EDISON

IQE

Strategy update

Photonics – the next growth wave

Tech hardware & equipment

IQE's ability to apply its epitaxial IP to multiple market segments enabled it to deliver strong profit growth during H116 as the business continues to diversify revenues. This diversification is set to continue, with technology innovations delivering strong growth in photonics applications and taking IQE into new segments such as the high-growth power electronics market. We see scope for further upward re-rating driven by continued growth in photonics sales.

Year end	Revenue (£m)	PBT* (£m)	EPS* (p)	DPS (p)	P/E (x)	Yield (%)
12/14	112.0	16.2	2.42	0.0	14.8	N/A
12/15	114.0	17.6	2.60	0.0	13.8	N/A
12/16e	122.0	19.0	2.73	0.0	13.1	N/A
12/17e	127.8	21.9	3.11	0.0	11.5	N/A

Note: *PBT and EPS are normalised, excluding intangible amortisation, exceptional items and share-based payments.

Diversification drives H116 growth

A key aspect of the H116 results is increased diversification. Non-wireless sales grew from 24% of total revenues in H115 to 31%, driven by strong growth in the photonics segment and modest growth in wireless. Non-wireless sales included a new revenue stream: licence income from JVs in the UK and Singapore. Group revenue rose by 18% to £63.0m and adjusted profit before tax by 71% to £10.1m.

Monetising IP

Our estimates (which are unchanged from our September update note) show continued investment in IP innovation delivering further growth. We assume that photonics revenues will continue to grow strongly, supported by innovative products for short-haul optical networks and a wide range of consumer applications. We assume that wireless revenues will continue to benefit from market share gains and new product developments. The acquisition of exclusive licensing rights for technology from Translucent gives a potential route to enter the lucrative filter market and regain share in the wireless switch segment, and accelerates IQE's entry into the power electronics market. It also secures IP in this high-growth segment. The formation of JVs in the UK and Singapore provide the first sources of licence income and create nuclei for compound semiconductor clusters in which IQE can commercialise early-stage academic research, taking novel materials from prototypes to high-volume production for industry partners. This activity also reduces IQE's wireless exposure.

Valuation: Diversification key to further re-rating

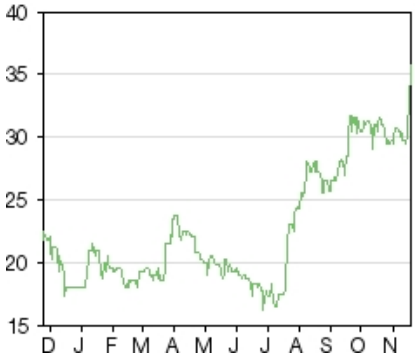
Although the share price has rallied from a low of 16.25p in June, IQE's rating still remains undemanding relative to its peers. Our indicative valuation range of 40-45p puts IQE on multiples that are close to the mean of our sample of listed peers. Further newsflow of photonics growth and stable wireless demand should help close the remaining valuation gap.

21 November 2016

Price	**35.75p**
Market cap	**£241m**

Net debt (£m) at end June 2016	33.6
Shares in issue	674.6m
Free float	88%
Code	IQE
Primary exchange	AIM
Secondary exchange	N/A

Share price performance



%	1m	3m	12m
Abs	15.3	27.7	55.4
Rel (local)	18.8	29.3	45.1
52-week high/low		35.8p	16.2p

Business description

IQE is the leading supplier of epitaxial compound semiconductor wafers globally. The principal applications include radio frequency semiconductors, devices for optical networks, vertical cavity lasers, infrared semiconductors, power electronics and CPV solar cells.

Next event

Prelims	March 2017

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Edison profile page

Investment summary

Leading epiwafer supplier across a number of verticals

IQE is the largest supplier of compound semiconductor epitaxy wafers globally and has the most comprehensive product offering. A significant majority of sales (69% in H116) are generated from the wireless segment, where the company's wafers are used to make radio frequency chips for use in mobile devices and mobile infrastructure. IQE has more than a 50% share of the wireless market and supplies all the major wireless chip manufacturers. It has reinvested some of the profits from supplying wireless epitaxy for the smartphone boom into creating a platform serving numerous industry verticals. Management sees this driving strong growth over a five- or six-year period. Most immediately, revenues from the photonics segment (17% of H116 revenues) are growing strongly, driven by rising market demand and new applications incorporating innovative technologies. Development work across a broad range of applications including touchless sensing, gesture recognition, non-invasive blood monitoring, CPV (concentrated photovoltaic) solar and power electronics is starting to reach maturity. In addition, IQE has begun to generate its first revenues from IP licencing.

Financials: Upside from new applications

Revenues increased by 18% year-on-year (£9.8m) during H116 to £63.0m. This resulted from modest growth in the wireless segment, strong growth in photonics and a contribution from licence income, (which started generating revenues in H215). Adjusted profit before tax rose by 71% (£4.2m) to £10.1m. Our estimates assume modest growth in wireless revenues, backed by market share gains, compound semiconductor hungry 4G handsets and deployment in new applications such as base stations (in partnership with MACOM). We assume that photonics revenues will continue to grow strongly, driven by rising underlying demand from data centre connectivity, consumer applications, industrial processing and fibre to the premises combined with a switch to outsourcing. We assume licence revenues will be lower in FY16 and FY17 because FY15 benefited from upfront fees, while we model only recurring revenues during FY16 and FY17. We note the potential for stronger growth associated with the deployment of infrared sensors in consumer applications, the adoption of gallium nitride on silicon (GaN-on-Si) in power electronics and volume roll-out of CPV technology.

Valuation: Rating remains undemanding despite recent rally

Although the share price has rallied from a low of 16.25p in June, IQE's rating still remains undemanding relative to its peers. As the reasons why investors have historically applied a discount have been removed (see pages 13-14 for detailed discussion), the share price has responded positively. Our analysis of peer multiples indicates that there is still some way to go before IQE is trading on similar multiples to its listed peers. Our indicative valuation range of 40-45p puts IQE on multiples that are close to the mean of our sample of listed peers. Further newsflow of photonics growth and stable wireless demand should help close the remaining valuation gap.

Sensitivities: Wireless exposure vs growth from other segments

While the growth in photonics has substantially diversified the business, 69% of H116 sales were attributable to the wireless segment. IQE's financial performance remains heavily influenced by the health and inventory cycle of the handset industry. The timing and rate of revenue growth from emerging technologies is difficult to gauge. Sales and earnings are also exposed to changes in the US dollar/sterling exchange rate. The impact is largely translational, with some transactional exposure.

Company description: Leading epitaxial wafer supplier

IQE is the largest outsourced supplier of compound semiconductor epitaxy wafers globally. It has the most comprehensive product offer, which encompasses over 100 patents and a rich pool of trade secrets. IQE takes very thin discs of compound semiconductor material up to 150mm in diameter (wafers) and deposits successive thin "epitaxial" layers, each containing different combinations of semiconductors on them. By controlling exactly the thickness and composition of each of the layers deposited on the substrate, IQE is able to provide customised wafers that meet each customer's precisely defined electrical and optical requirements. These epitaxy wafers are used by manufacturers of wireless chips and optical devices such as laser chips, which carry out further processing steps to create finished devices.

IQE has reached this dominant position with respect to both market share and breadth of product offer through a combination of organic development and acquisition (see Exhibit 1). It has facilities in Europe, the US and Asia, giving it a presence in all three major semiconductor manufacturing regions. IQE employs over 500 people and is headquartered in Cardiff, Wales.

Exhibit 1: Corporate and technological evolution

1988	Compound semiconductor epitaxial foundry established in Cardiff, co-founder Dr Drew Nelson, current CEO.
1999	IQE formed through the merger of two leading compound semiconductor epitaxial wafer foundries, one in Bethlehem, Pennsylvania, the other in Cardiff, UK. IPO and listing on NASDAQ Europe.
2000	Acquisition of Milton Keynes-based Wafer Technology for £41.3m. Wafer Technology manufactures the pure crystalline substrates that are used as the starting materials for manufacturing epitaxial wafers. Establishment of IQE Silicon, a separate facility on the Cardiff site, to develop advanced epitaxial structures based on silicon materials. Admission to LSE Full List. Placing raising £43m.
2001	Placing raising £20.4m (gross) at 15.5p/share (adjusted for share split).
2003	Placing raising £18.75m (gross) at 15p/share. Transfer to AIM.
2006	Acquisition of Emcore's Electronic Materials Division in New Jersey for $16m. Placing raising £12m (gross) at 13.75p/share. Acquisition of MBE in Singapore for $15m. Placing raising £4.5m (gross) at 18p/share.
2008	Relocation of Singapore operation to give capacity for new products.
2009	Introduction of Germanium on Insulator product. Acquisition of NanoGaN, which has critical IP for manufacturing free-standing gallium nitride substrates used in high-quality blue and green semiconductor lasers and ultra-high brightness LEDs.
2010	Acquisition of Galaxy Compound Semiconductors, a specialist manufacturer of antimony substrates used in infrared technology, for up to $14.15m in cash. Placing raising £20.8m at 32p/share.
2011	Introduction of customisable SOI for MEMs and sensor applications.
2012	$5m invested in a 9% equity stake in Solar Junction (SJC) to obtain exclusive rights to supply SJC with high-efficiency, advanced concentrated photovoltaic (CPV) wafers through a long-term supply agreement. Placing raising £10.5m (gross) at 24p/share. Acquisition of in-house RFMD's epiwafer manufacturing unit and exclusive agreement to supply RFMD's MBE wafers and the majority of its MOCVD wafer requirements for a seven-year period. Consideration funded through future wafer discounts. This strengthened market share.
2013	Acquisition of compound semiconductor epiwafer manufacturing business of Kopin Corporation to gain market share. Total consideration of $75m. Placing raising £16.5m (gross) at 29p/share. CPV materials qualified for high-volume manufacturing by SJC. Record CPV cell efficiencies reported.
2014	MoU with WIN Semiconductors Corp and Nanyang Technological University to form a centre of excellence for the development of compound semiconductor technology in Singapore. IQE to contribute its Singapore facility and equipment and IP.
2015	Establishment of JV with Cardiff University to lead the development and commercialisation of compound semiconductor technologies in Europe. IQE to contribute £12m of equipment, university £12m cash. Exclusive licence and option to acquire Translucent's rare earth oxide semiconductor technology used in the manufacture of compound semiconductor on silicon products, including GaN-on-Si for the power switching and RF technologies markets.
2016	IQE and Cardiff University to spearhead £50m UK compound semiconductor Catapult centre. Successful transfer of cREO technology to IQE's North Carolina facility.

Source: Edison Investment Research

Since its formation in 1999, the majority of IQE's revenues have been derived from the wireless market. Refinements to the basic technology are driving strong growth in the photonics sector and taking IQE into new application areas such as touchless sensing, gesture recognition, non-invasive blood monitoring, CPV solar and power electronics. However, continued growth of the wireless

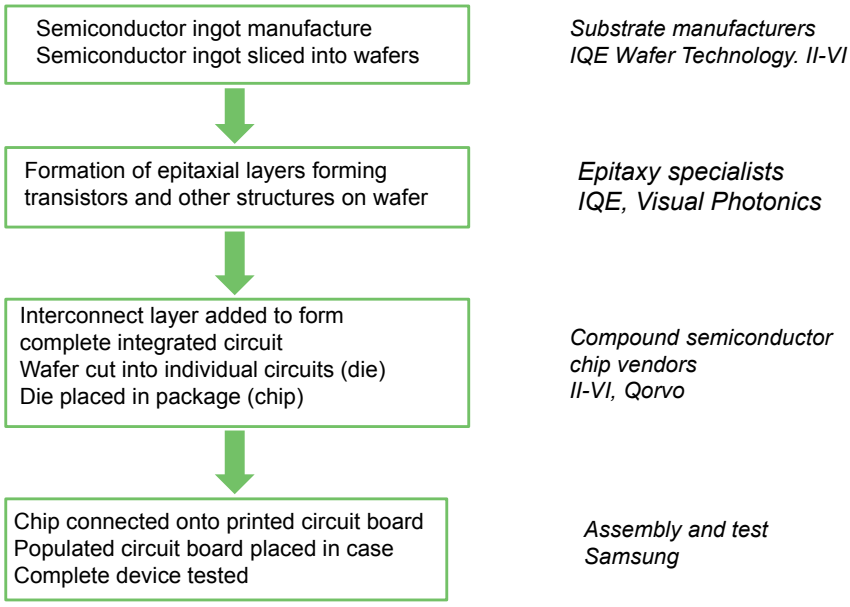
market itself and capture of share within it means that while the proportion of revenues derived from this segment has reduced (see Exhibit 4), it is still dominant. We expect the proportion of revenues from non-wireless applications to increase further. For example, the formation of JVs in the UK and Singapore delivered the first revenue from licencing IP during FY15. The JVs also form the nuclei of compound semiconductor clusters in which IQE can commercialise the JVs' academic research, taking novel materials from prototypes to high-volume production for industry partners. The JV formed with Cardiff University in July 2015 is to spearhead a new £150m UK National Catapult centre to develop and build next-generation compound semiconductors, in effect creating a national and European centre of excellence in South Wales.

Technology

Epitaxy: A key step in compound semiconductor manufacturing

A closer look at the epitaxial process

Exhibit 2: Compound semiconductor supply chain



Source: Edison Investment Research

IQE's epitaxial manufacturing service is a critical stage of the compound semiconductor supply chain. Its compound semiconductor epitaxial wafer foundries take very thin discs of substrate (compound semiconductor, sapphire or silicon) and deposit a succession of thin layers on them. Up to 300 epitaxial layers may be deposited, each of which may be only a few atoms thick. Each separate epitaxial layer contains a different combination of elements to give specific electrical or optical properties. By precisely controlling the thickness and composition of the layers deposited on the substrate, IQE provides customised epiwafers that meet each customer's specific electrical and optical requirements. The finished epiwafers are sold to manufacturers of high-frequency chipsets and laser chips, which carry out further processing steps to create finished devices.

Epitaxy – an ideal stage for outsourcing

Compound semiconductor processing remains a highly specialised field. Semiconductor processing facilities or foundries manufacturing silicon integrated circuits do not have the requisite experience or IP. Until 15 years ago, compound semiconductor chip vendors carried out the epitaxy stage in house, but many have opted to outsource the process, freeing up capital for elsewhere in the

business and gaining access to a wider range of technologies. For example, in 2012 RFMD (now part of Qorvo) sold its in-house epitaxy operation to IQE. In 2005 only 20% of compound semiconductor epitaxial wafer manufacture was outsourced; the figure is now over 50%.

Competitive position

Market consolidation means the number of independent compound semiconductor wafer manufacturers worldwide is decreasing. For example, IQE acquired Kopin's epitaxy activity in 2013 and in February 2015 Sumitomo Chemical acquired Hitachi Metals. In February 2016 semiconductor laser specialist II-VI acquired EpiWorks and in March 2016 Chinese LED manufacturer Sanan Optoelectronics announced its intention to acquire compound semiconductor foundry Global Communication Semiconductors, though the merger agreement was terminated in August. IQE now has the largest share, with over 50% of the non-captive wireless wafer market, an increase from the estimated 10% it held in 2005. The range of product and material processing capabilities it offers is probably the widest in the sector. This capability, together with the ability to offer internal dual sourcing from within the group, has made IQE the market leader.

The importance of compound semiconductors

Exhibit 3: Key properties of compound semiconductors by application

Reporting segment	Wireless			Photonics					Advanced materials
Property/ application	Mobile RF	RF infrastructure	M2M comms	Solar power (CPV)	Optoelectro-nics/VCSEL	Power electronics	Lighting	Thermal/IR sensors	
Higher operating speeds	✓✓	✓✓✓	✓		✓✓✓	✓✓			✓✓✓
Lower power consumption	✓✓✓	✓	✓✓✓	✓✓✓	✓✓	✓✓✓	✓✓✓		✓✓
Reduced noise and distortion	✓✓✓	✓✓✓	✓✓		✓✓✓				✓✓
Light-emitting and detecting properties		✓✓✓✓		✓✓✓✓	✓✓✓✓		✓✓✓✓	✓✓✓✓	✓✓
Incumbent technology	GaAs SOI	GaN	N/A	Silicon	GaAs, InGaP	Silicon	Non-LED-CFL, incandescent LED – SiC, Sapphire	Antimonides	Various, but predominantly silicon
Emerging technologies	Silicon/ silicon on insulator InGaP	GaN	Various (depending on requirements)	CPV solar (multiple layers of different compounds)	GaN	GaN-on-Si GaN-on-SiC	GaN on silicon	Antimonides	GaN, GaAs, various others depending on application

Source: Edison Investment Research

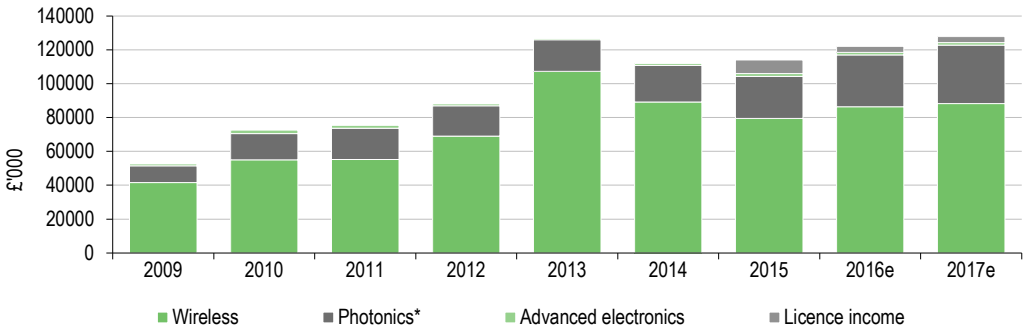
Compound semiconductors are key enabling materials in a wide range of electronic and optoelectronic systems. Compound semiconductors are necessary for these applications because, unlike silicon, which is a single element semiconductor and therefore has a fixed set of electronic characteristics, compound semiconductors are made from a mixture of elements. By combining elements (gallium, arsenic, indium, phosphorus and aluminium) in different proportions, engineers can make materials with a diverse range of optoelectronic and electronic properties.

Markets: Diversification initiatives bearing fruit

While wireless remains IQE's largest segment (69% of H116 revenues), the company's longstanding initiatives to drive diversified growth are now starting to bear fruit, with the photonics segment growing 45% year-on-year in H116 and contributing 17% of overall sales. In the same way that IQE was a significant beneficiary of the stellar growth in the mobile phone industry in the past, it is likely to benefit in the future from strong growth for photonics devices. Moreover, since the

range of applications within photonics is diverse, encompassing high-speed communications and numerous precision sensing applications, demand is likely to be less volatile than the wireless market, which is dominated by handsets. In the near term, top line performance will be dominated by prospects in wireless and photonics, but successful execution in power electronics could trigger a third wave of significant growth. IQE has also started to generate revenues from IP licensing. This strategy has proved successful, delivering revenue and profits growth during FY15 despite weakness in the wireless sector. In the longer term, this may open up opportunities in markets such as LED lighting where very high volumes of material are required.

Exhibit 4: Analysis of revenues by business segment



Source: IQE, Edison Investment Research. Note: *Including Infrared.

Wireless communications (69% H116 revenues)

Compound semiconductor material key enabler

Compound semiconductors allow electrons to travel much more quickly in them than in bulk silicon and can handle higher-voltage gradients before breaking down. This enables the creation of much higher-frequency, lower noise and more power-efficient electronic systems, which is important for mobile, satellite and wireless communications applications. In a mobile phone, the memory and data processing chips will be silicon, but the transmit and receive functions will typically be gallium arsenide (GaAs), particularly for higher-specification handsets. This is because GaAs power amplifiers are more efficient than their silicon counterparts and thus provide longer battery time.

Demand for compound semiconductors in wireless applications

According to Strategy Analytics, wireless applications currently account for slightly less than 80% of all GaAs device sales, while cellular terminals account for more than 50%. Consequently, while IQE was a significant beneficiary of the growth in the handset industry, its top line performance has fallen back since the peak in 2013. Overall growth prospects for the wireless GaAs wafer market are complicated by the fact that there are a number of contrasting structural factors at play: the size of the handset market; evolution of more complex smartphones; inventory cycles; price erosion; and chips getting smaller. IQE's newer GaN-on-Si technology opens up complementary wireless markets including base stations, reducing its dependence on handsets.

Smartphone complexity and handset market size

In June 2016, market analysts Gartner predicted that worldwide smartphone sales growth would slow to 7% in 2016 (1.5bn units), down from 14.4% in 2015, with a CAGR of 6% between 2016 and 2020. However, the shift to higher-specification handsets requiring greater bandwidths and support for multiple bandwidth and standards will result in a higher average value of RF components per phone year-on-year (see Exhibit 5). This means that the RF market is likely to grow more quickly than the smartphone market. While we caution against making a direct link from RF market

statistics to IQE's prospects by noting that the RF market includes SOI and silicon devices as well as compound semiconductor devices, data published in January 2016 by market research company The Information Network stated that the GaAs IC (Integrated Circuit) market grew by 25% during 2015 on smartphone and the Internet of Things (IoT) momentum. In August 2016 TechNavio, a technology research and advisory company, forecast that the GaAs wafer market would grow at a CAGR close to 13% between 2016 and 2020.

Exhibit 5: Average RF content/handset

	Typical 2G	Typical 3G	Regional LTE	Global LTE
Filter content	$0.25	$1.25	$4.00	$7.25
Switching/tuning	$0.00	$0.25	$1.50	$2.25
Power amplifiers	$0.30	$1.25	$2.00	$3.25
Other	$0.00	$0.00	$0.50	$0.50
Total RF content	$0.55	$2.75	$8.00	$13.25

Source: IQE

Threat of SOI power amplifiers has gone away

In order to reduce the bill-of-materials cost of mobile devices, handset manufacturers have investigated implementing the power amplifiers on SOI and integrating them with other elements of the RF front end such as the amplifier controller, which historically have been implemented in silicon. For several years most GSM (2G) phones have been using silicon-based power amplifiers but this cheaper material was not suitable for 3G and 4G signals. In February 2013 Qualcomm caused a stir by announcing two SOI power amplifiers for LTE (4G) phones. While some industry pundits claimed that this product introduction showed that SOI would swiftly displace compound semiconductors, causing a collapse in the share price of compound semiconductor stocks including IQE, this gloomy prediction has not been fulfilled. Even Qualcomm now recognises that SOI technology has its limitations. When announcing the formation of a JV with TDK in January 2016, Qualcomm disclosed that it was developing both SOI and GaAs power amplifiers and it has been actively recruiting compound semiconductor experts. Given that the two technologies are likely to continue to co-exist, the important question for IQE is the probable market share for each technology, which determines potential GaAs growth. GaAs's advantages of performance/power efficiency remain pertinent, especially as phone networks shift to higher frequencies in search of spectrum availability and battery life limitations remain an issue. A report from Strategy Analytics, published in October 2015, stated that despite headwinds from competitive technologies, ie SOI, and price erosion it still expected the GaAs RF device market to grow from an estimated $7bn in 2015 to peak at $8bn in 2018.

GaN-on-Si technology may enable IQE to take share in filter and switch markets

The exclusive agreement to licence Translucent's cREO technology (page 10) puts IQE back on the offensive by providing a potential route to recapture share in the handset antenna switch segment, which has transitioned largely to SOI over the past few years, and to take share in the filter segment. Exhibit 5 shows that the wireless switch, filter and power amplifier markets combined are collectively three to four times the size of the market for wireless power amplifier chips alone. Management note that this technology is at the development phase with a two- to three-year time horizon.

The inventory cycle

Visibility of underlying demand is obscured by the frequent but irregular inventory build-ups and then correction cycles experienced by customers. There was significant destocking during FY15, which does not appear to have continued into H116.

Segmental performance

IQE is currently the dominant supplier globally with over 50% market share. Following the acquisition of Kopin and RFMD's in-house epitaxy operations, IQE now provides epitaxy services to all the major RF chip suppliers. This reduces its exposure to market share swings, which had previously resulted in revenue volatility.

IQE's wireless revenues increased by 7% year-on-year during H116 to £43.2m, which is in line with management's estimates of mid-single-digit market growth. The destocking that characterised H215 has stopped. Our estimates model H2 sectoral sales at similar levels to H116 (IQE no longer feels that the 45/55 H1/H2 split is valid). This is underpinned by the renewal of a long-term supply contract with a premier Tier 1 customer for epiwafer products including power amplifiers, low-noise amplifiers and switches that management estimate will contribute over $55m in revenues in FY16. In addition, IQE is winning a higher proportion of clients' business and securing business related to new products such GaN on Si devices for base stations (with MACOM). These programme wins are supported by continuous improvements in technical performance.

Based on the Strategy Analytics report discussed earlier, we assume 2% growth in wireless revenues in FY17. This excludes any upside from roll-out of the cREO technology to recapture share in the switch segment.

Photonics (17% H116 revenues)

Compound semiconductors exhibit properties that convert light to electricity and electricity to light extremely efficiently. IQE has developed a range of epitaxial wafers based on two key technologies: vertical cavity surface emitting laser (VCSEL), which is used in data communications, consumer and industrial applications; and indium phosphide (InP), which is used in fibre to the premises (FTTP) and other short-haul optical networks.

VCSELs – the new era of laser technology

VCSELs can modulate signals at frequencies up to and exceeding 25Gbps, so are ideal for high-speed communications and precision sensing applications. They provide reliable operation at distances ranging from close proximity links (centimetres) up to 500m in data centre, enterprise and campus networks. Unlike light-emitting diodes (LEDs), which emit light from the top and sides, and edge-emitting lasers, which emit light from the side of the chip once it has been cut, VCSELs emit a beam of light at right angles to the top of the chip. This means it is possible to test the optical properties of an individual device before the wafer has been cut up and packed into individual devices, thus improving yield. Additionally, IQE is the first company to have a process for producing 6" diameter VCSEL wafers. Having a higher diameter means that more devices can be manufactured at the same time, substantially reducing cost/device. These two factors significantly reduce the cost of production, potentially enabling arrays of VCSELs to be deployed in consumer electronics devices (including gaming devices, smartphones and tablets) for laser focusing, 3D imaging, proximity sensing and gesture recognition. The reduced cost also means that it is possible to create a two-dimensional array consisting of hundreds of individual sources that collectively output a high power beam tuned to a specific frequency. This has applications in industrial illumination, 3D printing, drying and curing plastics and sintering metals. IQE is currently engaged directly with a number of OEMs (as opposed to the more common chip/component vendor relationship) on projects relating to high-volume end-markets.

InP – at the heart of fibre optic communications

Telecommunications companies are increasingly deploying passive optical networks (PONs) to deliver triple-play services including TV, voice over IP (VoIP) phone and internet service to subscribers. These networks are also referred to as FFTH (fibre to the home), FFTP (fibre to the

premises) or FTTC (fibre to the curb) networks. These optical networks can deliver the much higher data rates that are essential for distribution of video and other internet services. IQE has developed a novel technique for manufacturing distributed feedback (DFB) lasers used in these short-haul (up to 20km) networks. IQE has developed a proprietary technology that has enabled it to take on InP projects that previously customers had to manufacture themselves.

Segmental performance

IQE is currently the dominant outsource provider of epitaxy for photonics applications. This position was recognised in FY15 when IQE was appointed as key partner in a new consortium to establish the US's first Integrated Photonics Institute for Manufacturing Innovation, providing advanced epitaxy services to the 55 industrial partners.

IQE's photonics revenues grew by 45% during H116 to £10.7m. The company is benefiting from underlying market growth and by component vendors transitioning from a vertically integrated business model towards outsourcing wafer supply from IQE. Around half of the revenues were from VCSELs, the other half InP epitaxy. Our estimates model H2 sectoral sales at similar levels to H116. In August 2016 industry analysts Grand View Research predicted that the global photonics market would grow from over $600bn in 2015 to c $980bn by 2024. Given the market outlook and strong pipeline, we model a 17% increase during FY17, which may be revised upwards as development programmes convert to volume deliveries. Wafer prices for photonic applications are an order of magnitude higher than for wireless applications, giving a highly beneficial impact on margins.

Compound semiconductors for infrared sensing (7% H116 revenues)

Compound semiconductors containing antimonides are used to manufacture emitters and detectors of light in the infrared part of the spectrum. Historically, this has been a high-margin business focused on defence applications such as night vision equipment. IQE is able to produce the industry's first 6" indium antimonide wafers. The move to larger diameter wafers improves the economics of production. This permits the deployment of infrared chips in high-volume applications such as the measurement of environmental pollutants from industrial processes and automotive engines; non-invasive devices to monitor levels of oxygen, sugar or alcohol in the bloodstream; stand-off detection of explosives and biological threats; and specialised free space communication systems. In April 2016 IQE announced that it had joined a new consortium to create an end-to-end supply chain for a wide range of analytical micro-sensors based on the ability to emit and detect light in the mid-infrared part of the spectrum. The European Commission and the Swiss government are collectively investing €15m in the programme. IQE's role will be to provide consortium partners and commercial customers with a volume source of epitaxial wafers.

Segmental performance

Following the acquisition of Galaxy Compound Semiconductors in 2010, IQE is the largest supplier of infrared epitaxy globally, with almost an 80% market share. Sectoral revenues grew by 2% year-on-year during H116 to £4.7m. Our estimates model a modest 3% rise in sectoral sales during FY17. We believe faster FY17 growth is achievable given the potential expansion into consumer applications.

Compound semiconductors for solar power

CPV (concentrated photovoltaic) solar cells use lenses or mirrors to concentrate light up to 1,000x onto a small area of semiconductor material. Compound semiconductor material is able to withstand the high temperatures involved better than silicon. Moreover, it is possible to tailor the

compound semiconductor material to have multiple layers of different semiconductors, each tuned to absorb a different frequency of light and convert it to electricity. This means that a higher proportion of the incident light energy is converted to power than with conventional silicon-based solar cells.

Shift in focus to space applications

IQE and its partner, Solar Junction, are currently focused on space applications of compound semiconductor technology. For these applications the weight constraints imposed by needing to launch satellites into orbit are more important than the relative economics of deploying compound semiconductor PV (more efficient but more expensive) versus conventional solar cells, which determine terrestrial deployments. The greater efficiency of compound semiconductor PV cells gives more power, and thus more capacity for data-transmission for the same weight payload. A leading satellite manufacturer is currently qualifying Solar Junction's compound semiconductor PV modules to power satellites. We note that smartphone vendor Kyocera has demonstrated smartphones with integrated solar panels to extend time between battery charges. This application, where efficiency is paramount, may be a potential application area for compound semiconductor PV technology.

Potential for terrestrial applications in the longer term

The partnership with Solar Junction is still being targeted to generate revenues from terrestrial applications in the longer term. Solar Junction was acquired by Taqnia, an investment vehicle of the Saudi government, in 2014. The technology is of interest to the Saudi government because low oil prices have caused a $120bn budget deficit (22% of GDP). Currently, a significant proportion of domestically produced oil is used in power generation, a proportion that is expected to increase as the kingdom industrialises to reduce its dependence on oil. Widespread utility-scale deployment of solar power would release oil for export and reduce diesel imports, which are subsidised by the government. Volume deployment of Solar Junction's CPV modules in Saudi Arabia would fulfil several of the aims of the Saudi government's Vision 2030 Programme: reducing oil subsidies; reducing environmental pollution; participating in emerging technologies; and improving employment opportunities.

Segmental performance

Revenues from this sector were not material in H116, though ongoing development activities encourage management to expect good commercial progress in the next one to two years. Until IQE begins to ship meaningful volumes of the material, we will treat revenues from this sector as upside to our estimates.

Compound semiconductors for power electronics

Gallium nitride (GaN) compound semiconductor material is used for making power electronics chips because it can withstand higher voltages than silicon and is better at removing waste heat energy. Electric vehicles require high-performance power devices for their advanced power control systems, as do driverless vehicles for their highly complex sensor systems. However, GaN wafers are too expensive to be viable as a substrate material. In addition, it is currently not possible to manufacture compound semiconductor wafers with as large a diameter as silicon wafers. This means that fewer devices can be accommodated on each compound semiconductor wafer compared with a silicon wafer and that it is not possible to use efficient state-of-the-art silicon wafer handling equipment for compound semiconductor manufacturing, further increasing the relative cost compared with silicon. IQE is pioneering techniques that combine the cost-effectiveness of silicon with the enhanced properties of compound semiconductors by layering the compound semiconductor material on top of the silicon. This is not a trivial undertaking because the two

materials have different crystalline lattice structures. In the absence of any intervention, the compound semiconductor layer is full of defects that degrade its electrical properties.

IQE began its development of compound semiconductor on silicon substrate in 2000, when it established the IQE silicon facility in Cardiff. The acquisition of NanoGaN in 2009 brought additional IP. In September 2015 IQE accelerated its development activity in this segment by acquiring exclusive rights to Translucent's patented cREO (crystalline Rare Earth Oxide) technology. (Translucent is a subsidiary of ASX-listed Silex Systems.) This technique creates a buffer layer enabling GaN and other compound semiconductors to be deposited on silicon substrates in such a way that their electrical properties are not compromised. As discussed earlier, IQE intends to use this technology to recapture share in the wireless switch segment, as well as to strengthen its presence in the power electronics market. The technology has potential in all of IQE's other key markets as well. A major milestone towards commercialising the material was reached in May 2016, when IQE announced that it had successfully transferred the cREO technology to its facility in North Carolina. The same month, IQE also announced a strategic partnership with imec, a world-leading nanoelectronics research centre, to continue the development of GaN-on-Si power devices.

Importantly, Translucent has 74 granted patents and 13 pending patents. The agreement not only accelerates IQE's existing development programmes, but also secures IP rights, reducing the risk of IP disputes in the future.

Segmental performance

Revenues attributable to the power semiconductor market are not material at present and are included in advanced electronics (CMOS++) revenues. Until IQE begins to ship meaningful volumes of the material, which management estimates is two to three years off, we will treat revenues from this sector as upside to our estimates. The GaN market is very attractive for IQE as it represents one of the largest growth opportunities for compound semiconductors. Market analyst Yole Développement has estimated the GaN power semiconductor device market to be worth around $10m in 2015 (note: the wafer market will be smaller), but forecasts that this will grow at an estimated 93% CAGR through 2016-20 to reach more than $300m in its baseline scenario. Infineon's acquisition in July 2016 of Cree's Power and RF and silicon carbide substrate businesses with the intention of extending its portfolio to include more efficient power electronics/power management devices for IoT applications as well as higher frequency RF devices emphasises the importance of compound semiconductors for delivering competitive advantage in this sector.

Compound semiconductors for advanced electronics (1% H116 revenues)

Together with a number of partners (including Intel), IQE's CMOS++ (compound materials on silicon) business is developing technologies for creating hybrid integrated chips with areas of compound semiconductor material and traditional CMOS on a common silicon substrate. This would enable the creation of highly integrated devices combining a power amplifier in compound semiconductor with a filter and switch stack in CMOS. These developments are still in the research phase, although the Translucent acquisition has given the programme a substantial boost. Management expects this novel technology to deliver significant revenues over the next three to five years.

Licence income (6% H116 revenues)

Licence income, which totalled £3.5m in H116 (H115: nil), is a new revenue stream for IQE. At present it is generated from two JVs. The JV in Singapore is with WIN Semiconductors and Nanyang Technological University. The JV in Wales was formed in July 2015 with Cardiff University. Revenues are expected to be relatively lumpy. We expect FY16 licence revenues, which only

include recurring elements, to be lower than FY15 revenues (£8.0m), which include upfront elements as well. We model FY17 licence income at FY16 levels. This additional revenue stream is likely to become more significant in the longer term if IQE's technology is deployed in volume applications such as general-purpose LED lighting and solar power. The Translucent deal significantly boosts IQE's ability to benefit from licensing fees because it gives access to an extensive patent portfolio, helping establish IQE's rights to generate revenue from its IP.

Sensitivities

- **Wireless exposure:** with 69% of H116 sales coming from wireless, IQE's financial performance remains exposed to changes in dynamics within this segment. With blanket coverage of the main RF chip suppliers, exposure to OEM and chip vendor market share swings have now been largely mitigated, but sales are heavily influenced by the health of the handset industry, inventory cycles and the extent to which GaAs is used in front-end wireless chip designs.
- **Uncertainties in markets that are still not yet developed:** IQE has opportunities in many end-markets: power electronics, touchless sensing, chip-to-chip interconnect and gesture recognition, CPV, environmental monitoring and non-invasive blood monitoring. If each of these opportunities is successful and GaAs retains market share in wireless, there could be significant upside to revenue, but the timing and rate at which revenues from these applications could grow is difficult to gauge.
- **Currency:** IQE's presentational currency is sterling, but the company earns the large majority of revenues in US dollars. Translational risk is therefore unavoidable. Transactional risk is reduced, where possible, through matching input costs with revenues, although a proportion of costs are in sterling. Debt is denominated in dollars.

Group financials

Diversification drives earnings growth

Revenues increased by 18% year-on-year (£9.8m) during H116 to £63.0m. This resulted from modest growth in the wireless segment, strong growth in photonics and a contribution from licence income, which did not start generating revenues until H215. Adjusted gross margins rose by 4.2bp to 28.4%, reflecting a higher proportion of photonics revenues and licence income. Adjusted sales, general and administrative expenses grew by 17.0%, as management strengthened the engineering resource to provide capacity to support the anticipated growth in photonics and allocated labour to repurpose existing equipment for anticipated photonics production. In addition, while work on early-stage projects for customers yields a relatively high gross margin, it results in low utilisation rates because the equipment is used for very low volume runs. Adjusted profit before tax rose by 71% to £10.1m.

Our profitability model is based on a 50%+ contribution margin from product sales. This is different to gross margin because reported cost of goods includes both fixed and variable costs. The contribution margin varies depending on product mix, so we model it as increasing slightly during the forecast period to reflect the higher-margin photonics business. We model 7% total revenue growth in FY16 on the back of the recovery in wireless, which we expect to be partly offset by the absence of upfront licence fees that benefited FY15. The 5% revenue growth estimated for FY17 is primarily attributable to continued strong growth in photonics. We note the potential for stronger growth associated with the deployment of infrared sensors in consumer applications, penetration of

the power electronics market and volume roll-out of CPV solar technology. The H116 results show that IQE is in good shape to achieve the revenue and profit growth shown in our estimates.

Exhibit 6: Functional P&L model

Revenue by business segment (£000s)	2014	2015	2016e	2017e
Wireless revenues	89,110	79,482	86,456	86,185
Photonics revenues	12,485	15,985	21,410	25,157
Infrared revenues	9,276	8,878	9,118	9,392
CMOS++ revenues	1,140	1,655	1,542	1,588
Licence revenues	-	8,024	3,517	3,517
Group revenue	**112,011**	**114,024**	**122,043**	**127,836**
Variable costs	(56,006)	(57,012)	(59,801)	(61,361)
Variable profit	56,006	57,012	62,242	66,475
Variable margin	50.0%	50.0%	51.0%	52.0%
Fixed costs	(28,997)	(28,011)	(31,073)	(32,006)
Normalised EBITDA	**27,009**	**29,001**	**31,169**	**34,469**
EBITDA Margin	24.1%	25.4%	25.5%	27.0%
Depreciation and amortisation of internally generated intangibles	(9,391)	(10,024)	(10,800)	(11,600)
Adjusted EBIT	**17,618**	**18,977**	**20,369**	**22,869**

Source: IQE data, Edison Investment Research

Stronger cash generation and balance sheet

The improved profitability in H116, combined with a further reduction in the ongoing wafer discounts given to Qorvo (the merged RFMD/TriQuint entity), as deferred consideration for the RFMD epitaxy business, resulted in much stronger adjusted cash generation at the operating level (£13.0m vs £5.3m in H115). However, IQE still consumed cash during H116. Net debt increased by £10.4m to £33.6m (19.5% gearing). The main causes of this were: £10.7m final tranche of deferred consideration for Kopin; £2.8m capitalised development expenditure (higher than £2.1m in H115 because of the levels of photonic and other development activity); and £4.3m capex (£1.3m H115) as IQE invested in equipment modifications ahead of the anticipated ramp-up in photonics volumes.

Our estimates show net debt decreasing slightly during H216 to £30.5m at end FY16 (before the impact of any foreign currency retranslation). After FY16 the balance sheet will no longer be encumbered by any deferred consideration (£1.7m end June 2016). Cash conversion will improve as the last wafer discounts (estimated £5.5m payment in FY16) will be paid in H216. Following a long period of investment, capex, capitalised development costs and investment in other intangible fixed assets (£9.5m total) are expected to be less than D&A (£11.6m), so we estimate that the cash generated from operations will reduce net debt levels to £10.1m (6% gearing) at end FY17.

Valuation

Peer multiples

Although the share price has rallied from a low of 16.25p in June, IQE's rating still remains undemanding relative to its peers. We believe that a number of factors have contributed to this discount historically. These have included uncertainty over both the prospects for the wireless business and the timing and rate at which revenues in new non-wireless fields would grow. The company's net debt and deferred consideration liability, and the suppressing effect on cash flows of the RFMD wafer discounts, have probably had an impact as well.

With regards to concerns about the wireless market, the interim results show that the destocking that bedevilled H215 is over and the market is growing again, albeit at a modest rate compared with five or six years ago. In addition, reliance on the wireless sector is reducing because of strong growth in photonics revenues and the creation of a new revenue stream from licence income. The announcement in the interims of another six months of strong growth in photonics gives

reassurance that the contribution from this sector is here to stay. While there remains considerable uncertainty as to just how large revenues from this sector could become, our estimates treat the substantial growth that may result from existing photonics development programmes converting to volume deliveries as upside. As revenues from volume photonics projects, as well as material revenues from power electronics or advanced solar are excluded from our estimates, there is no reason to apply a discounted multiple to reflect downside risk to earnings from these sectors.

Examining the potential cash flow and balance sheet concerns, both of these disappear during H216. The RFMD wafer discount finishes in H216, improving cash conversion. The deferred consideration balance was eliminated in full by the end of September 2016.

As the reasons why investors have historically applied a discount have been removed, the share price has responded positively. However, our analysis of peer multiples indicates that there is still some way to go before IQE is trading on similar multiples to its listed peers. Our indicative valuation range of 40-45p puts IQE on multiples that are close to the mean of our sample. Further newsflow confirming photonics growth and stable wireless demand should help close the remaining valuation gap.

Exhibit 7: Multiples of listed peers

Company	Market cap	Current EV/S	Next EV/S	Current EV/ EBITDA	Next EV/ EBITDA	Current P/E	Next P/E
Epitaxy							
Visual Photonics Epitaxy Co Ltd	£203m	2.6x	2.8x	7.8x	7.0x	13.9x	14.2x
IntelliEPI Inc	£62m	2.3x	2.0x	10.5x	8.1x	18.9x	15.2x
Land Mark Optoelectronics Corp	£554m	8.7x	7.6x	14.0x	11.6x	21.1x	18.8x
SOITEC	£496m	3.0x	2.7x	19.1x	15.3x	55.9x	31.7x
Wireless							
Broadcom Ltd	£53,347m	5.2x	4.2x	11.5x	8.9x	14.8x	12.5x
Qorvo Inc	£5,559m	2.4x	2.2x	7.3x	6.5x	11.8x	9.5x
Skyworks Solutions Inc	£11,418m	3.7x	3.4x	8.5x	7.6x	12.3x	10.8x
Opto-electronics							
II-VI Inc	£1,447m	2.0x	1.8x	10.9x	9.3x	26.4x	19.7x
EMCORE Corp	£139m	0.7x	0.6x	9.9x	5.5x	42.1x	20.3x
Mean		**2.7x**	**2.5x**	**10.0x**	**8.9x**	**17.0x**	**15.1x**
IQE PLC at 31.0p/share FY15 debt	£209m	1.9x	1.8x	7.5x	6.7x	11.4x	10.0x
IQE PLC at 40p/share FY16e debt	£270m	2.5x	2.3x	9.6x	8.7x	14.7x	12.9x
IQE PLC at 45p/share FY16e debt	£304m	2.7x	2.6x	10.7x	9.7x	16.5x	14.5x

Source: Bloomberg, Edison Investment Research. Note: Prices at 17 November 2016. Grey shading indicates exclusion from mean.

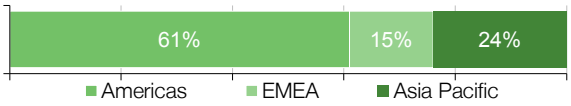
Exit multiples

For another approach to valuation we consider the prices paid to acquire peers. In calendar Q116 semiconductor laser specialist II-VI purchased IQE's smaller competitor EpiWorks for 3.5x CY15 revenues (including deferred consideration). In March 2016 Chinese LED manufacturer Sanan Optoelectronics announced its intention to acquire compound semiconductor foundry Global Communication Semiconductors for 4.5x historical revenues. In July 2016 Infineon acquired Cree's Power and RF business and associated silicon carbide wafer operations for 4.9x historical revenues. These transactions emphasise the value that the market is currently placing on companies that, like IQE, are rich in IP.

Exhibit 8: Financial summary

£000s	2014	2015	2016e	2017e
Year end 31 December	IFRS	IFRS	IFRS	IFRS
PROFIT & LOSS				
Revenue	112,011	114,024	122,043	127,836
Cost of Sales (inc D&A + SBP)	(80,459)	(81,585)	(88,643)	(92,044)
Gross Profit	31,552	32,439	33,400	35,792
EBITDA	27,009	29,001	31,169	34,469
Depreciation and Amortisation	(9,391)	(10,024)	(10,800)	(11,600)
Operating Profit (before amort. and except.)	17,618	18,977	20,369	22,869
Acquired Intangible Amortisation	(1,101)	(1,208)	(1,208)	(1,208)
Exceptionals	(7,892)	5,398	0	0
Share based payments	(1,458)	(2,001)	(2,001)	(2,001)
Operating Profit	7,167	21,166	17,160	19,660
Underlying interest	(1,429)	(1,403)	(1,343)	(1,007)
Exceptionals	(495)	(387)	0	0
Profit Before Tax (norm)	16,189	17,574	19,027	21,862
Profit Before Tax (FRS 3)	5,243	19,376	15,818	18,653
Tax	(3,247)	773	500	500
Profit After Tax (norm)	16,701	18,066	19,027	21,862
Profit After Tax (FRS 3)	1,996	20,149	16,318	19,153
Average Number of Shares Outstanding (m)	650.8	662.6	669.8	673.2
EPS - normalised fully diluted (p)	2.42	2.60	2.73	3.11
EPS - (IFRS) (p)	0.25	3.00	2.44	2.84
Dividend per share (p)	0.0	0.0	0.0	0.0
Gross Margin (%)	28.2	28.4	27.4	28.0
EBITDA Margin (%)	24.1	25.4	25.5	27.0
Operating Margin (before GW and except.) (%)	15.7	16.6	16.7	17.9
BALANCE SHEET				
Fixed Assets	160,999	174,207	176,699	173,391
Intangible Assets	82,079	86,843	87,135	87,027
Tangible Assets	66,588	65,154	67,354	64,154
Other	12,332	22,210	22,210	22,210
Current Assets	48,323	48,909	46,328	72,690
Stocks	18,276	21,215	22,000	25,900
Debtors	24,463	23,050	24,000	29,000
Cash	5,584	4,644	328	17,790
Other	0	0	0	0
Current Liabilities	(46,667)	(48,050)	(45,857)	(47,757)
Creditors	(31,947)	(44,809)	(39,616)	(44,516)
Short term borrowings	(14,720)	(3,241)	(6,241)	(3,241)
Long Term Liabilities	(41,480)	(28,032)	(28,032)	(28,032)
Long term borrowings	(22,115)	(24,626)	(24,626)	(24,626)
Other long term liabilities	(19,365)	(3,406)	(3,406)	(3,406)
Net Assets	121,175	147,034	149,138	170,292
CASH FLOW				
Operating Cash Flow	14,861	20,971	18,741	30,469
Net Interest	(1,428)	(1,403)	(1,343)	(1,007)
Tax	1,258	(459)	500	500
Capex	(9,426)	(10,002)	(14,500)	(9,500)
Acquisitions/disposals	0	0	(11,691)	0
Financing	278	544	977	0
Dividends	0	0	0	0
Net Cash Flow	5,543	9,651	(7,316)	20,462
Opening net debt/(cash)	34,351	31,251	23,223	30,539
HP finance leases initiated	0	0	0	0
Other	(2,443)	(1,623)	0	0
Closing net debt/(cash)	31,251	23,223	30,539	10,077

Source: IQE accounts, Edison Investment Research

Contact details	Revenue by geography
IQE Pascal Close St. Mellons, Cardiff CF3 0LW +44 (0)2920 839 400 www.iqep.com	

Management team

CEO: Dr Andrew Nelson OBE, BSc PhD, FREng	CFO: Phillip Rasmussen BSc, ACA
Dr Nelson joined BT in 1981 where he led the group responsible for the development of advanced optoelectronic devices for optical fibre communications and subsequently managed the technology transfer from BT to Agilent for mass production. He co-founded EPI in 1988. This merged with QED in 1999 to form IQE. He was appointed CEO of IQE in April 1999. He is a member of the high-level group appointed by the EC to oversee the implementation of key enabling technologies throughout Europe.	Phil Rasmussen qualified as a chartered accountant in the audit practice of Coopers & Lybrand, a predecessor firm of PwC. Before joining IQE, he was director of Transactions Services with PwC and worked with IQE on two major acquisitions during 2006. He was appointed CFO in 2007.
Chairman: Dr Godfrey Ainsworth BSc, PhD, FCA	
Dr Ainsworth qualified as a chartered accountant. After a period in the accountancy profession he founded Gambit Corporate Finance in 1992, specialising in corporate finance services. He was appointed to the board of IQE in 1997 and became chairman in 2002. He is chairman of Seren Photonics and director of Omniport Holdings.	

Principal shareholders	(%)
T Rowe Price International	10.8
AXA Framlington Investment Management	8.8
Sanlam Four Investments UK	5.5
Richard Griffiths	5.4
Herald Investment Management	5.2
Barclays Wealth	5.0
Hargreaves Lansdown Asset Management	4.9

Companies named in this report

II-VI Inc (IIVI:US), Anadigics Inc. (ANAD:US), Broadcom Inc. (AVGO:US), Emcore Corp (EMKR:US), GCS Holdings Inc. (4991:TT), IntelliEPI Inc. (4971:TT); Kopin Corp. (KOPN:US), Landmark Optoelectronics Corp (3081:TT), MACOM (MTSI:US); Qorvo Inc. (QRVO:US), Soitec SA (SOI:FP), Silex Systems Pty Ltd (SLX:AU), Skyworks Solutions Inc. (SWKS:US), Sumitomo Corp. (8053:JP), Virtual Photonics Epitaxy (2455:TT), WIN Semiconductors Corp. (3105:TT)

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