

Smart Lighting Inventive Energy

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SMART LIGHTING INVENTIVE ENERGY 2018

INTERNATIONAL PATENT CLASSES (IPC): Smart Lighting

IPC Domain	Description
H05B 37/02	Circuit arrangements for electric light sources in general; Controlling
H05B 33/02	Electroluminescent light sources; Details
H05B33/087	Circuit arrangements not adapted to a particular application for light emitting diodes [LEDs] comprising only inorganic semiconductor materials with control of the color point of the light involving load external environment sensing means
H05B 39/00	Circuit arrangements or apparatus for operating incandescent light sources and not adapted to a particular application
G08B 1/08	Systems for signalling characterised solely by the form of transmission of the signal; using electric transmission
G08B21/022	Message structure or message content, e.g. message protocol
H04H 60/82	Arrangements for broadcast applications with a direct linkage to broadcast information or to broadcast space-time; Broadcast-related systems; the transmission system being the Internet
H04L 29/06	Arrangements, apparatus, circuits or systems; characterised by a protocol
H05B 41/36	Circuit arrangements or apparatus for igniting or operating discharge lamp; Controlling
G08C 17/02	Arrangements for transmitting signals characterised by the use of a wireless electrical link; using a radio link

Typically, smart or intelligent lighting systems are used to connect with a Wi-Fi network and allow the user to operate the lights through smartphone applications or remote controls. The user can adjust the color temperature of individual light bulbs or change the color of them completely. Further, the user can set up the schedules, so the lights switch on and off at predefined times.

We identified the following top 10 International Patent Classification (IPC) in the smart lighting domain through the study of key patents. The overall number of Applications published in the United States Patent and Trademark Office (USPTO) and Patents granted by USPTO are given in the table below (from the year 2010 till 2017). These are total numbers granted and published by the world at large at USPTO in that specific year.

S.No	IPC Domain	Year								
		2010	2011	2012	2013	2014	2015	2016	2017	
1	H05B 37/02									
	Application	917	1022	1259	1145	608	698	6384	1105	
	Granted	1927	2201	2707	3350	4164	5179	6384	7689	
2	H05B 33/02									
	Application	24	9	25	62	24	5	4	2	
	Granted	795	814	836	851	851	907	945	967	
3	H05B33/0872									
	Application	1	1	1	1	1	1	1	1	
	Granted	1	1	1	1	1	1	1	1	
4	H05B 39/00									
	Application	47	14	1	2	1	2	1	1	
	Granted	1	945	1005	1062	1146	1224	1291	1317	
5	G08B 1/08									
	Application	284	245	237	117	38	12	4	15	
	Granted	1151	296	331	347	383	286	260	259	
6	G08B21/0222									
	Application	1	1	1	1	1	1	1	1	
	Granted	1	1	1	1	1	0	1	1	
7	H04H 60/82									
	Application	1	1	1	1	1	5	7	5	
	Granted	1	1	1	1	1	1	27	22	
8	H04L 29/06									
	Application	768	1109	1334	2149	5386	8850	10856	11511	
	Granted	619	683	1512	2161	2534	6714	10622	12336	
9	H05B 41/36									
	Application	366	175	98	52	25	10	11	17	
	Granted	29	93	155	139	153	119	113	70	
10	G08C 17/02									
	Application	50	22	39	113	277	246	256	357	
	Granted	1	4	4	8	7	157	316	463	

STATE OF ART OF ANY TECHNOLOGY USING CRAFITTI's INVENTIVE ENERGY

Inventive Energy (IE) is a yearly metric of the trend of last five years of invention activity in the specific technological domain such as the smart lighting calculated based on a number of patent applications published and a number of patents granted in the respective technological domain. **Inventive energy is a composite metric of two indices – Patent Intensity Index and Patent Activity Index.**

CRAFITTI's **INVENTIVE ENERGY** measures the pace and intensity of **inventive activity** in a particular technological field. Inventive Energy provides a true picture of the state of the art of technology as it is a **composite metric** of **Patents Granted** and **Patent Applications published** in specific technology domains annually for a period of five years.

Inventive Energy in specific technology domains can be utilized by existing technology players, start-ups, new players, investors, VCs, Research and Development teams and technology and Product Strategy Teams to design more informed future.

Patent Intensity Index of a year is measured in terms of the yearly average of a number of total patents granted and patent applications published in last 5 years. *As an analogy, the Patent Intensity Index is denoted as the Mass which is reflected as a number of Patents and Applications granted and published respectively in the preceding 5 years.*

Patent Activity Index is measured in terms of the yearly average of *relative* pace of patent applications and granted patents in the IPC domain. *As an analogy, the Patent Activity Index denotes the Velocity or relative pace of Patents and Applications, granted and published respectively in the preceding 5 years, with higher weightage assigned to recent years.*

For any year, the two indices include a measure of yearly averages of **last five years of a number of applications published and patents granted**. For example, for 2017, these indices use data from years 2013-2017.

Patent Activity Index of top 10 smart lighting IPC classes for years 2014-2017

A value of **Patent Activity Index** is less than 1.0 indicates that relative average number of applications filing is reducing compared to a number of patents being granted. **The index also gives a red, amber and green signal.** **Red** indicates the value of the index is less than 1.0. **Amber** indicates it is between 1.0 and 2.0 and **green** indicates it is above 2.0, i.e., *the number of applications being published every year on an average is more than 2 times the number of patents being granted on an average.* A higher value of patent activity index is an indication of more recent inventive activity in the domain or the specific IPC class. In turn, a higher activity index will signify a higher Inventive Energy. *Activity Index is analogous to*

the velocity of the particle. The PAI (Patent Activity Index) of top 10 smart lighting IPCs for years 2014-2017 are given below.

IPC Domain	Description	BM-PAI 2014	BM-PAI 2015	BM-PAI 2016	BM-PAI 2017
H05B 37/02	Circuit arrangements for electric light sources in general; Controlling	0.30	0.23	0.57	0.35
H05B 33/02	Electroluminescent light sources; Details	0.04	0.02	0.02	0.01
H05B33/087	Circuit arrangements not adapted to a particular application for light emitting diodes [LEDs] comprising only inorganic semiconductor materials with control of the color point of the light involving load external environment sensing means	1.00	1.00	1.00	1.00
H05B 39/00	Circuit arrangements or apparatus for operating incandescent light sources and not adapted to a particular application	4.12	0.00	0.00	0.00
G08B 1/08	Systems for signalling characterised solely by the form of transmission of the signal; using electric transmission	0.33	0.24	0.13	0.08
G08B21/022	Message structure or message content, e.g. message protocol	1.00	#DIV/0!	#DIV/0!	#DIV/0!
H04H 60/82	Arrangements for broadcast applications with a direct linkage to broadcast information or to broadcast space-time; Broadcast-related systems; the transmission system being the Internet	1.00	2.75	1.55	1.08
H04L 29/06	Arrangements, apparatus, circuits or systems; characterised by a protocol	1.56	1.43	1.23	1.14
H05B 41/36	Circuit arrangements or apparatus for igniting or operating discharge lamp; Controlling	1.56	0.36	0.18	0.19
G08C 17/02	Arrangements for transmitting signals characterised by the use of a wireless electrical link; using a radio link	26.83	12.96	8.88	6.31

*BM-PAI – *Bhushan Mishra Patent Activity Index* – named after its creators

As can be seen in the above table, the PAI for IPC class G08C 17/02 (Arrangements for transmitting signals characterised by the use of a wireless electrical link; using a radio link), indicated in **green**.

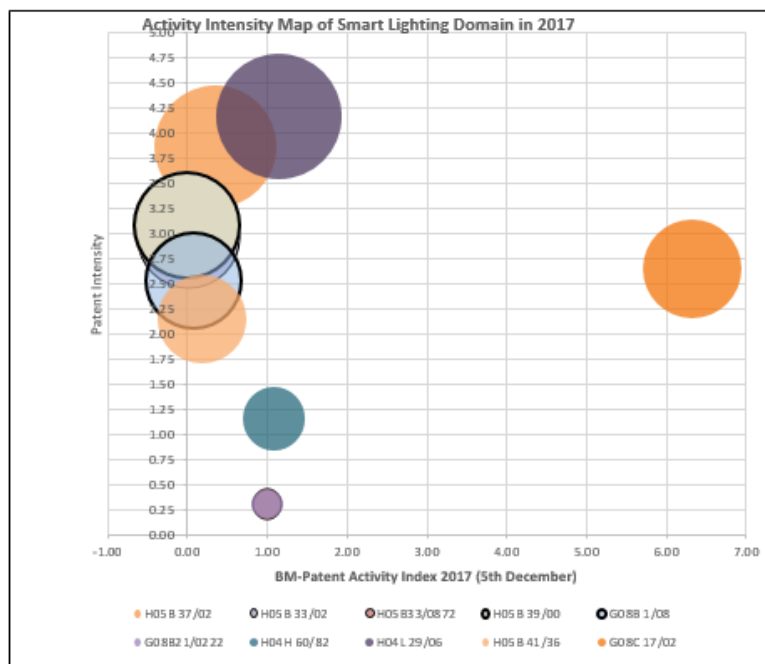
The PAI for H04H 60/82 (Arrangements for broadcast applications with a direct linkage to broadcast information or to broadcast space-time; Broadcast-related systems; the transmission system being the Internet) is above 2.0 for year 2015, indicated in **green**, and below 2.0 for the years 2014, and 2016-2017, indicated in **amber**. Similarly, for the IPC class H05B33/0872 (Circuit arrangements not adapted to a particular application for light emitting diodes [LEDs] comprising only inorganic semiconductor materials with control of the color point of the light involving load external environment sensing means); G08B21/0222 (Message structure or message content, e.g. message protocol); and H04L29/06 (Arrangements, apparatus, circuits or systems; characterised by a protocol), the PAI is below 1.0 for years 2014, 2015, 2016 and 2017, indicated by **amber**.

Further, the PAI for H05B 37/02 (Circuit arrangements for electric light sources in general; Controlling); H05B 33/02 (Electroluminescent light sources; Details); and G08B 1/08 (Systems for signalling characterised solely by the form of transmission of the signal; using electric transmission) is **red** (below 1.0) for the years 2014-2017. This implies that the number of Patent Applications being published in the preceding 5 years (inclusive of current year) *remains less* than the number of Patents being granted. Additionally, the PAI for H05B 39/00 (Circuit arrangements or apparatus for operating incandescent light sources and not adapted to a particular application) is above 2.0 for year 2014, indicated in **green**, and below 1.0 for the years 2014-2017, indicated in **red**. Further, the PAI for H05B 41/36 (Circuit arrangements or apparatus for igniting or operating discharge lamp; Controlling) below 2.0 for the year 2014, indicated in **amber** and below 1.0 for the years 2015-2017, indicated in **red**.

This indicates a reducing Invention activity in the specific domain. Thus, it can be concluded that IPC domains H05B 37/02; H05B 33/02; and G08B 1/08 are seeing reducing Invention Activity and has low invention velocity from 2010 to 2017.

G08C 17/02, and H05B 39/00 are the prominent IPC classifications in the smart lighting technology which talks about transmitting signals characterised by using wireless electrical link and Circuit arrangements for operating incandescent light sources respectively. The inventive activity in G08C 17/02 was higher in the year 2014, since then the patent activity has been reducing as the number of Patents being granted has started increasing. Further, the inventive activity in H05B 39/00 was also higher in the year 2014, since then the patent activity has been reducing. However, the inventive activity of G08C 17/02 is still higher than other key IPC classes.

Activity Intensity Maps of Top 10 smart lighting IPC classes in the year 2014 and 2017

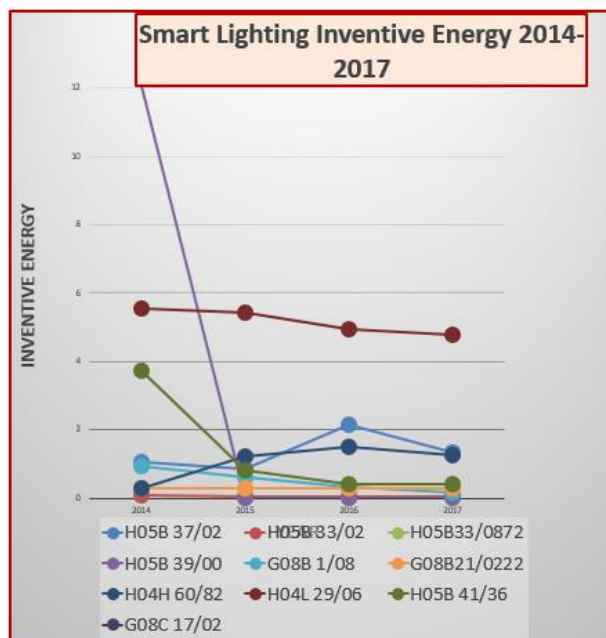


Activity Intensity Map (AIM) of a set of IPC classes is a Crafitti proprietary visualization of intensity in terms of a number of patents granted and patent applications published, and inventive activity in terms of relative pace of patent applications and granted patents in any IPC domain. For any year say 2014, these indices include a measure of yearly averages of last five years of a number of applications published and patents granted. For example, for 2014, these indices use data from years 2010, 2011, 2012, 2013 and 2014.

Smart lighting Inventive Energy of Top 10 IPC classes

IPC Domain	Patent Activity Index				Patent Intensity				INVENTIVE ENERGY			
IPC	BM-PAI 2014	BM-PAI 2015	BM-PAI 2016	BM-PAI 2017	2014	2015	2016	2017	2014	2015	2016	2017
H05B 37/02	● 0.30	● 0.23	● 0.57	● 0.35	3.59	3.65	3.80	3.87	1.07	0.85	2.16	1.34
H05B 33/02	● 0.04	● 0.02	● 0.02	● 0.01	2.93	2.94	2.96	2.97	0.11	0.07	0.05	0.04
H05B33/0872	● 1.00	● 1.00	● 1.00	● 1.00	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
H05B 39/00	● 4.12	● 0.00	● 0.00	● 0.00	2.93	3.03	3.06	3.08	12.06	0.01	0.00	0.00
G08B 1/08	● 0.33	● 0.24	● 0.13	● 0.08	2.84	2.66	2.61	2.54	0.95	0.64	0.34	0.19
G08B21/0222	● 1.00	● 1.00	● 1.00	● 1.00	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
H04H 60/82	● 1.00	● 2.75	● 1.55	● 1.08	0.30	0.45	0.96	1.15	0.30	1.23	1.50	1.25
H04L 29/06	● 1.56	● 1.43	● 1.23	● 1.14	3.56	3.81	4.02	4.17	5.57	5.44	4.95	4.77
H05B 41/36	● 1.56	● 0.36	● 0.18	● 0.19	2.41	2.31	2.24	2.15	3.75	0.83	0.41	0.41
G08C 17/02	● 26.83	● 12.96	● 8.88	● 6.31	2.02	2.24	2.45	2.64	54.23	29.09	21.78	16.69

Inventive Energy for the year 2014 for IPC class H05B 37/02 is simply a product of Patent Activity Index for the year 2014 (in this case a value of 0.30) and Patent Intensity for the year 2014 (in this case a value of 3.59). The Inventive Energy for the year 2014 for IPC domain H05B 37/02 comes out to be $0.30 \times 3.59 = 1.07$, as shown in the Table. In general, the Inventive Energy of IPC class G08C 17/02 (Arrangements for transmitting signals characterised by the use of a wireless electrical link; using a radio link) is highest among these top 10 IPC classes.



Key Findings

Due to its inherent simplicity and utilization of substantial information on published and granted patents, the present study on **the inventive energy** provides a de facto standard for enterprises active in the **smart lighting** to evaluate the front edge of technology in various applications of the **smart lighting**.

IPC class on the arrangements for transmitting signals characterized by the use of a wireless electrical link; using a radio link (G08C 17/02) has seen the tremendous inventive energy in the 2014-2017 Index. Other two prominent IPC classes on arrangements for broadcast applications with a direct linkage to broadcast information or to broadcast space-time (H04H 60/82), and protocols (H04L 29/06) have also been quite active among the smart lighting enthusiasts and R&D teams.

One of the findings from the present inventive energy study is that the patenting activity was higher in the smart lighting domain in the year 2014. Further, there is a decrease in the patent activity in the Circuit arrangements for electric light sources in general; Controlling which were higher in the year 2014-2016. The filing trend in the G08C 17/02 domain is relatively better than the other IPC.

Further, the reduction in Inventive Energy of G08C 17/02 from 2014 value of nearly 26.83 to the value of 6.31 in the year 2017, *indicates the trend of Patents grants has started in the period that typically brings down the Inventive Energy as it is a function of the ratio of applications published and a patent granted for the particular year.* Furthermore, the present inventive energy study identified that inventors are active in the lights which are fitted with a full complement of environmental sensors that automatically adapt the lighting to the needs of occupants in real time. Further, inventors are inventing to identify various mechanism to control the lighting units through a centralized network and software.

IPC classes with high Inventive Energy typically will have higher business potential and growth in the **smart lighting** technology. The Inventive Energy can be utilized to create the **smart lighting Inventive Strategy** to find problems in high inventive energy IPC classes. This can be a leading indicator for not only any startup or disruptor but also to existing patent owners to expand and strengthen their portfolio through this guidance rather than letting serendipity and opinion about future guide their inventive effort.

As the patent examiner not only evaluate the patentability of the corresponding technology but also assess the legal aspects of the filed patent application at various levels of scrutiny before granting the patent, therefore, patent grant trends identified by the present inventive energy study in the smart lighting technology will enable the decision maker with the due-diligence aspects of the smart lighting technology.

Any organization willing to invest in the smart lighting technology can utilize the invention energy metric in general and this study in particular, as it automatically takes care of three major inputs required to understand the state of the art of smart lighting technology – Patent Applications, Granted Patents and Specific IPC classes relevant to smart lighting technology in a composite metric.



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