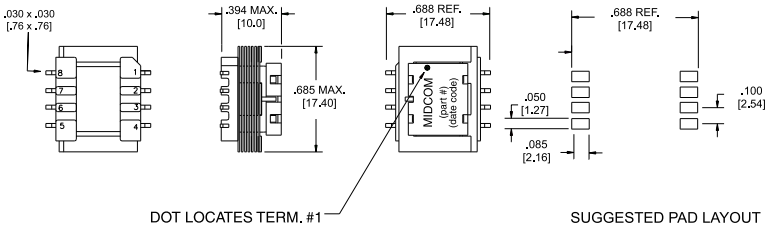
AnalogModem

V.90-UL1459 - Surface-mount and PCMCIA

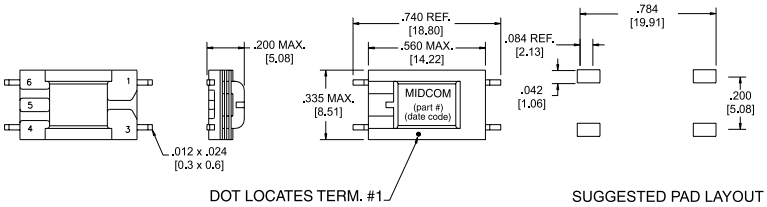
Features

- Low Distortion
- Cost Effective
- Surface mountable
- Flat top for automatic placement

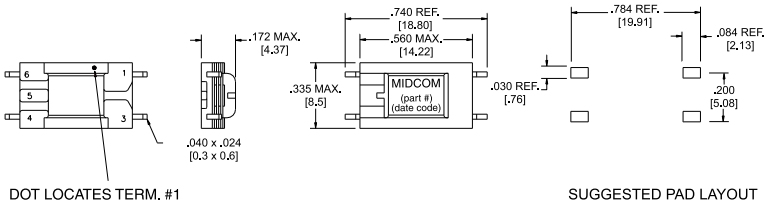
671-8422R
82020R
671-8482R



671-8447R

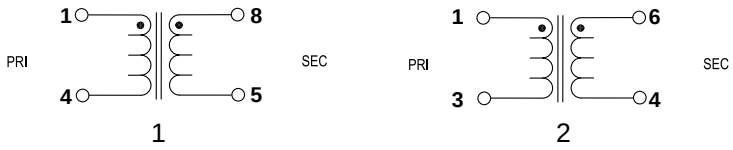


671-8443R
671-8444R
671-8445R
671-8446R



Part Number	THD(db)	RL(db)	IL(dB)	Pin Bend	Mechanicals	Schematic
*671-8422R	-82	25	2	-	SMD	1
*82020R	-86	14	3	-	SMD	1
671-8482	-76	25	1	-	SMD	2
671-8447R	-85	30	3	-	SMD	2
671-8443R	-85	30	3	0.096"	PCMCIA	2
671-8444R	-85	30	3	0.084"	PCMCIA	2
671-8445R	-85	30	3	0.064"	PCMCIA	2
671-8446R	-85	30	3	0.052"	PCMCIA	2

*Lower THD versions available



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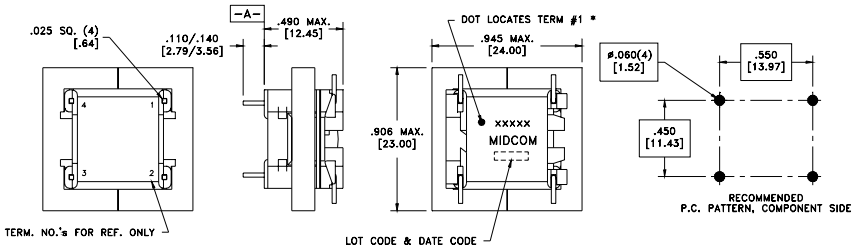
Midcom

WÜRTH ELEKTRONIK

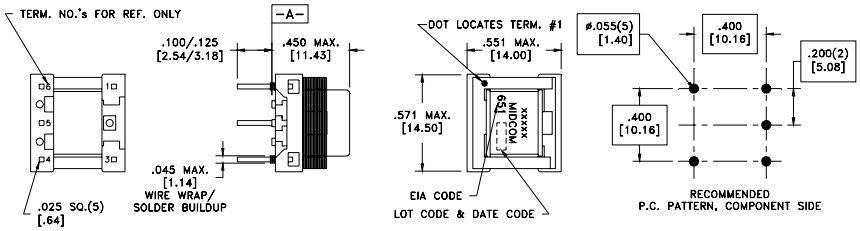
AnalogModem

V.29-UL1950

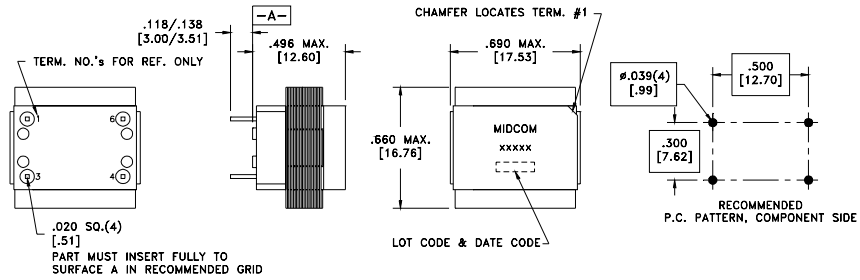
82107
82111
82113



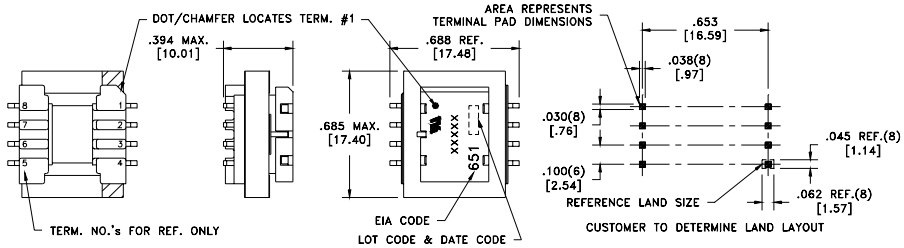
671-8240



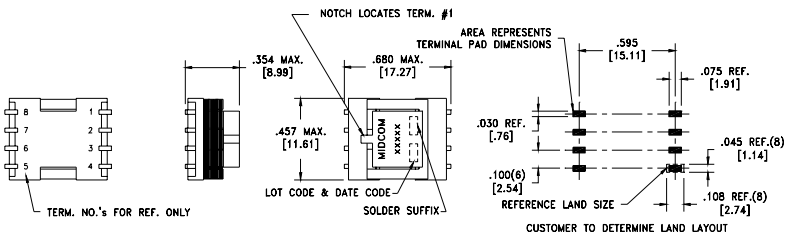
671-8238-M



82180R



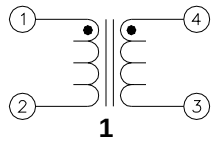
671-8275-MR



Features

- Low Cost
- Supplementary Insulation
- Small size, low profile
- Application drawings available

Part Number	RL (dB)	DC (mA)	IL (dB)	Mechanicals	Schematic
82107	10	65	3	TH	1
82111	10	100	2	TH	1
82113	10	100	2	TH	1
671-8240	14	-	1	TH	2
671-8238-M	14	-	1	TH	3
82180R	20	-	1	SMD	4
671-8275-MR	14	-	3	SMD	4



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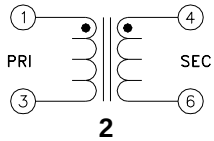

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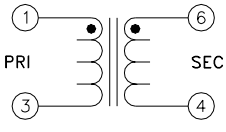

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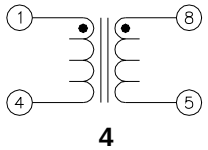


4

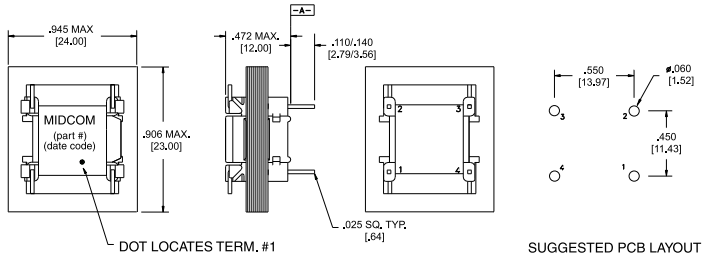
9/26/07 Details subject to change. Contact your Midcom sales representative for additional information. Dimensions: in/mm. All tolerances are ± .010/0,25 and electrical specifications are @ 25°C unless otherwise specified.

V.29 - UL1459

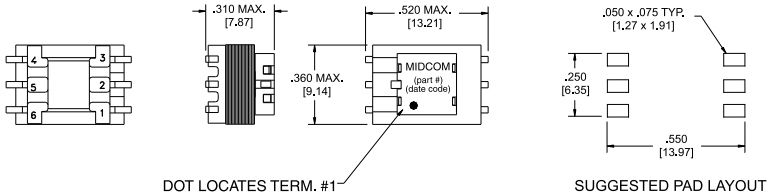
Features

- Low Cost
- Small size
- UL file number: E99406
  CSA file number: LR61218

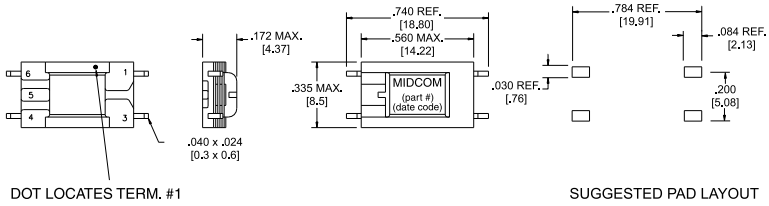
671-8001
671-8005



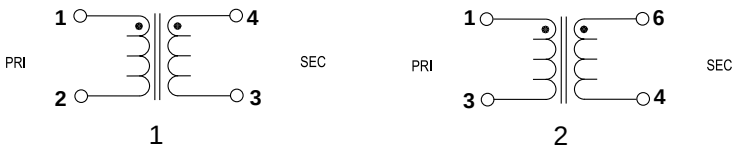
671-8424R



671-8443R



Part Number	THD(dB)	RL(dB)	DC(mA)	IL(dB)	Mechanicals	Schematic
671-8001	-	10	100	2	TH	1
671-8005	-71.5	10	100	2	TH	1
671-8424R	-82	20	-	3	SMD	2
671-8443R	-85	30	-	3	PCMCIA	2



Details subject to change. Contact your Midcom sales representative for additional information. Dimensions: in/mm. All tolerances are ± .010/0,25 and electrical specifications are @ 25°C unless otherwise specified. 9/26/07

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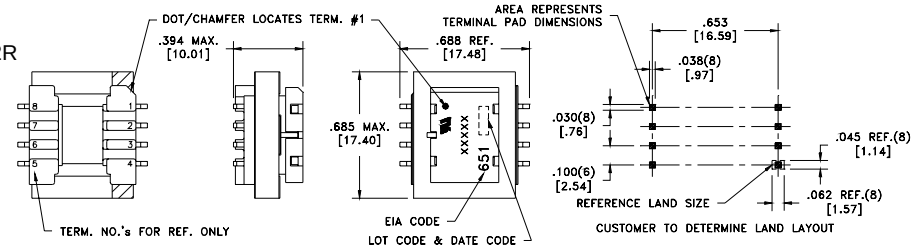
Audio – High Fidelity

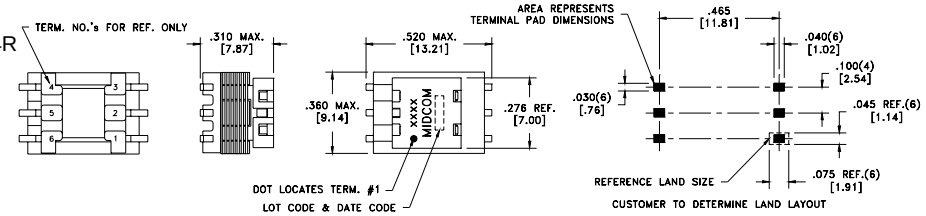
Features

- Low distortion
- Small size
- Cost effective
- 1:1 turns ratio
- Low crosstalk

671-8422R
82020R
82179R



671-8424R



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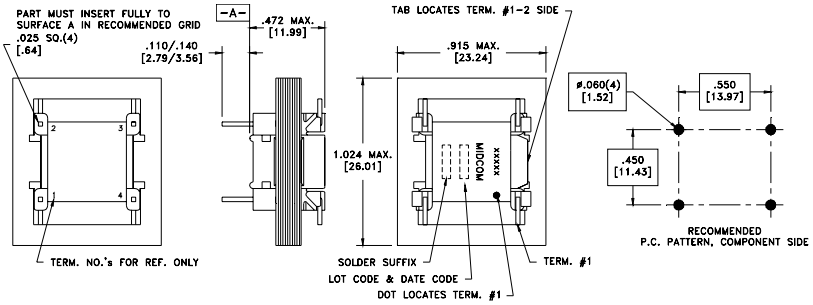
671-8056
671-8079



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82097
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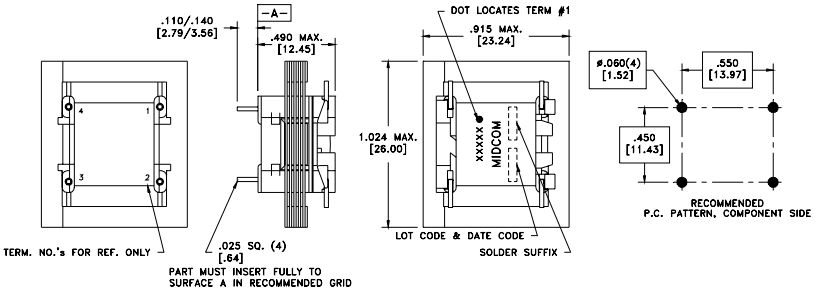
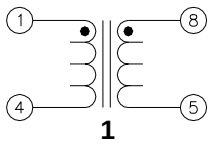


Part Number	THD (dB)	Pri Z	IL (dB)	Mechanicals	Schematic
671-8422-R	-82	600	2	SMD	1
82020R	-86	600	3	SMD	1
82179R	-82	600	2.5	SMD	1
671-8424R	-82	600	3	SMD	3
671-9372	-80	600	1	TH	2
671-8056	-82	600	2	TH	2
671-8079	-86	600	3	TH	2
82096	-80	600	1	TH	2
82097	-82	600	2	TH	2
82098	-85	600	3	TH	2



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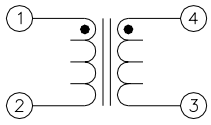

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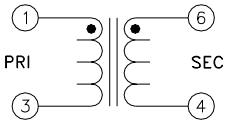

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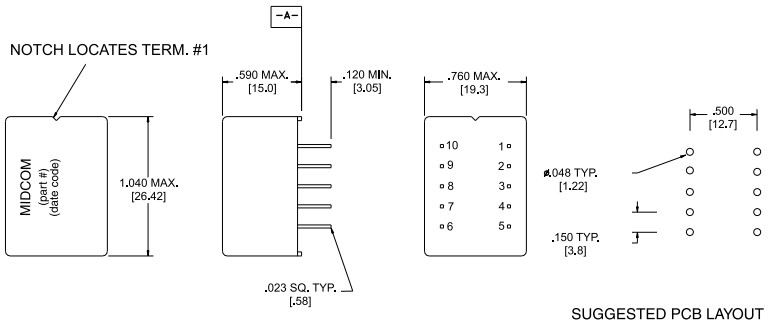
Test Transformers

Features

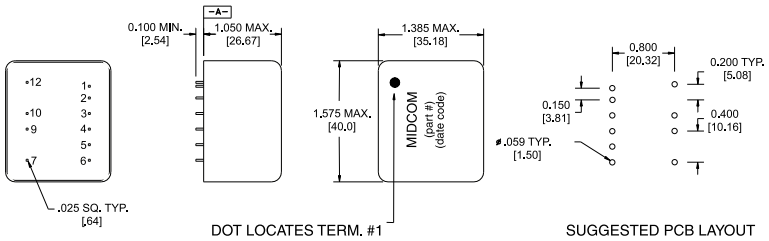
- Good longitudinal balance
- High Inductance
- Application drawings available

Longitudinal Balance

671-0244

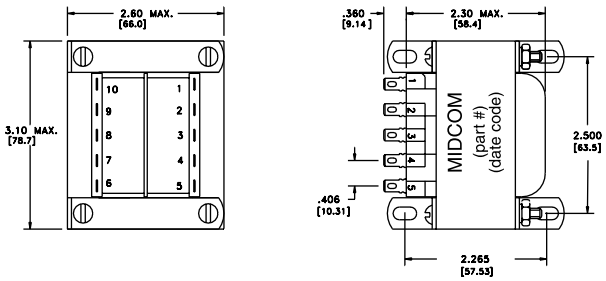


671-0323

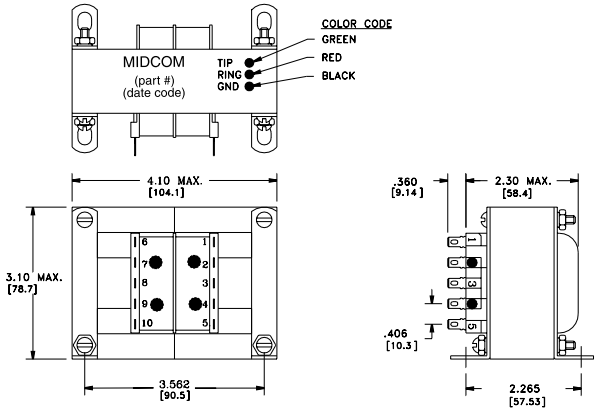


Loop Simulation

671-4125



671-4130



Details subject to change. Contact your Midcom sales representative for additional information. Dimensions: in/mm. All tolerances are ± .010/0,25 and electrical specifications are @ 25°C unless otherwise specified. 9/26/07

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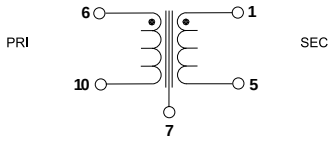
Test Transformers (continued)

Part Number	Inductance	Longitudinal Balance Test	Longitudinal Balance	DC(mA)	Mechanicals	Schematic
671-0244	5H	ANS/IEEE Std 455-1985	80	0	TH	1
671-0323	1H	FCC part 68.310(a)	80	0	TH	2
671-4125	20H	-	-	100	-	3
671-4130	20H	-	70	100	-	4



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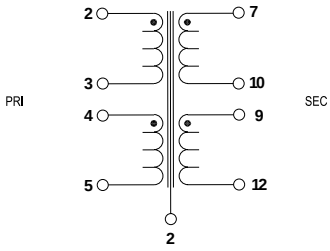

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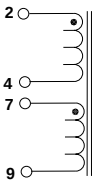

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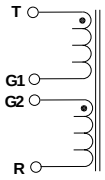

4

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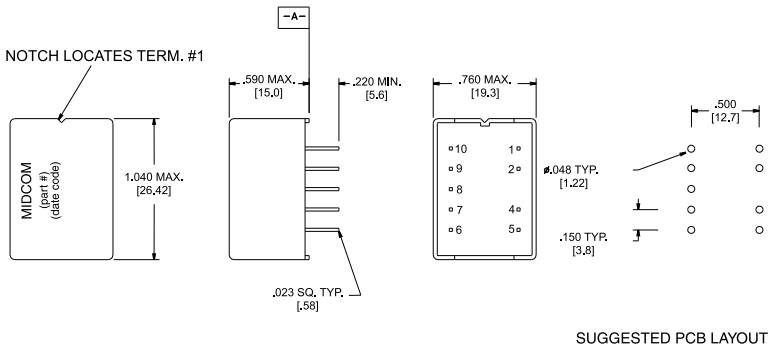
Hybrid - 2 Wire to 4 Wire

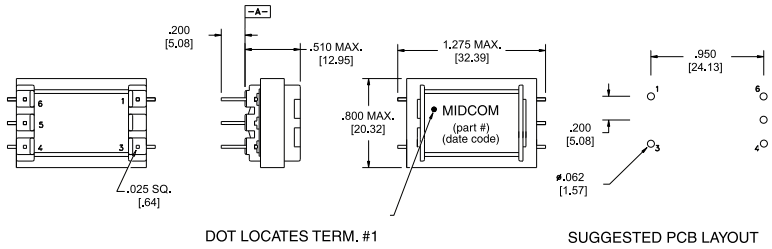
Features

- Low profile
- Good trans-hybrid loss
- Replaces active hybrid circuitry
- Low crosstalk
- Application drawings available

671-0339



671-1489



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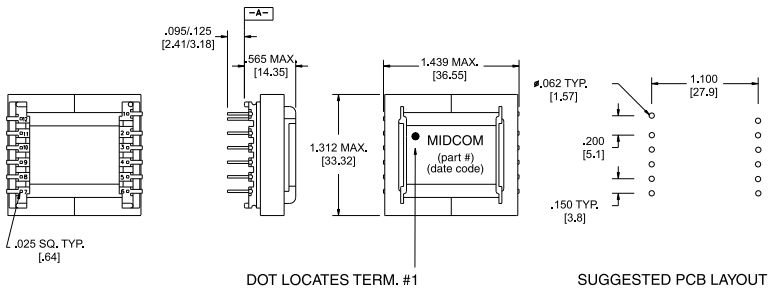
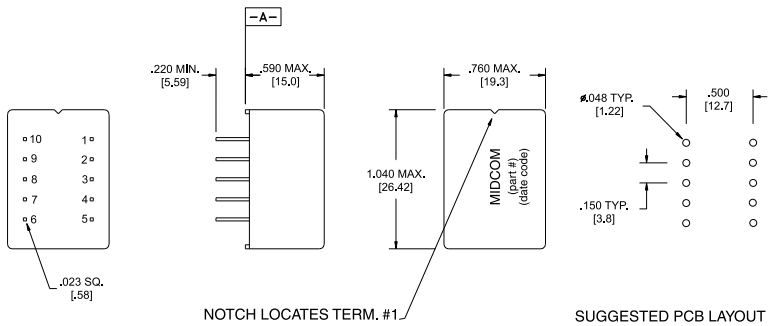


671-0261



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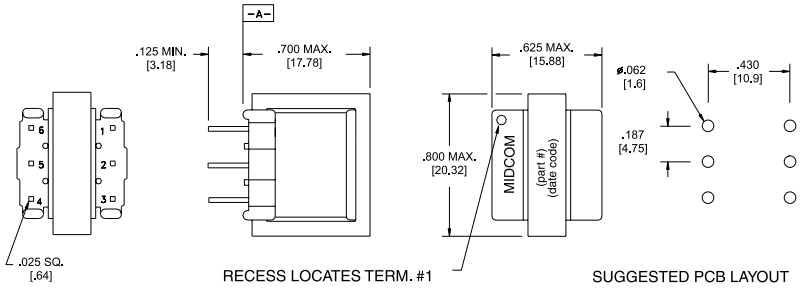
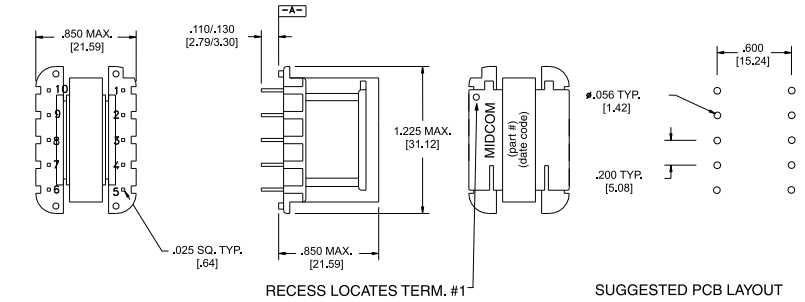
Hybrid - 2 Wire to 4 Wire (continued)

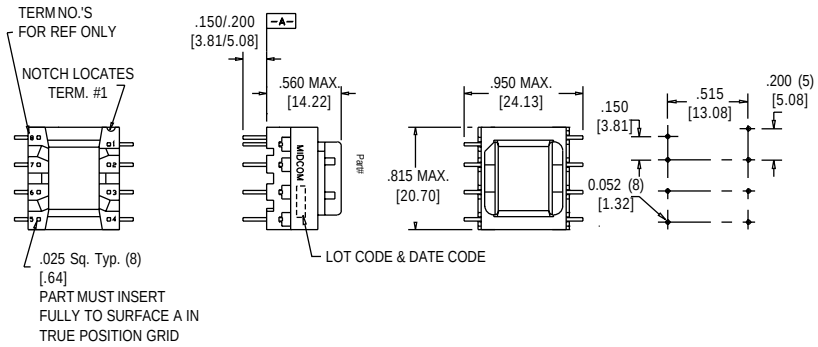
671-0359



671-1898



671-8213



Part Number	Impedance(W)	DC(mA)	THL(dB)	Hybrid	Schematic
671-0339	600	0	30	Single	1
671-1489	600	90	15	Single	2
671-8221	600	50	30	Single	3
671-8213	600	80	15	Single	4
671-0261	600	0	50	Dual	5
671-0359	600	0	45	Dual	6
671-1898	600	80	55	Dual	7

(Schematics continue on following page)

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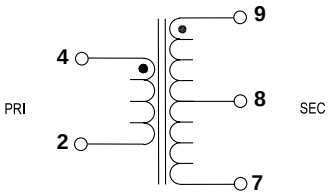
Hybrid - 2 Wire to 4 Wire (continued)



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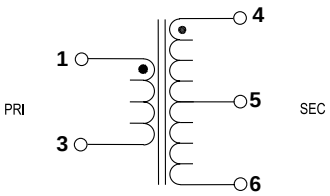

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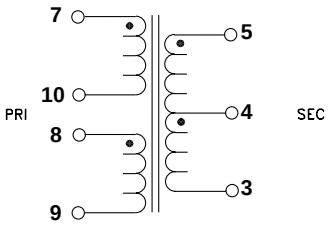

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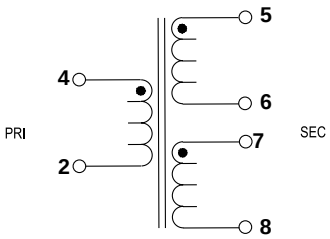

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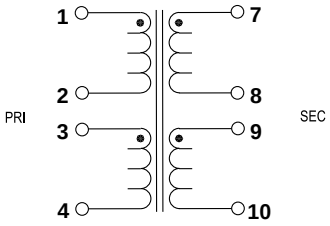

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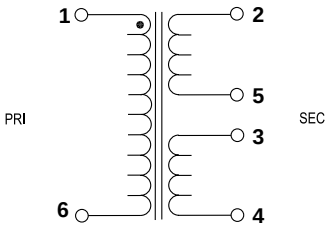

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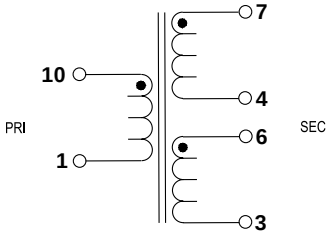

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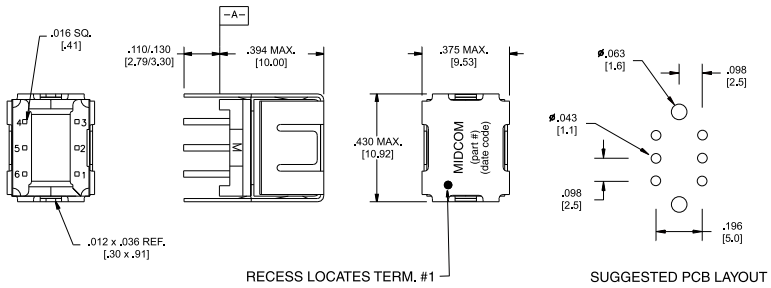
Filter Inductors

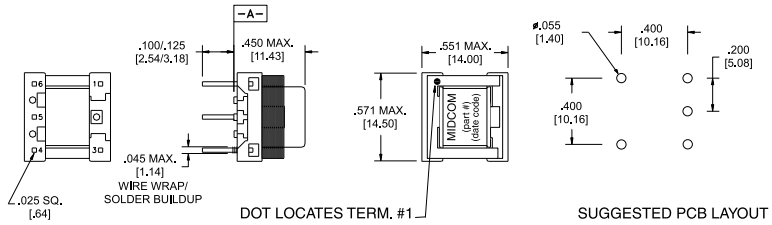
Features

- Good longitudinal balance
- High Inductance
- Application drawings available

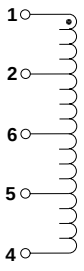
671-4345



671-4250



Part Number	Bandwidth	Attenuation (dB)	Mechanicals	Schematic
671-4345	12k-16k Hz	25	TH	1
671-4250	12k-16k Hz	30	TH	2



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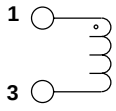

2

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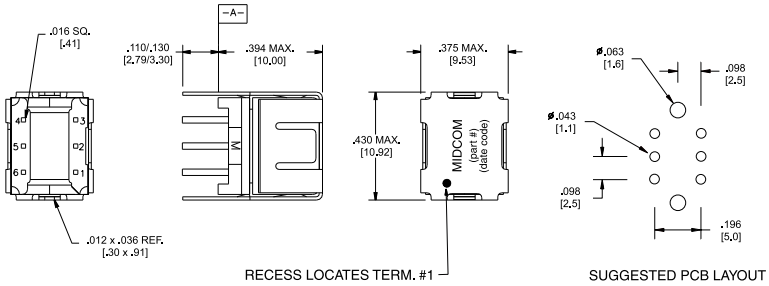
Voice / Analog Switching

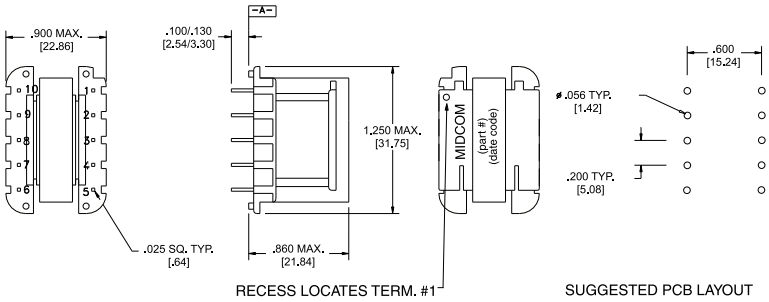
Features

- Small size
- Excellent longitudinal balance

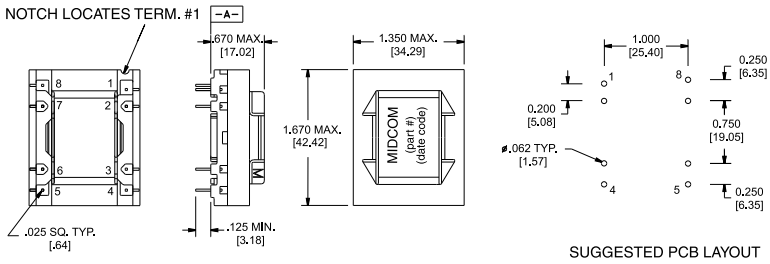
671-5932



671-1444



671-0353



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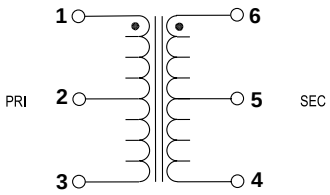
Voice / Analog Switching (continued)

Part Number	Impedance	DC(mA)	Mechanicals	Schematic
671-5932	600	0	TH	1
671-1444	150/600/1200	1	TH	2
671-0353	600	100	TH	3



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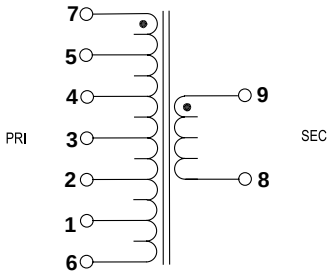

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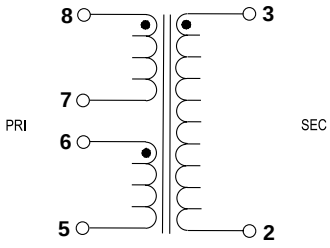

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Analog Modem
Transformer Design Inquiry

Midcom

WÜRTH ELEKTRONIK

Please complete this form and mail or fax it to Wurth Electronics Midcom. You need only include the specifications you require.

Company Information

Company _____ Current Wurth Electronics Midcom Customer? ☐Yes ☐No

Name _____ Sales Contact _____

Address _____ Phone_____ Fax _____

City _____ E-mail _____

Sate/Province _____ Postal Code_____ Samples Needed_____ Date Required _____

Customer Number_____ Mass Production Date _____

Application

If product safety is an issue, please contact us immediately for technical consultation. Our products are not designed for aviation, medical, automotive or life supporting devices. Such applications require our written approval prior to use.

IC Manufacturer _____ IC Number/Name _____

☐ 1200(V.22) ☐ 2400(V.22bis) ☐4800(V.29)
☐ 9600(V.32) ☐ 14.4K(V.32bis) ☐ 28.8k/33.6k(V.34) ☐ 56k(V.90)
☐ Single Hybrid ☐ Dual Hybrid ☐ Hybrid - No Preference
☐ Other _____

☐ Audio
☐ Test
☐ Voice
☐ Filter

Specifications – Note applicable frequency range and drive levels

Line Impedance (Ohms) _____ Load Impedance (Ohms) _____

DC Loop Current (mA) _____ Drive Level (VAC max.) _____

Insertion Loss (dB max.) _____ Frequency Response (±dB) _____

Return Loss (dB min.) _____ Longitudinal Balance (dB min.) _____

THD (dB min.) _____ Crosstalk (dB min.) _____

Trans-Hybrid Loss (dB min.)_____ Temperature Range _____

Package Style_____ ☐ SMD ☐ TH Max. Size: L_____ W_____ H_____ ☐in ☐mm

Cross Reference Manufacturer _____ Cross Reference Part Number _____

Agency Requirements

Regulatory Agencies: ☐ FCC ☐ IEC60950 ☐ BABT ☐ Austel ☐ Other_____

Insulation Requirements: ☐ Functional ☐ Basic ☐ Supplementary ☐ Reinforced

Dielectric Withstand Voltage _____ Operating Voltage _____

General

Target Price_____ at quantity _____ Attach additional notes and requirements as necessary.

Details subject to change. Contact Wurth Electronics Midcom for additional information. Dimensions in/mm. All tolerances are ±.010/.25 and electrical specifications are @25°C unless specified otherwise.

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7/17/2007
FM-0071

Terms and Definitions

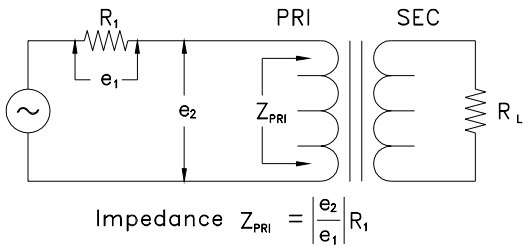
Impedance

Impedance is the ratio of voltage divided by current in an alternating current circuit. The impedances most encountered in wire telecommunications are 300, 600, and 900 ohms for voice-band analog; 135 ohms for subrate; and 75, 100, and 120 ohms for T1/ E1 digital lines.

These impedances must be closely maintained in order to reduce the possibility of undesirable reflections and echoes, which in long distance circuits can be delayed long enough to confuse the telephone user or destroy the data being sent.

Repeat coils and other matching transformers are used to correct and maintain the impedances within the system. Impedance containment within ten percent is usually required. Impedance, with respect to a standard network, is generally specified in critical applications. A simple circuit for measuring the magnitude of reflected impedance of a loaded transformer is shown in Figure 1.

Figure 1



Where:

Z_{PRI} = the impedance seen at the transformer's primary
e_1 = the voltage across the shunt resistor R_1
e_2 = the voltage at the transformer's primary winding
R_1 = the shunt resistor whose value is typically much lower than Z_{PRI}

An LCR bridge would be more appropriate in cases where it is necessary to know both the real and imaginary components of the impedance.

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Terms and Definitions

Return Loss

Return Loss is the ratio, expressed in decibels, of the fractional amount of signal reflection caused by an impedance mismatch; eg: at the input to a transformer with respect to its source impedance.

General Return Loss Equation:

$$\text{Return Loss} = 20 \log_{10} \left| \frac{Z_R + Z_M}{Z_R - Z_M} \right| \text{dB where:}$$

Z_R = the reference impedance
Z_M = the measured impedance

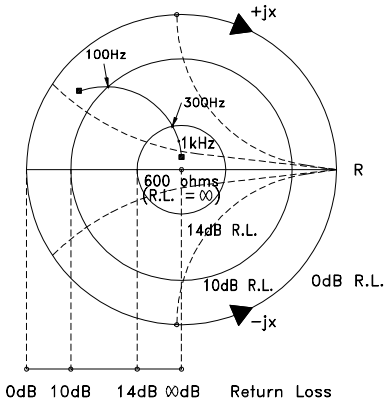
Expanded:

$$\text{Return Loss} = 20 \log_{10} \frac{[(R_R + R_M)^2 + (X_R + X_M)^2]^{1/2}}{[(R_R - R_M)^2 + (X_R - X_M)^2]^{1/2}} \text{dB where:}$$

R_R = reference or generator series resistance
X_R = reference or generator series reactance
R_M = equipment under test series resistance
X_M = equipment under test series reactance

Figure 2

Smith Chart showing impedance as a funtion of frequency.



Reflections in a long communication circuit may result in echoes of the transmitted signal. If the reflections are severe, this may cause the transmission path to go into a sustained oscillatory condition referred to as singing. When reflections impair voice circuits they may sound like phantom talkers on the line. The results of even moderate reflections are slower speech on voice facilities and reduced data rates on digital facilities. This reflection phenomena is particularly aggravated by the very long transmission distances associated with geosynchronous satellite connections.

Return loss figures are a function of the impedances of the circuits involved and are therefore frequency dependent. Figure 2 shows the impedance plot of a simplified transformer model. At high frequencies, the high magnetizing inductive reactance causes the network to look essentially like a resistor and results in a high (good) return loss figure.

As the frequency is decreased, the network reactance becomes more inductive and the return loss figure degrades. Using impedance correcting techniques, it is sometimes possible to improve the return loss of the transformer network by adding proper values of compensating capacitance.

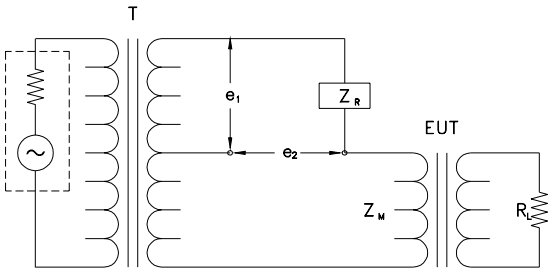
Wurth Electronics Midcom, Inc. USA
121 Airport Drive - PO Box 1330
Watertown, SD 57201
T: 605.886.4385 ~ F: 605.886.4486
www.we-online.com ~ email:sales@midcom-inc.com

Terms and Definitions

Return Loss Measurements

Return loss is measured in a comparison bridge or can be calculated from the equation shown if complex impedances can be measured in both real and imaginary parts at single frequencies.

Figure 3

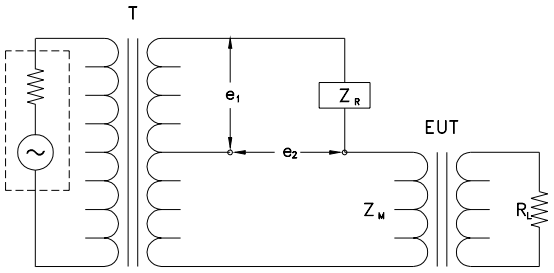


The drawing above shows a simple bridge circuit measuring the return loss of a loaded voiceband transformer (EUT) using a Midcom 671-0023 hybrid transformer.

Echo Return Loss

Since return loss figures may be highly dependent on frequency, another method for specifying voiceband return loss performance is often used . For audible echoes, the frequencies between about 560 to 2000 Hertz are considered in one, multi-frequency, return loss measurement. **Echo Return Loss**, or ERL, is measured by passing a white noise source through a passband shaping filter and then through a comparison bridge circuit, with the circuit under test in one of its arms. The residual signal remaining after the bridge is nulled is indicated on a meter (Figure 4, e_2) as Echo Return Loss.

Figure 4



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Watertown, SD 57201
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www.we-online.com ~ email:sales@midcom-inc.com

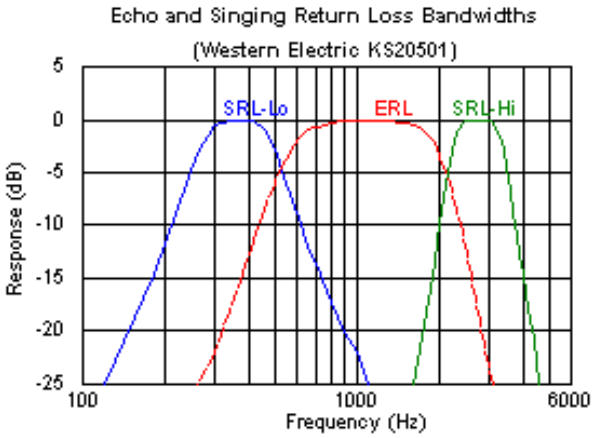
Terms and Definitions

Singing Return Loss

Singing Return Loss is the return loss in the bands of frequencies both below and above the ERL (Echo Return Loss) band. The bands Lo and Hi, measured separately, give an indication of the system's tendency to oscillate or "sing." SRL-Lo is measured like ERL except that the energy resides mainly in the band from 260 to 500 Hertz. SRL-Hi is a counterpart to SRL-Lo in the 2200 to 3400 Hertz band.

Test sets for measuring ERL, SRL-Lo, and SRL-Hi are more complex than single frequency bridges due to the noise shaping circuits employed, but they provide a more comprehensive return loss measurement by using a single number. See Figure 5.

Figure 5



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Watertown, SD 57201
T: 605.886.4385 ~ F: 605.886.4486
www.we-online.com ~ email:sales@midcom-inc.com

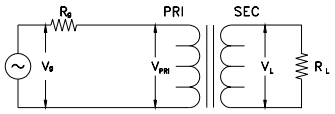
Terms and Definitions

Insertion Loss

Insertion Loss is a comparison of the load power available with the transformer in the circuit to the load power with the transformer not in the circuit. Transducer Loss is commonly referred to as Insertion Loss, but this is precisely true only when source and load impedance are equal.

Midcom measures transducer loss, but calls it "Insertion Loss" for simplicity (except in 'Transformer Analysis Program' analyses where losses are accurately differentiated. With R_L and R_G known (R_G adjusted to match the ideal reflected PRI impedance) and V_G a constant voltage, V_L^2/R_L is the power in R_L. This quantity is inverted and multiplied by $\frac{1}{4}(V_G^2/R_G)$ resulting in the input to output power ratio. The constant "¼" corrects for the fact that V_G^2 is four times the primary voltage under ideal input match conditions, that is when $V_{Rg} = V_{PRI} = \frac{1}{2}V_G$.

Figure 6



$$\text{Insertion Loss } * = 10\log_{10}\left|\frac{\text{maximum power available from source}}{\text{power delivered to the load with transformer inserted}}\right| \text{dB}$$

$$= 10\log_{10}\left|\frac{(V_g)^2 R_L}{4(V_L)^2 R_g}\right| \text{dB}$$

Where:
V_g = Generator Voltage
R_L = Load Resistance
V_L = Load Voltage
R_g = Generator Resistance
V_{PRI} = Transformer Primary Voltage

Therefore, this expression, valid for all turns ratios, includes not only the effect of real dissipative losses within the transformer but also the impedance mismatch losses at the input. Typical mid-band transformer insertion loss values are about one dB. Voiceband insertion loss is typically measured at a reference frequency of 1000 Hz, the mid-band frequency. The use of 1004 Hz is sometimes specified to prevent interference with multiplex sampling frequencies when testing telecom systems.

* Definitions are actually transducer loss, but are called insertion loss here in keeping with industry parlance. See text for details.

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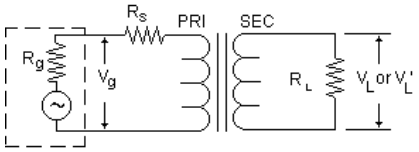
Watertown, SD 57201
T: 605.886.4385 ~ F: 605.886.4486
www.we-online.com ~ email:sales@midcom-inc.com

Terms and Definitions

Frequency Response

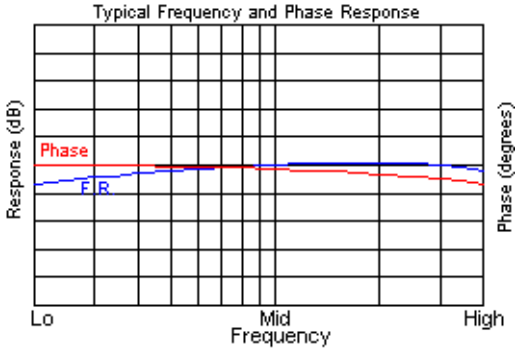
Frequency Response is defined as the variation in insertion loss over the specified frequency band with respect to the reference frequency and with the generator voltage held constant. See Figure 7. Coupling transformers typically exhibit a frequency response within ±0.5 dB over their operational frequency range. A graph of typical frequency and phase response is

Figure 7



$$\text{Frequency Response} = 20\log_{10}\left|\frac{V_L}{V_L'}\right| \text{ dB}$$

Figure 8



Where:
V_G = Generator Voltage held constant
V_L = Load Voltage at test frequency
$V_{L'}$ = Load Voltage at mid-band reference frequency
R_S = Source Impedance

As the telephone network spans a frequency range from tens of hertz to tens of megahertz with dynamic ranges of perhaps 100 dB, special transformer materials and design techniques are often required to maintain response over the level and frequency extremes.

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T: 605.886.4385 ~ F: 605.886.4486
www.we-online.com ~ email:sales@midcom-inc.com

Terms and Definitions

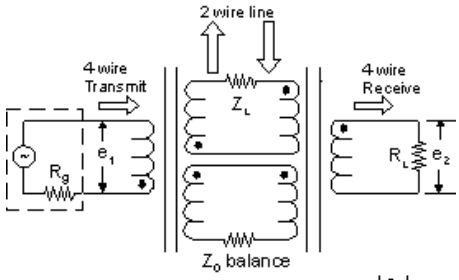
Trans-hybrid Loss

Trans-hybrid Loss is the loss, or isolation, between the transmit and receive ports of a two-wire to four-wire hybrid. It is directly dependent upon signal cancellation accomplished by defining the line impedance and mirroring it with a balance impedance.

The inherent quality of a two-transformer hybrid can be specified by testing trans-hybrid loss with the two-wire line and balance network impedance set to be exactly equal. Under these conditions, typical trans-hybrid losses could exceed 50 dB* under controlled lab conditions. See Figure 9.

Trans-hybrid Loss of a single transformer hybrid is shown in Figure 10. The value of the balance resistor, RBALANCE, may be calculated as shown in the Single Transformer Hybrids section.

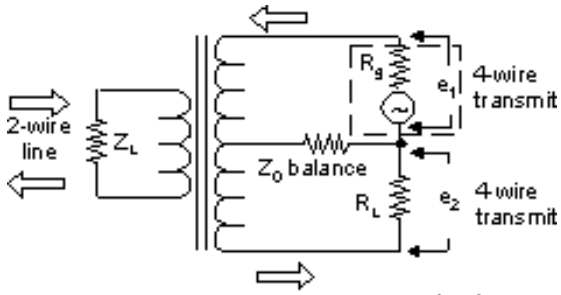
Figure 9



Trans-hybrid Loss (THL)* = $20 \log_{10} \left| \frac{e_1}{e_2} \right|$ dB

R_g = 4-wire source impedance
R_L = 4-wire load impedance
Z_0 = 2-wire line impedance
Z_L = balance network impedance
e_1 = 4-wire transmit voltage
e_2 = 4-wire receive voltage

Figure 10



Trans-hybrid Loss (THL)* = $20 \log_{10} \left| \frac{e_1}{e_2} \right|$ dB

Under these conditions, typical trans-hybrid loss may be as good as 20 to 30 dB* over the voice band for a single transformer hybrid.

* For ease of measurement, Midcom usually omits consideration of losses to or from the 2-wire line when specifying trans-hybrid loss.

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Watertown, SD 57201
T: 605.886.4385 ~ F: 605.886.4486
www.we-online.com ~ email:sales@midcom-inc.com

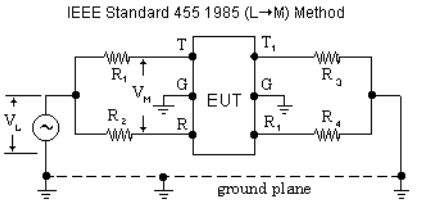
Terms and Definitions

Longitudinal (Transverse) Balance

Longitudinal (Transverse) Balance is a figure of merit for a transformer winding's symmetry with respect to ground which results in the hum, imbalance related noise, and crosstalk rejection of a transformer on balanced lines. It is the ratio, expressed in decibels, of the metallic (differential) signal with respect to the longitudinal (common mode) signal appearing between the transformer's winding and ground. Good balance is an integral part of analog and digital telecommunications worldwide. Transformer design and manufacturing techniques critically determine balance performance. Balance is, however, not a strong function of a transformer's DC current.

Two methods commonly used to measure balance are ANSI/IEEE Standard 455-1985, (American National Standards Institute/Institute of Electrical and Electronic Engineers) seen in Figure 11, and FCC 68.310 (Federal Communication Commission), as in Figure 12. CCITT Rec.0.121 (International Telephone and Telegraph Consultative Committee) embraces both methods and offers some additional definitions of balance. Equipment specifications should reflect the balance test method to be used as the dB figures are different for each procedure. Specifications should also include ground connection details.

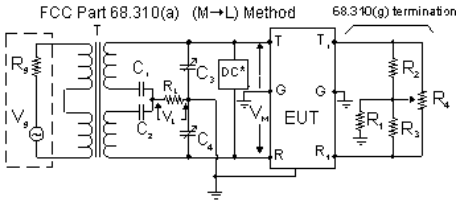
Figure 11



Longitudinal Balance = $20 \log_{10} \left| \frac{V_M}{V_L} \right|$ dB

R_1, R_2, R_3, R_4 = 368 ohm resistors precision matched for test set calibration within 0.01%
V_L = Longitudinal Voltage
V_M = Metallic Voltage (use of a balanced isolation transformer such as 671-0244 is recommended)

Figure 12



Longitudinal Transverse Balance = $20 \log_{10} \left| \frac{V_M}{V_L} \right|$ dB

C_1, C_2 = DC blocking capacitors
C_3, C_4 = trimmer capacitors
R_L = 500 ohms
T = Midcom 671-0323
V_L = longitudinal voltage

R_1 = 350 ohms
R_2, R_3 = 300 ohms
R_4 = 300k ohms
V_M = metallic voltage

Historically, in Canada, Europe, and most of the world, a method similar to the ANSI/IEEE 455 "L M" (longitudinal to metallic) method has prevailed. It applies a longitudinal signal simulating an undesired common mode signal, then measures the conversion within the EUT (Equipment Under Test) to metallic, "L M." Midcom's 671-0244 may be used to assemble the ANSI/IEEE 455 circuit illustrated in Figure 11, for voice-band measurement. Midcom's 671-5767 may be substituted for the 671-0244 for measurements with this circuit at higher frequencies.

In the USA, the FCC Method "M L" (metallic to longitudinal) applies a metallic reference signal, then measures the conversion within the EUT to longitudinal, expressing the undesired result as an absolute dB ratio with respect to the reference. FCC Part 68.310 shows this as "M L" (metallic to longitudinal). The Figure 12 circuit, when assembled with Midcom's 671-0323, may be used for voice-band measurement. This method is also known as transverse balance and will become standard in both Canada and the USA via recent US/Canadian harmonizations of telecom requirements.

Midcom has developed a high-frequency version of the Figure 12 circuit using Midcom's 671-5767 for frequencies from upper voiceband through 1.544 MHz. (See Midcom application note AD-671-5767 for details).

*Figure 12 DC Loop Bias (if required) may be sourced through a balanced battery feed inductor, such as Midcom 671-4130 from an unbalanced lab power supply. Floating battery power (independent of mains and preferably chemically derived) may be required for extremely critical balance measurements.

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121 Airport Drive - PO Box 1330
Watertown, SD 57201
T: 605.886.4385 ~ F: 605.886.4486
www.we-online.com ~ email:sales@midcom-inc.com

Analog Modem

UL1950/IEC950 (New Designs)

- **V.92/V.90(High Speed)**
  - **Silicon DAA - Conexant SmartDAA**

Small size	1:2 turn ratio	1:2.4 turns ratio
	82144R	82149R
	1:1.5 turn ratio	1:1.67 turn ratio
	82146R	82154R
Normal	1:2 turn ratio	1:2.4 turns ratio
	82128R	82127R

  - **STD DAA - Thru-Hole**

Insertion Loss/IC Manufacturer		
1dB/3Com		
Supplementary		
THD	-76dB	-82dB
	82096	82100
Reinforced		671-8248
2dB/Conexant		
Supplementary		82097
Reinforced		671-8236-M
3dB/Lucent		
Supplementary		82098
Reinforced		671-9690

  - **STD DAA - Surface-mount**

Insertion Loss/IC manufacturer	
1dB/3Com	
Supplementary	82081R
2dB/Conexant	
Supplementary	671-8496R
3dB/Lucent	
Supplementary	82074R
Low profile	671-8489R
Reinforced	671-8335-MR

  - **STD DAA - PCMCIA**

Insertion Loss/IC manufacturer		
3dB/Lucent		
Pin Bend	.096"	.084"
	671-8481R	671-8488R

- **V.29 (Slow Speed)**
  Thru-Hole

Need to Handle DC?	
Best Return Loss	82107
Best THD	82113
Lowest cost	82111
No DC	671-8238-M

UL1459 (Legacy Product)

- **V.92/V.90(High Speed)**
  - **STD DAA - Thru-Hole**

Insertion Loss/IC Manufacturer	
1dB/3Com	671-9372
2dB/Conexant	
Best Return Loss	671-8056
Optional	671-8262
3dB/Lucent	671-8079

  - **STD DAA - Surface-mount**

Insertion Loss/IC manufacturer	
1dB/3Com	671-8482R
2dB/Conexant	671-8422R
3dB/Lucent	
Standard	82020R
Low profile	671-8447R

  - **STD DAA - PCMCIA**

Insertion Loss/IC manufacturer		
3dB/Lucent		
Pin Bend	.096"	.084"
	671-8443R	671-8445R

- **V.29(Slow Speed)**
  Thru-Hole

Need to Handle DC?	
Best Cost	671-8001
Best Performance	671-8005

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T: 605.886.4385 ~ F: 605.886.4486
www.we-online.com ~ email:sales@midcom-inc.com