DATA SHEET
SE2436L: High Power 2.4 GHz 802.15.4 Front End Module

Applications

- Smart Meters
- In-home appliances
- Smart thermostats

Features

- Integrated PA with 27 dBm output power
- Integrated LNA with programmable bypass
- Integrated antenna switching with Tx and Rx diversity function
- Low FEM noise figure of 2.5 dB typical
- Differential 100 Ω common Tx/Rx RF interface
- Fast switch ON/OFF time <1 µsec
- 2.0 V – 4.8 V supply operation
- Sleep mode current <1 µA
- 4 x 4 x 0.9 mm 24 pin QFN
- Pb-free, RoHS compliant and Halogen free

Product Description

The SE2436L is a high performance, fully integrated RF Front End Module designed for ZigBee/Smart Energy and 802.15.4 applications requiring high transmit power.

The SE2436L is designed for ease of use and maximum flexibility, with fully matched 50 Ω output, and 100 Ω differential input , integrated inter-stage matching and harmonic filter, and digital controls compatible with 1.6 – 3.6 V CMOS levels.

The RF blocks operate over a wide supply voltage range from 2.0 to 4.8V allowing the SE2436L to be used in battery powered applications over a wide spectrum of the battery discharge curve.

Ordering Information

Part No.	Package	Remark
SE2436L-S	24 pin QFN	Samples
SE2436L-R	24 pin QFN	Tape & Reel
SE2436L-EK1	N/A	Evaluation kit

Functional Block Diagram

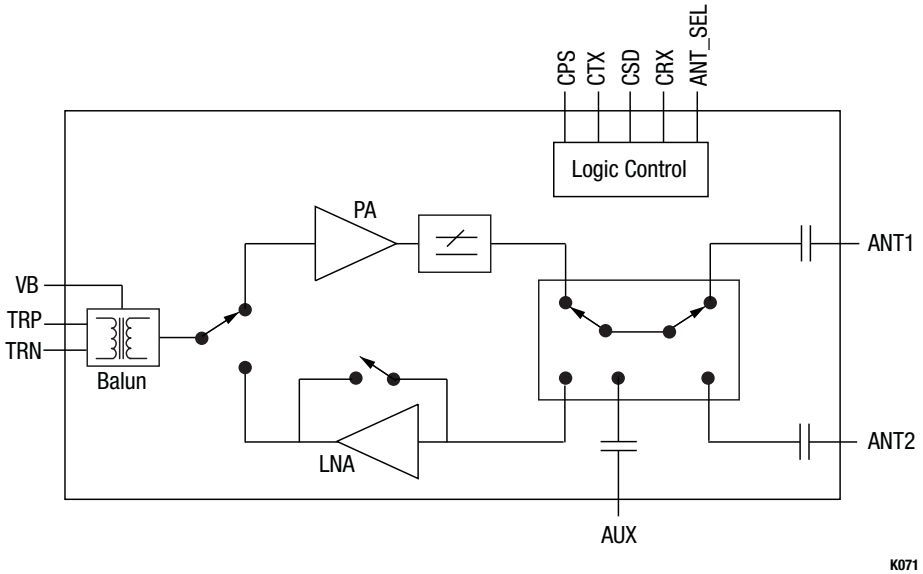


Figure 1: Functional Block Diagram

Pin Out Diagram

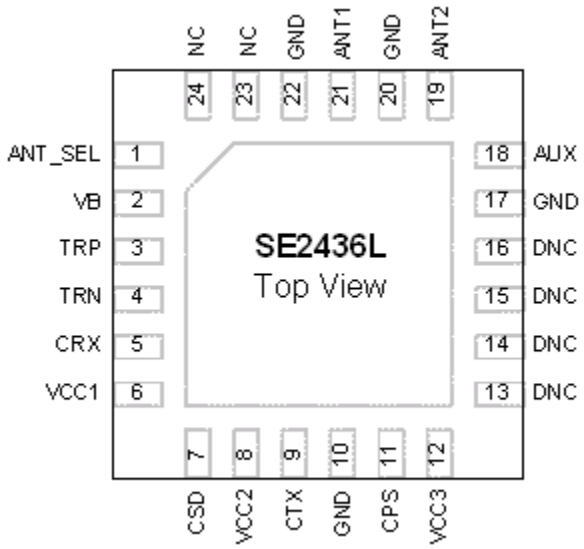


Figure 2: SE2436L Pinout

Pin Out Description

Pin No.	Name	Description
1	ANT_SEL	Connect to GPIO signal to control antenna switch (see “Logic controls” table)
2	VB	I/O balun DC connection (optional, please refer to SoC or RFIC requirements)
3	TRP	Transmit/Receive port from/to transceiver, 100 Ω differential
4	TRN	Transmit/Receive port from/to transceiver, 100 Ω differential
5	CRX	Connect to GPIO signal to control SE2436L modes (see “Logic controls” table)
6	VCC1	Connect to positive supply
7	CSD	Connect to GPIO signal to control SE2436L modes (see “Logic controls” table)
8	VCC2	Connect to positive supply
9	CTX	Connect to GPIO signal to control SE2436L modes (see “Logic controls” table)
10	GND	Connect to PCB ground
11	CPS	Connect to GPIO signal to control SE2436L modes (see “Logic controls” table)
12	VCC3	Connect to positive supply
13	DNC	Leave unconnected
14	DNC	Leave unconnected
15	DNC	Leave unconnected
16	DNC	Leave unconnected

Pin No.	Name	Description
17	GND	Connect to PCB ground
18	AUX	Auxiliary I/O port
19	ANT2	Connect to 50 Ω antenna
20	GND	Connect to PCB ground
21	ANT1	Connect to 50 Ω antenna
22	GND	Connect to PCB ground
23	NC	Not internally connected
24	NC	Not internally connected
Paddle	GND	Exposed die paddle; electrical and thermal ground; Connect to PCB ground

Absolute Maximum Ratings

These are stress ratings only. Exposure to stresses beyond these maximum ratings may cause permanent damage to, or affect the reliability of the device. Avoid operating the device outside the recommended operating conditions defined below. This device is ESD sensitive. Handling and assembly of this device should be at ESD protected workstations.

Symbol	Definition	Min.	Max.	Unit
VCC	Supply Voltage	-0.3	4.8	V
T_{OP}	Operating temperature	-40	85	°C
$T_{STORAGE}$	Storage temperature	-40	125	°C
	ESD all pins (HBM)	-	1000	V
Pin_Tx_max	Tx input power at TR port	-	+6	dBm
Pin_Rx_max	Rx input power at ANT1 or ANT2 ports	-	+10	dBm
VSWR	Voltage Standing Wave Ratio		10:1	

Recommended Operating Conditions

Symbol	Parameter	Min.	Typ.	Max.	Unit
T_A	Ambient temperature	-40	25	85	°C
	Current drive capability from VB_IN to TRN and TRP ports			30	mA
VCC	Supply voltage on VCC	2.0	4.0	4.8	V
	Logic input voltages	0	-	3.6	V

DC Electrical Characteristics

Conditions: VCC = 4.0 V, T_A = 25 °C, as measured on Skyworks Solutions's SE2436L-EK1 evaluation board (de-embedded to device), unless otherwise noted

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$I_{CC-Tx27}$	Total Supply Current	Tx mode P_{OUT} = 27 dBm CPS = CSD = CTX = Logic '1'	-	400	-	mA
I_{CQ-Tx}	Quiescent Current	No RF CPS = CSD = CTX = Logic '1'	-	80	-	mA
I_{CC-Rx}	Total Supply Current	Rx mode CRX = CPS = CSD = Logic '1', CTX = 0 V	-	5	7	mA
$I_{CC-RxBypass}$	Total Supply Current	Rx bypass mode CRX = CSD = Logic '1', CPS = CTX = 0 V	-	-	300	uA

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
I_{CC_OFF}	Sleep Supply Current	No RF, CSD = 0 V or CRX = CTX = 0 V, all digital controls at 0 V	-	-	1	µA

Logic Characteristics

Conditions: VCC = 4.0 V, T_A = 25 °C, as measured on Skyworks Solutions' SE2436L-EK1 evaluation board (de-embedded to device), unless otherwise noted.

Symbol	Parameter	Note	Min.	Typ.	Max.	Unit
V_{IH}	Logic input high		1.6	-	3.6	V
V_{IL}	Logic input low		0	-	0.3	V
I_{IH}	Logic input high		-	-	2	µA
I_{IL}	Logic input low		-	-	1	µA

Logic Controls

Conditions: VCC = 4.0 V, T_A = 25 °C

Mode	Mode description	Note	CPS	CSD	CRX	CTX
0	All off (sleep mode)	1, 3	0	0	0	0
0	All off (sleep mode)	1, 2, 3	0	1	0	0
1	Rx bypass mode	1, 2	0	1	1	0
2	Rx mode	1, 2	1	1	1	0
3	TX bypass mode	1,2	0	1	0	1
4	Tx mode	1, 2	1	1	0	1
5	Auxiliary mode	1,2	1	0	1	X

Note: (1) Logic '0' level compliant to V_{IL} as specified in the "Logic Characteristics" table
(2) Logic '1' level compliant to V_{IH} as specified in the "Logic Characteristics" table
(3) All logic signals must be in a defined state in order to meet the sleep current specification at 1 uA max

Conditions: VCC = 4.0 V, T_A = 25 °C

Mode description	Note	CPS	CSD	CTX	CRX	ANT_SEL
ANT1 port enabled	1	X	X	X	X	0
ANT2 port enabled	2	X	X	X	X	1

Note: (1) Logic '0' level compliant to V_{IL} as specified in the "Logic Characteristics" table
(2) Logic '1' level compliant to V_{IH} as specified in the "Logic Characteristics" table

AC Electrical Characteristics, Transmit

Conditions: VCC = 4.0 V, T_A = 25 °C, as measured on Skyworks Solutions' SE2436L-EK1 evaluation board (de-embedded to device), all unused ports terminated with 50 Ω, unless otherwise noted.

Symbol	Parameter	Condition	Note	Min.	Typ.	Max.	Unit
F_{IN}	Frequency Range			2400	-	2483	MHz
Pout	Output power at ANT1 or ANT2 ports	VCC = 4.0 V VCC = 3.3 V VCC = 3.0 V	1	-	27 25 22	-	dBm
S_{21}	Small Signal Gain		1	27	30	33	dB
ΔS_{21}	Small Signal Gain Variation		1	-	-	2	dBp-p
S_{21byp}	Small Signal Gain bypass		1	-	-2.5	-	dB
Tx_G	Large Signal Gain Variation	Pin at 0 dBm	1	-	-	1	dBp-p
HD2-HD10	Harmonics	P_{OUT} = 27 dBm	1, 2	-	-	-42	dBm/MHz
ACP	Spectral Mask		1, 3	-	-	-30	dBm
Trise	Turn on time		4	-	-	800	ns
Tfall	Turn off time		5	-	-	800	ns
STAB	Stability	CW, P_{IN} = 0 dBm 0.1 GHz – 20 GHz Load VSWR = 6:1		All non-harmonically related outputs less than -42 dBm/MHz			
RU	Ruggedness	CW, PIN = +6 dBm, Load VSWR = 10:1		No permanent damage			

Note: (1) 2400 – 2483 MHz
(2) IEEE 802.15.4 source
(3) Integrated power from band edges to Fc ± 3.5 MHz
(4) From 50% of CTX edge to 90% of final RF output power
(5) From 50% of CTX edge to 10% of final RF output power

AC Electrical Characteristics, Receive

Conditions: VCC = 4.0 V, T_A = 25 °C, as measured on Skyworks Solutions' SE2436L-EK1 evaluation board (de-embedded to device), all unused ports terminated with 50 Ω, unless otherwise noted.

Symbol	Parameter	Condition	Note	Min.	Typ.	Max.	Unit
F_{IN}	Frequency Range			2400	-	2483	MHz
Rx_gain	Receive gain	CPS = CSD = logic '1', CTX = logic '0'	1	9.0	11.5	14	dB
NF	Receive noise figure	CPS = CSD = logic '1', CTX = logic '0'	1	-	2.5	3.5	dB
IIP3	Input 3rd order intercept	CPS = CSD = logic '1', CTX = logic '0'	1	-3	2	-	dBm
IP1dB	Input 1-dB compression point	CPS = CSD = logic '1', CTX = logic '0'	1	-13	-8	-	dBm
$S11_{ANT}$	Antenna port return loss		1	-	-14	-10	dB
Trise	Turn on time		2	-	-	800	ns
Tfall	Turn off time		3	-	-	800	ns
G_bp	Gain in bypass mode	CPS = CTX = logic '0', CSD = logic '1'		-	-3	-	dB
IP1dB	Input 1-dB compression point in bypass mode	CPS = CTX = logic '0', CSD = logic '1'		19	-	-	dBm

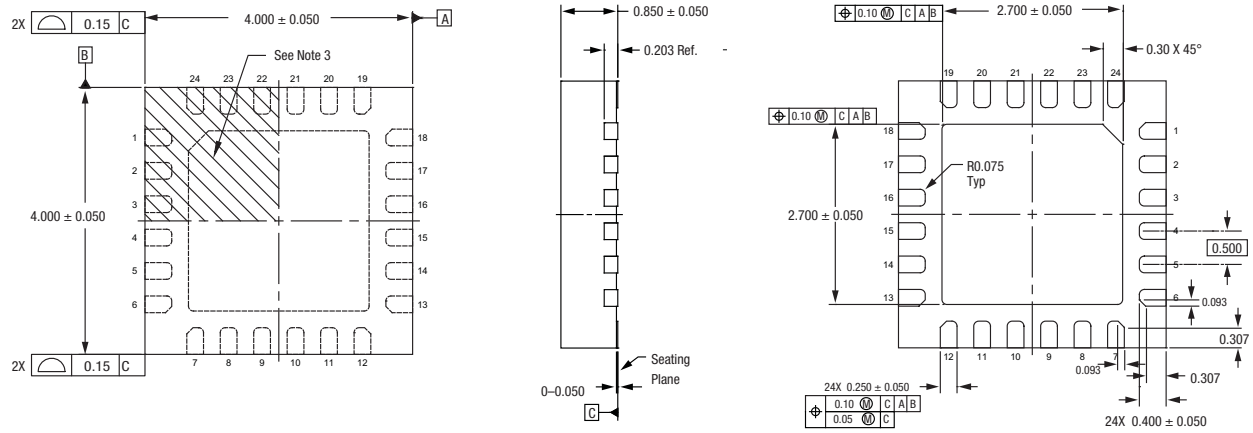
Note: (1) 2400 – 2483 MHz
(2) From 50% of CTX edge to 90% of final RF output power
(3) From 50% of CTX edge to 10% of final RF output power

AC Electrical Characteristics, Diversity Antenna Function

Conditions: VCC = 4.0 V, T_A = 25 °C, as measured on Skyworks Solutions' SE2436L-EK1 evaluation board (de-embedded to device), all unused ports terminated with 50 Ω, unless otherwise noted.

Symbol	Parameter	Min.	Typ.	Max.	Unit
$ISOL_{ANTSW}$	Isolation Between ANT1 and ANT2 Ports	-	-20	-	dB
$S11_{ANT1,2}$	Input return loss into 50 Ω, ANT1 and ANT2 ports	-	-14	-6	dB
$S22_{ANT1,2}$	Output return loss into 50 Ω, ANT1 and ANT2 ports	-	-14	-6	dB
$T_{ANT1-ANT2}$	Antenna 1 to Antenna 2 switching time	-	800	-	nsec

Package Drawing



Notes:

1. *All measurements are in millimeters.*
2. *Dimensions and tolerances according to ASME Y14.5M-1994.*
   Unless otherwise specified, the following values apply:
   Decimal Tolerance: Angular Tolerance:
   X.X (1 place) ± 0.1 mm ±1°
   X.XX (2 places) ± 0.05 mm
   X.XXX (3 places) ± 0.025 mm
3. *Terminal #1 identification mark located within marked area.*
4. *Unless specified, dimensions are symmetrical about center lines.*

Y0676

Figure 3: Package Drawing

Tape and Reel Information

Parameter	Value
Devices Per Reel	3000
Reel Diameter	13 inches
Tape Width	12 millimeters

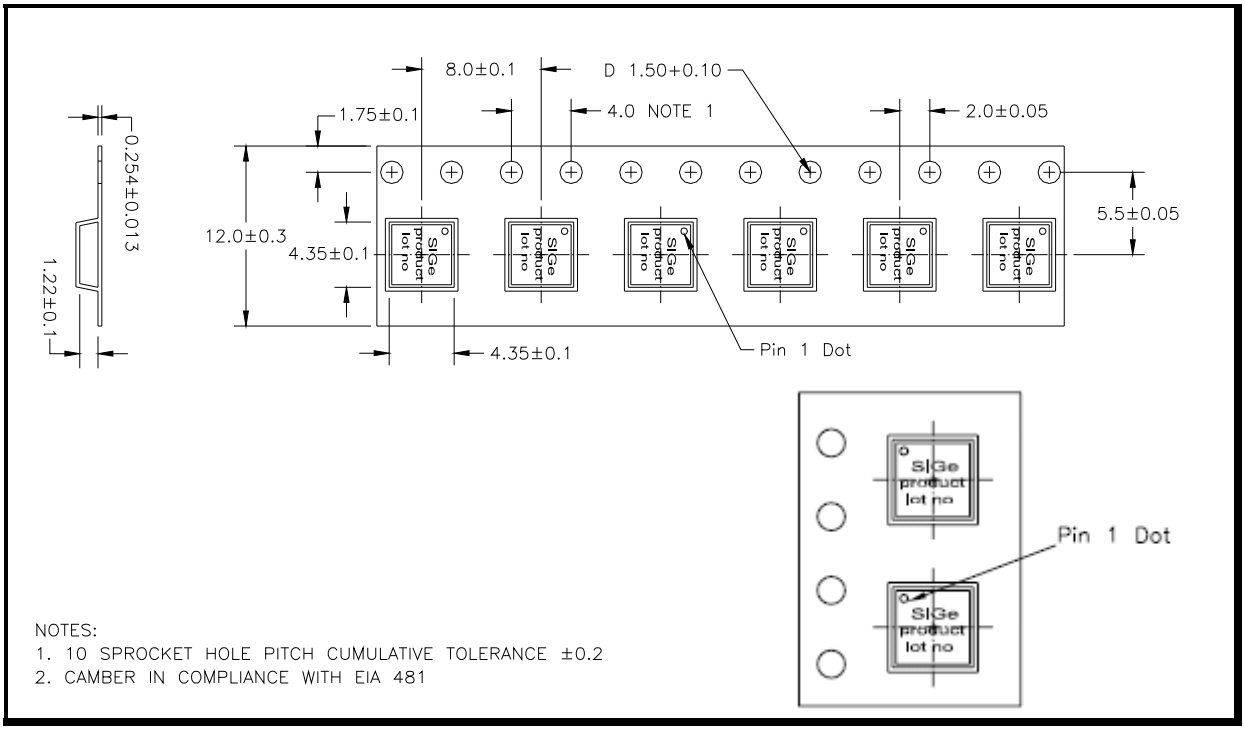


Figure 4: Detailed Tape and Reel Information (All diminensions in Millimeters)

Recommended Reflow Temperature Profile

Profile Feature	SnPb Eutectic Assembly	Lead (Pb) Free Assembly
Average Ramp-up Rate (T_L to T_P)	3°C/s (max)	3°C/s (max)
Preheat		
Temperature Min. (T_{smin})	100°C	150°C
Temperature Max. (T_{smax})	150°C	200°C
Time (Min. to Max) (t_s)	60 - 120s	60 - 80s
Ramp Up		
Tsmax to t_L	-	3°C/s (max)
Time 25°C to Peak Temperature	6 mins. (max)	8 mins. (max)
Reflow		
Temperature (t_L)	183°C	217°C
Time maintained above t_L	60 - 150s	60 - 150s
Peak Temperature (t_p)	240 ±5°C	260 +0/-5°C
Time Within 5°C of Actual Peak Temperature (t_p)	10 - 30s	20 - 40s
Ramp-Down		
Ramp-Down Rate	6°C/s (max)	6°C/s (max)

Reflow Profile (Reference JEDEC J-STD-020)

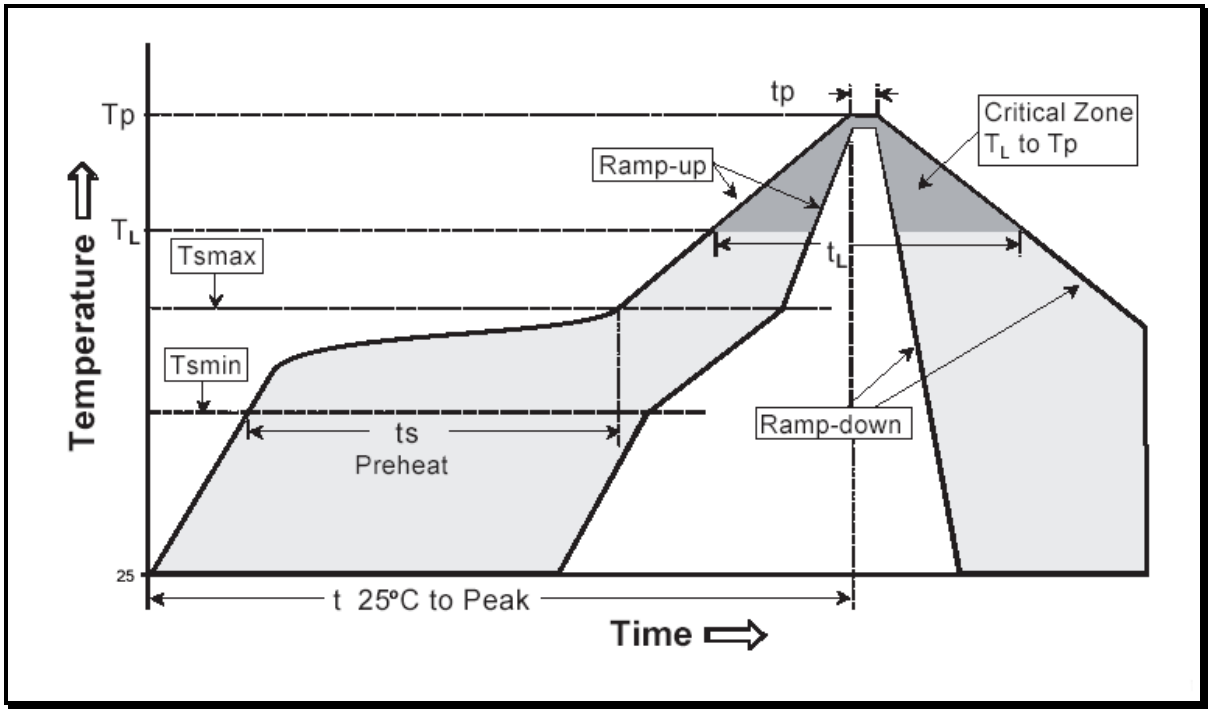


Figure 5: Reflow temperature profile

Branding Information

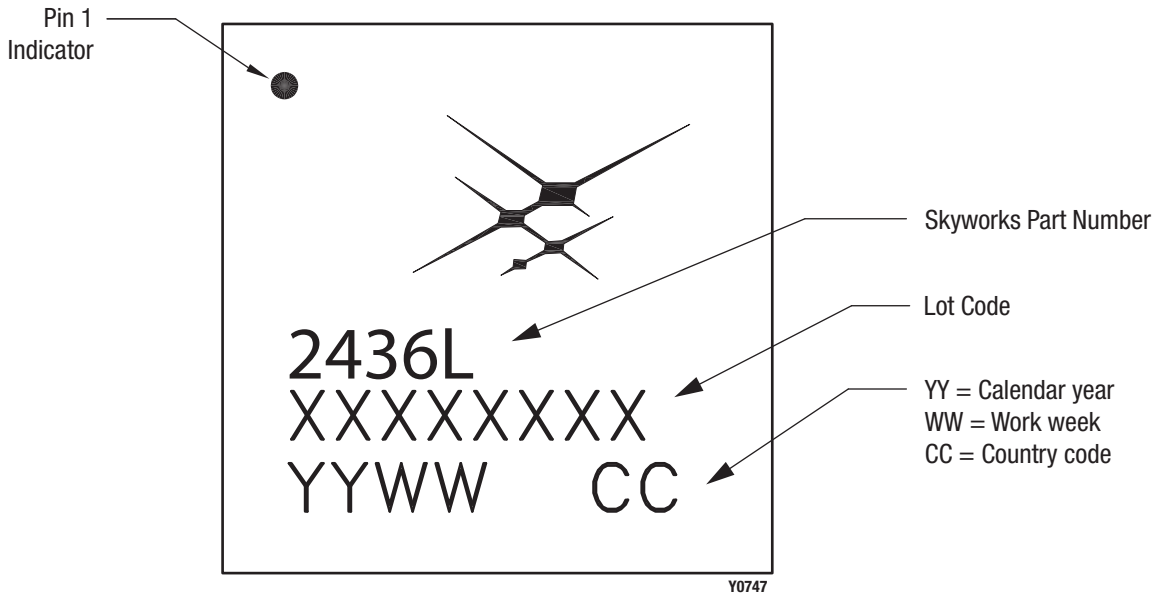


Figure 6: SE2436L Typical Part Marking

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