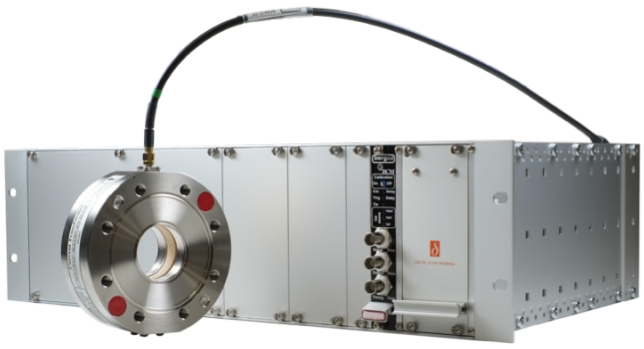
ICT & BCM - Integrating Current Transformer with Beam Charge Monitor



ICT integrates bunch charge without loss
For FEL, transfer lines, injection/extraction monitoring
For laser-plasma, wakefield accelerators

Single very short bunches, down to femtoseconds are integrated without loss. Microsecond long trains of very short micro bunches are integrated with negligible loss.
High sensitivity for pC resolution pulse measurement

Principle developed by K. Unser

Operating principle
ICT combines two nested transformers: a shorted one-turn current transformer loads the full bunch charge instantly into capacitors. Then the charge is transferred to the output by a readout transformer, at a slow pace, to avoid core loss. Cores are specially annealed to lower their coercive field and further minimize core loss.
The ICT signal is integrated by BCM-IHR, a boxcar type asynchronous differential detector. The output voltage proportional to the beam pulse charge is available 30µs after the trigger. It is maintained up to 400µs, then reset. Another pulse can then be measured.

Two packaging types
for the ICT

In-flange ICT are mounted directly in the beam line. UHV compatible. Available for many pipe diameters from 1" to 250mm. Also with elliptical aperture or other arbitrary shape aperture. Ceramic gap, shields and wall current bypass are included. Bellows are not required.

In-air ICT are installed over the vacuum chamber. It requires a "gap" in the vacuum chamber to prevent the wall current from flowing through the ICT aperture. The gap can be a brazed ceramic ring or an organic material O-ring depending on the vacuum requirements. Typical installations include bellows, a wall current bypass and an electromagnetic shield enclosing the ICT.

BCM-IHR-E inserts into a wired station of BCM-RFC, the 19" 3U RF-shielded chassis including power supplies.
Up to 10 stations per chassis can be installed.

Operating range
Using a 5Vs/C sensitive ICT, the noise per single bunch measurement is 0.55pC. Less noise may be obtained using higher sensitivity (10 or 20Vs/C) ICT.

DISTRIBUTORS

U.S.A.: GMW Associates
www.gmw.com
sales@gmw.com

Japan: REPIC Corp.
www.repic.co.jp
sales@repic.co.jp

India: GEEBEE International
www.geebeeinternational.com
info@geebeeinternational.com

China: Beijing Conveyi Limited
www.conveyi.com
sales@conveyi.com

MANUFACTURER

BERGOZ Instrumentation
www.bergoz.com
Espace Allondon Ouest
01630 Saint Genis Pouilly, France
sales@bergoz.com

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In-flange ICT dimensions

In-flange ICT sensor order code	Pipe OD	Mating flange	ID (mm)
ICT-CF3"3/8-22.2-40-UHV-xx	1"	DN/NW50CF	22.2
ICT-CF4"1/2-34.9-40-UHV-xx	1.5"	DN/NW63CF	34.9
ICT-CF4"1/2-38.0-40-UHV-xx	40	DN/NW63CF	38.0
ICT-CF6"-47.7-40-UHV-xx	2"	DN/NW100CF	47.7
ICT-CF6"-60.4-40-UHV-xx	2.5"	DN/NW100CF	60.4
ICT-CF6"3/4-96.0-40-UHV-xx	4"	DN/NW130CF	96.0
or ICT-CF8"-96.0-40-UHV-xx		DN160/NW150CF	
ICT-CF10"-147.6-40-UHV-xx	6"	DN/NW200CF	147.6
ICT-CF12"-198.4-40-UHV-xx	8"	DN/NW250CF	198.4
ICT-CFXX"-XXX-XX-UHV-5 Vs/C and lower		Axial length H	40.0
ICT-CFXX"-XXX-XX-UHV-10 Vs/C and ICT-CFXX"-XXX-XX-UHV-20 Vs/C**			

In-air ICT dimensions

In-air ICT sensor order code	ID min (mm)	OD max (mm)	H max (mm)
ICT-016-xx	16	42	
ICT-028-xx	28	64	
ICT-055-xx	55	91	
ICT-082-xx	82	118	
ICT-122-xx	122	156	
ICT-178-xx	178	226	
ICT-XXX-2.5 Vs/C and lower			32
ICT-XXX-5.0 Vs/C and above			45
ICT-XXX-10 Vs/C and ICT-XXX-20 Vs/C**			

**For sensitivities 10 Vs/C and 20 Vs/C, please contact Bergoz Instrumentation for dimensions

Specifications

Sensitivity (nominal)	0.5	1.25	2.5	5.0	10	20	Vs/C
Turns ratio (old reference)	50:1	20:1	10:1	05:1	N/A	N/A	
Max. pulse train length	7.5	1.2	0.35	0.1	0.1	0.1	µs
- With Low droop option	20	4	10:01	0.25	0.25	0.25	µs

Integrating Current Transformer

Position dependence	Negligible
ICT output connectors	SMA, Radiation tolerant on option

Beam Charge Monitor - Integrate-Hold-Reset

Full scale ranges	Selectable in a range of 50:1 by TTL
Most sensitive range	800pC, using 5Vs/C ICT
Least sensitive range	400nC, using 0.5 Vs/C ICT
Range control	Full scale and polarity (4 TTL bits)
Noise on single bunch	0.55pCrms, limited by dynamic range
Dynamic range	>35'000, limited by resolution
Output	±8V, available 50µs after trigger, held for 350µs (up to 10ms on option)
Trigger	TTL, ≥10ns (NIM on option)
Trigger frequency	20kHz max. (ask factory for preset)
Front panel connectors	BNC 50Ω for oscilloscope: Signal View, Output View, Timing View
Back panel connectors	SMA Input, SMA Trigger input, SMA Output, DB9 for control lines
Front-panel controls	Integration window time potentiometer Trigger delay potentiometer
Calibration pulses	1pC, 10pC, 100pC, 1nC, accuracy ±2%
Calibration controls	Enable, polarity and charge, by TTL
Front-panel control	Calibration ON/OFF switch Calibration pulse delay potentiometer

Power Supply

Output	±15Vdc, 2 x 400mA, linear
Mains	95/125Vac - 215/245Vac, 48-62Hz, 30VA

Order codes

ICT	See codes in above tables
BCM-IHR-E	Beam Charge Monitor Integrate-Hold-Reset electronics module
BCM-RFC/xx	19"x3U RF-Shielded chassis, with xx equipped stations (max. 10)
BCM-Cxxx	SMA-SMA cable with PTFE dielectric plugs, XXX meters
BCM-RHCxxx	SMA-SMA cable with PEEK dielectric plugs, XXX meters

Options

-LD	Low droop
-316LN	AISI 316LN instead of 304
-ARB#xx	Arbitrary shape aperture
-BK150C	150°C (300°F) bakeable, In-flange only
-BK185C	185°C (365°F) bakeable, In-flange only
-VAC	Degassed in-air sensor
-H	Radiation tolerant sensor and connector

Environment

Temperature	
In-air models:	100°C (212°F) any time
In-flange models:	100°C (212°F) any time
On option:	150°C (300°F) 185°C (365°F)
Core saturation	2 mT radial field 2A permanent DC current
Radiation damage	
Standard SMA	PTFE: 1E3 Gray max
On option:	
Rad-tolerant SMA	PEEK: 6E7 Gray max 1E17 n/cm2 max