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# H11F1M, H11F2M, H11F3M Photo FET Optocouplers

## Features

As a remote variable resistor:

- $\leq 100\Omega$  to  $\geq 300M\Omega$
- $\leq 15pF$  shunt capacitance
- $\geq 100G\Omega$  I/O isolation resistance

As an analog switch:

- Extremely low offset voltage
- 60 V<sub>pk-pk</sub> signal capability
- No charge injection or latch-up
- UL recognized (File #E90700)

## Applications

As a remote variable resistor:

- Isolated variable attenuator
- Automatic gain control
- Active filter fine tuning/band switching

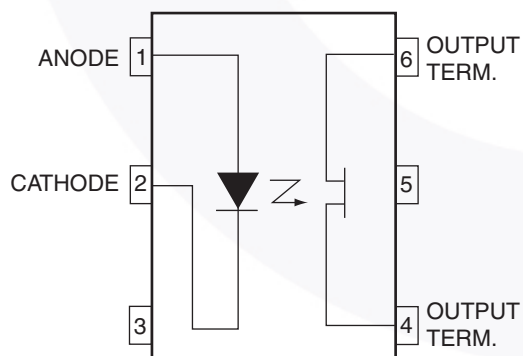
As an analog switch:

- Isolated sample and hold circuit
- Multiplexed, optically isolated A/D conversion

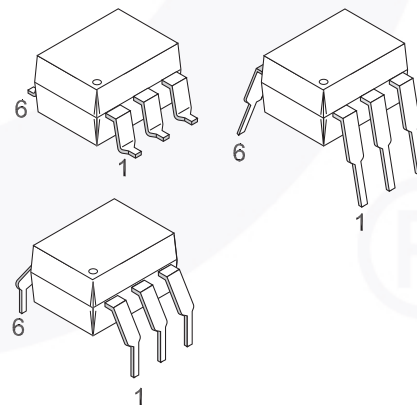
## General Description

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.

## Schematic



## Package Outlines



**Absolute Maximum Ratings** ( $T_A = 25^\circ\text{C}$  unless otherwise specified)

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter	Device	Value	Units
<b>TOTAL DEVICE</b>				
$T_{STG}$	Storage Temperature	All	-40 to +150	$^\circ\text{C}$
$T_{OPR}$	Operating Temperature	All	-40 to +100	$^\circ\text{C}$
$T_{SOL}$	Lead Solder Temperature	All	260 for 10 sec	$^\circ\text{C}$
<b>EMITTER</b>				
$I_F$	Continuous Forward Current	All	60	mA
$V_R$	Reverse Voltage	All	5	V
$I_{F(pk)}$	Forward Current – Peak (10 $\mu\text{s}$ pulse, 1% duty cycle)	All	1	A
$P_D$	LED Power Dissipation 25 $^\circ\text{C}$ Ambient Derate Linearly from 25 $^\circ\text{C}$	All	100	mW
			1.33	mW/ $^\circ\text{C}$
<b>DETECTOR</b>				
$P_D$	Detector Power Dissipation @ 25 $^\circ\text{C}$	All	300	mW
	Derate linearly from 25 $^\circ\text{C}$		4.0	mW/ $^\circ\text{C}$
$BV_{4-6}$	Breakdown Voltage (either polarity)	H11F1M, H11F2M	$\pm 30$	V
		H11F3M	$\pm 15$	V
$I_{4-6}$	Continuous Detector Current (either polarity)	All	$\pm 100$	mA

**Electrical Characteristics** ( $T_A = 25^\circ\text{C}$  unless otherwise specified.)

**Individual Component Characteristics**

Symbol	Parameter	Test Conditions	Device	Min.	Typ.*	Max.	Unit
<b>EMITTER</b>							
$V_F$	Input Forward Voltage	$I_F = 16\text{mA}$	All		1.3	1.75	V
$I_R$	Reverse Leakage Current	$V_R = 5\text{V}$	All			10	$\mu\text{A}$
$C_J$	Capacitance	$V = 0\text{V}, f = 1.0\text{MHz}$	All		50		pF
<b>OUTPUT DETECTOR</b>							
$BV_{4-6}$	Breakdown Voltage Either Polarity	$I_{4-6} = 10\mu\text{A}, I_F = 0$	H11F1M, H11F2M	30			V
			H11F3M	15			
$I_{4-6}$	Off-State Dark Current	$V_{4-6} = 15\text{V}, I_F = 0$	All			50	nA
		$V_{4-6} = 15\text{V}, I_F = 0,$ $T_A = 100^\circ\text{C}$	All			50	$\mu\text{A}$
$R_{4-6}$	Off-State Resistance	$V_{4-6} = 15\text{V}, I_F = 0$	All	300			M $\Omega$
$C_{4-6}$	Capacitance	$V_{4-6} = 15\text{V}, I_F = 0,$ $f = 1\text{MHz}$	All			15	pF

**Transfer Characteristics**

Symbol	Characteristics	Test Conditions	Device	Min	Typ*	Max	Units
<b>DC CHARACTERISTICS</b>							
$R_{4-6}$	On-State Resistance	$I_F = 16\text{mA},$ $I_{4-6} = 100\mu\text{A}$	H11F1M			200	$\Omega$
			H11F2M			330	
			H11F3M			470	
$R_{6-4}$	On-State Resistance	$I_F = 16\text{mA},$ $I_{6-4} = 100\mu\text{A}$	H11F1M			200	$\Omega$
			H11F2M			330	
			H11F3M			470	
	Resistance, non-linearity and assymetry	$I_F = 16\text{mA},$ $I_{4-6} = 25\mu\text{A RMS},$ $f = 1\text{kHz}$	All		2		%
<b>AC CHARACTERISTICS</b>							
$t_{on}$	Turn-On Time	$R_L = 50\Omega, I_F = 16\text{mA},$ $V_{4-6} = 5\text{V}$	All			45	$\mu\text{s}$
$t_{off}$	Turn-Off Time	$R_L = 50\Omega, I_F = 16\text{mA},$ $V_{4-6} = 5\text{V}$	All			45	$\mu\text{s}$

**Isolation Characteristics**

Symbol	Characteristic	Test Conditions	Device	Min.	Typ.*	Max.	Units
$V_{ISO}$	Isolation Voltage	$f = 60\text{Hz}, t = 1\text{ sec.}$	All	7500			$V_{ACPEAK}$
$R_{ISO}$	Isolation Resistance	$V_{I-O} = 500\text{VDC}$	All	$10^{11}$			$\Omega$
$C_{ISO}$	Isolation Capacitance	$f = 1\text{MHz}$	All		0.2		pF

\*All Typical values at  $T_A = 25^\circ\text{C}$

## Safety and Insulation Ratings

As per IEC 60747-5-2, 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.

Symbol	Parameter	Min.	Typ.	Max.	Unit
	Installation Classifications per DIN VDE 0110/1.89 Table 1				
	For Rated Main Voltage < 150Vrms		I-IV		
	For Rated Main voltage < 300Vrms		I-IV		
	Climatic Classification		55/100/21		
	Pollution Degree (DIN VDE 0110/1.89)		2		
CTI	Comparative Tracking Index	175			
$V_{PR}$	Input to Output Test Voltage, Method b, $V_{IORM} \times 1.875 = V_{PR}$ , 100% Production Test with $t_m = 1$ sec, Partial Discharge < 5pC	1594			$V_{peak}$
	Input to Output Test Voltage, Method a, $V_{IORM} \times 1.5 = V_{PR}$ , Type and Sample Test with $t_m = 60$ sec, Partial Discharge < 5pC	1275			$V_{peak}$
$V_{IORM}$	Max. Working Insulation Voltage	850			$V_{peak}$
$V_{IOTM}$	Highest Allowable Over Voltage	6000			$V_{peak}$
	External Creepage	7			mm
	External Clearance	7			mm
	Insulation Thickness	0.5			mm
RIO	Insulation Resistance at $T_s$ , $V_{IO} = 500V$	$10^9$			$\Omega$

## Typical Performance Curves

Figure 1. Resistance vs. Input Current

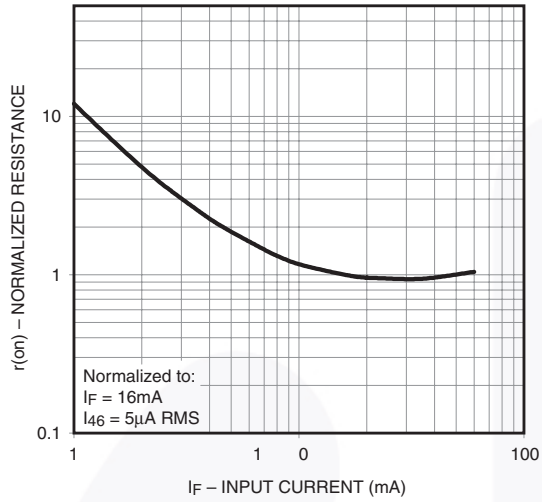


Figure 2. Output Characteristics

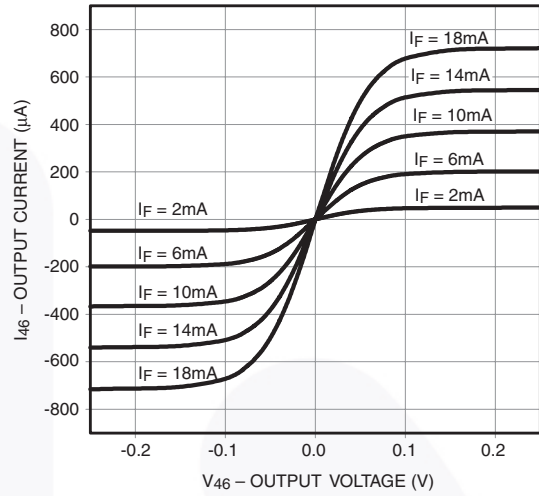


Figure 3. LED Forward Voltage vs. Forward Current

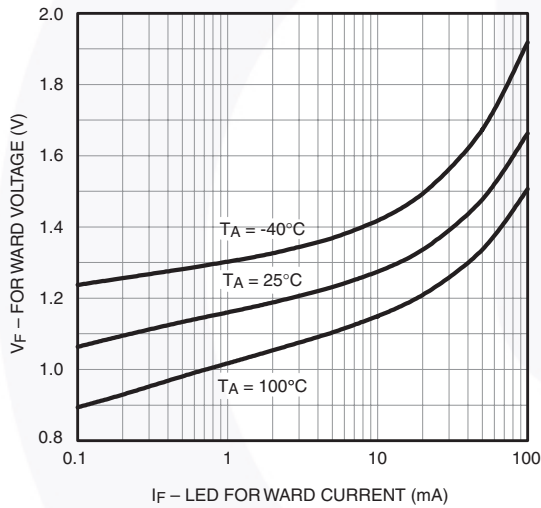


Figure 4. Off-state Current vs. Ambient Temperature

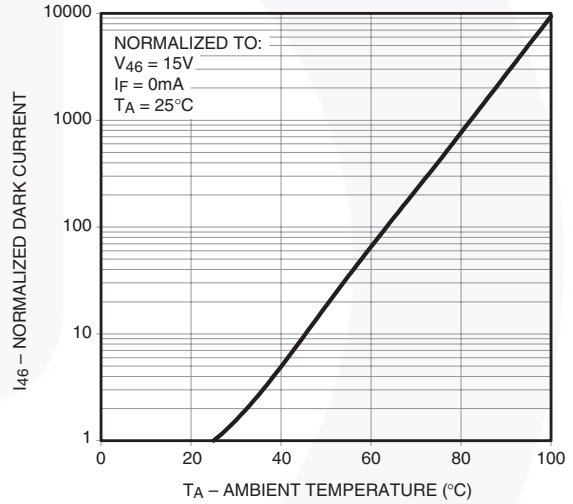
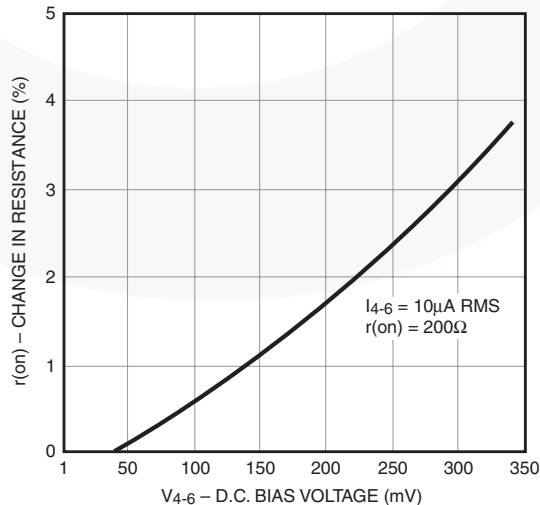


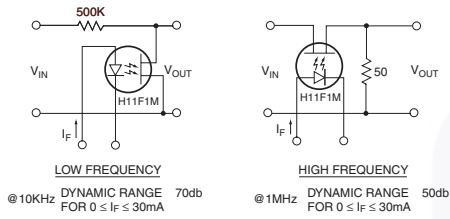
Figure 5. Resistive Non-Linearity vs. D.C. Bias



## Typical Applications

### As a Variable Resistor

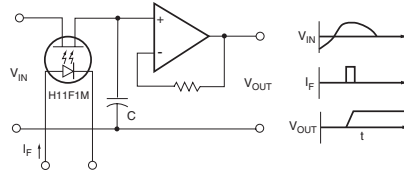
#### ISOLATED VARIABLE ATTENUATORS



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

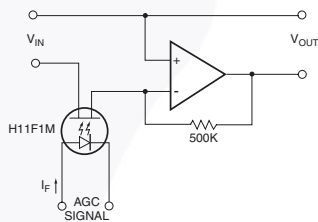
### As an Analog Signal Switch

#### ISOLATED SAMPLE AND HOLD CIRCUIT



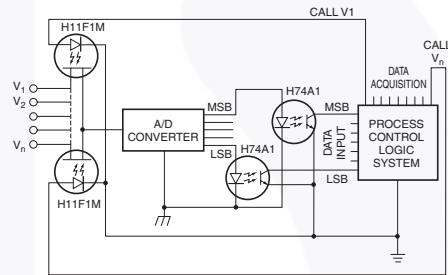
Accuracy and range are improved over conventional FET switches because the H11FXM has no charge injection from the control signal. The H11FXM also provides switching of either polarity input signal up to 30V magnitude.

### AUTOMATIC GAIN CONTROL



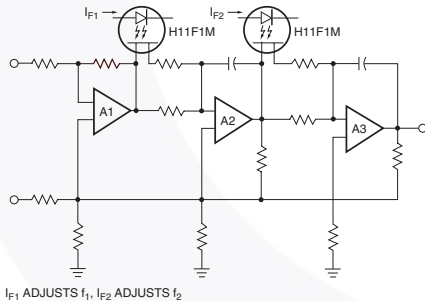
This simple circuit provides over 70db of stable gain control for an AGC signal range of from 0 to 30mA. This basic circuit can be used to provide programmable fade and attack for electronic music.

### MULTIPLEXED, OPTICALLY-ISOLATED A/D CONVERSION



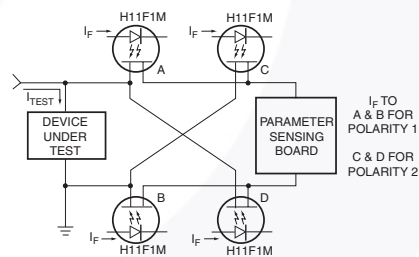
The optical isolation, linearity and low offset voltage of the H11FXM allows the remote multiplexing of low level analog signals from such transducers as thermocouples, Hall effect devices, strain gauges, etc. to a single A/D converter.

### ACTIVE FILTER FINE TUNING/BAND SWITCHING



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

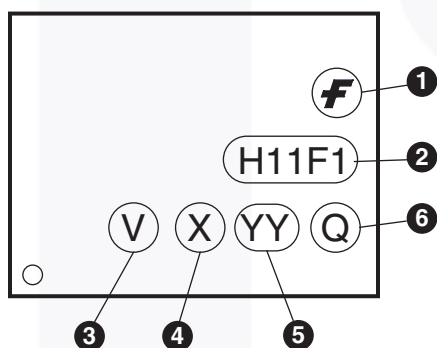


In many test equipment designs the auto polarity function uses reed relay contacts to switch the Kelvin Contact polarity. These reeds are normally one of the highest maintenance cost items due to sticking contacts and mechanical problems. The totally solid-State H11FXM eliminates these troubles while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

### 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	IEC60747-5-2 approval
TV	H11F1TVM	IEC60747-5-2 approval, 0.4" Lead Spacing
SV	H11F1SVM	IEC60747-5-2 approval, Surface Mount
SR2V	H11F1SR2VM	IEC60747-5-2 approval, Surface Mount, Tape and Reel

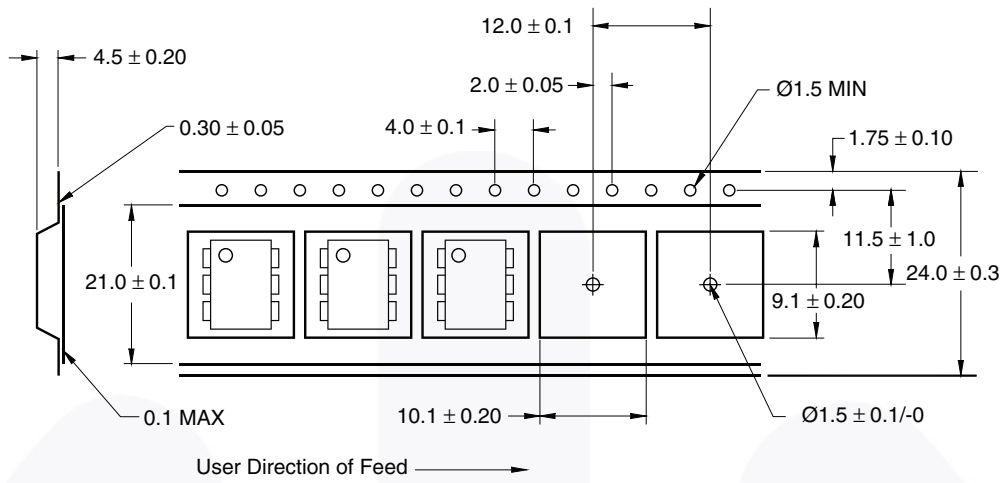
### Marking Information



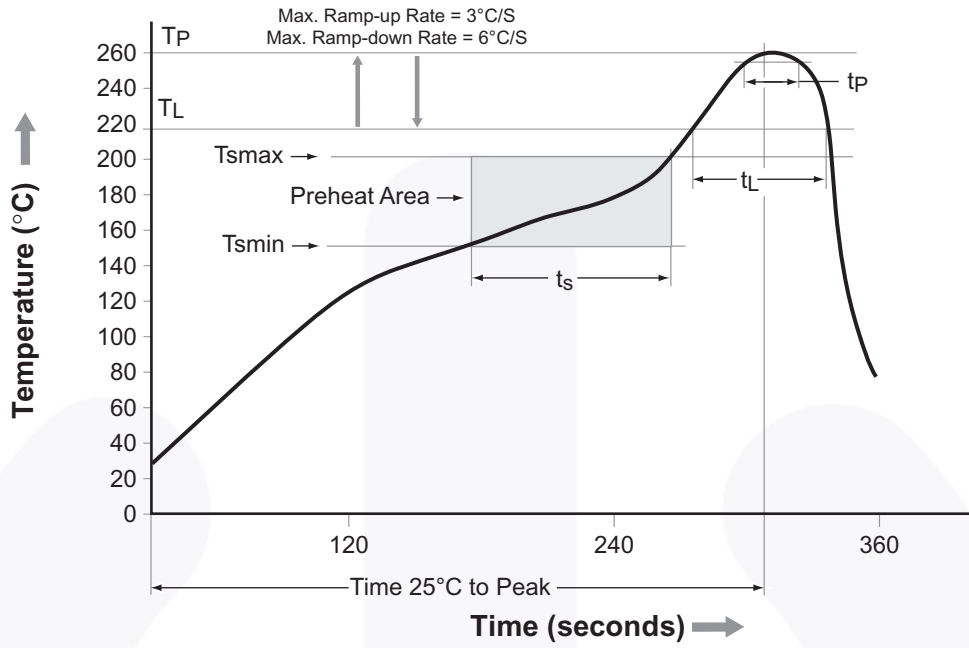
Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4	One digit year code, e.g., '7'
5	Two digit work week ranging from '01' to '53'
6	Assembly package code



### Carrier Tape Specification



**Reflow Profile**



Profile Feature	Pb-Free Assembly Profile
Temperature Min. (Tsmín)	150°C
Temperature Max. (Tsmáx)	200°C
Time (ts) from (Tsmín to Tsmáx)	60–120 seconds
Ramp-up Rate (tL to tP)	3°C/second max.
Liquidous Temperature (TL)	217°C
Time (tL) Maintained Above (TL)	60–150 seconds
Peak Body Package Temperature	260°C +0°C / -5°C
Time (tp) within 5°C of 260°C	30 seconds
Ramp-down Rate (TP to TL)	6°C/second max.
Time 25°C to Peak Temperature	8 minutes max.



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