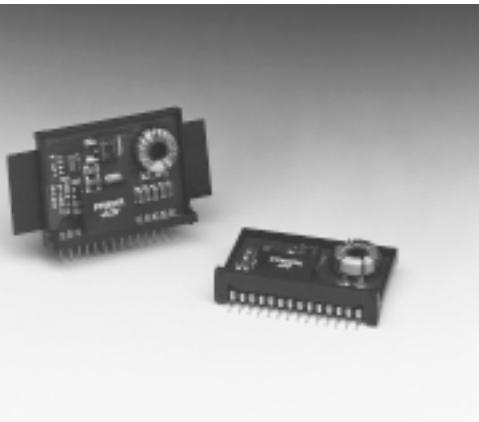


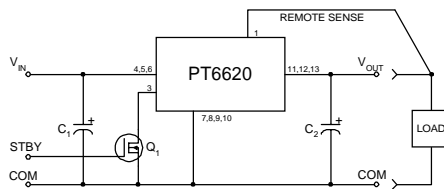
# PT6620 Series

6 A 12-V Input  
Integrated Switching Regulator

SLTS036C - FEBRUARY 1999 - REVISED JUNE 2003



## Standard Application



$C_1$  = Required 330 $\mu$ F electrolytic (1)  
 $C_2$  = Required 330 $\mu$ F electrolytic (1)  
 $Q_1$  = Optional N-Channel MOSFET

## Features

- Single Device: 6-A Output
- Input Voltage Range: 9 V to 16 V
- Adjustable Output Voltage
- 83 % Efficiency
- Remote Sense Capability
- Standby Function
- Over-Temperature Protection
- 16-pin Mount Option (Suffixes L, M, Q, & F)

## Description

The PT6620 series is a line of 12-V input Integrated Switching Regulators (ISRs). These regulators are designed for stand-alone operation in applications requiring as much as 6 A of output current. The PT6620 series is packaged in a 14-Pin SIP (Single In-line Package), which is available in either a vertical or horizontal configuration, including surface mount.

## Pin Configuration

Pin	Function
1	$V_o$ Sense
2	Do Not Connect
3	STBY*
4	$V_{in}$
5	$V_{in}$
6	$V_{in}$
7	GND
8	GND
9	GND
10	GND
11	$V_{out}$
12	$V_{out}$
13	$V_{out}$
14	$V_o$ Adjust

## Ordering Information

PT6621	$\square$ =3.3 Volts
PT6622	$\square$ =1.5 Volts
PT6623	$\square$ =2.5 Volts
PT6624	$\square$ =3.6 Volts
PT6625	$\square$ =5.0 Volts
PT6626	$\square$ =9.0 Volts
PT6627	$\square$ =1.8 Volts

## PT Series Suffix (PT1234 x)

Case/Pin Configuration	Order Suffix	Package Code *
Vertical	<b>P</b>	(EED)
Horiz	<b>D</b>	(EEA)
SMD	<b>E</b>	(EEC)
Horiz, 2-Pin Tab	<b>M</b>	(EEM)
SMD, 2-Pin Tab	<b>L</b>	(EEL)
Horiz, 2-Pin Ext Tab	<b>Q</b>	(EEQ)
SMD, 2-Pin Ext Tab	<b>F</b>	(EEF)
Vertical, Side Tab	<b>R</b>	(EEE)
Horiz, Side Tab	<b>G</b>	(EEG)
SMD, Side Tab	<b>B</b>	(EEK)

\* Previously known as package styles 400/410.  
 (Reference the applicable package code drawing for the dimensions and PC board layout)

## Specifications

Unless otherwise stated,  $T_a = 25^\circ\text{C}$ ,  $C_2 = 330\ \mu\text{F}$ ,  $V_{in} = 12\ \text{V}$ ,  $I_o = I_{o\text{max}}$

Characteristics	Symbols	Conditions	PT6620 SERIES			Units	
			Min	Typ	Max		
Output Current	$I_o$	$T_a = 60^\circ\text{C}$ , 200 LFM, pkg P $T_a = 25^\circ\text{C}$ , natural convection	0.1 (2) 0.1 (2)	—	6 6	A	
Input Voltage Range	$V_{in}$	$0.1\ \text{A} \leq I_o \leq 6\ \text{A}$	9 $V_o + 3$	—	16 16	V	
Output Voltage Tolerance	$\Delta V_o$	$T_a = 0$ to $60^\circ\text{C}$	$V_o - 0.1$	—	$V_o + 0.1$	V	
Output Voltage Adjust Range	$V_{o\text{adj}}$	Pin 14 to $V_o$ or ground	$V_o = 3.3\ \text{V}$ $V_o = 1.5\ \text{V}$ $V_o = 2.5\ \text{V}$ $V_o = 3.6\ \text{V}$ $V_o = 5\ \text{V}$ $V_o = 9\ \text{V}$	2.3 1.4 1.9 2.5 2.9 5.2	— — — — — —	4.5 2.6 3.7 4.8 6.5 10	V
Line Regulation	$\text{Reg}_{\text{line}}$	$V_{in(\text{min})} \leq V_{in} \leq V_{in(\text{max})}$	—	$\pm 0.5$	$\pm 1$	% $V_o$	
Load Regulation	$\text{Reg}_{\text{load}}$	$0.1 \leq I_o \leq 6\ \text{A}$	—	$\pm 0.5$	$\pm 1$	% $V_o$	
$V_o$ Ripple (pk-pk)	$V_r$	20 MHz bandwidth, $V_o \leq 6\ \text{V}$ $V_o > 6\ \text{V}$	—	50 1	— —	mV <sub>pp</sub> % $V_o$	
Transient Response	$t_{\text{tr}}$ $\Delta V_{\text{tr}}$	1 A/ $\mu\text{s}$ load step, 50 to 100% $I_o$ max Recovery time $V_o$ over/undershoot	— —	100 150	— —	$\mu\text{Sec}$ mV	
Efficiency	$\eta$	$I_o = 3\ \text{A}$	$V_o = 3.3/3.6\ \text{V}$ $V_o = 1.5\ \text{V}$ $V_o = 2.5\ \text{V}$ $V_o = 5.0\ \text{V}$ $V_o = 9.0\ \text{V}$	— — — — —	84 68 76 86 93	— — — — —	%
		$I_o = 6\ \text{A}$	$V_o = 3.3/3.6\ \text{V}$ $V_o = 1.5\ \text{V}$ $V_o = 2.5\ \text{V}$ $V_o = 5.0\ \text{V}$ $V_o = 9.0\ \text{V}$	— — — — —	83 66 75 85 92	— — — — —	%
Switching Frequency	$f_s$	$V_{in(\text{min})} \leq V_{in} \leq V_{in(\text{max})}$ $0.1\ \text{A} \leq I_o \leq 6\ \text{A}$	PT6622 Except PT6622	500 550	550 650	600 750	kHz kHz

Continued

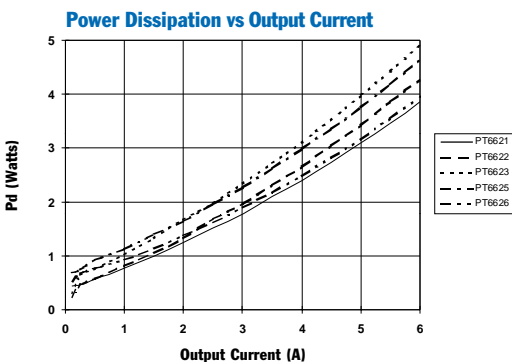
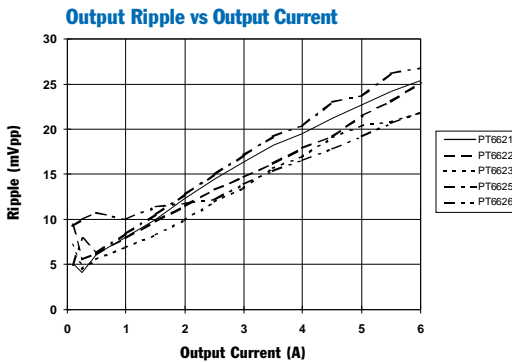
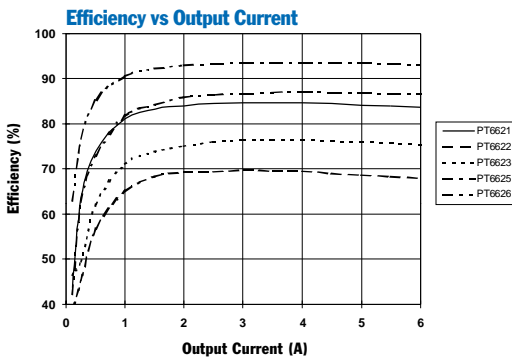
### Specifications *(continued)*

Characteristics	Symbols	Conditions	PT6620 SERIES			Units
			Min	Typ	Max	
Operating Temperature Range	$T_a$	Over $V_{in}$ range	-40	—	+85 <sup>(3)</sup>	°C
Storage Temperature	$T_s$	—	-40	—	+125	°C
Mechanical Shock	—	Per Mil-STD-883D, Method 2002.3	—	500	—	G's
Mechanical Vibration	—	Per Mil-STD-883D, Method 2007.2, 20–2000 Hz, soldered in a PC board	—	7.5	—	G's
Weight	—	—	—	14	—	grams

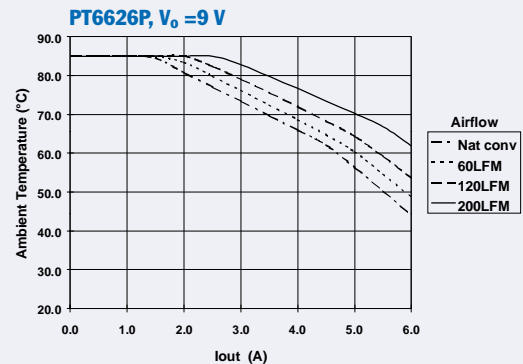
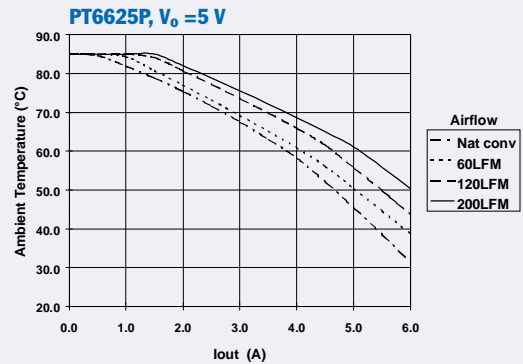
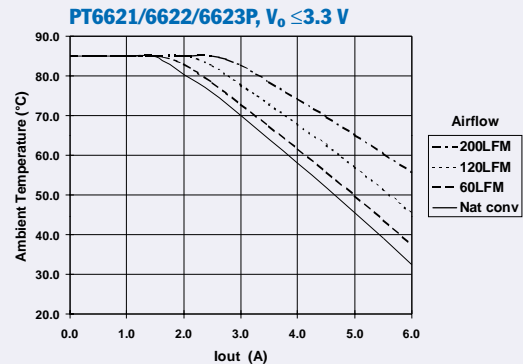
- Notes:** (1) The PT6620 Series requires a 330  $\mu$ F(output) and 100  $\mu$ F(input) electrolytic capacitors for proper operation in all applications.  
 (2) ISR will operate down to no load with reduced specifications  
 (3) See safe Operating Area curves or contact the factory for the appropriate derating.

## TYPICAL CHARACTERISTICS

PT6620 Series @  $V_{in}=12$  V (See Note A)



Safe Operating Area,  $V_{in}=12$  V (See Note B)



**Note A:** All characteristic data in the above graphs has been developed from actual products tested at 25 °C. This data is considered typical for the ISR.

**Note B:** SOA curves represent operating conditions at which internal components are at or below manufacturer's maximum rated operating temperatures.

### Adjusting the Output Voltage of the PT6620 6 A, 12-V Bus Converter Series

The output voltage of the Power Trends PT6620 Series ISRs may be adjusted higher or lower than the factory trimmed pre-set voltage with the addition of a single external resistor. Table 1 accordingly gives the allowable adjustment range for each model in the series as  $V_a$  (min) and  $V_a$  (max).

**Adjust Up:** An increase in the output voltage is obtained by adding a resistor  $R_2$ , between  $V_o$  Adjust (pin 14) and GND (pins 7-8, 9-10).

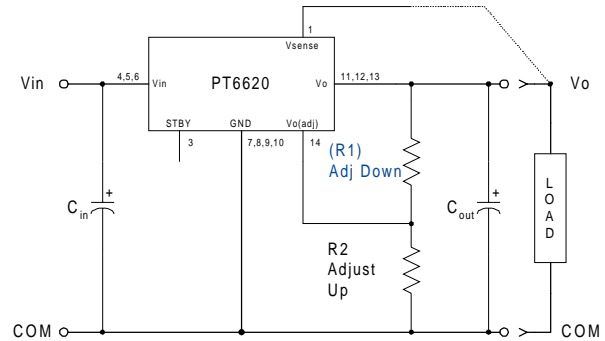
**Adjust Down:** Add a resistor ( $R_1$ ), between  $V_o$  Adjust (pin 14) and  $V_{out}$  (pins 11-13).

Refer to Figure 1 and Table 2 for both the placement and value of the required resistor, either ( $R_1$ ) or  $R_2$  as appropriate.

#### Notes:

1. Use only a single 1% resistor in either the ( $R_1$ ) or  $R_2$  location. Place the resistor as close to the ISR as possible.
2. Never connect capacitors from  $V_o$  Adjust to either GND,  $V_{out}$ , or the Remote Sense pin. Any capacitance added to the  $V_o$  adjust pin will affect the stability of the ISR.
3. If the Remote Sense feature is being used, connecting the resistor ( $R_1$ ) between  $V_o$  Adjust (pin 14) and Remote Sense (pin 1) can benefit load regulation.
4. The minimum input voltage required by the part is  $V_{out} + 3$ , or 9 V, whichever is higher.

**Figure 1**



The values of ( $R_1$ ) [adjust down], and  $R_2$  [adjust up], can also be calculated using the following formulae.

$$(R_1) = \frac{R_o (V_a - 1.25)}{(V_o - V_a)} - R_s \quad k\Omega$$

$$R_2 = \frac{1.25 R_o}{V_a - V_o} - R_s \quad k\Omega$$

Where:  $V_o$  = Original output voltage  
 $V_a$  = Adjusted output voltage  
 $R_o$  = The resistance value in Table 1  
 $R_s$  = The series resistance from Table 1

**Table 1**

**PT6620 ADJUSTMENT AND FORMULA PARAMETERS**

Series Pt #	PT6622	PT6623	PT6621	PT6624	PT6625	PT6626
$V_o$ (nom)	1.5 V	2.5 V	3.3 V	3.6 V	5 V	9.0 V
$V_a$ (min)	1.4 V	1.9 V	2.3 V	2.5 V	2.9 V	5.2 V
$V_a$ (max)	2.7 V	3.7 V	4.5 V	4.8 V	6.5 V	10 V
$R_o$ (k $\Omega$ )	4.99	10.0	12.1	12.1	16.2	12.1
$R_s$ (k $\Omega$ )	2.49	4.99	12.1	12.1	12.1	12.1

PT6620 Series

Table 2

PT6620 ADJUSTMENT RESISTOR VALUES

Series Pt #	PT6622	PT6623	PT6621	PT6624	PT6625	Series Pt #	PT6625	PT6626
V <sub>o</sub> (nom)	1.5 V	2.5 V	3.3 V	3.6 V	5 V	V <sub>o</sub> (nom)	5 V	9 V
V <sub>a</sub> (req'd)						V <sub>a</sub> (req'd)		
1.4	(5.0) kΩ					5.2	89.1 kΩ	(0.5) kΩ
1.5						5.3	55.4 kΩ	(1.1) kΩ
1.6	59.9 kΩ					5.4	38.5 kΩ	(1.9) kΩ
1.7	28.7 kΩ					5.5	28.4 kΩ	(2.6) kΩ
1.8	18.3 kΩ					5.6	21.7 kΩ	(3.4) kΩ
1.9	13.1 kΩ	(5.8) kΩ				5.7	16.8 kΩ	(4.2) kΩ
2.0	10.0 kΩ	(10.0) kΩ				5.8	13.2 kΩ	(5.1) kΩ
2.1	7.9 kΩ	(16.3) kΩ				5.9	10.4 kΩ	(6.1) kΩ
2.2	6.4 kΩ	(26.7) kΩ				6.0	8.2 kΩ	(7.1) kΩ
2.3	5.3 kΩ	(47.5) kΩ	(0.6) kΩ			6.1	6.3 kΩ	(8.1) kΩ
2.4	4.4 kΩ	(110.0) kΩ	(3.4) kΩ			6.2	4.8 kΩ	(9.3) kΩ
2.5	3.8 kΩ		(6.8) kΩ	(1.7) kΩ		6.3	3.5 kΩ	(10.5) kΩ
2.6	3.2 kΩ	120.0 kΩ	(11.2) kΩ	(4.2) kΩ		6.4	2.4 kΩ	(11.9) kΩ
2.7		57.5 kΩ	(17.1) kΩ	(7.4) kΩ		6.5	1.4 kΩ	(13.3) kΩ
2.8		36.7 kΩ	(25.4) kΩ	(11.3) kΩ		6.6		(14.9) kΩ
2.9		26.3 kΩ	(37.8) kΩ	(16.4) kΩ	(0.6) kΩ	6.7		(16.6) kΩ
3.0		20.0 kΩ	(58.5) kΩ	(23.2) kΩ	(2.1) kΩ	6.8		(18.4) kΩ
3.1		15.8 kΩ	(99.8) kΩ	(32.7) kΩ	(3.7) kΩ	6.9		(20.5) kΩ
3.2		12.9 kΩ	(224.0) kΩ	(46.9) kΩ	(5.5) kΩ	7.0		(22.7) kΩ
3.3		10.6 kΩ		(70.6) kΩ	(7.4) kΩ	7.1		(25.2) kΩ
3.4		8.9 kΩ	139.0 kΩ	(118.0) kΩ	(9.7) kΩ	7.2		(27.9) kΩ
3.5		7.5 kΩ	63.5 kΩ	(260.0) kΩ	(12.2) kΩ	7.3		(31.0) kΩ
3.6		6.4 kΩ	38.3 kΩ		(15.1) kΩ	7.4		(34.4) kΩ
3.7		5.4 kΩ	25.7 kΩ	139.0 kΩ	(18.4) kΩ	7.5		(38.3) kΩ
3.8			18.2 kΩ	63.5 kΩ	(22.3) kΩ	7.6		(42.8) kΩ
3.9			13.1 kΩ	38.3 kΩ	(26.9) kΩ	7.8		(53.9) kΩ
4.0			9.5 kΩ	25.7 kΩ	(32.5) kΩ	8.0		(69.6) kΩ
4.1			6.8 kΩ	18.2 kΩ	(39.2) kΩ	8.2		(93.0) kΩ
4.2			4.7 kΩ	13.1 kΩ	(47.6) kΩ	8.4		(132.0) kΩ
4.3			3.0 kΩ	9.5 kΩ	(58.5) kΩ	8.6		(210.0) kΩ
4.4			1.7 kΩ	6.8 kΩ	(73.0) kΩ	8.8		(445.0) kΩ
4.5			0.5 kΩ	4.7 kΩ	(93.2) kΩ	9.0		
4.6				3.0 kΩ	(124.0) kΩ	9.2		63.5 kΩ
4.7				1.7 kΩ	(174.0) kΩ	9.4		25.7 kΩ
4.8				0.5 kΩ	(275.0) kΩ	9.6		13.1 kΩ
4.9					(579.0) kΩ	9.8		6.8 kΩ
5.0						10.0		3.0 kΩ
5.1					190.0 kΩ			

R<sub>1</sub> = (Blue) R<sub>2</sub> = Black

### Using the Standby Function on the PT6620 Series of 12-V Bus Converters

For applications requiring output voltage On/Off control, the 14-pin PT6620 ISR series incorporates a standby function. This feature may be used for power-up/shut-down sequencing, and wherever there is a requirement for the output status of the module to be controlled by external circuitry.

The standby function is provided by the *STBY*\* control, pin 3. If pin 3 is left open-circuit the regulator operates normally, providing a regulated output whenever a valid supply voltage is applied to  $V_{in}$  (pins 4, 5, & 6) with respect to *GND* (pins 7-10). Connecting pin 3 to ground<sup>1</sup> will disable the regulator output and reduce the input current to less than 30 mA<sup>3</sup>. Grounding the standby control will also hold-off the regulator output during the period that input power is applied.

The standby input is ideally controlled with an open-collector (or open-drain) discrete transistor (See Figure 1). It can also be driven directly from a dedicated TTL<sup>2</sup> compatible gate. Table 1 provides details of the threshold requirements.

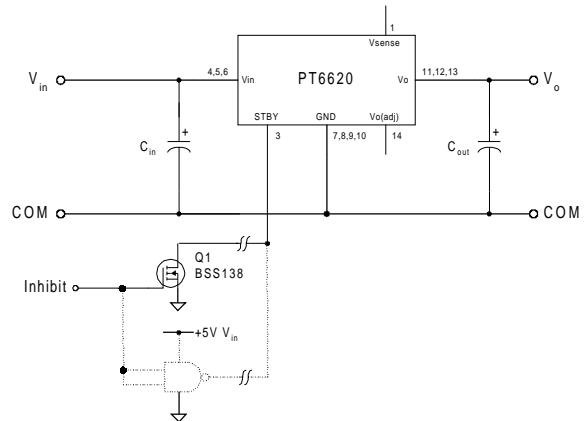
**Table 1 Inhibit Control Thresholds<sup>(1,2)</sup>**

Parameter	Min	Max
Enable ( $V_{IH}$ )	1 V	5 V
Disable ( $V_{IL}$ )	-0.1V	0.3V

#### Notes:

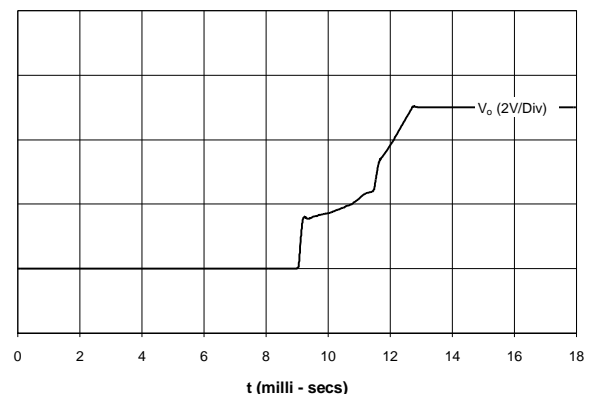
1. The Standby input on the PT6620 regulator series may be controlled using either an open-collector (or open-drain) discrete transistor, or a device with a totem-pole output. A pull-up resistor is not necessary. The control input has an open-circuit voltage of about 1.5 Vdc. To disable the regulator output, the control pin must be "pulled" to less than 0.3 Vdc with a low-level 0.25 mA max. sink to ground.
2. The Standby input on the PT6620 series is also compatible with TTL logic. A standard TTL logic gate will meet the 0.3 V  $V_{IL(max)}$  requirement (Table 1) at 0.25 mA sink current. *Do not* drive the Standby control input above 5 Vdc.
3. When the regulator output is disabled the current drawn from the input source is reduced to approximately 15 mA (30 mA maximum).
4. The turn-off time of  $Q_1$ , or rise time of the standby input is not critical on the PT6620 series. Turning  $Q_1$  off slowly, over periods up to 100 ms, will not damage the regulator. However, a slow turn-off time will increase both the initial delay and rate-of-rise of the output voltage.

**Figure 1**



**Turn-On Time:** Turning  $Q_1$  in Figure 1 off, removes the low-voltage signal at pin 3 and enables the output. The PT6620 series of regulators will provide a fully regulated output voltage within 20ms. The actual turn-on time may vary with load and the total amount of output capacitance. Figure 2 shows the typical output voltage waveform of a PT6625 (5 V) following the prompt turn off of  $Q_1$  at time  $t=0$  secs. The waveform was measured with a 12-V input voltage, and 5-A resistive load.

**Figure 2**



**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
PT6621B	LIFEBUY	SIP MODULE	EEK	14		TBD	Call TI	Call TI	-40 to 85		
PT6621E	OBSOLETE	SIP MODULE	EEC	14		TBD	Call TI	Call TI	-40 to 85		
PT6621F	LIFEBUY	SIP MODULE	EEF	14		TBD	Call TI	Call TI	-40 to 85		
PT6621L	LIFEBUY	SIP MODULE	EEL	14		TBD	Call TI	Call TI	-40 to 85		
PT6621M	LIFEBUY	SIP MODULE	EEM	14		TBD	Call TI	Call TI	-40 to 85		
PT6621Q	LIFEBUY	SIP MODULE	EEQ	14		TBD	Call TI	Call TI	-40 to 85		
PT6622B	LIFEBUY	SIP MODULE	EEK	14		TBD	Call TI	Call TI	-40 to 85		
PT6622E	LIFEBUY	SIP MODULE	EEC	14		TBD	Call TI	Call TI	-40 to 85		
PT6622F	LIFEBUY	SIP MODULE	EEF	14		TBD	Call TI	Call TI	-40 to 85		
PT6622G	LIFEBUY	SIP MODULE	EEG	14		TBD	Call TI	Call TI	-40 to 85		
PT6622L	LIFEBUY	SIP MODULE	EEL	14		TBD	Call TI	Call TI	-40 to 85		
PT6622M	LIFEBUY	SIP MODULE	EEM	14		TBD	Call TI	Call TI	-40 to 85		
PT6622Q	LIFEBUY	SIP MODULE	EEQ	14		TBD	Call TI	Call TI	-40 to 85		
PT6622R	LIFEBUY	SIP MODULE	EEE	14		TBD	Call TI	Call TI	-40 to 85		
PT6623B	NRND	SIP MODULE	EEK	14		TBD	Call TI	Call TI	-40 to 85		
PT6623D	NRND	SIP MODULE	EEA	14		TBD	Call TI	Call TI	-40 to 85		
PT6623E	NRND	SIP MODULE	EEC	14		TBD	Call TI	Call TI	-40 to 85		
PT6623G	NRND	SIP MODULE	EEG	14		TBD	Call TI	Call TI	-40 to 85		
PT6623L	NRND	SIP MODULE	EEL	14		TBD	Call TI	Call TI	-40 to 85		
PT6623M	NRND	SIP MODULE	EEM	14		TBD	Call TI	Call TI	-40 to 85		
PT6623Q	NRND	SIP MODULE	EEQ	14		TBD	Call TI	Call TI	-40 to 85		
PT6623R	NRND	SIP MODULE	EEE	14		TBD	Call TI	Call TI	-40 to 85		
PT6624B	NRND	SIP MODULE	EEK	14		TBD	Call TI	Call TI	-40 to 85		
PT6624E	NRND	SIP MODULE	EEC	14		TBD	Call TI	Call TI	-40 to 85		
PT6624F	NRND	SIP MODULE	EEF	14		TBD	Call TI	Call TI	-40 to 85		
PT6624G	NRND	SIP MODULE	EEG	14		TBD	Call TI	Call TI	-40 to 85		
PT6624L	NRND	SIP MODULE	EEL	14		TBD	Call TI	Call TI	-40 to 85		
PT6624M	NRND	SIP MODULE	EEM	14		TBD	Call TI	Call TI	-40 to 85		
PT6624P	NRND	SIP MODULE	EED	14		TBD	Call TI	Call TI	-40 to 85		
PT6624Q	NRND	SIP MODULE	EEQ	14		TBD	Call TI	Call TI	-40 to 85		

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
PT6624R	NRND	SIP MODULE	EEE	14		TBD	Call TI	Call TI	-40 to 85		
PT6625F	LIFEBUY	SIP MODULE	EEF	14		TBD	Call TI	Call TI	-40 to 85		
PT6625L	LIFEBUY	SIP MODULE	EEL	14		TBD	Call TI	Call TI	-40 to 85		
PT6625M	LIFEBUY	SIP MODULE	EEM	14		TBD	Call TI	Call TI	-40 to 85		
PT6625Q	LIFEBUY	SIP MODULE	EEQ	14		TBD	Call TI	Call TI	-40 to 85		
PT6626B	LIFEBUY	SIP MODULE	EEK	14		TBD	Call TI	Call TI	-40 to 85		
PT6626E	LIFEBUY	SIP MODULE	EEC	14		TBD	Call TI	Call TI	-40 to 85		
PT6626F	LIFEBUY	SIP MODULE	EEF	14		TBD	Call TI	Call TI	-40 to 85		
PT6626G	OBSOLETE	SIP MODULE	EEG	14		TBD	Call TI	Call TI	-40 to 85		
PT6626L	LIFEBUY	SIP MODULE	EEL	14		TBD	Call TI	Call TI	-40 to 85		
PT6626M	LIFEBUY	SIP MODULE	EEM	14		TBD	Call TI	Call TI	-40 to 85		
PT6626Q	LIFEBUY	SIP MODULE	EEQ	14		TBD	Call TI	Call TI	-40 to 85		
PT6627D	NRND	SIP MODULE	EEA	14		TBD	Call TI	Call TI			
PT6627E	NRND	SIP MODULE	EEC	14		TBD	Call TI	Call TI			
PT6627F	NRND	SIP MODULE	EEF	14		TBD	Call TI	Call TI			
PT6627G	NRND	SIP MODULE	EEG	14		TBD	Call TI	Call TI			
PT6627L	NRND	SIP MODULE	EEL	14		TBD	Call TI	Call TI			
PT6627M	NRND	SIP MODULE	EEM	14		TBD	Call TI	Call TI			
PT6627P	NRND	SIP MODULE	EED	14		TBD	Call TI	Call TI			
PT6627Q	NRND	SIP MODULE	EEQ	14		TBD	Call TI	Call TI			
PT6627R	NRND	SIP MODULE	EEE	14		TBD	Call TI	Call TI			

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

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**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

<sup>(3)</sup> MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

<sup>(4)</sup> There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

<sup>(5)</sup> Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

<sup>(6)</sup> Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

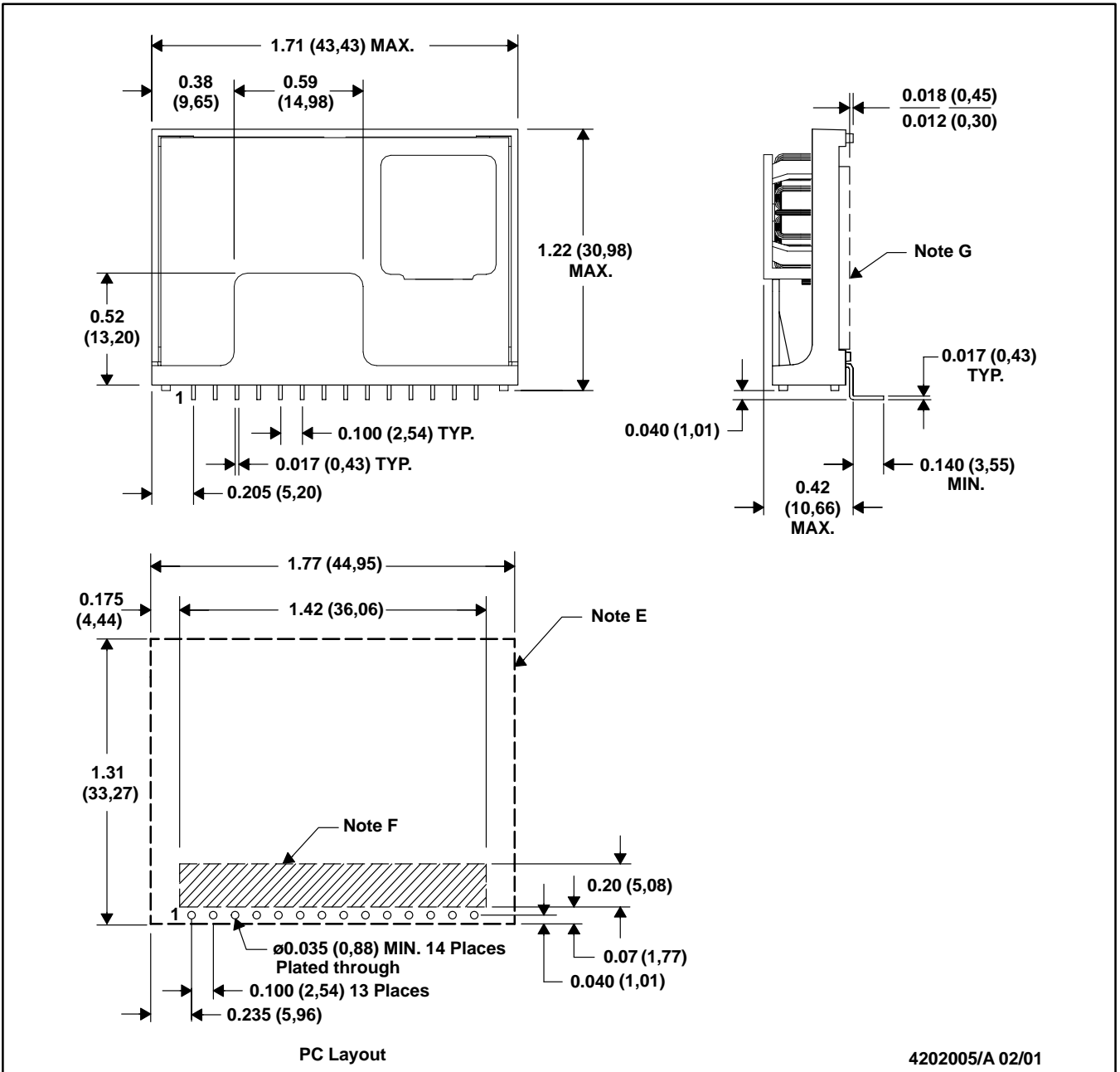
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EEA (R-PSIP-T14)

PLASTIC SINGLE-IN-LINE MODULE

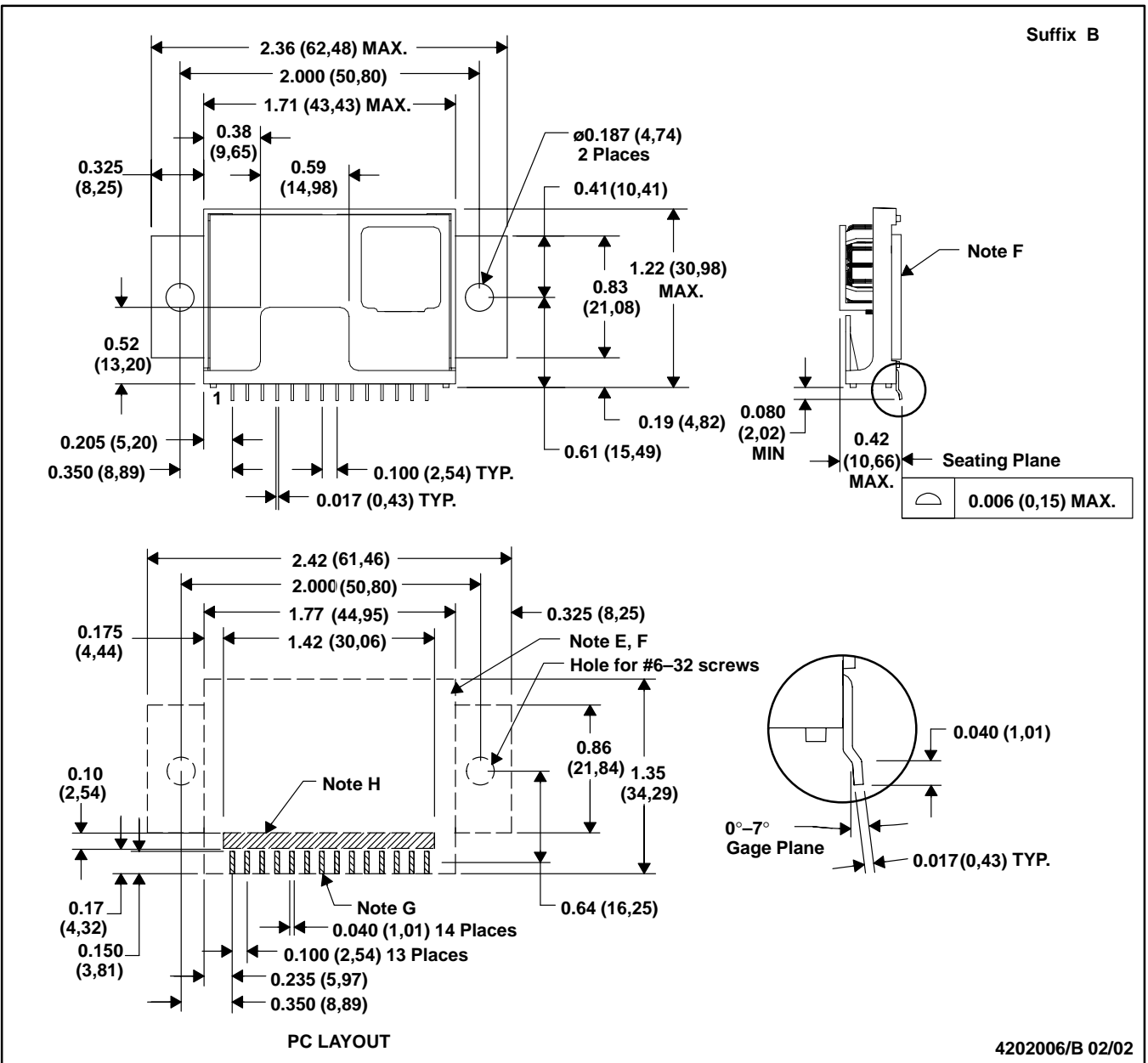


- NOTES: A. All linear dimensions are in inches (mm).  
 B. This drawing is subject to change without notice.  
 C. 2-place decimals are  $\pm 0.030$  ( $\pm 0,76$  mm).  
 D. 3-place decimals are  $\pm 0.010$  ( $\pm 0,25$  mm).  
 E. Recommended mechanical keep-out area.  
 F. No copper, power or signal traces in this area.

- G. D-suffix parts include a metal heat spreader.  
 No signal traces are allowed under the heat spreader area.  
 A solid copper island is recommended, which may be grounded.  
 A-suffix does not include a metal heat spreader.

EEK (R-PSIP-G14)

PLASTIC SINGLE-IN-LINE MODULE

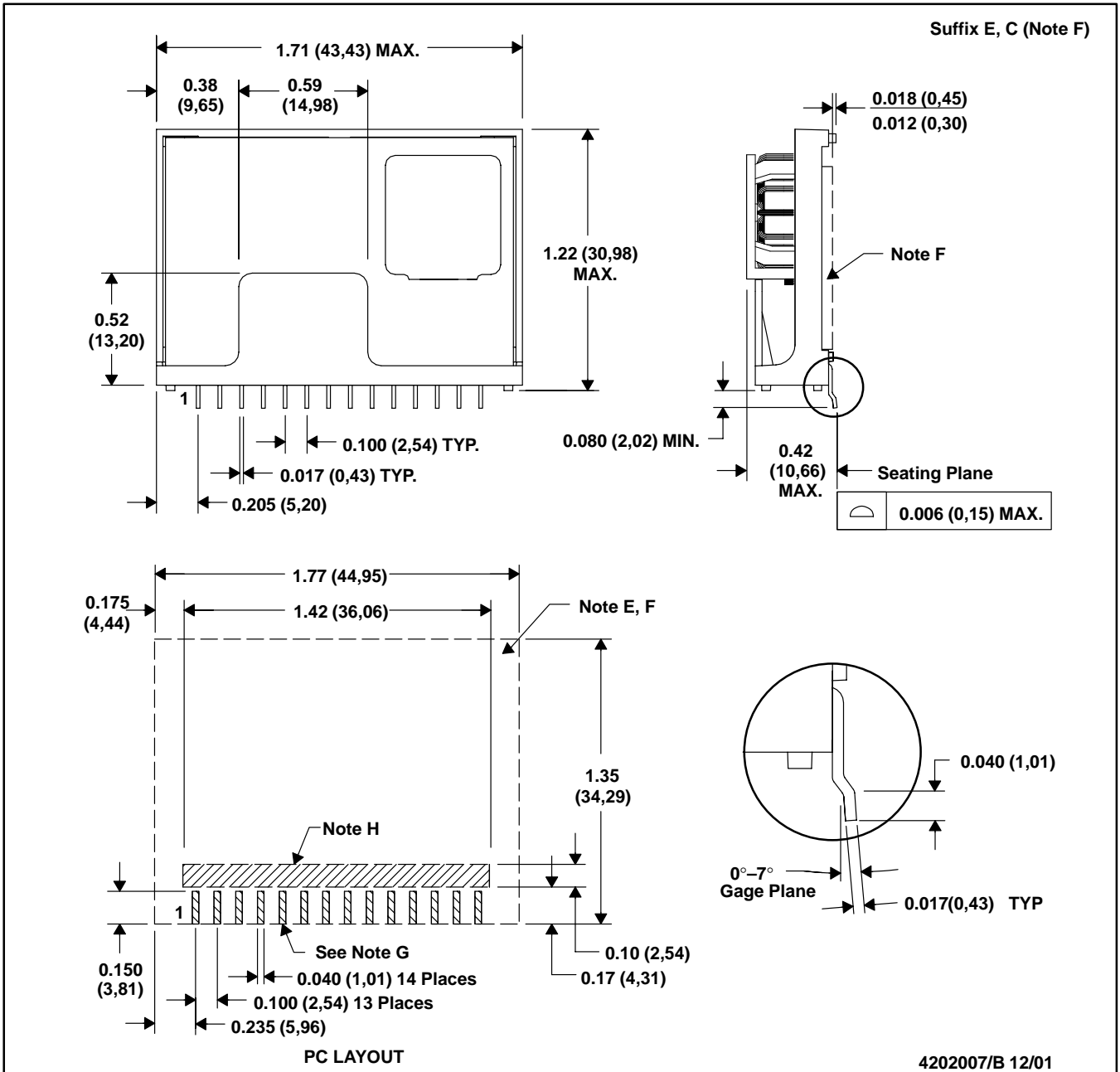


- NOTES: A. All linear dimensions are in inches (mm).  
 B. This drawing is subject to change without notice.  
 C. 2-place decimals are  $\pm 0.030$  ( $\pm 0,76$  mm).  
 D. 3-place decimals are  $\pm 0.010$  ( $\pm 0,25$  mm).  
 E. Recommended mechanical keep-out area.  
 F. The metal tab is isolated but electrically conductive.  
 No signal traces are allowed under the metal tab area.  
 A solid copper island is recommended, which may be grounded.

- G. Power pin connections should utilize two or more vias per input, ground and output pin.  
 H. No copper, power or signal traces in this area.

EEC (R-PSIP-G14)

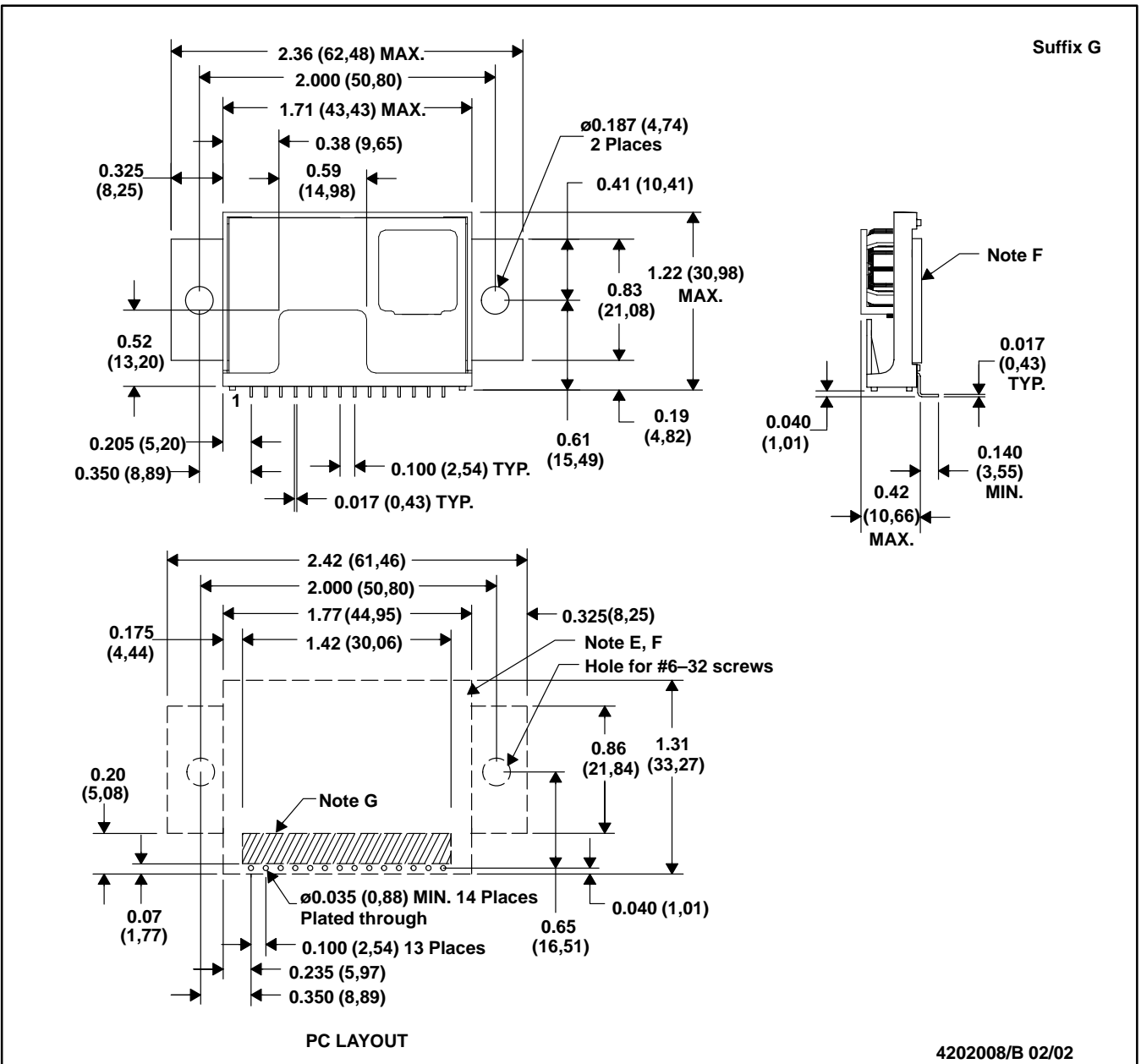
PLASTIC SINGLE-IN-LINE MODULE



- NOTES:
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  - B. This drawing is subject to change without notice.
  - C. 2-place decimals are  $\pm 0.030$  ( $\pm 0,76$  mm).
  - D. 3-place decimals are  $\pm 0.010$  ( $\pm 0,25$  mm).
  - E. Recommended mechanical keep-out area.
  - F. E-suffix parts include a metal heat spreader.  
No signal traces are allowed under the heat spreader area.  
A solid copper island is recommended, which may be grounded.
  - C-suffix does not include a metal heat spreader.
  - G. Power pin connections should utilize two or more vias per input, ground and output pin.
  - H. No copper, power or signal traces in this area.

EEG (R-PSIP-T14)

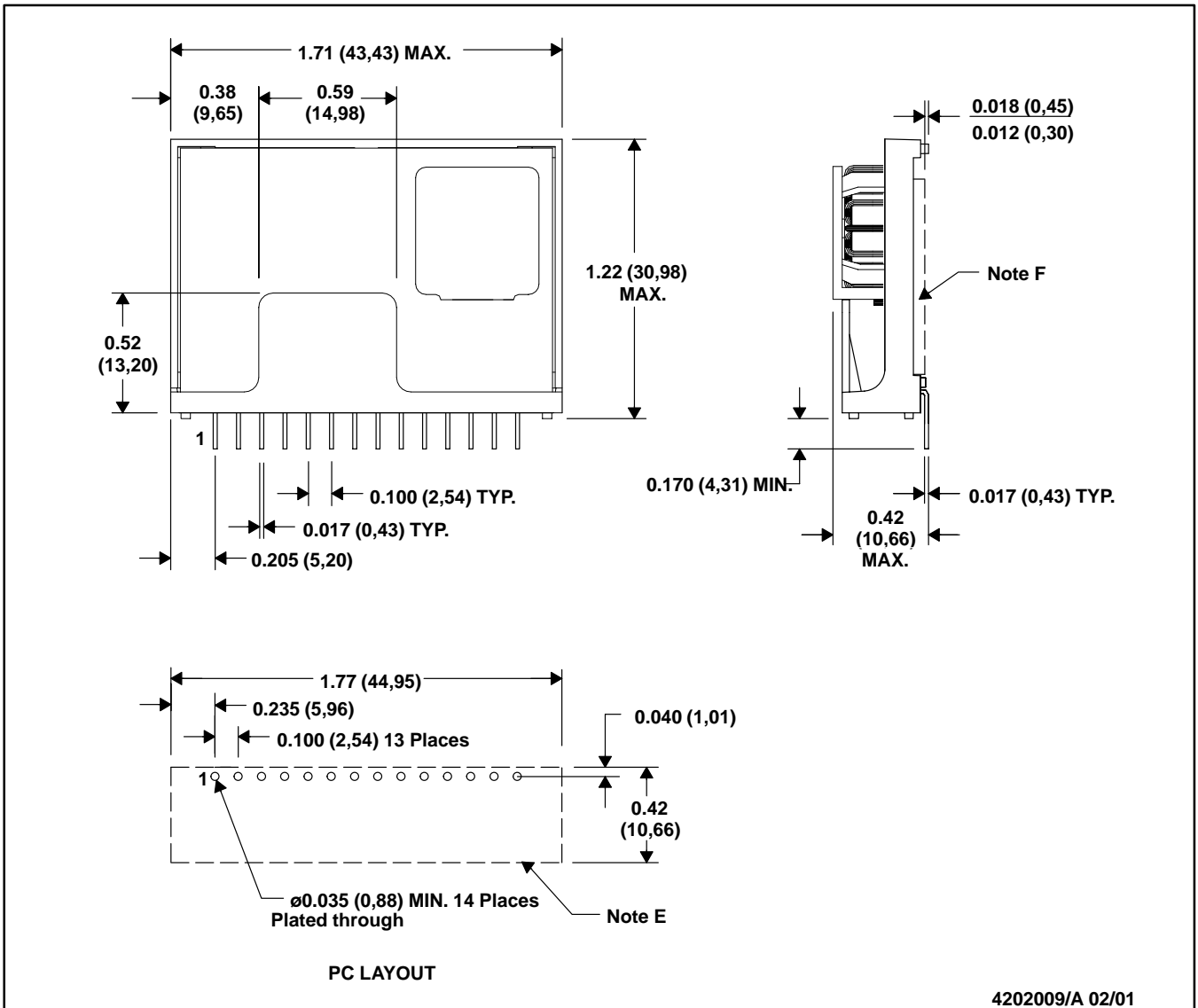
PLASTIC SINGLE-IN-LINE MODULE



- NOTES: A. All linear dimensions are in inches (mm).  
 B. This drawing is subject to change without notice.  
 C. 2-place decimals are  $\pm 0.030$  ( $\pm 0,76$  mm).  
 D. 3-place decimals are  $\pm 0.010$  ( $\pm 0,25$  mm).  
 E. Recommended mechanical keep-out area.  
 F. The metal tab is isolated but electrically conductive.  
 No signal traces are allowed under the metal tab area.  
 A solid copper island is recommended, which may be grounded.  
 G. No copper, power or signal traces in this area.

EED (R-PSIP-T14)

PLASTIC SINGLE-IN-LINE MODULE

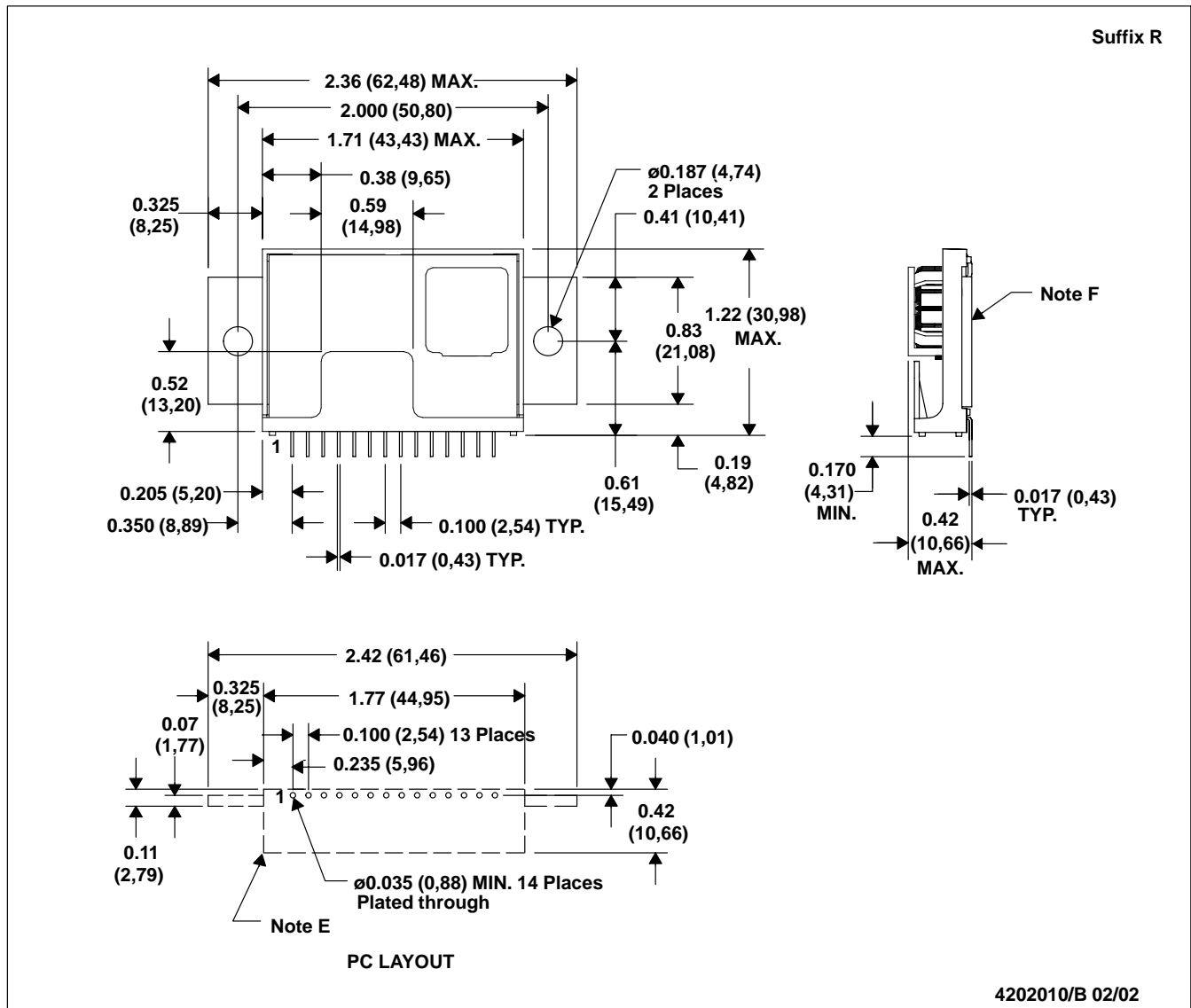


- NOTES: A. All linear dimensions are in inches (mm).  
 B. This drawing is subject to change without notice.  
 C. 2-place decimals are  $\pm 0.030$  ( $\pm 0,76$  mm).  
 D. 3-place decimals are  $\pm 0.010$  ( $\pm 0,25$  mm).  
 E. Recommended mechanical keep-out area.  
 F. P-suffix parts include a metal heat spreader.  
 The heat spreader is isolated but electrically conductive, it can be grounded.  
 N-suffix does not include a metal heat spreader.

EEE (R-PSIP-T14)

PLASTIC SINGLE-IN-LINE MODULE

Suffix R

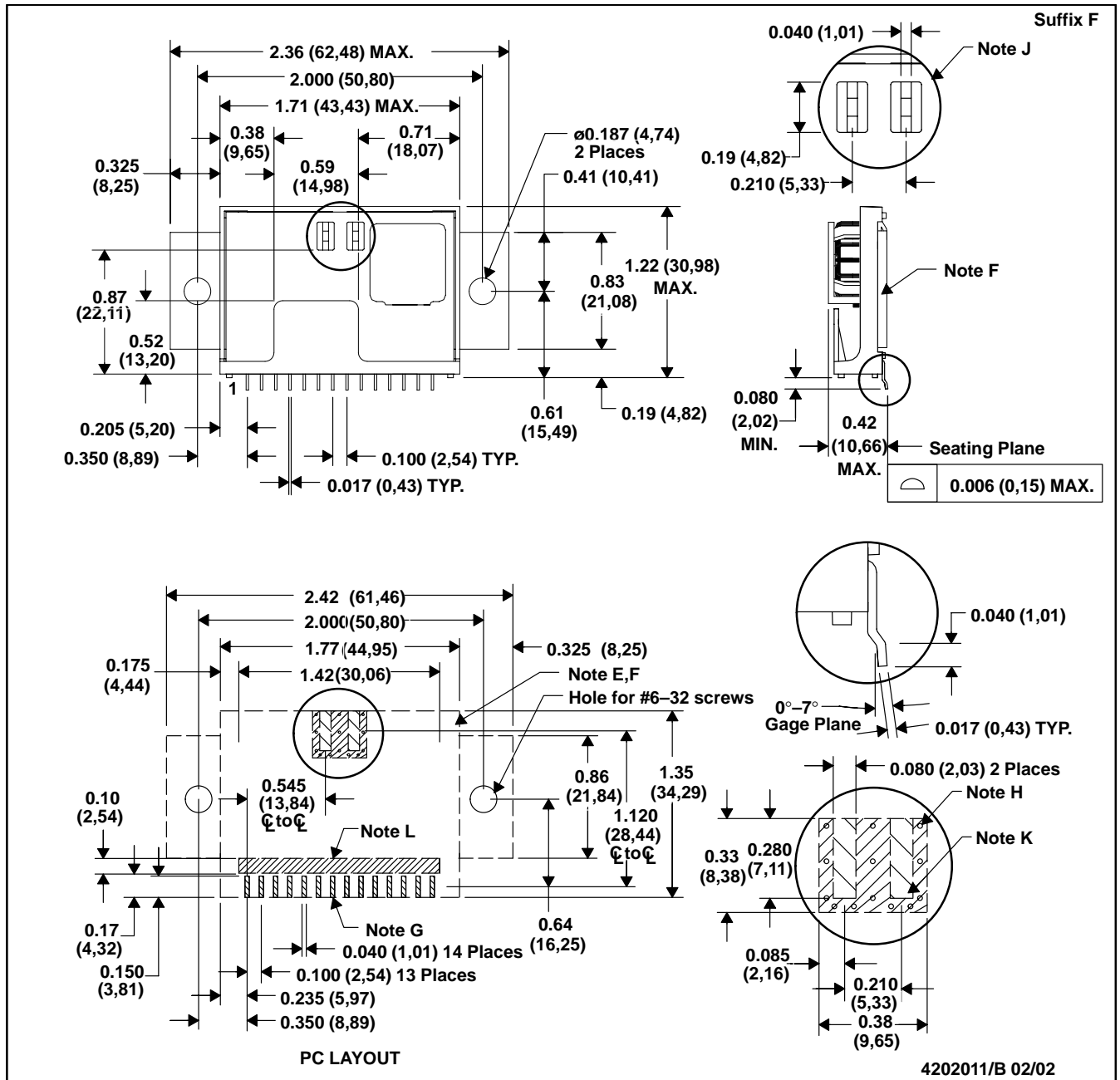


4202010/B 02/02

- NOTES:
- A. All linear dimensions are in inches (mm).
  - B. This drawing is subject to change without notice.
  - C. 2-place decimals are  $\pm 0.030$  ( $\pm 0,76$  mm).
  - D. 3-place decimals are  $\pm 0.010$  ( $\pm 0,25$  mm).
  - E. Recommended mechanical keep-out area.
  - F. The metal tab is isolated but electrically conductive, it can be grounded.

EEF (R-PSIP-G14)

PLASTIC SINGLE-IN-LINE MODULE

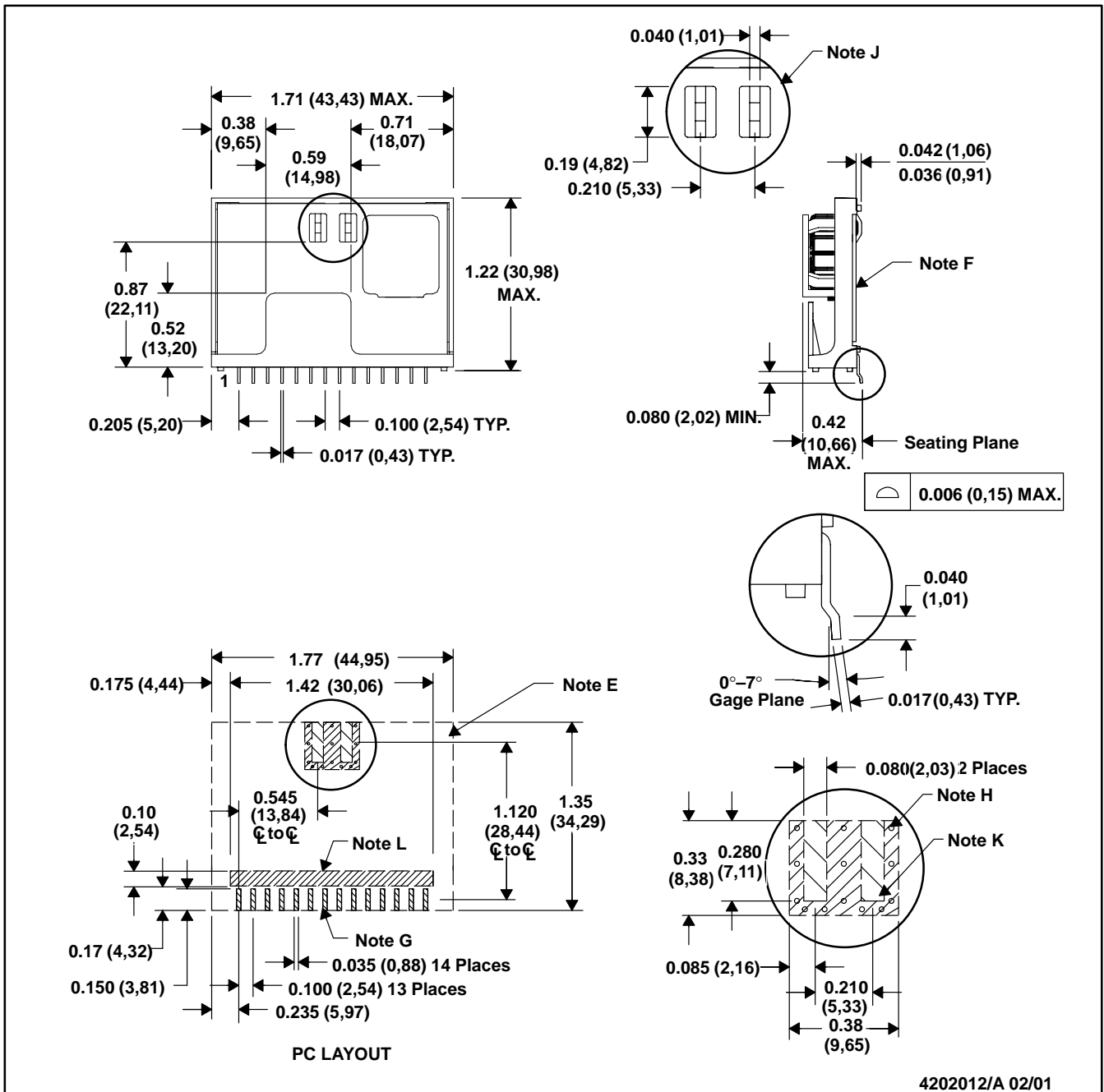


- NOTES: A. All linear dimensions are in inches (mm).  
 B. This drawing is subject to change without notice.  
 C. 2-place decimals are  $\pm 0.030$  ( $\pm 0,76$  mm).  
 D. 3-place decimal are  $\pm 0.010$  ( $\pm 0,25$  mm).  
 E. Recommended mechanical keep-out area.  
 F. The metal tab is isolated but electrically conductive.  
 No signal traces are allowed under the metal tab area.  
 A solid copper island is recommended, which may be grounded.  
 G. Power pin connections should utilize two or more vias per input, ground and output pin.

- H. Minimum copper land area required for solder tab. Vias are recommended to improve copper adhesion or connect land to other ground area.  
 J. Underside solder tabs detail.  
 K. Solder mask openings to copper island for solder joints to mechanical pins.  
 L. No copper, power or signal traces in this area.

EEL (R-PSIP-G14)

PLASTIC SINGLE-IN-LINE MODULE



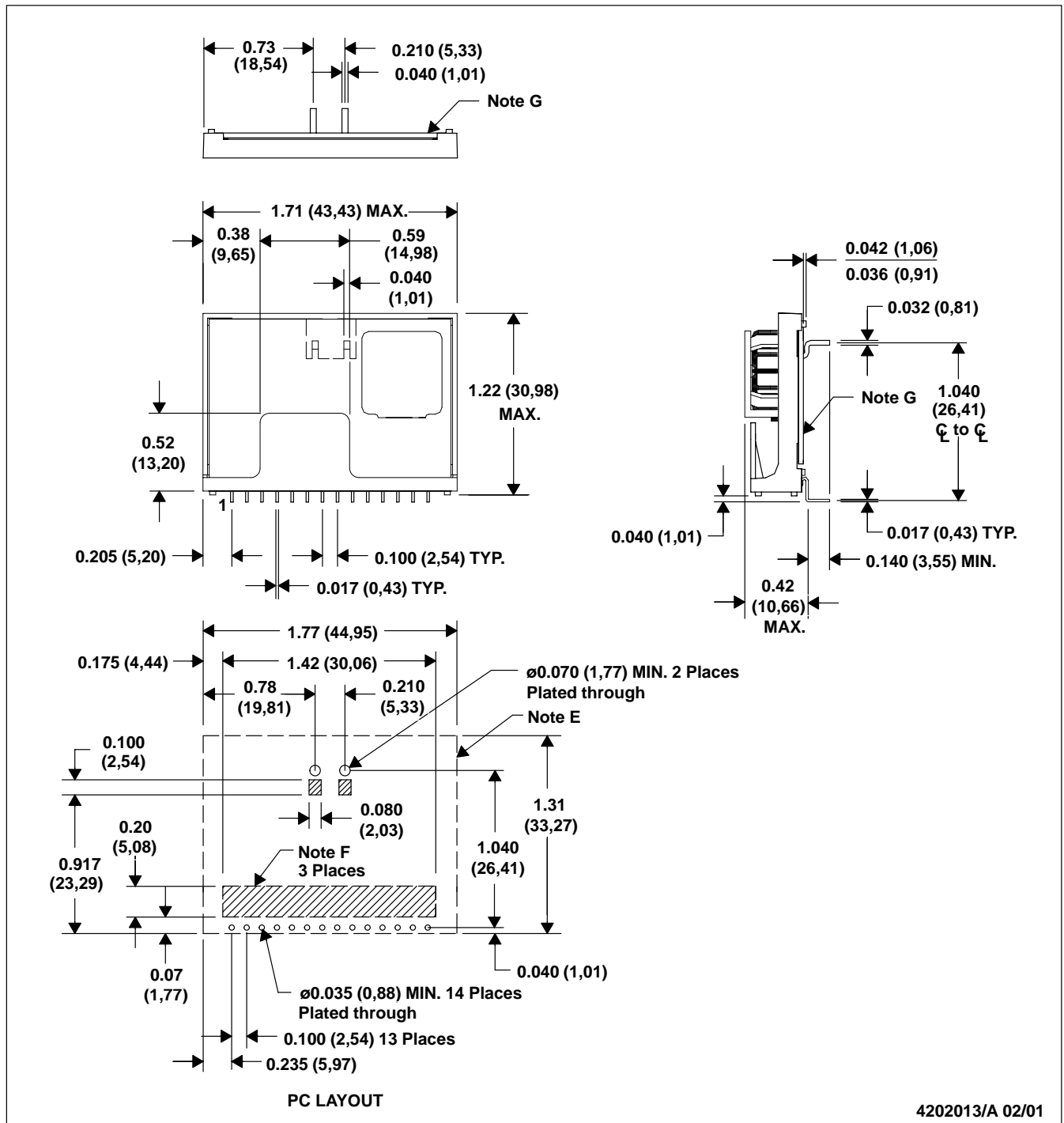
- NOTES: A. All linear dimensions are in inches (mm).  
 B. This drawing is subject to change without notice.  
 C. 2-place decimals are  $\pm 0.030$  ( $\pm 0,76$  mm).  
 D. 3-place decimals are  $\pm 0.010$  ( $\pm 0,25$  mm).  
 E. Recommended mechanical keep-out area.  
 F. The metal tab is isolated but electrically conductive. No signal traces are allowed under the metal tab area. A solid copper island is recommended, which may be grounded.  
 G. Power pin connections should utilize two or more vias per input, ground and output pin.

- H. Minimum copper land area required for solder tab. Vias are recommended to improve copper adhesion or connect land to other ground area.  
 J. Underside solder tabs detail  
 K. Solder mask openings to copper island for solder joints to mechanical pins.  
 L. No copper, power or signal traces in this area.



EEM (R-PSIP-T14)

PLASTIC SINGLE-IN-LINE MODULE



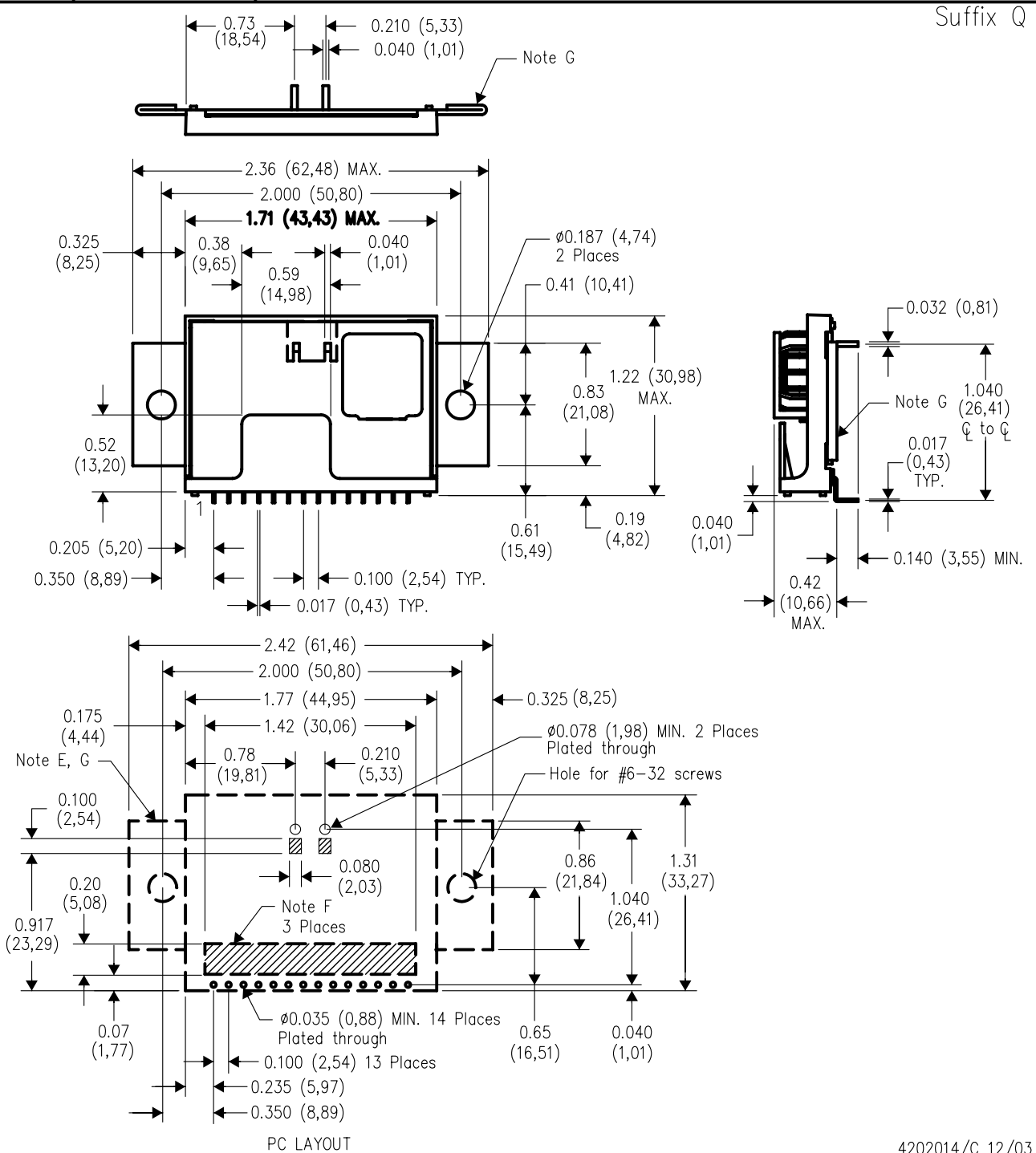
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 C. 2-place decimals are  $\pm 0.030$  ( $\pm 0,76$  mm).  
 D. 3-place decimals are  $\pm 0.010$  ( $\pm 0,25$  mm).  
 E. Recommended mechanical keep-out area.  
 F. No copper, power or signal traces in this area.

- G. The metal tab is isolated but electrically conductive. No signal traces are allowed under the metal tab area. A solid copper island is recommended, which may be grounded to the two underside pins.

EEQ (R-PSIP-T14)

PLASTIC SINGLE-IN-LINE MODULE

Suffix Q



4202014/C 12/03

- NOTES:
- A. All linear dimensions are in inches (mm).
  - B. This drawing is subject to change without notice.
  - C. 2 place decimals are  $\pm 0.030$  ( $\pm 0,76$ mm).
  - D. 3 place decimals are  $\pm 0.010$  ( $\pm 0,25$ mm).
  - E. Recommended mechanical keep out area.
  - F. No copper, power or signal traces in this area.
  - G. The metal tab is isolated but electrically conductive. No signal traces are allowed under the metal tab area. A solid copper island is recommended, which may be grounded to the two underside pins.

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