

**DEPARTMENT OF MECHANICAL ENGINEERING  
INDIAN INSTITUTE OF TECHNOLOGY-DELHI  
HAUZ KHAS, NEW DELHI-110 016**

Dated: 10-June-2012

**Notice Inviting Quotations**

Sealed quotations in separate envelopes of technical and commercial bid kept in one sealed outer envelope, are invited for purchase of “**Complete Automation Solution for Research Mould**” including the hardware and software as per specifications given below. Your sealed quotation should reach **within 15 days (latest by 25<sup>th</sup> June 5.00 pm)** from the date of advertisement, **to the undersigned**. Your quotation must be super-scribed “**Quotation for Complete Automation Solution for Research Mould**”.

**Specifications desired for the purchase “Complete Automation Solution for Research Mould”**

1. System supported with single user licensed version of data acquisition and control software for MS-windows OS.
2. Data acquisition and control hardware should be capable to meet the following control & automation tasks (see appendix-I);

**(a). Control of Permanent Magnet Servo Motor** (Make: Electrocraft Corp.) without driver circuit. The system should be able to control the RPM of motor and encoder feedback about the movement.

*Note: Only motor (without driver and encoder) will be provided by the IIT-D.*

**(b). Control of Mold Heating.**

**(i).Sensor:** Two thermocouple (J-type) each mounted on fixed and moving halves of mould.

**(ii).Controller:** Based on PID Logic

**(iii).Switching:** Via Solid State Relay (SSR).

**(iv).Heaters:** There will 8 heaters (750W/230V – 4No. and 400W/230V – 4No.).

*Note: The heaters and thermocouples will be provided by the IIT-D.*

**(c).Pressure and Temperature Data acquisition** from the PT-sensor (Piezoelectric) make Kistler, model PT-sensor 6189ASP and model Charge amplifier: 5155A21D1 (see appendix-II for detailed specification of PT sensor and charge amplifier).

*Note: The above mentioned PT sensor and charge amplifier will be provided by the IIT-D.*

**(d). Control of centrifugal pump (Mold cooling)**

**(i).Controller:** On/Off type

**(ii).Switching:** Via Solid State Relay (SSR).

**(iii). Pump:** 1 HP, 230V, Monoblock self priming type.

**(e). Control of Pneumatic Cylinder**

**(i).Controller:** On/Off type

**(ii).Actuation:** Via Solenoid operated pneumatic direction control valve.

**(iii). Pneumatic Cylinder:** dia 50mm, stroke 70mm, working pressure 6 – 8 bar make: Festo.

***Note: The Pneumatic Cylinder and compressed air facility will be provided by the IIT-D.***

3. Include the wiring, insulation cable, connectors etc. required for connection between the sensors/ FCE and control hardware.
4. A PC/ Laptop along with UPS installed with MS-Windows (XP) will be provided by IIT-Delhi.
5. Include the housing/ cabinet (if needed) for hardware attached with PC.
6. The user interface should be designed in coordination with IIT-Delhi.
7. The system should be synchronized with injection molding machine make Battenfeld, Austria having B&R PLC as controller. Also the system should get the information from the injection molding machine's controller about the start and end time of each molding operations such as start of injection phase to end of injection phase, etc.
8. Export of acquired data in popular formats such as .xls, .txt etc.
9. Should provide the source code as well as .exe file to IIT-Delhi as its sole property.

**Terms & Conditions:**

1. The quotations must have validity of at least four months.
2. Sealed quotations should be in separate envelopes of technical and commercial bid kept in one sealed outer envelope.
4. The products will be used for educational purposes. Any applicable academic institution discounts should be offered and stated.
5. Detailed Brochures should accompany the offer.
6. If the bidder is an authorized dealer then the authorized Indian dealership certificate from the principles should be enclosed.
7. Two year comprehensive warranty of smooth running of supplied system.
8. Payment will be 100% after successful installation and commissioning only.
9. In case the items are proprietary products of the company, a proprietary item certificate stating the same must be provided.
10. Institute reserves the right to accept or reject any or all the quotations without assigning reasons thereof.

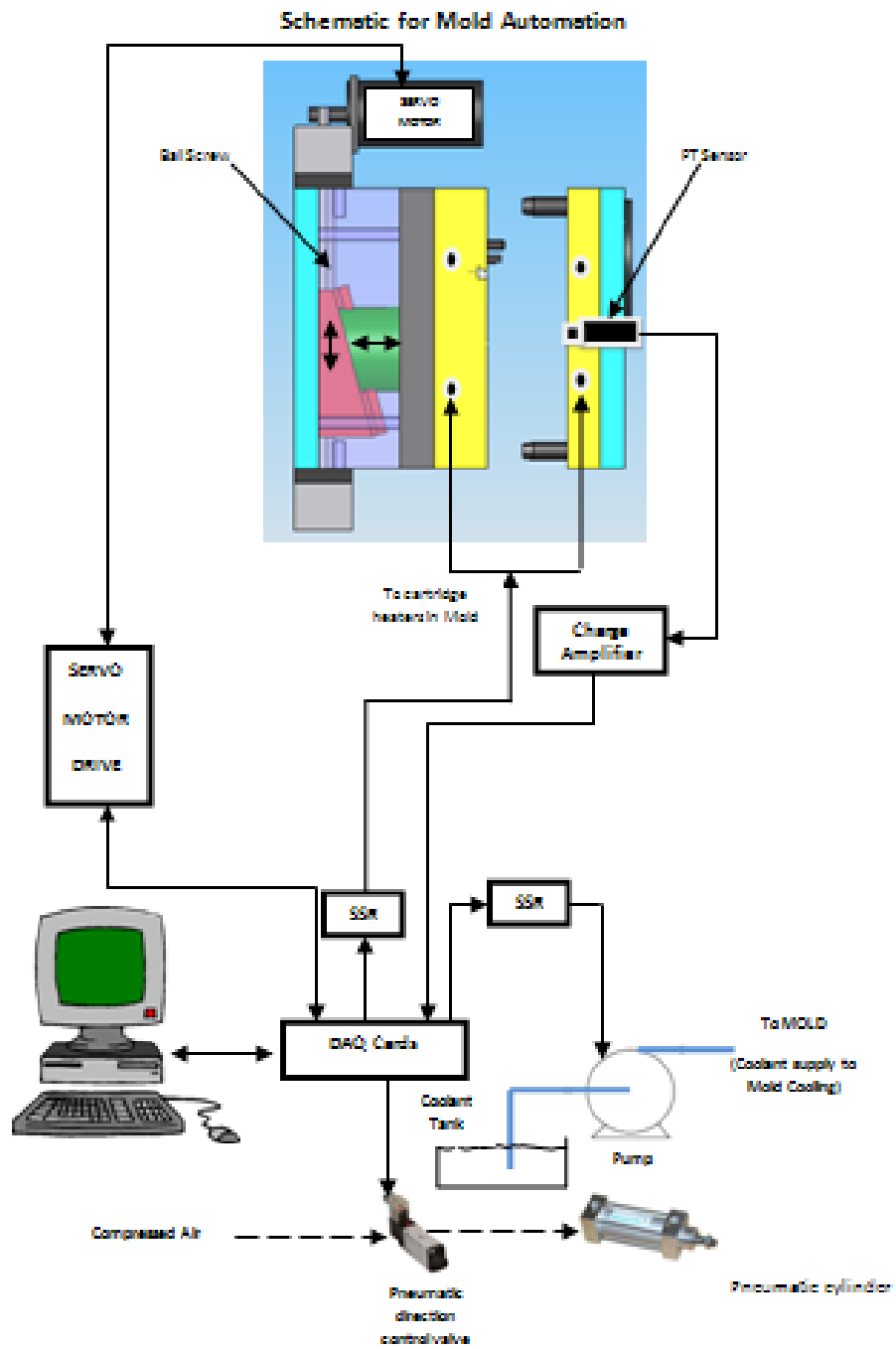
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IIT Delhi

# Appendix-I



Electronics & Software



## Multichannel Amplifier for the Injection Molding Industry

The purpose of the multichannel charge amplifier Type 5155A... with 1, 2 or 4 channels is to convert the charge signal from piezoelectric sensors or the signal from thermocouples into a proportional voltage signal. This amplifier has been developed for industrial applications, primarily for injection molding machines.

- Charge amplifier with 2 measuring ranges
- Charge and thermocouple amplifier
- Self-optimizing switch-over output (SmartAmp-Option)
- Industrial case with IP65 protection

### Description

The multichannel charge amplifier Type 5155A... is provided with one, two or four charge amplifier modules (indicated in the circuit diagram as MLV). The two measuring ranges of the charge amplifier inputs can be switched over for each channel individually by remote control. Amplifiers equipped with temperature inputs are provided with 1 charge amplifier and 1 temperature amplifier or 2 charge amplifiers and 2 temperature amplifiers. All charge amplifier modules contain at the input a capacitive negative feedback amplifier in hybrid design with an extremely high insulation resistance.

In thermoplastic injection molding, the SmartAmp option "self-optimizing switch-over detection" automatically detects volumetric filling of the mold, and in each cycle sends a control signal to the injection molding machine. The mold must be equipped with a directly measuring cavity pressure sensor close to the gate.

### Application

The multichannel charge amplifier Type 5155A... is intended for use with all types of piezoelectric sensors and Type K thermocouples. The output signals can be used to monitor, control and optimize the injection molding process.

Type 5155A...



Photo of version with  
2-channel charge amplifier (TNC) +  
2-channel thermocouple amplifier

The SmartAmp option "self-optimizing switch-over detection" can be easily integrated in machine control systems. For retrofitting, the injection molding machine must be prepared by the machine manufacturer. This option considerably reduce the setting-up time, since the switching point is automatically preset by means of the charge amplifier without the need of manual optimization. During production, the option automatically compensate process fluctuations, thereby producing moldings of greater uniformity.

5155A\_000-40360309

**QUALITY  
MOLDING**  
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This information corresponds to the current state of knowledge. Kistler reserves the right to make technical changes. Liability for consequential damage resulting from the use of Kistler products is excluded.

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**Technical Data**

**Charge Amplifier**

Number of channels		1, 2 or 4
Measuring range I	pC min.	±5 000
	pC max.	±50 000
adjusted to		
Type 5155A1xxx	pC	±50 000
Type 5155A2xxx	pC	±20 000
Type 5155A3xxx	pC	customer option
Measuring range ratios		
Range I/Range II		
Type 5155A1xx		10
Type 5155A2xx		4
Type 5155A3xx		2
Drift	pC/s	≤±0,05
Reset-Operate transient	pC	≤±2
Maximum voltage between sensor GND and output/supply GND	V	≤±4
Interference signal rejection between sensor GND and output/supply GND (0 ... 0.3 kHz)	dB	>50
Maximum input signal:		
Voltage (continuous)	V	±10
Charge	pC	±150 000

**Voltage Output**

Error	%	<1
Zero point error (Reset)	mV	≤±10
Output voltage	V	0 ... ±10
Output voltage limitation	V	>11
Output current	mA	0 ... ±5
Output impedance	Ω	10
Output interference signal (0,1 Hz ... 1 MHz)	mV <sub>rms</sub>	<10
Frequency response		
Deviation (-5 %)	kHz	+0 ... >3,5
Deviation (-3 dB)	kHz	+0 ... >10

**Current Output 4 ... 20 mA**

Option in place of voltage output. Not available for combined charge amplifier and thermocouple amplifier versions.

Error	%	<1,3
Zero point error (Reset)	mA	≤±0,016
Output current	mA	4 ... 20
Output current limitation	mA	25
Output impedance	MΩ	>40
Maximum load resistance	Ω	650

**Thermocouple Amplifier**

Noise suppression (ground loop) through differential input stage

Number of channels		1 or 2
Thermocouple (switchable to Type J available on request)	Type	K
Measuring range	°C	0 ... 200
Output voltage	V	0 ... 10
Output current	mA	0 ... 2
Input impedance	MΩ	>1
Output impedance	Ω	10
Zero point error	mV	<10
Transmission sensitivity <sup>2</sup>	mV/K	50
Error (gain)	%	±0,5
Error (non-linearity)	°C	<1,5
Output interference signal (0,1 Hz ... 1 MHz)	mV <sub>rms</sub>	<20
Frequency range	kHz	0 ... >1
Max. voltage between input minus and output/supply GND	V	≤±4
Sensor disconnection detection	V	≈4

<sup>2</sup> Calibration: 0 °C = 0 V, 100 °C = 5 V

A differential input circuit ensures that common-mode signals of ±4 V between Sensor/Low and Output/Power GND, such as occur in industrial environments, have no disturbing influence.

**Control inputs for Reset/Operate, Measuring Range II, Sensitivity, Test**

Actuation is bipolar and electrically isolated via optocouplers. The common input of Test/Operate/Measuring range II/Sensitivity (Control GND, PIN 18 of the D-Sub connector) can be connected internally either with the potential Exct 1B ... 30 VDC or Exct GND. Accordingly Test, Operate, Measuring range II and Sensitivity are actuated with negative voltage or optionally with user specified voltage.

Actuation voltage		
Operate (logic 1)	V	3 ... 30
Reset (logic 0)	V	<2
Measuring range II (logic 1)	V	3 ... 30
Measuring range I (logic 0)	V	<2
Test signal (logic 1)	V	3 ... 30
No Test signal (logic 0)	V	<2
Sensitivity <5 pC/bar (logic 1)	V	3 ... 30
Sensitivity >5 pC/bar (logic 0)	V	<2
Actuation current	mA	0,6 ... 9
Output signal when Test and Measuring range II active		
Voltage output	V	8
Current output 4 ... 20 mA	mA	16,8
Tolerance of test signal	%	5

**FK/SL**

The outputs are switched via photo MOS relays.

Current rating, continuous	mA	<100
Current rating, pulse (<0,1 s)	mA	<300
Resistance		
when switched on	$\Omega$	<50
typical	$\Omega$	30
Constant voltage	V	<±42
Voltage between outputs and protective ground	$V_{max}$	<30

**Power Supply**

Supply voltage	VDC	18 ... 30
Current consumption per		
Charge amplifier channel (without load and without SLP)	mA	≈10
Thermocouple channel (without load)	mA	≈15
Additional current consumption by		
SLP	mA	≈35
Current output per channel (without load)	mA	≈2,5

**Connections**

Sensor		
Charge input	Type	TNC neg. or BNC neg. or 4-channel Fischer multipole plug
Thermocouple input	Type	Fischer DEPU 102 A051 female
Supply, signal outputs, Control inputs	Type	D-Sub 25 pin male

**General Data**

Operating temperature range	°C	0 ... 60
Min./max. temperature	°C	-10/70
Vibration resistance (20 ... 2 000 Hz, duration 16 min., cycle 2 min.)	gP	10
Shock resistance (1 ms)	g	200
Degree of protection (only with screw-on TNC connectors) DIN 40050	IP	65
Housing material		die cast aluminium
Weight	g	≈400

- Recommended mounting position: on perpendicular surface, connections downward
- The case ground is connected to the output or supply ground only via an R/C network. This prevents interference due to a "floating" case.

**Contact Assignment D-Sub 25 Connector**



- 1 Signal Out Ch1
- 2 Signal Out Ch2 a)
- 3 Signal Out Ch3 a)
- 4 Signal Out Ch4 a)
- 5 NC
- 6 Ext 18 ... 30 VDC
- 7 Ext 18 ... 30 VDC
- 8 Ext GND
- 9 NC
- 10 NC
- 11 Common FB/SL
- 12 FX d)
- 13 SL d)
- 14 Signal GND
- 15 NC
- 16 NC
- 17 NC
- 18 Common Control
- 19 Operate
- 20 SensItMty c)
- 21 Test
- 22 Range II Ch1
- 23 Range II Ch2 a)
- 24 Range II Ch3 a)
- 25 Range II Ch4 a)

- a) with 1 channel version: NC
- b) with 1 and 2 channel version: NC
- c) with version without SmartAmp "self-optimizing switching-point detection": NC
- d) with temperature input: NC

Block Schematic Diagram

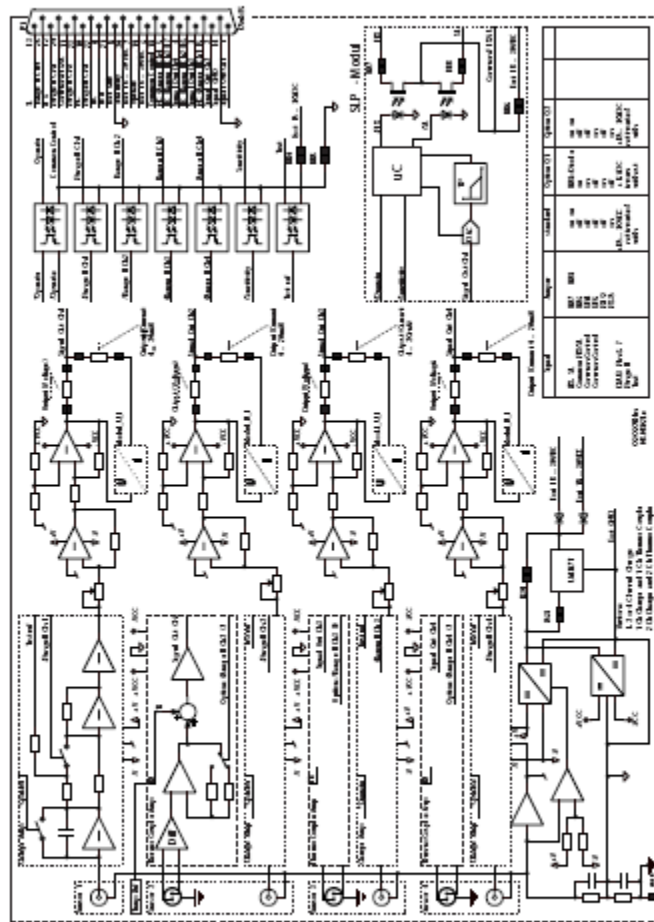


Fig. 1: Block schematic diagram for Type 5155A... with SmartAmp "self-optimizing switching-point deletion"

Dimensions

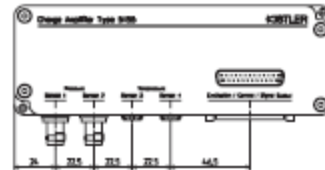
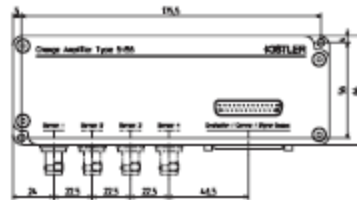
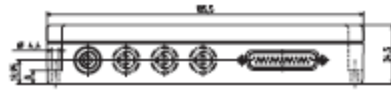


Fig. 2: Dimensions of charge amplifier Type 5155Acc7x, 5155Acc8x, 5155Acc3x, 5155Acc4x, 5155Acc1x, 5155Acc2x (1-, 2-, 4-channel charge amplifier)

Fig. 4: Dimensions of charge amplifier Type 5155AccCx, 5155AccDx (2-channel charge amplifier, 2-channel thermocouple amplifier)

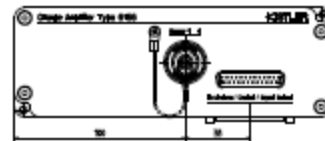
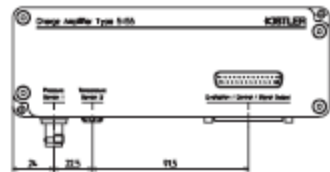


Fig. 3: Dimensions of charge amplifier Type 5155AccAx, 5155AccBx (1-channel charge amplifier, 1-channel thermocouple amplifier)

Fig. 5: Dimensions of charge amplifier Type 5155A2251 (4-channel charge amplifier)



Optional Accessories	Art. No./Type	Optional Accessories	Art. No./Type
• 2 cheese-head screws M4 x 16	6.120.013	• D-Sub plastic cover, water-tight,	1557A10
• 2 spring washers M4	6.230.063	shielded and 25 pin D-Sub connector	
• TNC-BNC adapter	1709	(CONEC 165 X 150390)	
• Connecting cable (with open end) for connection to the injection molding machine	1200A73	• Connecting cable (equalizing cable) for the connection of temperature sensors	2295A2
		Length = 2 m	2295A5
		Length = 5 m	

**Ordering Key**

**Measuring Range I (Calibrated)**

±50 000 pC	1
±20 000 pC	2
According to order	3

**Ratio Measuring Range I/Measuring Range II**

10	1
4	2
2	3

**Channels, Sensor Connection**

1 channel charge, TNC nag, (IP65)	1
1 channel charge, BNC nag, (IP60)	2
2 channel charge, TNC nag, (IP65)	3
2 channel charge, BNC nag, (IP60)	4
4 channel charge, TNC nag, (IP65)	7
4 channel charge, BNC nag, (IP60)	8
4 channel charge, 4 channel connector for cable type 1995A...	5****
1 channel charge, TNC nag, 1 channel temperature (IP65)	A***
1 channel charge, BNC nag, 1 channel temperature (IP60)	B***
2 channel charge, TNC nag, 2 channel temperature (IP65)	C***
2 channel charge, BNC nag, 2 channel temperature (IP60)	D***

**SmartAmp**

SmartAmp without SmartAmp, voltage output	1
without SmartAmp, current output	2*
with SmartAmp "self-optimizing switching-point detection", voltage output	3**
with SmartAmp "self-optimizing switching-point detection", current output	4**

- \* Not possible in combination with thermocouple amplifier
- \*\* Charge amplifiers are supplied only with Range I = 20 000 pC and ratio Range I/Range II = 4
- \*\*\* Charge and thermocouple amplifier only available with Range I = 20 000 pC and ratio Range I/Range II = 4
- \*\*\*\* Charge amplifiers are supplied only with Range I = 20 000 pC and ratio Range I/Range II = 4; without SmartAmp; current output not available

Type 5155A

