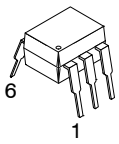
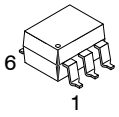
Photo FET Optocouplers

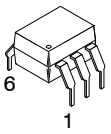
H11F1M, H11F2M, H11F3M



PDIP6 8.51x6.35, 2.54P
CASE 646BX



PDIP6 8.51x6.35, 2.54P
CASE 646BY



PDIP6 8.51x6.35, 2.54P
CASE 646BZ

General Description

The H11FXM series consists of a Gallium−Aluminum−Arsenide IRED emitting diode coupled to a symmetrical bilateral silicon photo−detector. The detector is electrically isolated from the input and performs like an ideal isolated FET designed for distortion−free control of low level AC and DC analog signals. The H11FXM series devices are mounted in dual in−line packages.

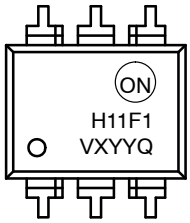
Features

- As a Remote Variable Resistor:
  - ≤ 100 Ω to ≥ 300 MΩ
  - ≤15 pF Shunt Capacitance
  - ≥100 GΩ I/O Isolation Resistance
- As an Analog Switch:
  - Extremely Low Offset Voltage
  - 60 V_{pk-pk} Signal Capability
  - No Charge Injection or Latch−Up
  - UL Recognized (File #E90700)
- These are Pb−Free Devices

Application

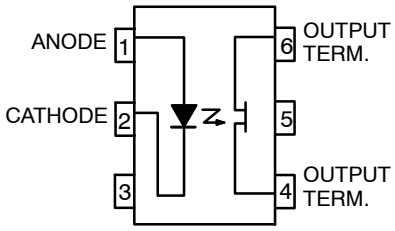
- As a Remote Variable Resistor:
  - Isolated Variable Attenuator
  - Automatic Gain Control
  - Active Filter Fine Tuning/Band Switching
- As an Analog Switch:
  - Isolated Sample and Hold Circuit
  - Multiplexed, Optically Isolated A/D Conversion

MARKING DIAGRAM



H11F1	= Specific Device Code
V	= VDE Mark (Only appears on parts ordered with VDE option − See order entry table)
X	= One−Digit Year Code, e.g., “7”
YY	= Two Digit Work Week Ranging from “01” to “53”
Q	= Assembly Package Code

SCHEMATIC



ORDERING INFORMATION

See detailed ordering and shipping information on page 6 of this data sheet.

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SAFETY AND INSULATION RATINGS

(As per DIN EN/IEC 60747−5−5, this optocoupler is suitable for “safe electrical insulation” only within the safety limit data. Compliance with the safety ratings shall be ensured by means of protective circuits.)

Parameter		Characteristics
Installation Classifications per DIN VDE 0110/1.89 Table 1	< 150 Vrms	I−IV
	< 300 Vrms	I−IV
Climatic Classification		55/100/21
Pollution Degree (DIN VDE 0110/1.89)		2
Comparative Tracking Index		175

Symbol	Parameter	Value	Unit
V_{PR}	Input to Output Test Voltage, Method A, V_{IORM} x 1.6 = V_{PR}, Type and Sample Test with t_m = 10 s, Partial Discharge < 5 pC	1360	V_{peak}
	Input to Output Test Voltage, Method B, V_{IORM} x 1.875 = V_{PR}, 100% Production Test with t_m = 1 s, Partial Discharge < 5 pC	1594	V_{peak}
V_{IORM}	Maximum Working Insulation Voltage	850	V_{peak}
V_{IOTM}	Highest Allowable Over Voltage	6,000	V_{peak}
	External Creepage	≥7	mm
	External Clearance	≥7	mm
	External Clearance (for Option TV, 0.4″ Lead Spacing)	≥10	mm
DTI	Distance Through Insulation (Insulation Thickness)	≥0.5	mm
T_S	Case Temperature (Note 1)	175	°C
$I_{S,INPUT}$	Input Current (Note 1)	350	mA
$P_{S,OUTPUT}$	Output Power (Note 1)	800	mW
R_{IO}	Insulation Resistance at Ts, V_{IO} = 500 V (Note 1)	$>10^9$	Ω

1. Safety limit values − maximum values allowed in the event of a failure.

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C unless otherwise specified)

Symbol	Parameter		Value	Unit
TOTAL DEVICE				
T_{STG}	Storage Temperature		−40 to +125	°C
T_{OPR}	Operating Temperature		−40 to +100	°C
T_{SOL}	Lead Solder Temperature		260 for 10 seconds	°C
EMITTER				
I_F	Continuous Forward Current		60	mA
V_R	Reverse Voltage		5	V
I_F(pk)	Forward Current − Peak (10 μs Pulse, 1% Duty Cycle)		1	A
P_D	LED Power Dissipation Ambient 25°C Ambient		100	mW
	Derate Linearly from 25°C		1.33	mW/°C
DETECTOR				
P_D	Detector Power Dissipation at 25°C		300	mW
	Derate Linearly from 25°C		4.0	mW/°C
BV_{4-6}	Breakdown Voltage (Either Polarity)	H11F1M, H11F2M	±30	V
		H11F3M	±15	V
I_{4-6}	Continuous Detector Current (Either Polarity)		±100	mA

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

INDIVIDUAL COMPONENT CHARACTERISTICS

Symbol	Parameter		Test Conditions	Min	Typ*	Max	Unit
EMITTER							
V_F	Input Forward Voltage		I_F = 16 mA	–	1.3	1.75	V
I_R	Reverse Leakage Current		V_R = 5 V	–	–	10	μA
C_J	Capacitance		V = 0 V, f = 1.0 MHz	–	50	–	pF
OUTPUT DETECTOR							
BV_{4-6}	Breakdown Voltage Either Polarity	H11F1M, H11F2M	I_{4-6} = 10 μA, I_F = 0	30	–	–	V
		H11F3M		15	–	–	
I_{4-6}	Off−State Dark Current		V_{4-6} = 15 V, I_F = 0	–	–	50	nA
			V_{4-6} = 15 V, I_F = 0, T_A = 100°C	–	–	50	μA
R_{4-6}	Off−State Resistance		V_{4-6} = 15 V, I_F = 0	300	–	–	MΩ
C_{4-6}	Capacitance		V_{4-6} = 15 V, I_F = 0, f = 1 MHz	–	–	15	pF

TRANSFER CHARACTERISTICS

Symbol	Characteristics		Test Conditions	Min	Typ*	Max	Unit
DC CHARACTERISTICS							
R_{4-6}	On−State Resistance	H11F1M	I_F = 16 mA, I_{4-6} = 100 μA	–	–	200	Ω
		H11F2M		–	–	330	
		H11F3M		–	–	470	
R_{6-4}	On−State Resistance	H11F1M	I_F = 16 mA, I_{6-4} = 100 μA	–	–	200	Ω
		H11F2M		–	–	330	
		H11F3M		–	–	470	
	Resistance, Non−Linearity and Assymetry		I_F = 16 mA, I_{4-6} = 25 μA RMS, f = 1 kHz	–	2	–	%
AC CHARACTERISTICS							
t_{on}	Turn−On Time		R_L = 50 Ω, I_F = 16 mA, V_{4-6} = 5 V	–	–	45	μs
t_{off}	Turn−Off Time		R_L = 50 Ω, I_F = 16 mA, V_{4-6} = 5 V	–	–	45	μs

ISOLATION CHARACTERISTICS

Symbol	Characteristics	Test Conditions	Min	Typ*	Max	Unit
V_{ISO}	Input−Output Isolation Voltage	t = 1 Minute	4170	–	–	VAC_{RMS}
R_{ISO}	Isolation Resistance	V_{I-O} = 500 VDC	10^{11}	–	–	Ω
C_{ISO}	Isolation Capacitance	f = 1 MHz	–	0.2	–	pF

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.
*All Typical values at T_A= 25°C.

TYPICAL PERFORMANCE CURVES

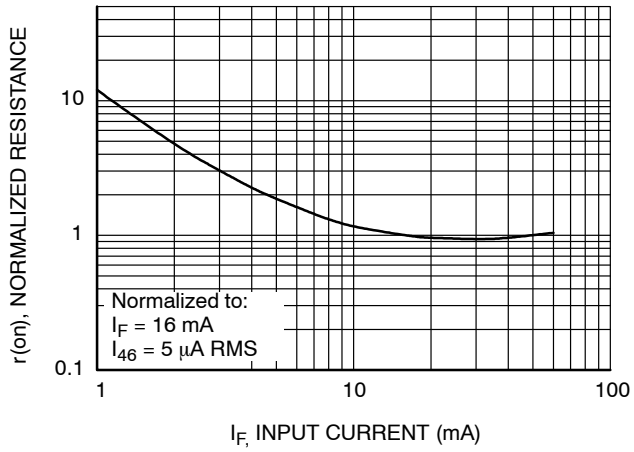


Figure 1. Resistance vs. Input Current

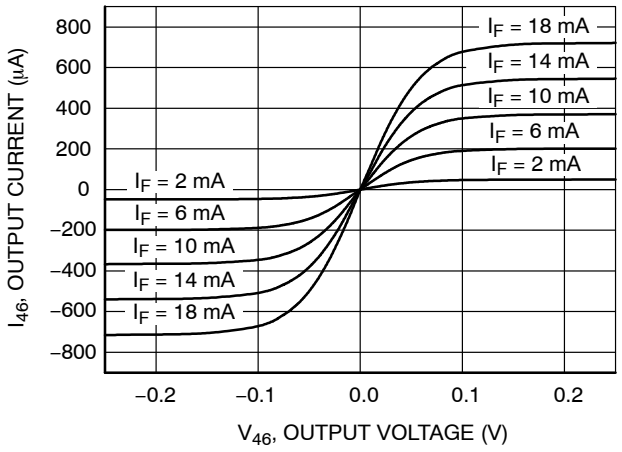


Figure 2. Output Characteristics

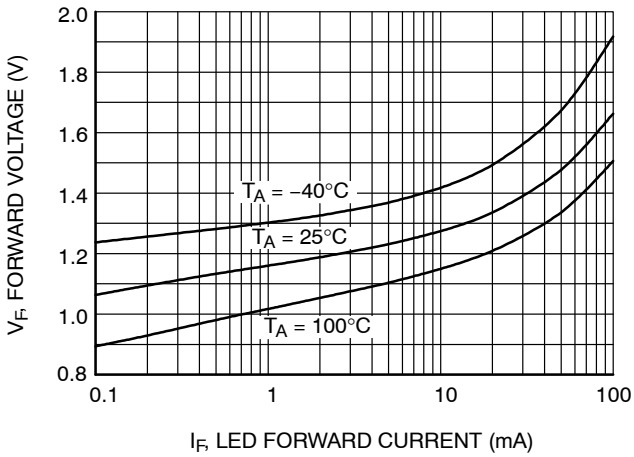


Figure 3. LED Forward Voltage vs. Forward Current

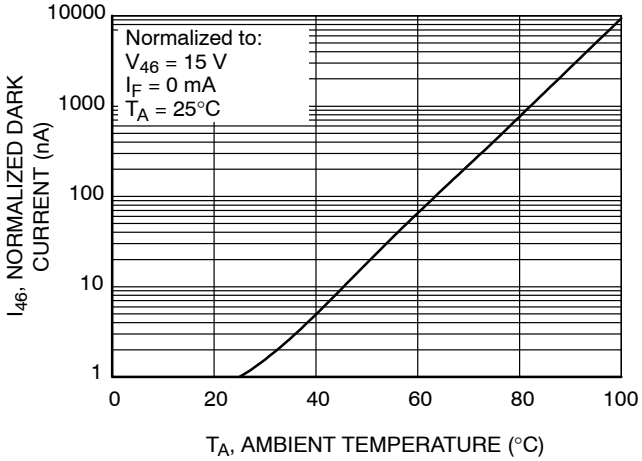


Figure 4. Off−State Current vs. Ambient Temperature

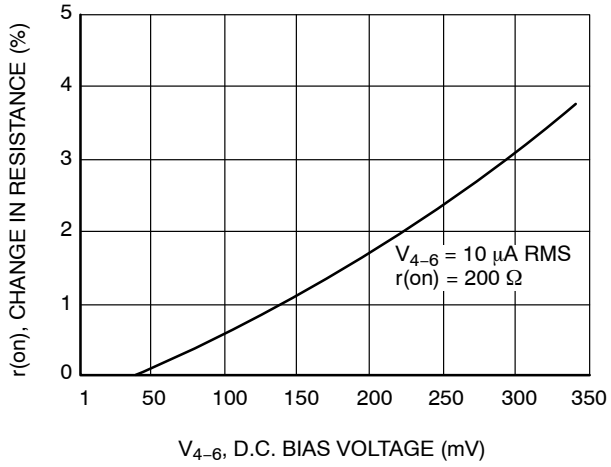
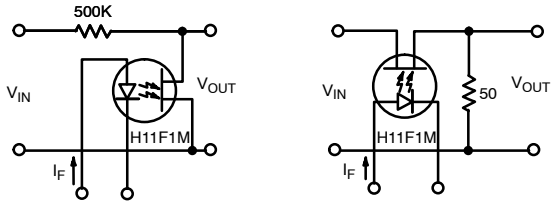


Figure 5. Resistive Non−Linearity vs. D.C. Bias

TYPICAL APPLICATIONS

As a Variable Resistor

ISOLATED VARIABLE ATTENUATORS



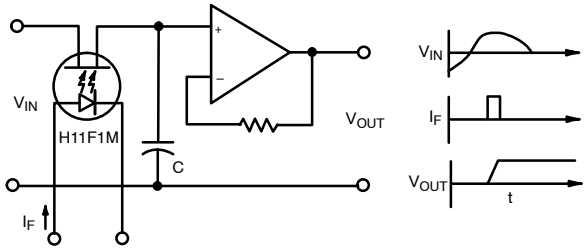
LOW FREQUENCY
Dynamic Range 70 db
@ 10 kHz For $0 \le I_F \le 30$ mA

HIGH FREQUENCY
Dynamic Range 50 db
@ 1 MHz For $0 \le I_F \le 30$ mA

Distortion free attenuation of low level A.C. signals is accomplished by varying the IRED current, IF Note the wide dynamic range and absence of coupling capacitors; D.C. level shifting or parasitic feedback to the controlling function.

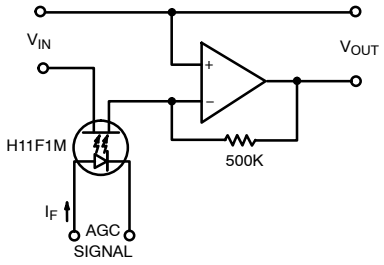
As an Analog Signal Switch

ISOLATED VARIABLE ATTENUATORS



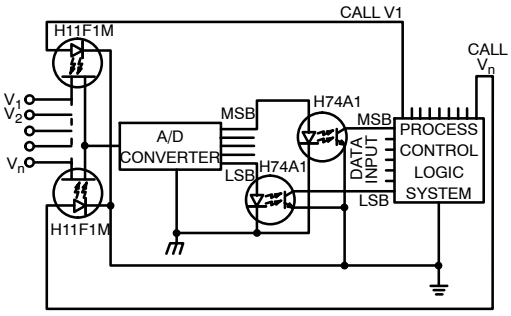
Accuracy and range are improved over conventional FET switches because the H11FXM has no charge injection from the control signal. The H11FXM also provides switching of either polarity input signal up to 30V magnitude.

AUTOMATIC GAIN CONTROL



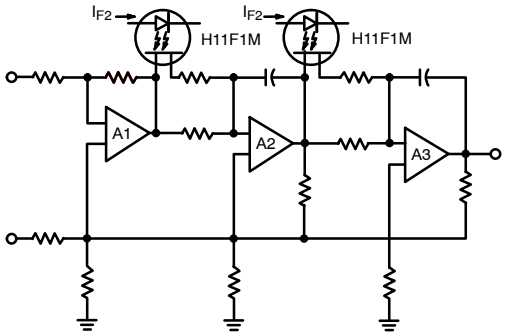
This simple circuit provides over 70db of stable gain control for an AGC signal range of from 0 to 30mA. This basic circuit can be used to provide programmable fade and attack for electronic music.

MULTIPLEXED, OPTICALLY−ISSOLATED A/D CONVERSION



The optical isolation, linearity and low offset voltage of the H11FXM allows the remote multiplexing of low level analog signals from such transducers as thermocouplers, Hall effect devices, strain gauges, etc. to a single A/D converter.

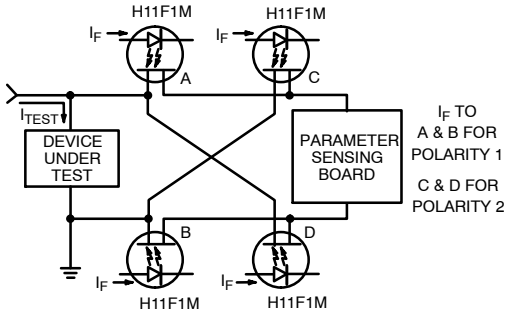
ACTIVE FILTER FINE TUNING/BAND SWITCHING



I_{F2} ADJUSTS f_1, I_{F2} ADJUSTS f_2

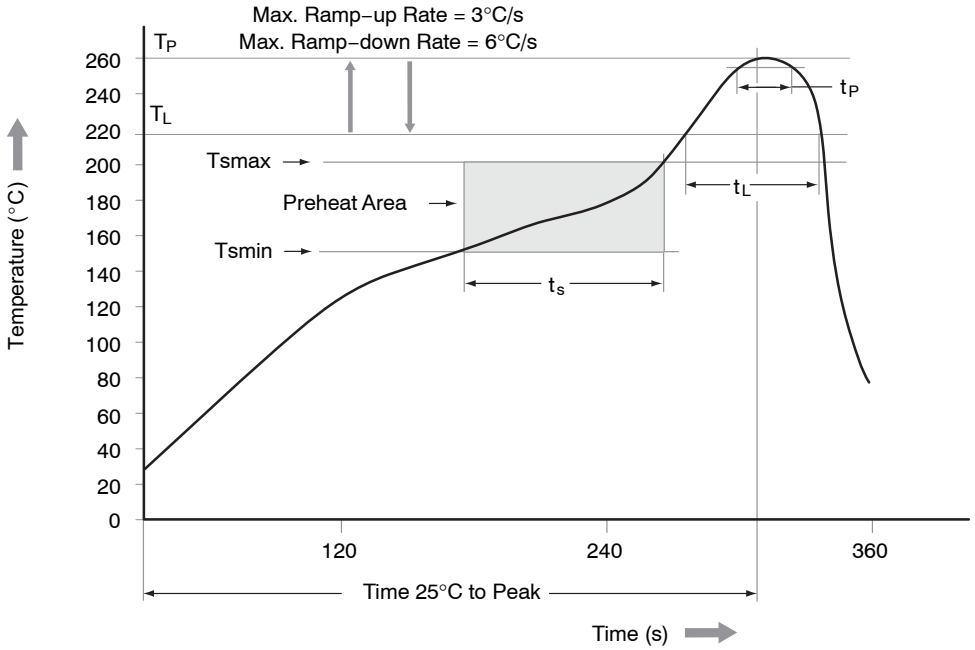
The linearity of resistance and the low offset voltage of the H11FXM allows the remote tuning or band−switching of active filters without switching glitches or distortion. This schematic illustrates the concept, with current to the H11F1M IRED 's controlling the filter's transfer characteristic.

TEST EQUIPMENT − KELVIN CONTACT POLARITY



In many test equipment designs the auto polarity function uses reed relay contacts to switch the Kelvin Contact polarity. These reeds are normally one of the highest maintenance cost items due to sticking contacts and mechanical problems. The totally solid−State H11FXM eliminates these troubles while providing faster switching.

REFLOW PROFILE



Profile Feature	Pb−Free Assembly Profile
Temperature Min. (Tsmin)	150°C
Temperature Max. (Tsmax)	200°C
Time (t_S) from (Tsmin to Tsmax)	60−120 seconds
Ramp−up Rate (t_L to t_P)	3°C/seconds max.
Liquidous Temperature (T_L)	217°C
Time (t_L) Maintained Above (T_L)	60−150 seconds
Peak Body Package Temperature	260°C +0°C / −5°C
Time (t_P) within 5°C of 260°C	30 seconds
Ramp−down Rate (T_P to T_L)	6°C/seconds max.
Time 25°C to Peak Temperature	8 minutes max.

ORDERING INFORMATION

Option	Order Entry Identifier (Example)	Description
No option	H11F1M	Standard Through Hole Device
S	H11F1SM	Surface Mount Lead Bend
SR2	H11F1SR2M	Surface Mount; Tape and Reel
V	H11F1VM	IEC60747−5−5 approval
TV	H11F1TVM	IEC60747−5−5 approval, 0.4” Lead Spacing
SV	H11F1SVM	IEC60747−5−5 approval, Surface Mount
SR2V	H11F1SR2VM	IEC60747−5−5 approval, Surface Mount, Tape and Reel

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ISSUE O

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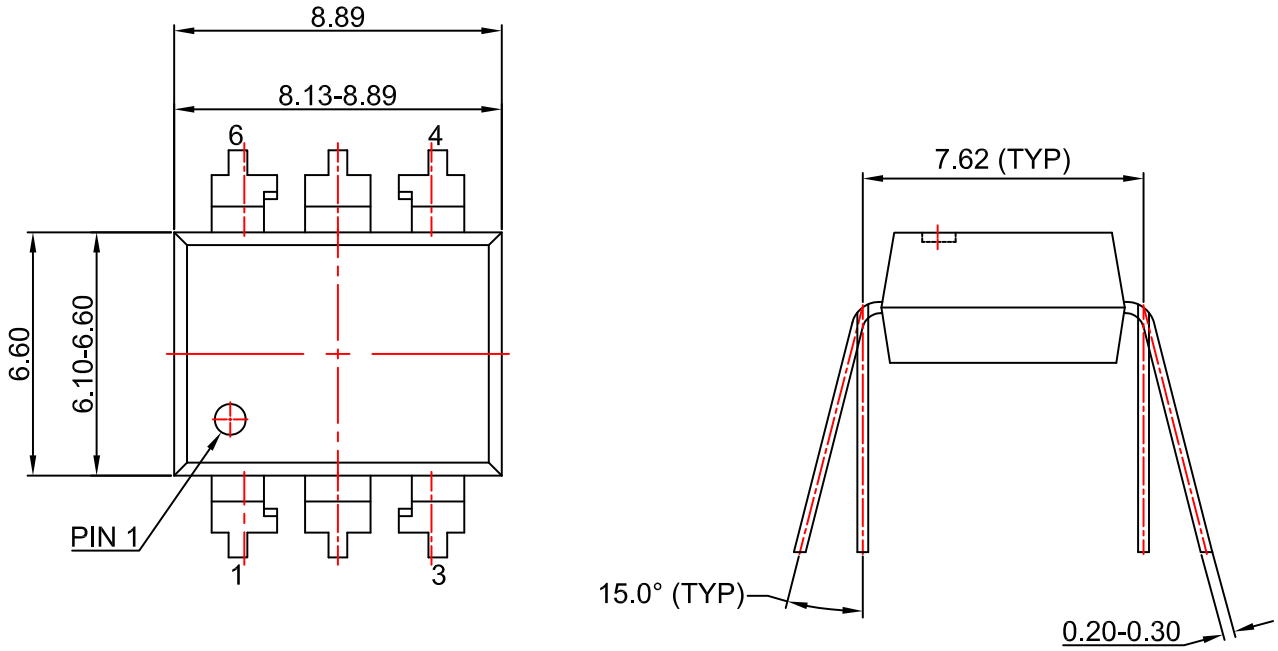

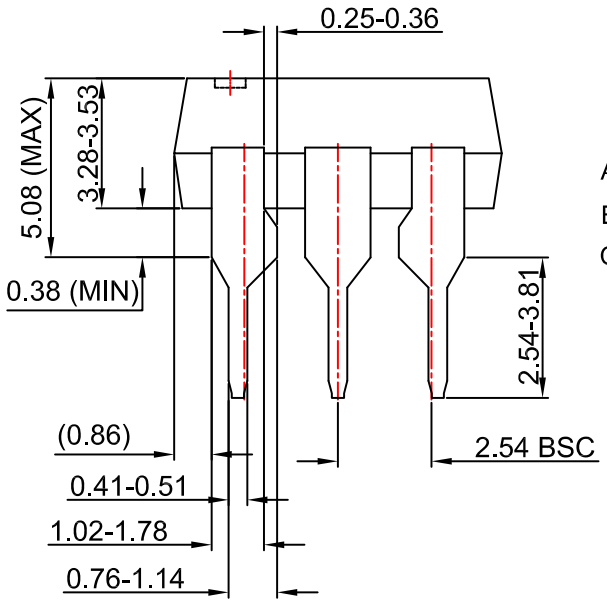

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CASE 646BY
ISSUE A

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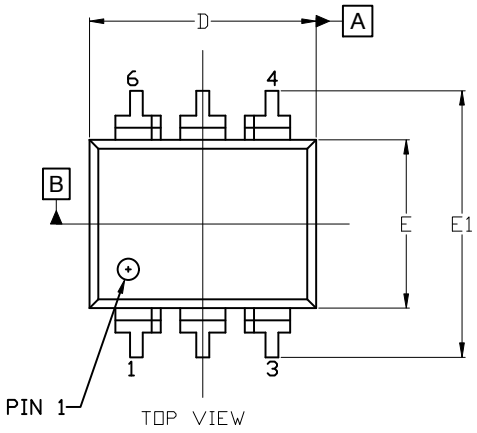
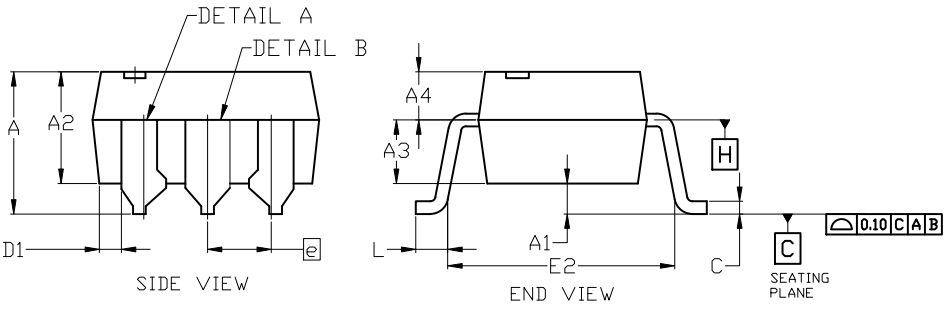
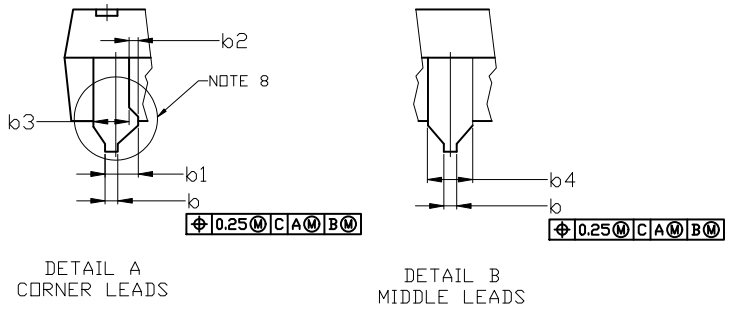
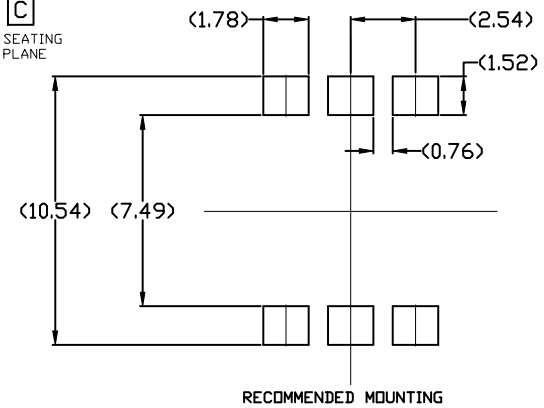


NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSIONS A, A1, AND L ARE MEASURED WITH THE PACKAGE SEATED.
4. DIMENSIONS D, D1, AND E1 DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS ARE NOT TO EXCEED 2.54mm.
5. PACKAGE CONTOUR IS OPTIONAL (ROUNDED OR SQUARE CORNERS).
6. CENTER LINE OF CORNER LEADS ARE LOCATED BY LOCATING THE CENTER OF FEATURE b2 AND b3.

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	---	---	4.80
A1	0.38	---	---
A2	3.28	3.40	3.53
A3	2.49 REF		
A4	1.89 REF		
b	0.41	0.46	0.51
b1	0.76	0.92	1.14
b2	0.25	0.28	0.36
b3	1.02	1.40	1.78
b4	1.778 REF		
c	0.20	0.25	0.30
D	8.13	8.51	8.89
D1	0.86 REF		
E	6.10	6.35	6.60
E1	8.43	9.17	9.90
E2	8.13 REF		
e	2.54 BSC		
L	0.16	0.52	0.88







* For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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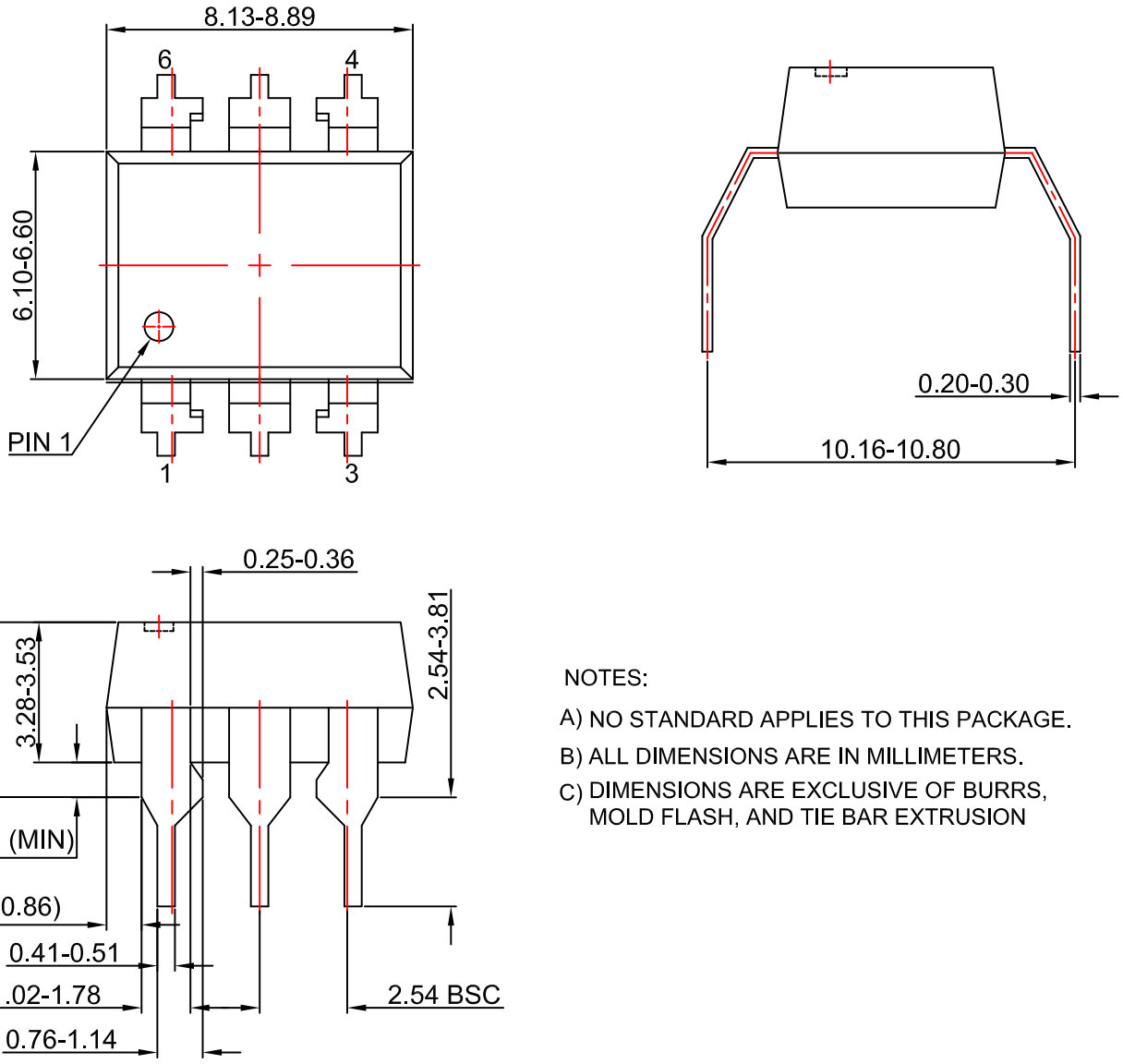

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